 <p>SEVENTH FRAMEWORK PROGRAMME</p>	<p>Project Acronym: Pandora - FP7-ICT-SEC-2007-1 Project Title: Advanced Training Environment for Crisis Scenarios Grant agreement no.: 225387 Start date: 1st January 2010 End date: 31st March 2012</p>
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Section 4.1 of the Final Report

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1. General Information

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² The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

2. Executive Summary (1 page)

The PANDORA project has developed a smart, novel digital support environment and crisis simulation system to enhance and expand training exercises for Gold Commanders in crisis management. Gold Commanders are specifically engaged in the development of strategic plans to deal with a wide range of potential crisis situations that can arise in civil society. These crisis situations could include:

- Natural events e.g. extreme weather.
- Transport events e.g. plane, train or vehicle crashes
- Service failures e.g. water supply failure
- Health crises e.g. pandemics
- Technology failures e.g. breakdown of automated control systems
- Policing and terrorism events

The role of individuals identified as Gold Commanders is explicitly strategic, rather than tactical (Silver) or operational (Bronze). In an actual crisis situation Gold Commanders from different areas, e.g. police, fire, health, will be expected to work together as a team and therefore need to be trained as a team to help develop their:

- Collaborative, Strategic thinking, Negotiation and Decision-making skills
- Flexibility and capability under pressure
- Ability to recognise and challenge assumptions, both their own and those of others in the team
- Ability to think of innovative solutions to problems when pre-prepared plans are no longer appropriate

Currently, the primary model of training offered to Gold Commanders consists of group-based, table-top activities led by an expert trainer. The bulk of the information provided to the trainees is paper-based, with some limited audio-visual input, and the activities take place during an intensive, time constrained training event. These can be seen as unrealistic, make it difficult to engage the Gold Commanders in the stress of a real crisis situation, and are almost entirely dependent on the ability of the trainer to engage and motivate the trainees, and to assess their performance subjectively in the training event. The PANDORA system addresses the shortcomings of the existing training model, enhances the range and scope of the training events, and offers the potential for future development by:

- Offering a fully-featured multimedia environment to provide information to the trainees, including audio, video, maps, texts, email, graphics and text
- Developing a crisis scenario model based on a structured, timeline-based, event network, running in a computer-based simulation environment controlled by the trainer
- Providing real-time operational inputs demonstrating strategic decision outcomes to trainees, asking them to dynamically revise strategic plans and decisions
- Capturing trainee behaviour and emotional state, through the use of pre-event information capture, direct sensor inputs, self-reporting by trainees, and trainer inputs, and using affective media to induce changes to those behavioural and emotional states
- Providing a graphical virtual representation of the training environment to support on-line distributed training events
- Providing virtual characters, in any form from textual through to full animation, to engage in the event, including replacements for missing trainees, to ensure the full scenario enactment is supported in all training events
- Providing the trainer with a full control system for the training event, including the ability to change events, add new events, expand and compress timelines, provide direct interventions into the scenario, and increase or decrease the emotional stress applied to individual trainees.
- Maintaining a detailed log of the training event, to permit rerun of some or all events, modelling of individual trainee performance, and capture of relevant and useful events as exemplars for future training

- Maintaining configurable scenario models, knowledge, multimedia asset and data bases to enable the system to build a wide range of crisis scenarios, to use as training events for those involved in crisis management at all levels

2. Summary description of the project context and the main objectives (4 pages)

Context and Background

It is often human behaviour alone that prevents a disaster from becoming a crisis, however major crises are rare events and although those required to deal with them will have pre-prepared plans, they may have little or no experience of a real crisis situation or any understanding of how they might personally react in the event of a real crisis situation. Training is therefore extremely important in order to prepare people to take on leadership roles in a crisis situation. The vast majority of the training systems currently available focus on preparing people at the tactical (Silver) and operational (Bronze) levels, however it is the strategic (Gold) level personnel who make the key decisions and set the direction for managing a crisis, and, where necessary, make life and death decisions. Typical crisis situations will present complex problems to solve, and require a coordinated, multi-agency response. Examples of crises can include one or more of the following situations:

- Policing and terrorism events - fire or explosions
- Natural events - extreme weather, earthquake, landslides, storms, wind, heat-wave etc.
- Transport events – sea, air, train or vehicle crashes.
- Service failures - electrical power plant failure, water supply failure, etc.
- Health crises - pandemics, epidemics, containment conditions, disease (including animal disease), toxic chemical release impacting the environment etc.
- Technology failures - breakdown of automated control systems, central services

Gold Commanders are typically involved in a crisis when an event threatens health, life, service infrastructures etc. Their remit is quite wide and can include:

- Relieving suffering, saving and protecting life and promoting / facilitating self-help
- Containing the emergency, ensuring the health and safety of staff are protected
- Protecting property and safeguarding the environment
- Maintaining/restoring critical services
- Facilitating the investigation/inquiry and evaluating and identifying lessons learned.
- Providing the public with information as appropriate, including management of the media.

Strategic level commanders, henceforward referred to as Gold Commanders (a UK terminology), are typically trained in one of two ways. The first, and dominant approach, is through the use of table-top exercises. These are where a group of trainees (typically representing different emergency services e.g. fire, police, health) sit around a table, and are given a written description of an initial crisis scenario e.g. lorry carrying inflammable liquid has crashed into a tunnel wall, which caused a fire to break out and the loss of mains electricity to the local town. The group might be presented with the occasional audio or video clip of some news for example but fundamentally it is a paper-based exercise and it is down to the enthusiasm of the trainer to try and engage the trainees in the scenario and make it feel as realistic as possible. Another key problem with this approach is that management of a crisis scenario will often require that key emergency roles are represented in order to make a scenario realistic. However, if, for example, the Fire Chief was unable to attend the training session that day, then the trainer will often have to act out that role which is hard to do as they know the implications of the decisions but it also detracts from their role as a trainer, making the training session considerable more challenging to run. The second approach is a live training exercise where part of a scenario is realistically simulated. Whilst these will inevitably engage trainees in the emotion and stress of a real crisis situation, they are very expensive, time consuming to run and can only ever simulate part of a real crisis situation with a limited number of outcomes.

The key outcomes planned for training events designed for Gold Commanders are:

- Collaborative, Strategic thinking, Negotiation and Decision-making skills.

- Ability to work in teams, demonstrating flexibility and capability under pressure and to come up with solutions in a time constrained manner.
- Ability to understand the impact of their decisions on other emergency services.
- Ability to recognise and challenge assumptions, both their own and those of other team members, ensuring that they can provide a full justification after the event, as if something goes wrong during the management of the crisis assumptions will be a key focus of any investigation.
- Ability to think of innovative and alternative solutions to problems when pre-prepared plans are no longer appropriate.
- Ability to reflect on whether the decisions made during the course of the crisis management made the situation worse or better.
- Ability to deal with the media, which is inevitable in the event of a crisis.

From the trainer's perspective, the outcomes will be:

- Monitoring the risk taking behaviour of the group, given research shows that appetite for risk tends to increase in a group situation.
- Assessing the capabilities of each individual and determining whether it would be appropriate to involve them in a real crisis situation.

Research tells us that many of the characteristics identified above and carried out by individuals in everyday life, e.g. the ability to consider alternative solutions before making a decision, may not occur in very stressful situations. For example when time is precious and lives are at stake it can be all too easy to implement the first solution thought of. A key part of the reason that training must be realistic is so that people can discover how they might really behave in a real crisis situation.

The context for the development of the Pandora system, named the Pandora Advanced Training Environment (PATE), is to bridge the gap between the table-top exercises and live exercises, providing an environment that can run a crisis scenario that feels realistic and can engage trainees at an emotional level, ensuring that they experience the stress of a real crisis situation.

The Pandora Training Environment

In the Pandora system, training takes place in a crisis training room which has two interfaces: a software client that can be downloaded and installed on a local workstation, and a 3D virtual room delivered through a web browser in which trainees are represented by avatars. Both of these can be used to deliver training in the following ways:

- i) At a training site which would be typically used for training Gold Commanders. In this mode, the trainer and trainees are co-located in the same room. In the middle of the room there is a table around which the trainees will periodically meet, at the request of the chair (one of the trainees) to discuss strategy. However, for the majority of the training, the trainees are physically separated, working at their own workstations and using the Pandora system to communicate. In addition, several large screens may be used to display multimedia information to all the trainees such as sound, pictures, maps, animations, videos, to simulate receiving information about the crisis, such as news broadcasts.
- ii) Same as i) however delivered at a non-specialised site such as the offices of one of the Gold Commanders (portable mode).
- iii) The trainer and the trainees are geographically dispersed and communicate only through the Pandora system (distributed mode).

A crisis scenario is described in terms of a sequence of events that occur as the crisis unfolds, e.g. event 1 = plane crashes into a dam, event 2 = flood in local town, event 3 = town loses electricity supply etc. All of these events are represented on a timeline within an event network, and can be delivered to the trainees through a variety of media, e.g. via text message, through a news broadcast, or through a multimedia clip.

Trainer Support Framework

The crisis room is managed through the Trainer Support Framework, which provides a number of facilities to setup and configure the system both prior to, and during a training session. For example: loading a scenario; the ability to interject new events into a scenario prior to execution or dynamically as the scenario is executing; rollback a scenario to a previous decision point, or jump forward to a future point; and speed up or slow down the execution of the scenario as it is running. The trainer is also able to configure the scenario to set up non-playing characters (NPC), for example to role play an emergency service not represented within the group of trainees (some scenarios require that certain roles are filled e.g. Chief of Police, if no physical trainee is available to undertake that role); subject matter experts; higher control (HICON), such as Government ministers; and lower control (LOCON) - representing the lower levels of command within the crisis team. The system can be configured to play the roles automatically, but the trainer can also take over and simulate responses by these NPCs at any time during the execution of the scenario if they so desire.

A record of every event, trainee decision, action, email, use of the chat facility etc. is logged and can be viewed or printed at the end of the training session to support an objective post-training analysis, reflection and feedback by both the trainer and the individual trainee.

Emotional Modelling and Use of Augmented Reality to create Affect

In order to impact the emotions of trainees and provide personalisation of a training plan, various psychological traits that have been shown to impact decision-making under stress are assessed prior to the training event. Examples of these psychological traits are background experience (known as a static trait, as this cannot change) and stress and anxiety (which are dynamic traits, which can vary during a training session). These traits are ascertained through a pre-training questionnaire, and are used in conjunction with goals set by the trainer for each individual trainee (e.g. trainee profile shows insecurity so the system needs to put them through a confidence building exercise) to adapt the training as the scenario unfolds.

During scenario execution, the system runs through a continuous cycle of planning, execution and re-planning. Throughout the training, the stress level of individual trainees is measured through a number of means such as self-reporting, physiological sensors (such as a heart rate monitor), and trainer observation. At some point the trainer might decide that one or more trainees appears too relaxed or too stressed and that the stress levels for one or more trainees should be increased or decreased, to better reflect a real world crisis scenario. This can be done through a variety of manual interventions such as compressing timelines thus forcing decisions to be taken faster or by interjecting new events into the system manually. More importantly, however, it can be addressed in an automated mode by the Pandora system.

Within the Pandora training environment, the relationship between affective state and learning is key, and in order to optimise that the project has to have techniques to determine the affective state of the trainee, described above, and make appropriate changes to the environment and scenario to address that state. Pandora uses a W3C standard on emotional modelling, to which the project has contributed and which is still under development, called EmotionML, to develop the Pandora affective model and mark-up affective content. Having determined the emotional and behavioural state of each trainee, the calculation of the desired state may be pre-defined within the training scenario, dynamically generated by the system, or as a result of direct trainer input. If the desired state differs from the existing state, the system has to plan suitable events to affect trainee emotions towards the target state. The information related to the existing and target states is passed to an internal rule-based mash-up engine, which can construct multimedia content representations, using affectively marked content, in a multi-channel, polyphonic, time-constrained model driven by a trajectory definition to move from an existing trainee state towards a desired state.

The key argument for the use of affect in the Pandora scenario is in the creation of affective ambience, by which we mean the use of multimedia assets and information management and manipulation to engender requisite levels of emotional impact on the trainees at the decision making

points. Although there is some consideration of the use of avatar representations of emotion in the distributed mode of the Pandora Box, the key affective representation is associated with the creation of ambience or atmosphere. A number of techniques have been taken from film and TV production, combined with a number of known issues in information distribution and management, to create a set of rules by which multimedia mashups can be created and made available to the trainees across a set of configured media channels. This provides the potential to induce stress in the trainees through the use of vocative inflections, video and image representations of crisis situations, and textual updates from those situations. An example of this might be to show a picture of a hospital that is flooded, and overlay an appropriate piece of audio either saying that the water is receding, if the desired effect is to reduce the stress of a trainee, or that the water is rising and people are about to drown, if the desired effect is to increase the stress of a trainee.

However, the system can also induce stress through the corruption of media channels, incomplete information, missing information, noisy channels, and a variety of other techniques to diminish the certainty of information available to trainees at those points in the scenario where they are required to make decisions. Using this kind of induced stress the system can impact on trainees in terms of their self-efficacy, leadership capability, and existing personality traits, to determine their capability to make effective and appropriate decisions under stress.

Testing and Evaluation

The Pandora system was thoroughly tested over three days of user trials with 13 different Gold Commanders with a range of experience, at the UK Government Emergency Planning College. All trainees were completely immersed in the solving the crisis situation they had been presented with for the entire day of training. The feedback was overwhelmingly positive and, without exception, the trainees described the training experience as far more realistic than any other training models they had experienced. Similarly positive feedback was received from the trainers. There was also considerable enthusiasm from both trainees and trainers that the Pandora system be made available to them for practical use.

Conclusions

Unlike existing systems, the Pandora system has been developed both as an augmented and virtual reality environment, with a view to offering both blended learning and a fully virtual experience, where this is appropriate and desired. The system has the potential to encompass crisis situations of all types and perspectives and to support strategic level training in all of them. The Pandora box (PATE), being the set of tools and the methodological approach to configure the system and environment, have intentionally been developed to be generic rather than specific, and could therefore be applied to event-based scenarios in domains other than crisis management, e.g. inter alia stock portfolio planning or health service delivery planning.

3. Description of the main S & T results/foregrounds (25 pages)

3.1 The Pandora Advanced Training Environment (system prototype)

3.1.1 Introduction

This report provides a guided walkthrough of the key components that have been developed in the Pandora Advanced Training Environment. This is shown predominantly from the perspective of the trainer support framework, which provides a view and interaction mechanism for all the functionalities of the system. The system is in a beta prototype stage, addressing a severe weather scenario and the examples provided in this section should be viewed in that context. The following schema presents the different blocks that compose the Trainer Support Framework, which is composed of 4 main sub modules:

- **A GUI trainer manager:** which is the global interface between the trainers and the whole PANDORA system;
- **The learning strategies expert system,** which is devoted to the elaboration of the best pedagogical methods according to the training objectives, which the trainer has defined at the beginning of the training session, and to the profile of the trainees.
- **The trainer runtime manipulation manager,** which allows the trainer to modify the course of events in the training session. This means for example being able to go forward and backward in terms of timing, to accelerate or decelerate the session and so on. This component allows also changes in the event flow of the event network (Event Network Manipulation). In addition, the module also allows the NPC(s) to be manipulated in order to answer a specific learning need (NPC manipulation manager);
- **The De-briefing support manager,** which supports the trainer during or at the end of the training session to prepare the report for debriefing. It receives information from the trainee performance during the training session, in order to organise that information into a report to which the trainer can add his evaluation and comments.

The Trainer Support Framework architecture is shown in **Error! Reference source not found.1.**

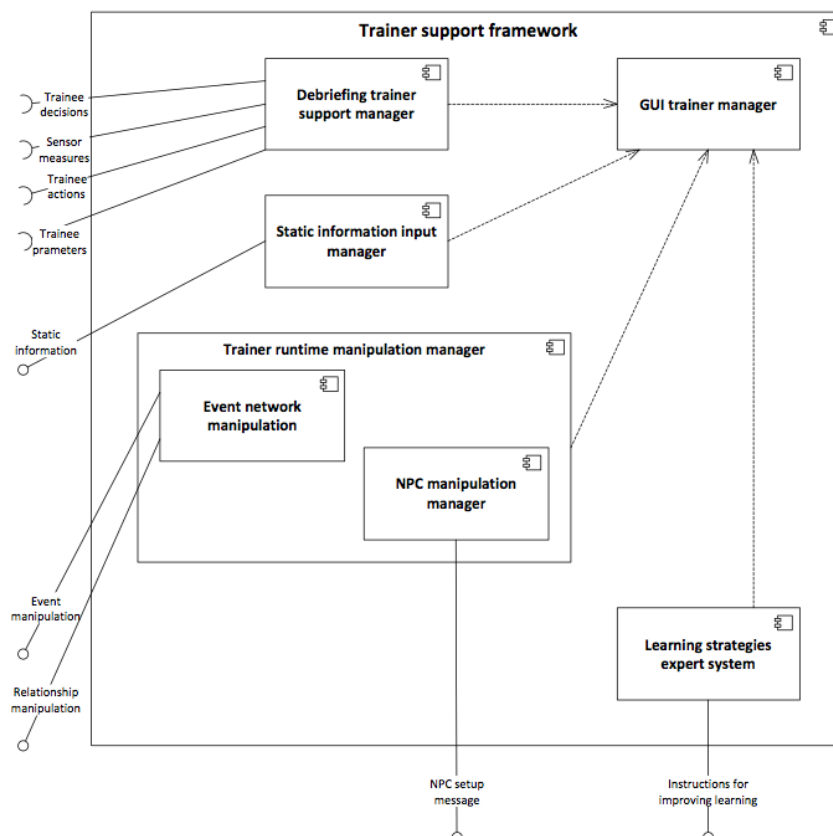


Figure 1 Trainer support framework architecture

Our walkthrough begins here:

3.1.2 Classroom and Event network management

By clicking on the “Create Class”  button, the Trainer can set-up the classroom

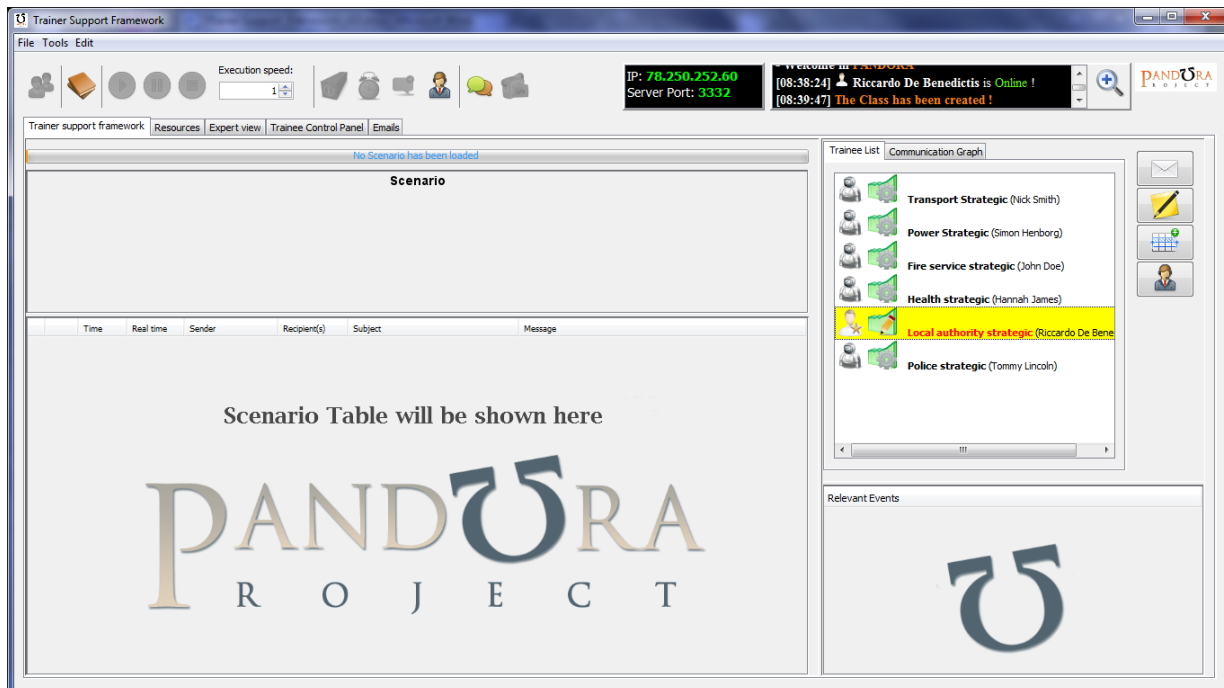



Figure 2 Pandora main screen updated with the list of trainees composing the class

The class can be composed of both “real trainees” and “virtual trainees” in case not all the agencies’ representatives are present. Indeed if some of the trainees are not present they will be replaced by what we call “missing trainees”. On-line real trainees are displayed on the left-list (see **Error! Reference source not found.2**). By selecting them to be part of the class, the corresponding missing trainees of the same role will be automatically de-selected. The class is then automatically completed by adding the missing players that have the roles not already included in the class group.

3.1.3 Scenario management

By pressing the “Scenario”  icon you can select one of the available scenarios in the Pandora System (see Figure 3)

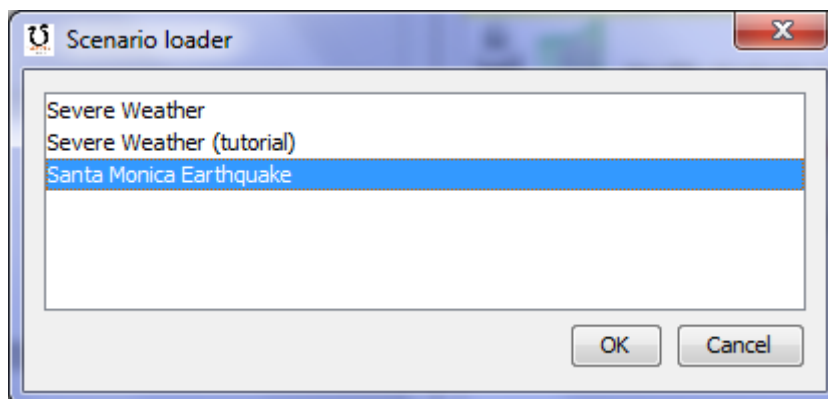


Figure 3 Selecting the scenario

Clicking on the “Ok” button, the scenario will be loaded into the system as presented below:

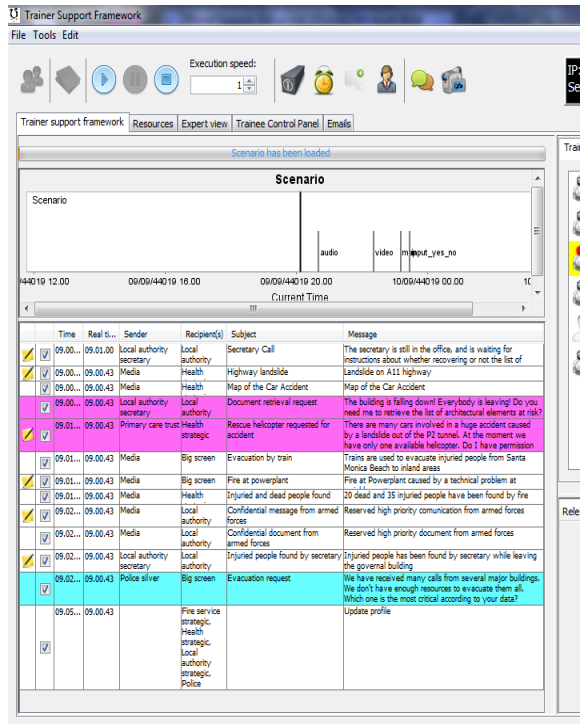


Figure 41 Scenario loaded in the PANDORA system

3.1.4 Handling Missing Trainees

Right-clicking one of the missing trainees will allow the trainer to select whether to take control of it automatically or manually (in that case the trainer will have to answer each request for this missing trainee). Note: the red point on the Missing Trainee Icon means that this Missing player is under control of the Trainer, whilst other missing Trainees are under control of the system.

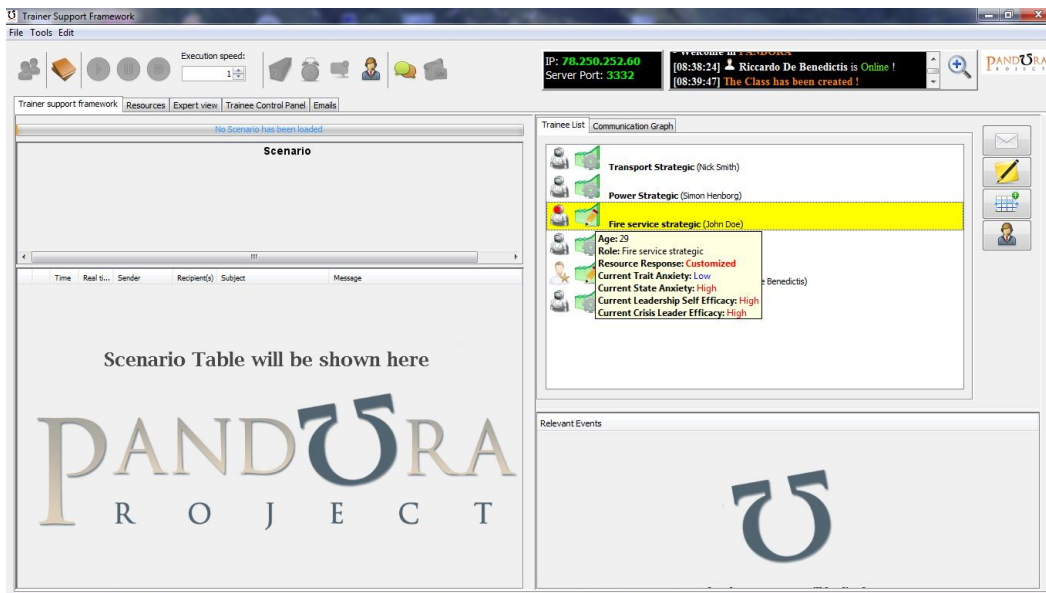


Figure 52 Taking control of a missing trainee

More detail: by default, running a training session, the missing trainees “Default Behaviours” are given as answers to each request in the scenario. This is an automatic process, except if the Trainer decides, for a particular trainee, to take control of him/her (that is to provide an answer for all requests); in that case, the Trainer will see a pop-up window in order to answer on behalf of the trainee (that will automatically disappear after 10 minutes by sending the default behaviours answers to the system; thus avoiding the trainer missing an answer if they were otherwise engaged).

3.1.5 The Trainer Framework Main Screen

Figure 6 shows the PANDORA main screen after a scenario has been loaded. The different parts of the window will be presented hereafter:

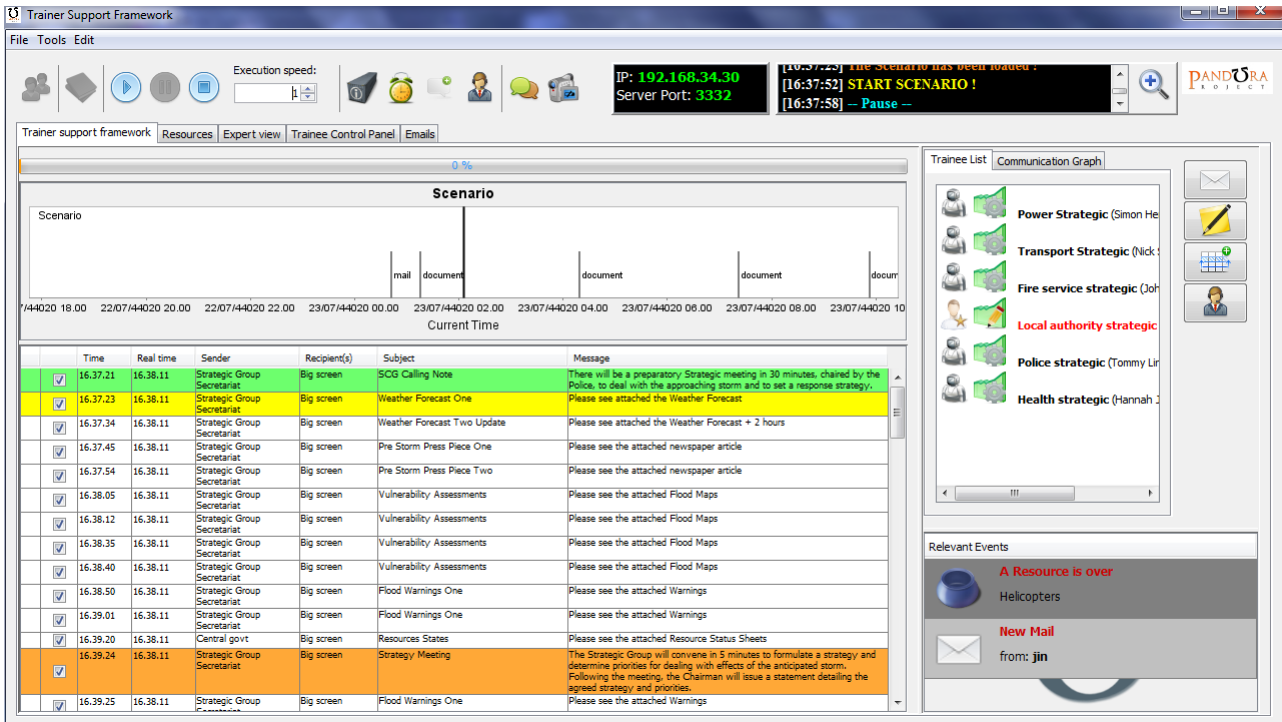













Figure 6 Pandora main screen after a scenario has been loaded

The Upper Part is displaying the set of Functionalities available for the Trainer for creating a

ClassRoom , for loading a scenario , for playing it , for pausing it , stopping it , for speeding-up the execution speed of the scenario, for sending a custom resource sheet to trainees , for “putting pressure on Trainees” with the Hurry-up Countdown , for Creating Events for the scenario , for managing Non Player Characters and events related to them , for accessing the Debriefing functionality , for accessing the Recording functionality .

At the top of the Trainer support framework tab, a progress bar will show the advancement of the Scenario in terms of percentage of time, 100% progress will be reached when the last scheduled event has been executed. Adding, removing or editing events in the scenario will change the status of this progress bar. This progress bar can also act as a time-jump selector: moving the mouse over the bar, a little panel will be displayed showing for each point, the immediately previous and next event related to the point. This facility is shown into the picture below (see Figure):

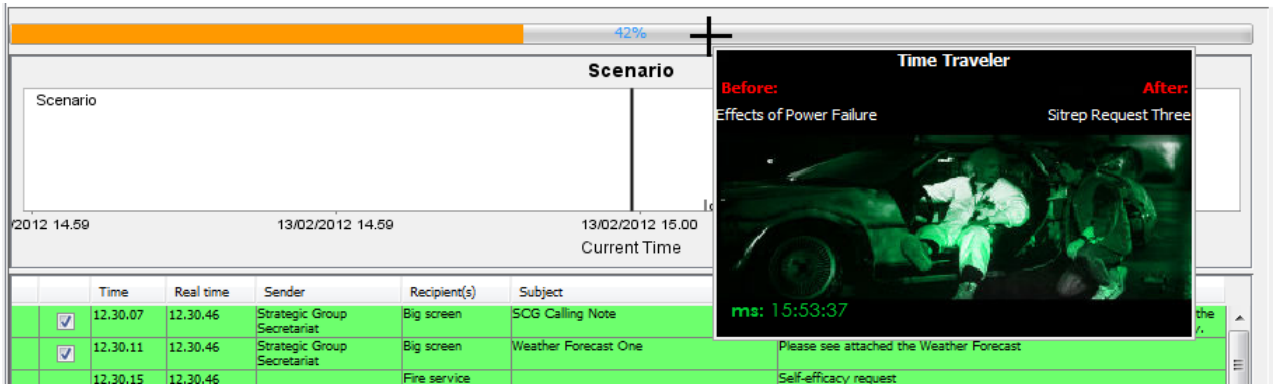


Figure 7 Moving back and forward in time

Double Clicking on a resource-row a dialog will appear where is it possible to modify the progress of the selected resource by adding consumptions or productions. The Chart will display the full state of the resource from the start point to the end point of the Scenario.

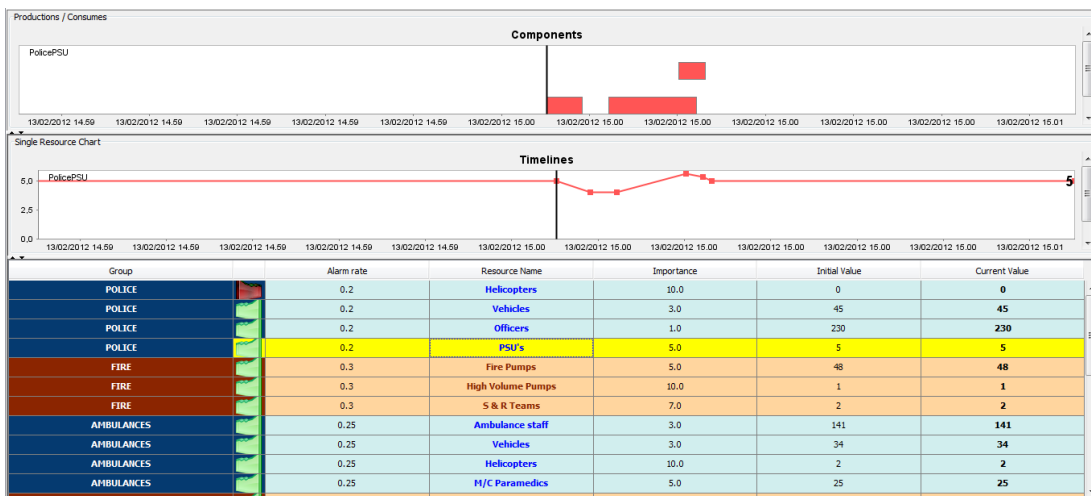


Figure 8 Modifying Resources values

The "Expert View" Tab depicts graphs representing each timeline of the scenario (see Figure):

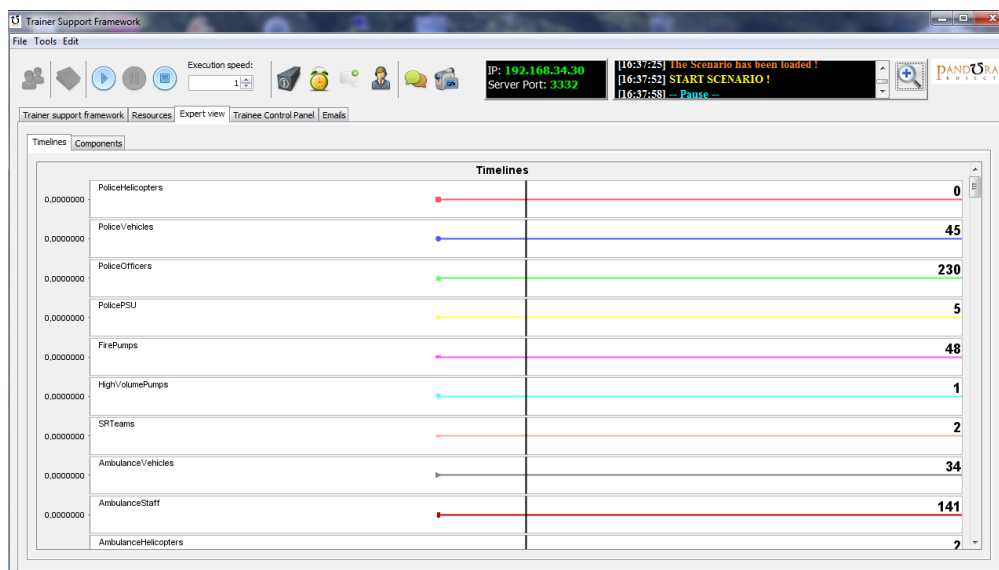


Figure 9 The PANDORA expert view: timelines of the scenario

This perspective directly shows the timeline based Pandora core. The timelines represented are as follows:

- one timeline for each resource
- one set of timelines representing the dynamic behavioural parameters per Trainee
- three timelines that represent decision consequences in terms for instance of *dead, injured, property damage*.
- one output timeline per trainee containing the decisions taken by trainees.
- one main scenario timeline in which the main scenario flow is scheduled. Through this timeline, all the scenario material, questions to trainees, decision points are represented.

The “Trainee Control Panel” Tab displays information on Trainees:

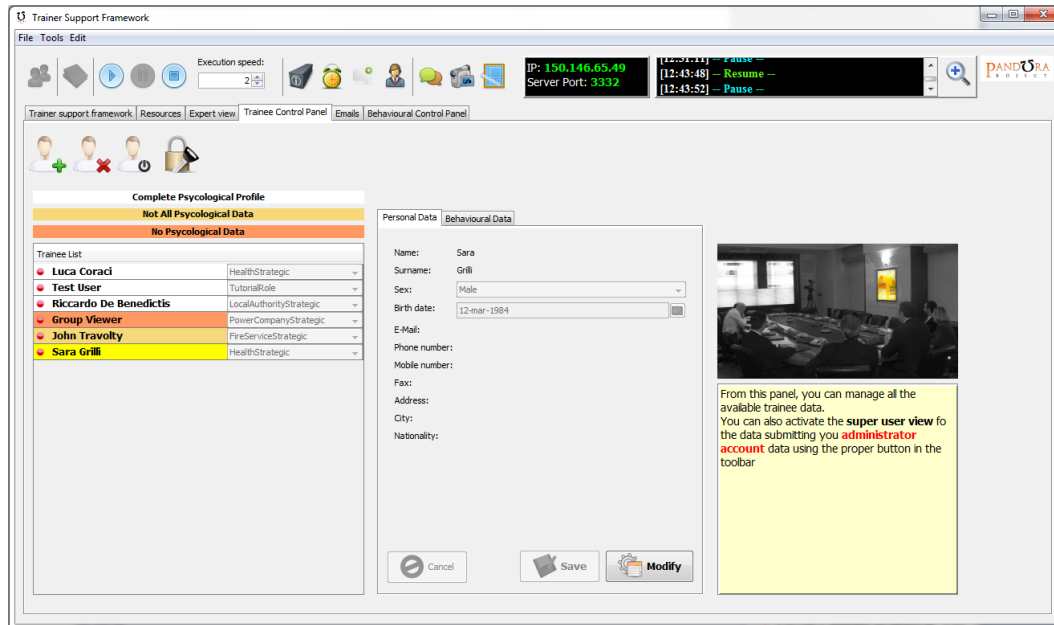



Figure 10 Trainee information panel

This panel shows all the persistent (stored in Database or Knowledge base) information about trainees. Through this panel, this data can be edited. It is also possible to quickly create or remove trainees. From this panel it is also possible to view the information collected through the questionnaires submitted to the trainees in the registration phase. These data are displayed in the ‘Behavioural Data’ tab and they are also updatable.

3.1.6 Interacting with Trainees during Scenario execution

Right-clicking on each Trainee allows Trainers to have access to a menu with different facilities (Chat, Mail, Take Control, ...)

Chatting facility

For chatting  with a specific trainee or with the group (to send a message to all the trainees)

Chat Facility to discuss issues with trainees is presented below:

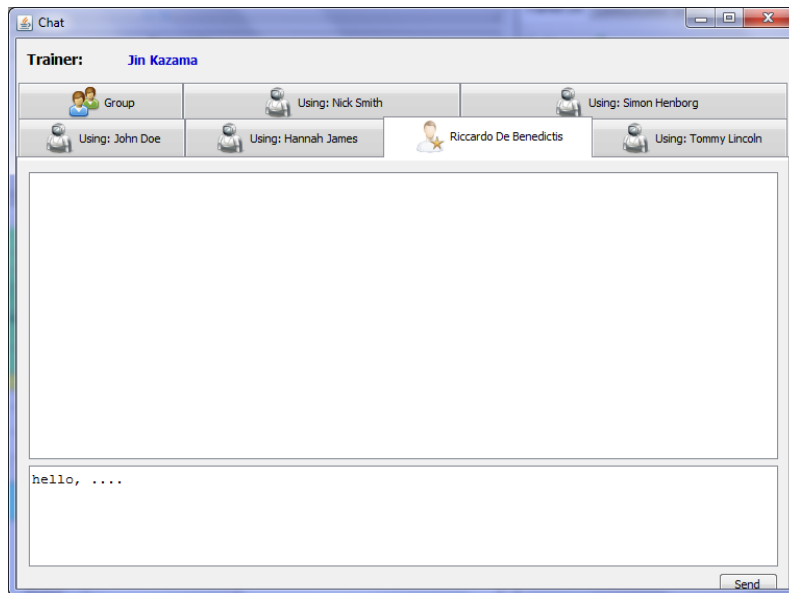


Figure 11 Chat Panel

As a trainer, you can also speak with trainees through the Missing Player Characters.

3.1.7 NPC (Non Playing Characters) manipulation manager

Description: A GUI exists for manipulating NPC (Non Playing Characters that represent the External characters that act in the scenario: Specialists, High Level commanders, Low Level Commander and also missing Trainees) events, that can be used before the scenario execution and also during the run-time of a training session. One can use already existing NPCs (characters or Stimuli) in order to “send” to the targeted trainees multimedia messages with a realistic rendering.

The aim of an NPC is to enable the trainer to create character and Stimuli, based on pre-existing models that can be customized by the trainer to represent a character needed in the scenario, such as an external specialist, or the wife of one trainees that needs to call her husband, etc.

Managing NPC Models for Characters and Stimulis

NPC model management for Characters and Stimulis can be achieved by selecting a pre-existing model of an NPC in the drop-down list as shown below and by defining a set of attributes for that model, such as Name, Description, Role, etc...and emotional type (that will be used to represent the character (sad, happy, nervous, anxious, yes, no, angry, ...) that is particularly important for character definition.

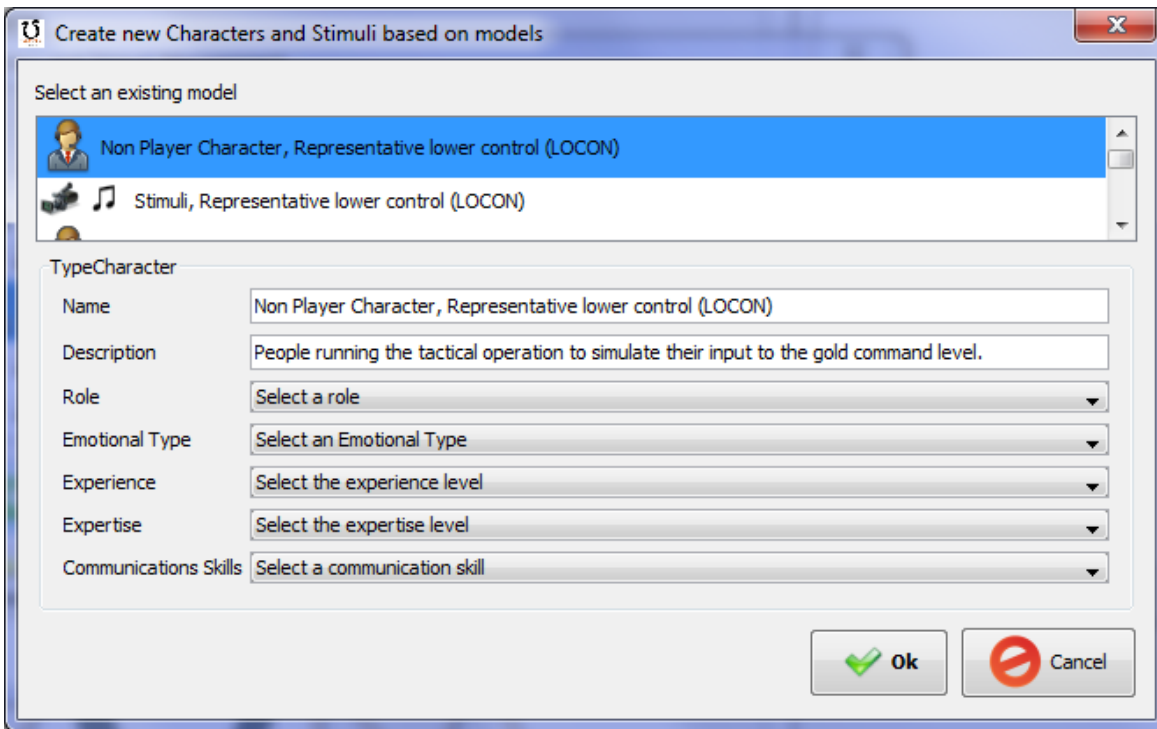


Figure 12 Creating new NPC Models

3.1.8 Creating my own NPC Events

Using Existing Assets

By using the “Open Asset Selector” button, the Trainer can select existing Assets and use them in NPC Rendering sequences.

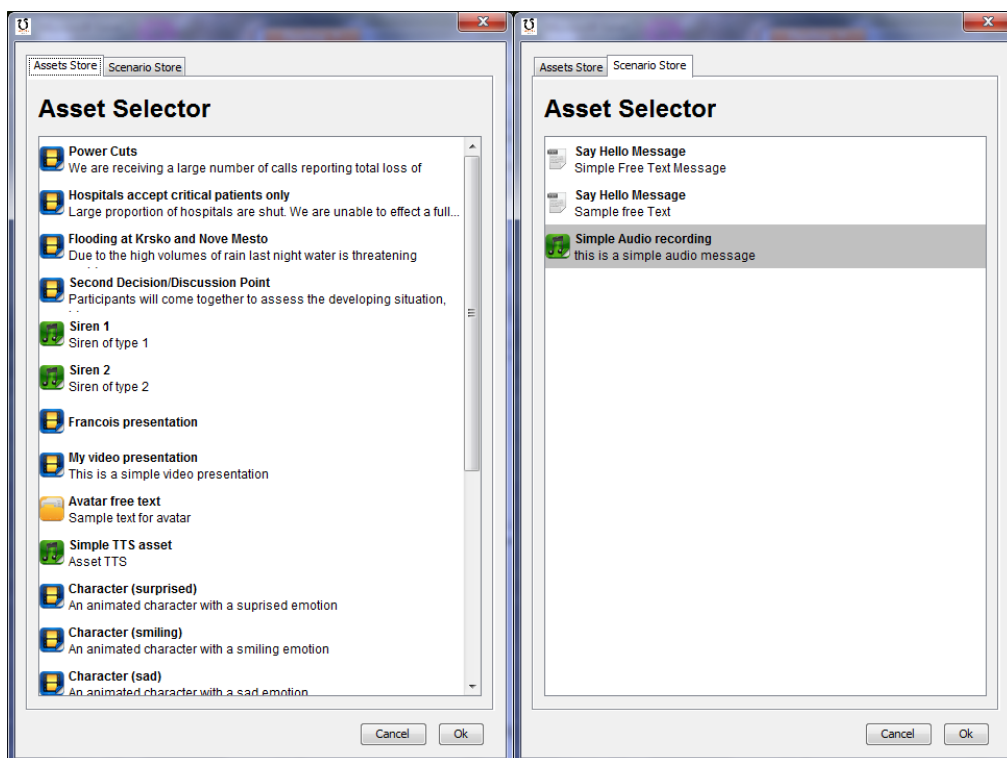


Figure 13 Managing NPC: Selecting existing assets

When modifying an existing asset or adding new one, the asset manager is displayed.

Recording Audio Assets using a microphone

Press the Start Audio Recording button, the recording is starting,

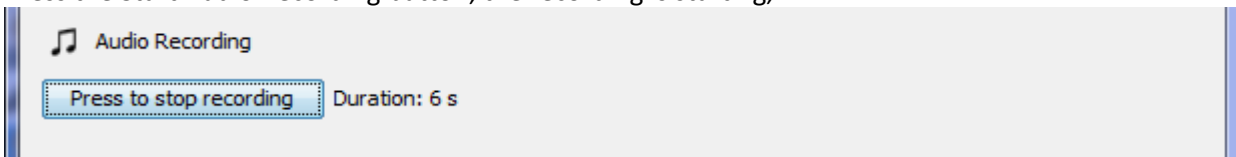


Figure 14 Managing NPC: recording your own audio message assets

You should see the Duration label changing every second, once your audio message has been recorded, press the “Press to stop recording” button to stop the recording. A pop-up (shown below) will appear, fill-in the attribute of that audio message:

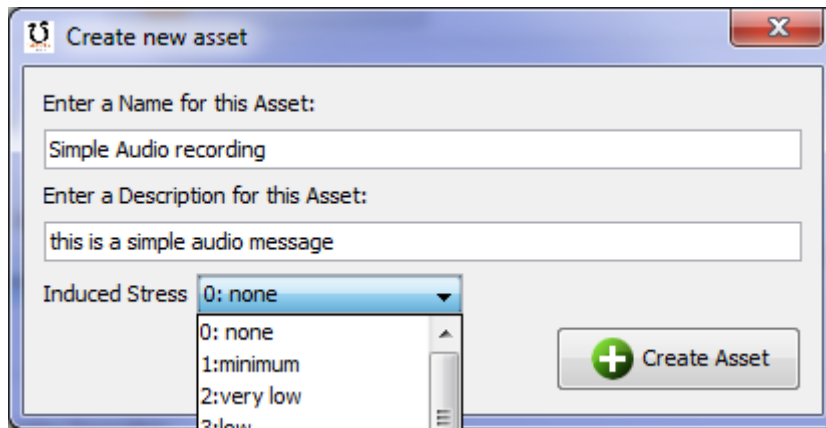


Figure 15 Managing NPC: recording your own audio message assets, storing the asset

Press the “Create Asset” button to save your asset into the Asset Store.

You can play your asset to verify the audio message by pressing the “Play ...’ button:

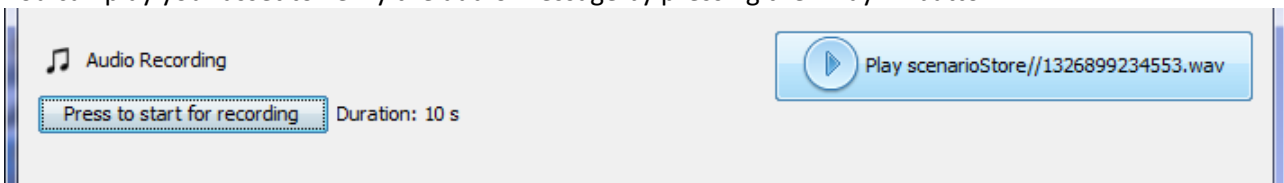


Figure 16 Managing NPC: recording your own audio message assets, playing it

Ordering the sequence to be displayed to trainees

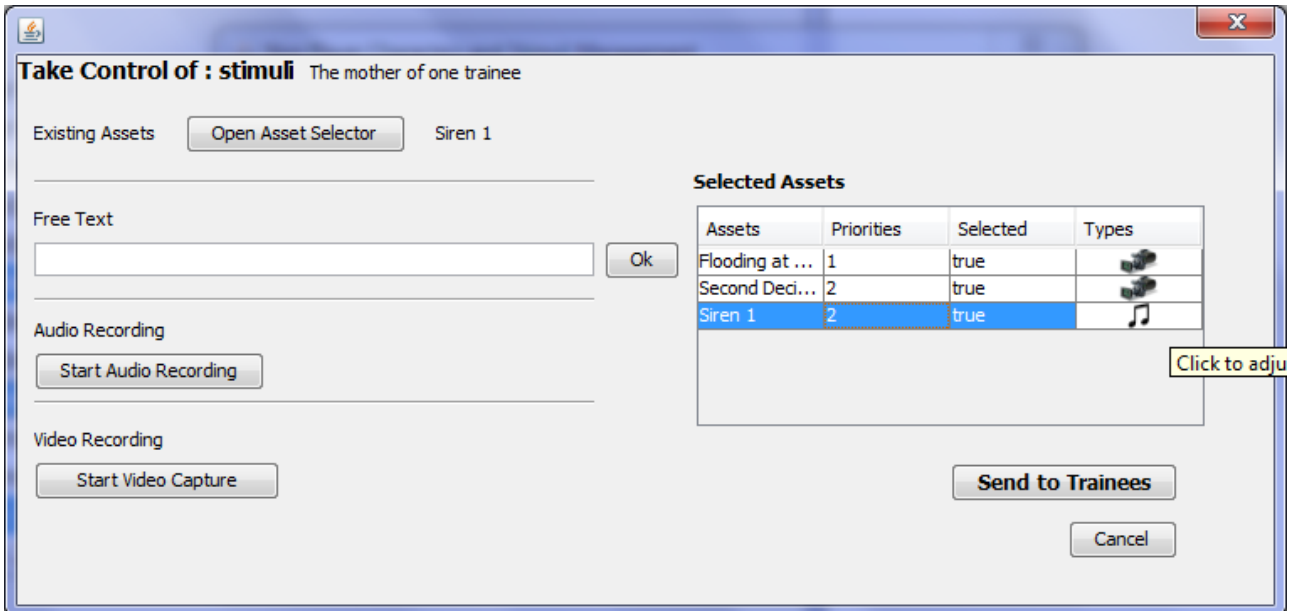


Figure 17 Managing NPC: ordering the sequence of assets to be rendered

3.1.9 Live Streaming GUI



Clicking on the Debriefing Icon will display the Live Streaming GUI as presented below. This GUI allows the connection with a remote webcam that can be instructed to record what happens in the training room. The connection must be configured with a proper dialog.

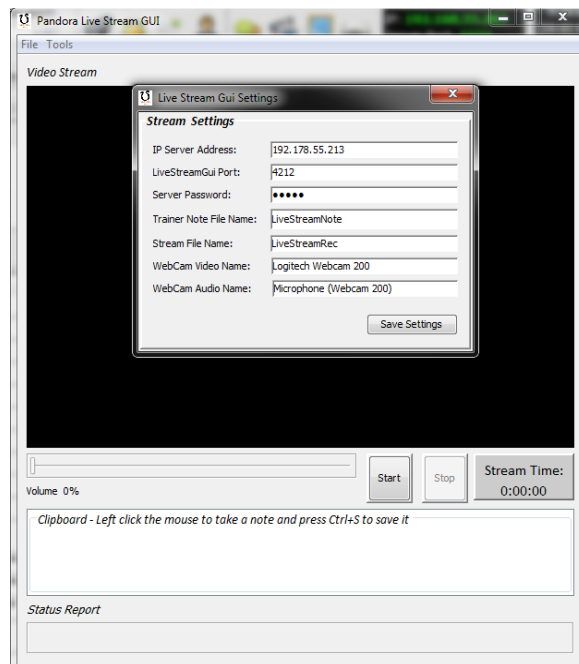


Figure 18 LiveStream GUI: Settings

3.1.10 Trainee Debriefing



Clicking on the Debriefing Icon will display the Debriefing GUI as presented below. The Debriefing GUI can be displayed at any time, however it will only contain data when the STOP



Scenario button has been pressed at the end of the training session. Otherwise the Load Scenario From the File button must be pressed to select the folder in which the xml file of all training session recorded events and the recorded video file are stored.

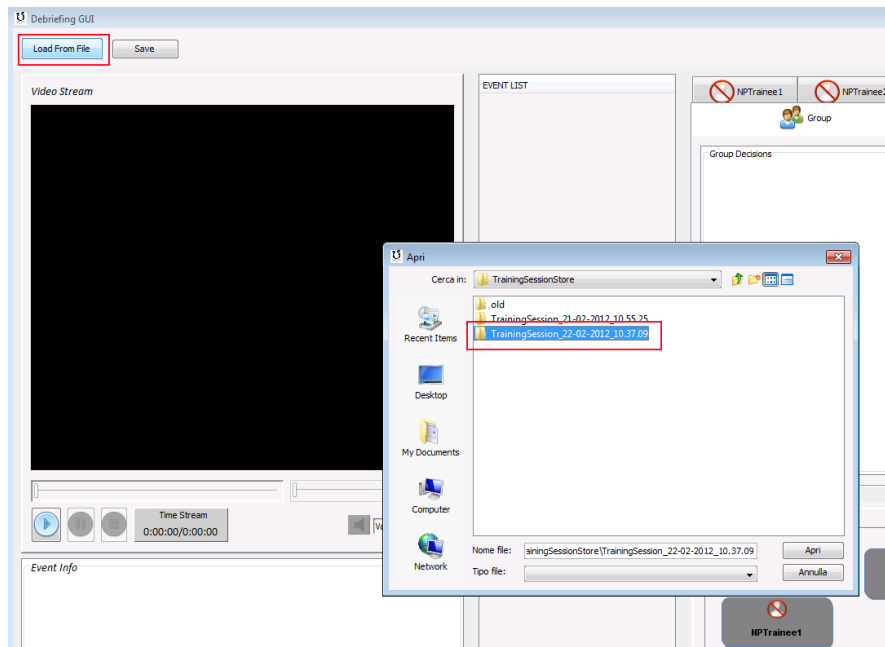


Figure 19 Debriefing part: Loading an existing session

In any case, when the recorded events are retrieved, the Debriefing GUI displays them appropriately. There are three main areas in the GUI:

- The event list and the corresponding related information.
- The Trainee information part
- The Trainees connection graph.

In the event list area, all the main recorded events are displayed in a list. There is also the video display and control buttons that shows the video file if it is available. When one event in the list is selected, the GUI shows the corresponding details in the Event list text area and, if the video is available, the video control changes the start video position to the timestamp of the selected recorded event. Furthermore the trainer can add notes in the underneath notes text area. When saved, these notes are added to the recorded events information and can be displayed when the event is selected again.

The screenshot displays the PANDORA system interface during a training session. It is divided into three main sections:

- Video Stream (Top Left):** Titled "VIDEO OF THE TRAINING SESSION", it shows a group of people in a meeting room. A large screen in the background displays a map and a logo. Below the video is a playback control bar with a "Time Stream" indicator showing "0:00:14/0:03:25" and a volume control set to "50%".
- Event Details (Middle Left):** Titled "EVENT DETAILS", it provides information for a specific event:
 - Event Info
 - TIMESTAMP: 0:01:05
 - CONTENT TYPE: Planner Content
 - SUB CONTENT TYPE: TextInputActionContent
 - SOURCE: Strategic Group Chair - Planner
 - QUESTION: The Strategic Group will convene in 5 minutes to formulate a strategy and determine priorities for dealing with effects of the anticipated storm. Following the meeting, the Chairman will issue a statement detailing the agreed strategy and priorities.
 - ASSOCIATED TRAINER NOTES:
- Event List (Right):** A scrollable list of events with columns for time, name, and role. The entry "0:01:05 Planner - Strategic Group C..." is highlighted in blue.

At the bottom of the interface, there is a "Clipboard" section with the instruction "Left click the mouse to take a note and press Ctrl+S to save it" and a "TEXT AREA FOR ADDING NOTES".

Figure 20 Debriefing part: Viewing event details

In the trainee information part, the recorded events are subdivided and organized for each trainee. Each trainee has its own tab that can provide all the available information (single decisions, sent emails, chats, holter data, resource usage, inserted notes, and so on) including the notes that the trainer has added on the performance of that trainee during the training session. Moreover, the trainer, analysing the available data, can add further debriefing notes on a trainee's performance by clicking on the "Add Notes for the Trainee" button. The trainer can also print this data for each trainee in an Excel file using the "Save Trainee Report" button.

3.1.11 The Behavioural Monitoring functionality

Another functionality of the PANDORA system is the Behavioural Monitoring of trainees. The panel to assess this functionality is the Behavioural Control Panel, which aims to bring together in one general view the set of behavioural parameters defined in the PANDORA context.

It also provides simple features to help the trainer to collect data and update at strategic points, the information on each trainee's profile. For instance, through the list of trainees available on the left of the panel (see Figure) it is possible to send direct requests to trainees to self assess their level of confidence and anxiety.

Answers to these questions, directly update each psychological trainees' profiles. Specifically,

pressing the appropriate icon of the selected trainee, he/she will receive a question, whose answer will be processed by the PANDORA engine and will be then displayed through the main behavioural chart presented here. Specifically, the main chart exposes several parameters, some of which, are initialized with the static values gathered from the questionnaires, filled during registration. The coloured bars on the chart, representing the individual parameters, are arranged in a temporal disposition from the beginning to the end of the scenario. A vertical bar is updated with the progress of the scenario, hiding the part not yet executed. If a trainee has worn the Holter device, a heart icon will appear on the trainee list indicating the active heart beat monitor status. Clicking on the trainee, a further panel will be available containing the graph of his/her heartbeats with two information lines represented by two horizontal lines (see figure 22) as follows:

- **Baseline:** the average of the heartbeats for such person calculated by the Holter System during the initialization phase of that device.
- **Threshold:** the number of beats per minute that discriminates the low/high stress conditions for each trainee computed using his/her baseline.

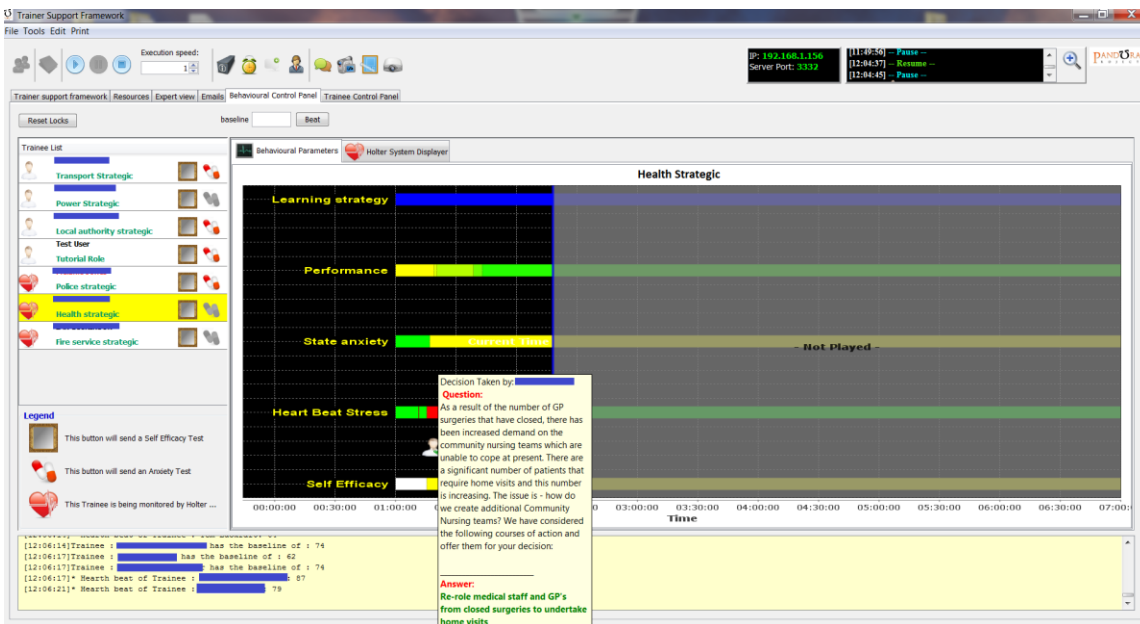


Figure 21 Behavioural Control Panel



Figure 22 Heart Activity Monitoring

3.1.12 Multi-screen Display Scenarisation Editor (MDS Editor)

The MDS Editor is an application, called from Trainer Support Framework that enables a trainer to create multi-screen display audiovisual sequences. The trainer uses the MDS Editor before running a training session as a tool to edit the multi-screen display content to be used in a training scenario.

The MDS editorial space is divided into two main functional areas, namely:

- Screens topology setting
- Display content editing

The screen display topology setting allows the trainer to specify how many screens are to be used for a set of contents to be displayed, whilst the display content editing enables the trainer to create the different scenarised content pieces that will be played on the selected multi-screen topology. In order to call the MDS Editor, the trainer clicks on the “Tools” menu and then on the “MDS Editor”:

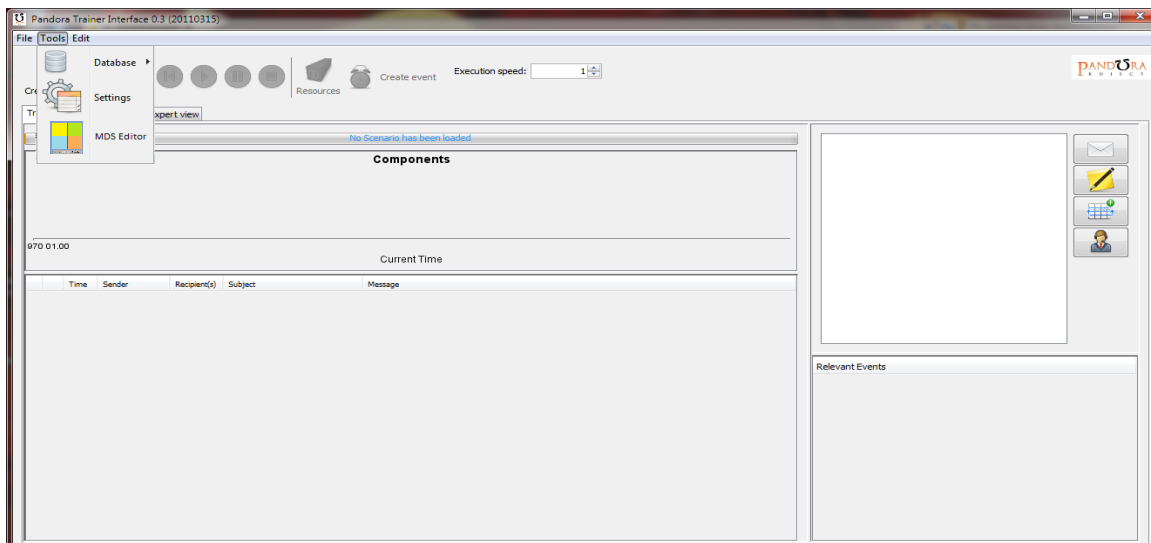


Figure 23 MDS: Accessing the tool

The trainer is now ready to start creating / editing MDS sequences by: specifying the number of screens; importing the audiovisual content (images, videos, links) s/he wants to display; and scenarising along a timeline the content to be displayed.

a) Multi-screen topology setting

The trainer may create one or many screen displays for each card part of an MDS sequence, by specifying for each card a single or a multiple mosaic screens topology of 1, 4, 9 or 16 display screens as follows:

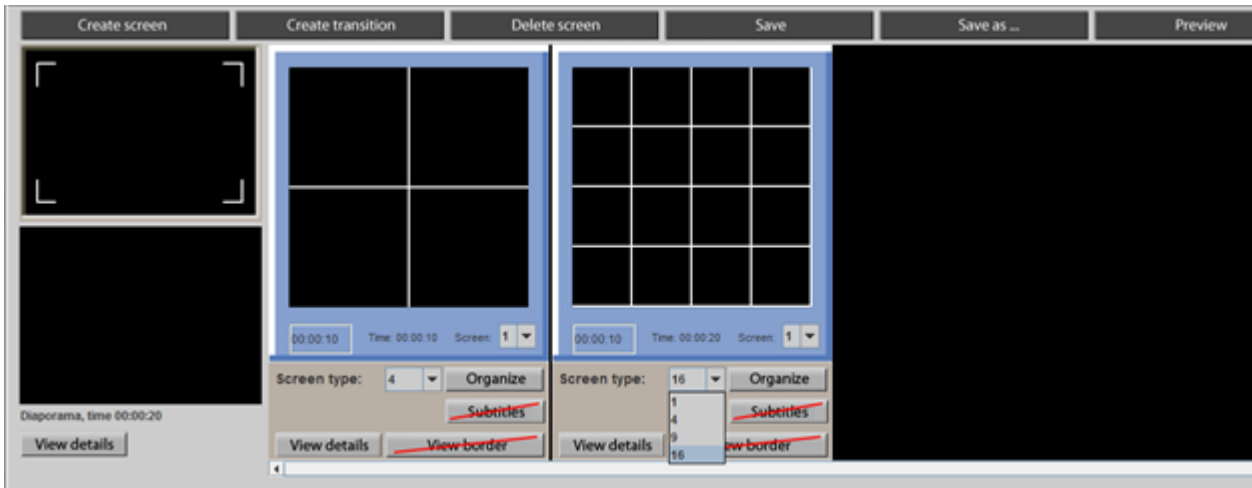


Figure 24 MDS: Topology settings

b) Audio visual content importing

The trainer, before starting the creation of a multi-screen display sequence, must first import the images and the videos s/he wants to display as follows:

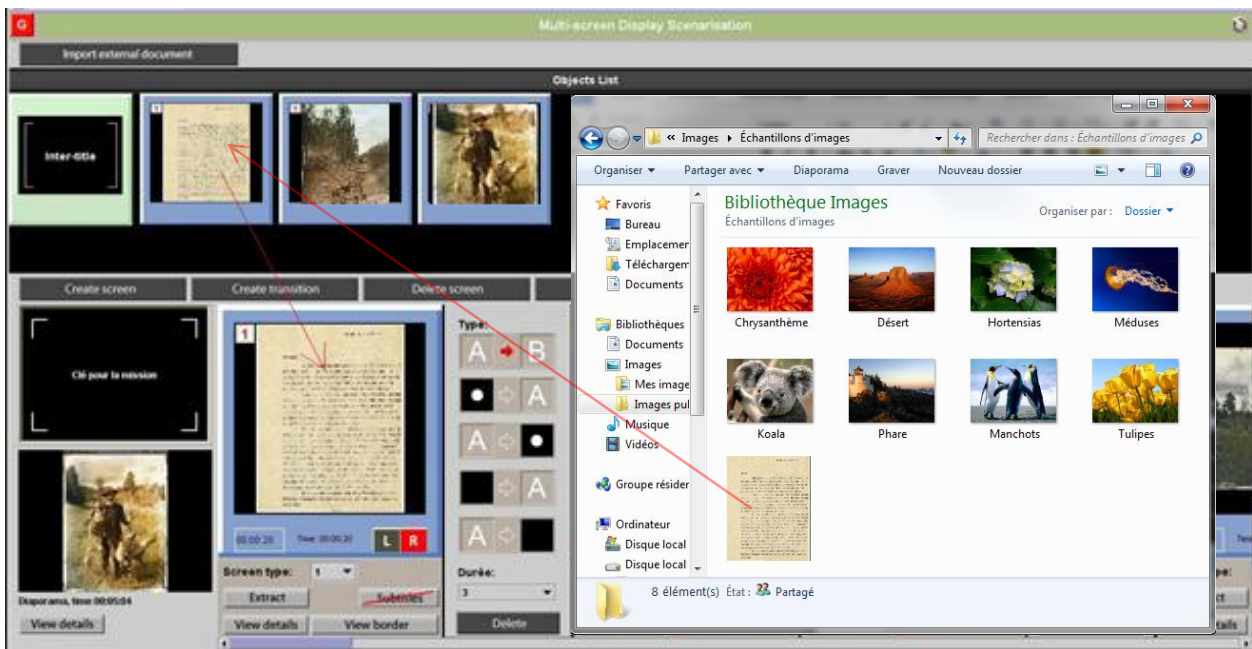


Figure 25 MDS: Contents importation

3.1.13 Trainee Perspective

In the fixed site training and even in the deployed site, the session can take place only when each trainee joins the virtual table by logging in with the personal console. The system then displays his/her name on class register. The Fig. 2 below shows the personal console as it appeared in the evaluation tests carried out at FUB-Rome by Italian usability experts using the Heuristics of Nielsen-Shneiderman.

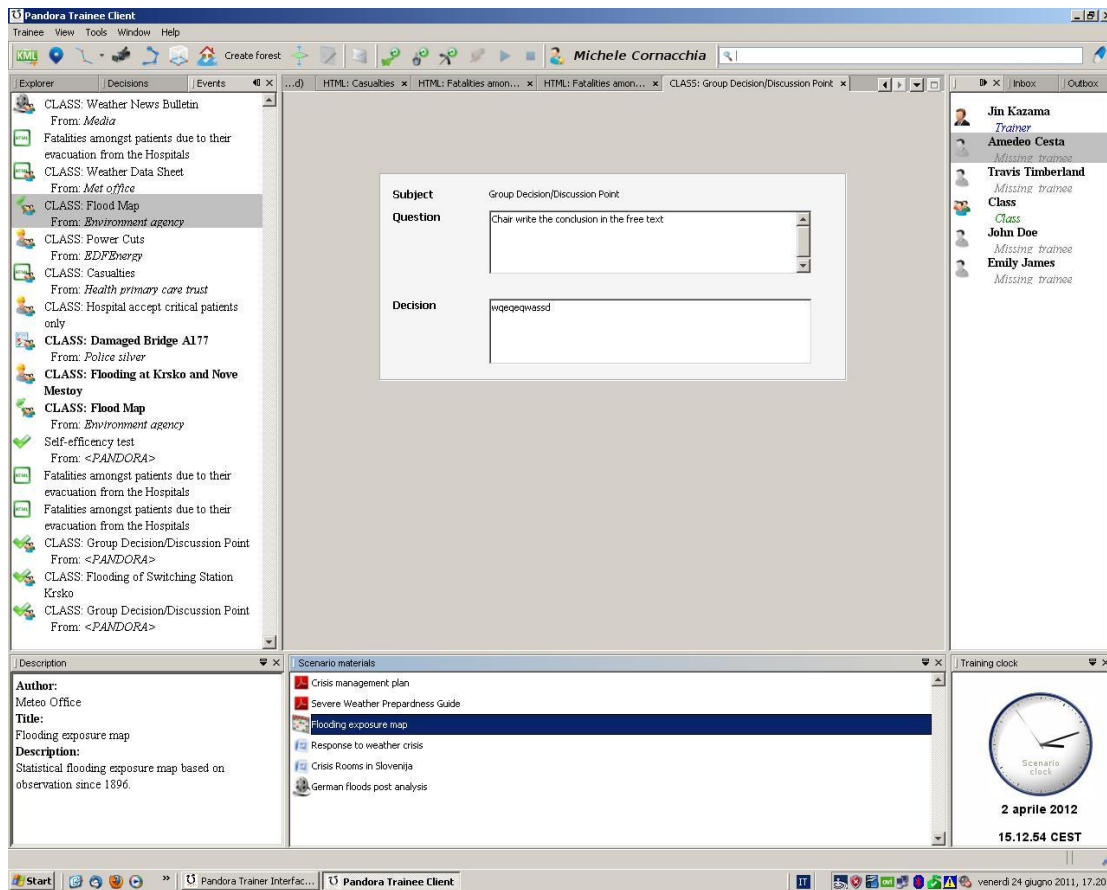


Figure 26 The Trainee's personal console in PANDORA (beta version).

As the picture shows the console makes the trainees able to adequately receive into the main central box all media from the Pandora system running the flooding scenario, or to handle the personal communication either from/to the other colleagues and/or the trainer. The console provides from the beginning the material needed for all participants, it manages a channel to control the individual/group decision process and it forwards the decision made through a dedicated side box. A register of the actions taken by the trainees is also available to be displayed with other environment facilities to give the session the much more effective as possible. The experts pointed out the usability problems and violations by rating them into a severity scale. These results were finally delivered to the developers for the necessary improvement of the GUI.

Lesson plan adaptation to user actions, making use of planning features, can be demonstrated through the Run Time Trainer Interface. Once the class of trainee has been created and a scenario is loaded, the exercise can start by clicking on the execution button. Each trainee starts receiving, several events and among them, specific request events, identifiable by a red flag on their interface. Indeed during the training session, trainees are often involved in taking some decision, or asked to express their own opinion on some aspects of the decision making process. Different ways to submit user's decisions are implemented within PANDORA: a Free Text mode, the Yes-No mode and the Multi-choice mode.

The following Figure shows an example where, double-clicking on the flag marked with a “There is a flood in Termini station...” label a new window pops-up asking whether or not the Termini Station should be closed (Yes-No mode).

Question to trainees (Yes/No Type Example)

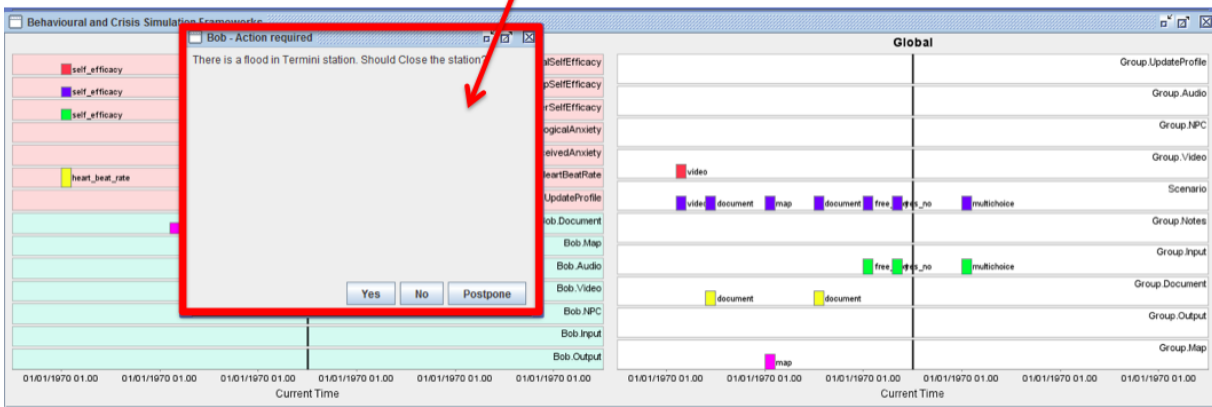


Figure 27 Action request to trainees

An affirmative answer causes the posting of an action event (the cyan event in Figure) having consequences on the scenario timeline and, consequently, on the document timeline of the group. This simple example shows how the addition of an event to the current event network triggers the planning process to re-establish world consistency. The affirmative answer generates, through a planning rule, a document event on the scenario timeline that, in turns, needs to be supported (sub-goaling process at work). Consequently, a document event on the group timeline is added to the event network. The planning process goes on until no flaws are present in the current state ending up with a consistent event network.

New Document Event added to the Event Network

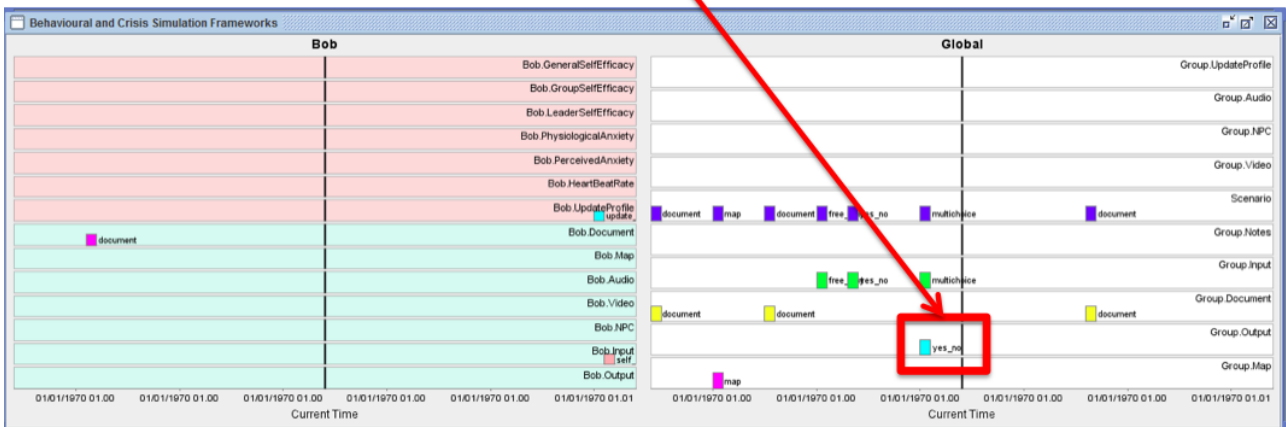


Figure 28 Posting new events on a timeline, as trainees' actions, triggers planning features

Multi-choice request events have similar effects but give more flexibility than simple yes/no requests. Notice that consequences of user actions can be more complicated than those of the provided example including more than a target value on any timeline generating, eventually, new requests to the user and thus a complex and involving evolution of the simulated scenario.

3.2 Results

3.2.1 Testbed infrastructure

The Pandora testbed consists of a Pandora server and several personal laptops - one for each Trainee. In the current solution, the Pandora server is the trainer's personal computer while in the future it will be decoupled. All computers run in a private network, either local (LAN) or virtual (VPN). Direct IP visibility is required between all computers. The required minimum network speed is 10 Mbps - for high quality video and small delays.

3.2.2 Pandora Server

The Pandora server is a virtual machine running on a standard Xen host. Virtualization is used to support multiple instances in case several testbeds were needed. Its hardware requirements are small - currently 1GB of memory and 8GB of disk are sufficient, both parameters are extendable by means of the used virtualization platform.

The Pandora server is a standard Linux server running the following software:

- **Ubuntu server 10.10**
- **Apache HTTP Server (for static content)**
Scenario assets, statics material and other static content is stored on a dedicated disk folder and exposed as a web folder and over NFS.
- **MySQL 5**
Crisis Knowledge Base (CKB) uses database storage.
- **GlassFish v3 Web Application Server (for web applications)**
Not used in the current deployment, but RMI might be exchanged with REST or Web Service API. In that case an advanced web application container would be useful. Such an approach would also allow easier firewall transition. That would eliminate the need for VPN in the distributed training use case while still ensuring sufficient security.
- **Sun JDK6 + Pandora Backend solution**
Sun/Oracle JDK has been used, being the most widely accepted as a standard. Pandora BE is a standalone Java executable running in its JVM.

3.2.3 Trainee Laptop

A trainee uses a personal computer for his/her personal console to run the Pandora Training System. In single site and deployed training use cases the trainee receives, takes actions and communicates with others, using the Desktop Trainee GUI. It is designed for a large volume and frequency of events, rich multimedia interactions and advanced training features. In parallel the group events intended for all trainees are presented on a videowall controlled by the Group Trainee GUI (running on another computer).

In the distributed environment the group events are presented in a Distributed Virtual Environment Trainee GUI - a completely new trainee experience that also allows communication between trainees in a virtual world (like Second Life).

Desktop Trainee GUI (suited for large volume and frequency of events, rich multimedia interaction and advanced training features):

- Windows 7 or XP
- VLC player installed
- Desktop Trainee GUI application installed

Distributed Virtual Environment Trainee GUI (presentation of *group events* in a virtual world crisis room, no backward information):

- Windows 7 or XP

- DVE Client installed
- Desktop Trainee GUI application installed

Group Trainee GUI (presentation of *group events* on the videowall, no backward information):

- Windows 7 or XP
- Group Trainee GUI application installed (with MDS application included)

The Group Trainee GUI is designed to run on a separate computer, but could also run on any existing computer in the system.

3.2.4 Portability

The whole solution is developed more or less in Java therefore it should work on all standard operation systems (Windows, Linux, MacOS, etc.), but that gets trickier when it comes to the display of multimedia components and every port to a new operating system (OS) has to be thoroughly tested.

The Pandora BE is designed only to run on a Linux virtual machine, which can run on a host with any OS.

All three types of Trainee GUI focus on Windows, however the Desktop Trainee GUI has the potential to run on both Linux and MAC OS with minimal reconfiguration. For all early adopters we plan to provide a virtual machine with the Desktop Trainee GUI so that it can run on a host with any OS.

3.2.5 Testing plan and outcomes

In this sub-section we give a brief description of the sequence of tests carried out in the development of the Pandora system. All tests have been carried out with an acceptable success rate, ensuring that all core functionality was fully functional and operational, and peripheral functionality was predominantly functional and operational.

Basic static testing was performed; mainly interfaces review, inspection of configuration and brief review of main classes.

Functionality testing, based on **technical requirements**, follows the grey box approach. The same applies to non-functional testing.

Unit tests were written, making use of the **JUnit** framework, for the most important sections of the application, and regularly executed through the whole development cycle. We also made use of the **Hudson** platform for **continuous integration** that automatically and periodically re-builds the entire system and runs all defined tests when there are changes in the source code repository (checked every hour), alerting the developers if the changes introduced compilation problems, and preparing a full report of the testing results. This was integrated with the **code coverage** and analysis tool **Cobertura**, which provides automatic up-to-date fine grained line, branch, method, class and package code coverage statistics for the entire project. The goal was that all substantial parts of the code were properly covered by unit tests. Every module author was responsible for delivering tests together with the module code.

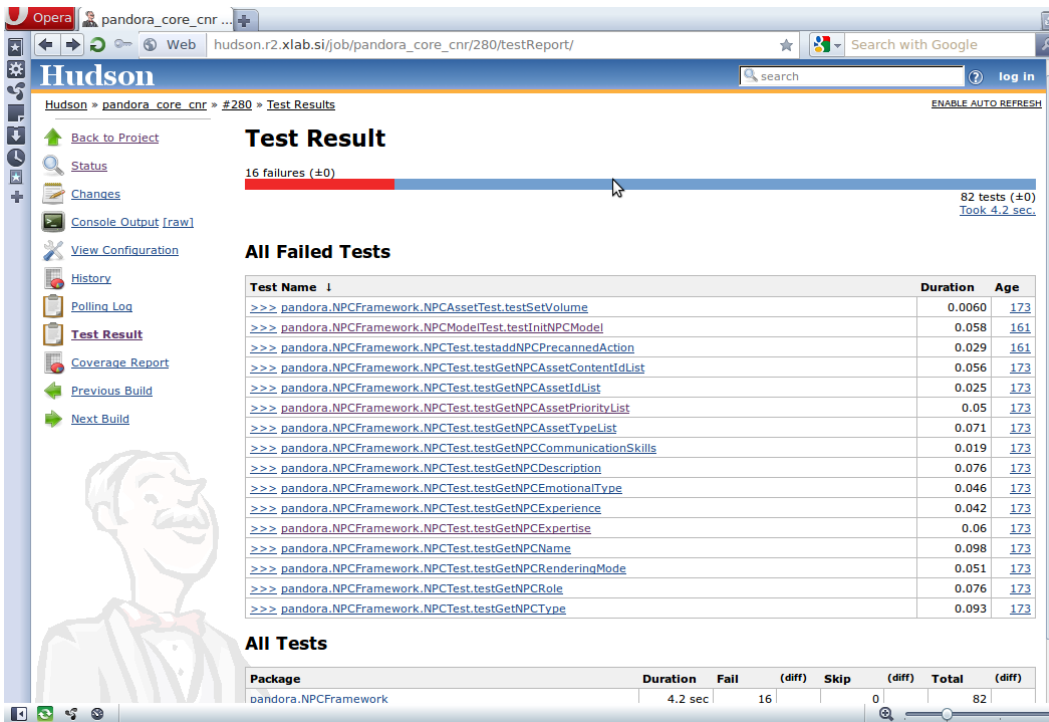


Figure 29: Hudson interface displaying details for the 16 failing tests out of 82 during development

Unit tests are very useful for testing processes and functions, but are ill suited for testing heavily interactive programs, especially those driven by events such as graphical user interfaces. In those cases the functional and integration tests are imperative for the interaction with the user interface, and the triggering of events can only be validated that way.

Integration tests were prepared, updated and performed by the **testing team**. Their aim was to thoroughly test the behavior of the modules and their interaction with other modules when working together in the final solution. **Test cases** were based on technical specifications and technical requirements.

The majority of these tests required a human tester to execute and evaluate the results. Defects were reported. When the issue was resolved, the tester repeated the related tests to verify the resolution, as well as confirming that new defects had not been introduced.

System testing followed the successful integration testing phase. System tests were also prepared and performed by the testing team and were based on the technical specification and developed software solution.

There was a smaller subset of key integration and system tests used for **regression testing**. Those tests were repeated at each major code modification and before every milestone.

A usability test was performed as the last part of the development, and its results were used by the development team (particularly that of the user interface) to improve the usability of the application.

User acceptance tests, alpha and beta testing were also carried out successfully at end user sites in Paris and York.

3.3

User Evaluation

3.3.1 Usability of Pandora System (GUIs)

The Pandora evaluation utilised a range of heuristic evaluation techniques based on Nielsen-Shneiderman heuristics combined with other heuristics set out in the work of Nielsen and Molich, to evaluate Pandora's GUIs, these being:

- *Simplified think aloud*, a discount usability method used in case of small scale tests.
- *Cognitive walkthrough*, a method based on the assumption that users make selections based on the expectation that the action will help to achieve the current goal.
- *Guideline review*, a method in which the reviewers check the product for conformance to a list of standing guidelines and/or golden rules:
 - o Simply presented information
 - o Content reduced to essentials
 - o Manageable logical structure
 - o Intuitive usability
 - o Uniform appearance, consistently designed
 - o Good design and appealing graphics
 - o Quick delivery information

The Pandora's GUIs for trainee and trainer were evaluated in line with the principles above in order to find and return some useful information on the usability of the system, and to recommend improvements for the design of the final product. Standard questionnaires, SUMI and QUIS, were deployed as they could be used by naïve potential users. These also permit the integration of measures on:

- *Efficiency*
- *Affect*
- *Helpfulness*
- *Control*
- *Learnability*
- *Satisfaction*

3.3.2 User Experience and Acceptance

Since end users, in the case the trainer and the trainees, are required to interact with the Pandora Advanced Training Environment, consideration of their view of the user experience and their acceptance of the technology is important in the evaluation of the system. The user experience issues to assess can be identified as follows, the intention being that each measure below reflects user opinion or perception:

- **Realism**, that is the sense for the trainee to be in the real crisis situation during the training session. Different features of the technological system may contribute to the perception of realism such as the representation of the context of actual crisis and the capability of the system to induce in the training context the same psychological processes that are experienced in attending the current crisis.
- **Quality of interaction** during the training session in a technology mediated environment. In addition to the bidirectional interactions of trainer and trainees, multidirectional (or cooperative) interactions within trainees are of great interest. Typical variables from this side are dealing, e.g., either with the trainer interventions, the trainees spontaneous

interventions, the trainees interventions inspired by the trainer, the turn taking, and so on, or by subjective scales to measure the trainees' freedom (perception of) to attend the training session, naturalness of conversation, appropriateness of interruptions, etc.

- **Learning climate.** An important aspect influencing training effectiveness is the so called learning climate which can be defined as the perception by the trainee about interpersonal relationships between the trainee and the trainer (instructor) and also among the trainees. The indicators to measure the perception of the "learning climate" can include: the perception of friendliness, the degree of cooperation, creativity, and capability to promote learning.
- **Quality of the tutorials** (pre-session) delivered to both trainees and trainer about properly using/interacting with Pandora tools. An adequate procedure to instruct the trainer has to be activated, and as well as an adequate procedure to instruct the trainees before any demo session. Indicators of such issue typically are clearness and exhaustiveness of the provided instructions.
- **Security and privacy of the end-users.** In this context important factors affecting the usability are security and privacy as perceived by the end-users. These include procedures of registration and access to the system, and also the conformity to security protocols and confidentiality of personal data.

The results generated in relation to these variables have contributed to improve our understanding of user interaction with the Pandora system. Despite the complexity of the system and the setting of the training environment, the end-users were positively impressed by the scenario represented as they were quickly able to develop both an understanding of the system and its use, interact with the scenario, and experience some emotional engagement, at the familiarisation stage and at run time. None of them encountered problems in the areas of privacy and security, as they exhibited confidence in the system, and trusted it along with their fellow trainees and the trainer, to achieve a positive outcome.

This leads us to the conclusion that the Pandora system successfully met the criteria for user acceptance, and provided a more than positive user experience. This outcome is a significant achievement from the evaluation, especially given the fact that all end-users involved in the exercise were real-world Gold Commanders. Most of them had very positive reactions towards the Pandora training system, finding it easy to use, engaging, credible as a work tool, and potentially extremely useful for their respective work situations. A few minor comments were raised on improvements to the GUI and the processes and procedures of the training tutorial, but all of these were seen to be positive enhancements to an already very successful system.

3.3.3 Individual and Group Performance

Following the IPO (Input-Process-Output) model, we analysed differences between the participants, independent from the training group (in terms of personality and level of expertise), training process (in terms of anxiety and confidence experienced by trainees during sessions, communication and activity) and outcome (in terms of user experience and user acceptance). Although theoretically the process should be interpreted as linear (that is from input to output) some individual characteristics could directly affect the perceptions of the trainee experience.

Eleven participants, from three trainee groups, were analysed using the IPO method. With the expectation of levels of expertise, when Input and Process variables were used as independent variables the analysis resulted in a normal distribution. To test for statistically significant variances a

one way ANOVA for each independent variable was run. Due to the very small sample size, the significant level was set at $p < 0.10$. The measure employed were:

3.3.4 Input

Expertise: level of prior content experience (8 with high experience, 3 with medium experience).

Big Five: 15 adjectives assessing the five basic personality factors: Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness to Experience (three adjectives for each dimension). Mean analysis and distributions of participants in the big five were little bit higher compared to the normal population, in particular for the Conscientiousness dimension.

3.3.5 Process

Anxiety: Level of Anxiety was assessed during the session by questions embedded in the training scenario asking directly how anxious each trainee felt in that moment. The mean score was used as measure. Overall the mean was quite low, which may be explained in part by the fact that all participants had at least some level of expertise as Gold Commanders.

Confidence: as with anxiety, the level of confidence was assessed during the training session through direct questions to the trainees asking them to evaluate their level of confidence at given decision points. Again, the mean score was used as measure, and the overall mean was reasonably high. Potentially this also reflects the experience within the group.

Communication: communication was measured through the number of chat messages sent during the session. In this case, frequencies of chat sent are quite differentiated between the trainees. This measure maybe less useful, since it may be indicative of personal preference of familiarity with digital chat facilities, data on which was not captured in advance.

Activity: the volume of activity amongst trainees was measured by their utilisation of the tools and facilities provided within the system, calculated by the number opened and used during the session.

3.3.6 Output

User Acceptance: user acceptance was assessed via a post-session questionnaire, asking participants to evaluate the technology (e.g. performance, quality etc.). The overall evaluation was extremely positive from all participants, irrespective of previous familiarity with such technologies.

User Experience: the user experience evaluates the system on different sub-dimensions: Learning Climate, Self Perception of Learning, Oral Instructions, Tutorial and User Interface. As described earlier in this report overall the evaluation was extremely positive, (with a particularly high score for the learning climate). Minor comments were received with suggestions to improve the Tutorial and Oral Instructions for use of the system.

3.3.7 Evaluation results

A considerably body of data was collected in relation to the evaluation experiments carried out for the Pandora Advanced Training Environment. The data was collected from a group of real-world end-users, all with some experience as Gold Commanders, therefore representing expert users within the domain. This data has been analysed in detail and will be presented and disseminated through a number of papers in relevant journals and presentations at international conferences and workshops. A short summary of the evaluation findings follows:

- The prototype was found to be easily usable, reflecting both the use of standard designs in the interface and well understood domain process flow within the scenario presentation.
- The trainees found the representation of information realistic and stimulating, commenting on that they found this training considerably closer to the real situation than traditional training systems they had encountered.
- The system was compared favourable, by the trainees, with existing commercial systems with which they were familiar, with some trainees even suggesting they would be prepared to use the prototype as it stood.

- There was considerable enthusiasm amongst both trainers and trainees for the physiological and behavioural monitoring system, and the feedback it provided linked to the debriefing system.
- In terms of the IPO model, all variables were assessed as positive to the success and acceptance of the Pandora system.
- With regard to the user experience, the evaluation was extremely positive, with some minor criticisms on the tutorial and oral information being provided.
- With regard to the user interface, trainees were impressed by ease of use and were familiar with the metaphors employed. A number of minor criticisms were raised on layout and functionality, all of which have been addressed in the revisions to the prototype.

Overall, the outcomes of the Pandora evaluation experiments were considerably more positive than the project partners could have hoped, given that the system was being tested in beta prototype. The view of trainers and trainees alike was that the system represented an improvement on existing training methods and tools for Gold Commanders, was comparable, if not better than, existing commercial tools for crisis management used in training situations, and provided a more realistic training experience. In this context, we can clearly argue that Pandora has met and exceeded the objectives of the project.

3.3.8 Contribution to the state-of-the-art

The Pandora project has developed a number of innovative ideas, techniques, components, algorithms, all of which make a contribution to the state-of-the-art in training for crisis management and may make a wider contribution. Additionally, contributions have been made to standards development, and in the utilisation of technologies from other disciplines and domains into crisis management training. A list of the contributions is provided below:

- The Pandora Advanced Training Environment (PATE):
 - Has introduced a rich multimedia, augmented reality to extend the existing table-top model.
 - Can be utilised in three modes, dedicated site deployment, user site deployment and distributed (web-based.)
 - Also offers a full immersive virtual reality deployment.
 - Provides a dynamic, emotionally affective, realistic training experience.
 - Provides a mechanism through NPC utilisation to ensure that training exercises are always fully populated.
- Pandora has developed a new ontology to:
 - Represent event information within a crisis training scenario utilising timeline based planning (from space research).
 - Develop a component service model mediated by an open source middleware tool developed in the project.
- The timeline based event model technology:
 - Generate stimuli for trainees
 - Supports user modelling (psychological and physiological data)
 - Connects personalisation and simulation environment
 - Provides abstraction for the trainer to use (link from scenarios event to internal timeline representation).
- The system provides real-time interactive control by the trainer, providing the ability to:
 - Interject new events within the scenario.
 - Compress and expand timelines.
 - Communicate directly with trainees individually or group, personally or by taking control of an NPC.
- The system provides a multiple virtual displays (MDS) facility, which can:
 - Synchronise different feeds to a range of displays.
 - Allow the trainer an editing facility to create several feeds each with different content.

- The system supports realistic crisis scenarios through the use of affect to impact stress levels in trainees by:
 - Classifying trainees and modelling their behaviour, which, combined with emotionally affective multimedia information, supports individualised customised decision making under stress within the learning environment.
 - Manipulation of information feeds to provide various forms of information inconsistency, e.g. information overload, missing information, etc. to impact decision-making and thereby reflect real-world constraints.
 - Dynamically creating new multimedia feeds, set at appropriate affective levels to impact trainee stress, by combining multimedia assets using automated mashup rules.
- Training can be reinforced through the use of behavioural feedback to trainees, achieved by:
 - Profiling trainees before and during training through the use of pre-training questionnaires, in-training physiological monitoring and in-training trainee self-reporting.
 - Consideration of decision-making performance during training through rollback facility, and post-training using recording and debriefing framework to provide detailed feedback.
- Whilst developed for crisis management training, the system has the potential to:
 - Be generalised, and then utilised to support a large number of application areas such as military strategic planning, health service delivery planning, organisational strategic planning, local government service delivery planning, stock portfolio planning, business continuity planning and any other application area which can be categorised as a sequence of information and decision events within a timeline based model.
 - Evolve to provide a significant range of potential outcomes, overcoming the limitations of a constrained desktop or table-top exercise environment.

4. Potential impact (including the socio-economic impact and the wider societal implications of the project so far) and the main dissemination activities and the exploitation of results

4.1 Awareness and Wider Societal Implications

4.1.1 Pandora Awareness of Differentiation between users

The Pandora project has made considerable effort to ensure that the services, facilities and tools provided within the Pandora system are equable, or neutral in their treatment of differences between users. To achieve this, we can consider each of the major differentiating characteristics within the system:

- Gender – there is no distinction within the Pandora system to indicate whether a trainee is male or female or, perhaps more importantly whether a specified role within the trainee team is associated to a particular gender. This means that NPC characters can be gender specified when instantiated, and human trainees are not expected to represent any gender other than their own. As a result, we can argue that Pandora treats all subjects equally in terms of gender, although there may be some gender attributes identified in behaviour analysis, but these will be related back into the individual feedback provided to trainees. It is important to stress that the project has sought to ensure that no actor associated either within a scenario, or as an active participant in a training event, is prejudiced by reason of their gender.
- Ethnicity – as with gender above, the project has sought to ensure that there is no prejudice associated with any actor in the system or using the system, by reason of ethnicity. The role specified within the scenario in the demonstrator prototype could be occupied by people of any racial background, and the ethnicity of NPC characters can be explicitly selected at run-time.
- Age – There are age characteristics associated with both the trainees and the roles operational during an instantiation of the Pandora system. This is inevitable, since the trainees are Gold Commanders, as that status cannot be achieved without having achieved a rank and / or position commensurate with a number of years' experience and associated senior responsibility within a real-world role. Accordingly, the age profile of trainees within the Pandora system can be identified as between 30 and 70 years of age, since it is unlikely that trainees would have achieved the necessary status and responsibility before the age of 30, and we would anticipate that anyone over the age of 70, would have retired rather than occupying a Gold Commander role. There are obviously exceptions and exceptional situations but since the system makes no use of age data, as opposed to experience, these exceptions do not cause any problems for the system. In keeping with the age profile of the trainees NPC characters are also represented as fitting the relevant age profile. This has the advantage of ensuring consistency of representation and one hopes, understanding between all actors in the crisis scenario.
- Social status – As with age, we would anticipate that Gold Commander trainees, occupying senior roles in public services and industry, would be representative of the A, B social status groupings. These groupings imply certain standards of language, behaviour and social performance, which would be expected not only of the trainees but also of all other actors engaged in the scenario, and the Pandora environment, information and NPC characters are all configured to be compliant and consistent with such standards of behaviour. It is likely that were the system to be configured for operational level training a wider range of groupings and behaviours would be deemed acceptable and necessary for the systems to be fully representative.
- Educational background – it is reasonable to assume that Gold Commander trainees will have achieved a tertiary level of education, whether by formal qualification, or through practice or

experience. As such, the Pandora system, and in particular the language and terminology in use within the system, is reflective of that level of knowledge and understanding and all actors in the system including the trainees are expected to operate comfortably at that level. Once again, if the system were to be used more widely, particularly at an operational level, then consideration would have to be given to extending the terminology and lowering the expectations of knowledge and understanding of the trainees.

- Creed / Religion – Within the system there is no explicit representation nor consideration of secular issues associated with any particular creed or religion. However, it cannot be guaranteed that the use of mainstream information and media representations will be holy consistent or compliant with the demands of different religious groups. It is therefore important that where the system is to be used in areas predominated by particular religious groups, or where we can anticipate that the trainees will all be representative of a particular religious grouping, consideration is given to ensuring that information within the system is acceptable for use with that group. There may be additional religious rules which impact on the processes and procedures for crisis management in different societies, of which the project is currently unaware, and to ensure the usability of the system within such situations, all aspects or process and information related to the crisis scenarios is completely configurable.
- Legal and cultural issues – The Pandora system has been developed to be compliant with the regulatory systems, rules and cultural dynamics of the EU member states and, as far as is possible, we believe that this has been achieved. However, outwith of the EU, different regulatory models may well apply which will impact the viability and appropriateness of the processes currently enacted within the Pandora demonstrator prototype. Variability of cultural models will undoubtedly impact on decision processes and outcomes within the crisis scenario, and may also have impacts on the procedures and processes utilised within the system. Once again, in an attempt to address these issues, the Pandora system has been made completely configurable however, this would require authoring effort by trainers experienced in crisis management and expert in the relevant regulatory and cultural models.

It should be noted, that while the project has sought to make the system configurable and thereby flexible for a wide variety of usage, the major outcome of the project at this time is a methodological approach to the development of crisis scenario within the Pandora system, the Pandora box from which the system can be instantiated, and a demonstrator prototype utilising a severe weather scenario. The project has not had the time, or resources, to separately develop an authoring tool for crisis scenarios, for use by trainers outwith of the Pandora consortium. As a result, authoring of new scenarios and configuration of the Pandora system currently requires significantly more expertise and knowledge of the Pandora box than we would wish. This will have an impact on the take up of the system, however, since the intention of the project is to make the Pandora outcomes available as open source, our goal will be to build a user community and help them develop the relevant expertise, while also seeking further funding to enable the development of appropriate authoring tools.

4.1.2 Scientific Impact

The Pandora system, has been designed and developed both to provide a useable and working system for crisis management trainers, training Gold Commanders, and to advance the state of the art in terms of tools and technological approaches to crisis management training. To this end, the project has incorporated and further developed technologies from a range of different sources:

- Event network planning - the crisis scenario models are enacted within the Pandora system as timeline based event networks, where every actor, media stream, decision thread, and relevant groupings thereof are addressed by their own timeline. These timelines provide a range of facilities within the training scenario, including:
 - Generating stimuli for trainees;
 - Supporting user modelling (psychological & physiological data);

- Connecting the personalisation and simulation environments.

This technology has been adapted from space research activity in AI planning and extended to meet the needs of the Pandora system, in particular in dynamic re-planning and redistribution of resources as a result of trainer and trainee decisions. Additionally, the system provides the ability for the trainer to compress and expand timelines, and to interject new events dynamically into a training scenario, to increase or decrease the complexity of the situation and the stress applied to the trainees.

- Behavioural analysis – the Pandora system develops user models of the trainees before and during training through:
 - Pre-modelling of behavioural and personality traits.
 - In training capture of physiological stress indicators and decision making performance to assess individuals performance

This information is used within the system by the Affective State Framework, to capture levels of user stress and impact on that as required, and after the training, to support analysis of trainee decision-making and performance under stress. This behavioural capture and reporting is novel for training systems of this kind, and extends the state of the art to provide more targeted indications of the impact of the training scenario.

- Knowledge base utilisation – Pandora has taken on board existing knowledge base research in particular from expert systems, to provide decision point support and information management within the crisis scenario, combined with an appropriate rules base to govern trainee interactions and event sequencing.
- Representation of actors within the Pandora system – one key aspect of any multi-agency training event, such as Gold Commander training, is the requirement that all key agencies are represented in order for the training to be effective. Owing to the demands and pressures of the work place on the individuals, this can prove difficult to achieve with the result that training events occur less frequently that might be desirable. The Pandora system offers a solution to this problem through the use of NPC characters, a term taken from games technology meaning non-playing characters, although in this instance these characters have a greater level of engagement that would be the norm. The NPC Framework provides the opportunity to introduce a range of NPC actors into the scenario, each of which can be configured with specific characteristics such as experience, expertise, communication skills, emotional type. The range of NPC actors that can be represented are:
 - Missing trainees e.g. Police, Fire, Hospital, Local Authorities.
 - Locon: staff at operational level reporting to Trainees
 - Hicon: people at higher level to whom Trainees report
 - Experts who may provide advice / information

This facility enables the Pandora system to ensure that each training event has a complete set of actors involved in the scenario and in all decision-making events, even when some human actors are unavailable. This frees the trainer from any responsibility in having to represent a missing trainee, allowing them to concentrate on running the training event itself, but it also provides the trainer with the opportunity to take over NPC actors to provide additional inputs, scenario changes, better information or expert input as required. Again, this functionality is unique to the Pandora system and provides a significant advance on the current state of the art in table-top training.

- Affective computing – The emotion engine within the Pandora system, which comprises the NPC Framework and the Affective State Framework is based on research work carried out by the affective computing community on the representation of emotion and the affective impact of emotion on users. The project has extended this work, in the process providing a contribution to the development of the EmotionML markup language standard, to develop a combination of emotive tagging of multimedia assets and mashup rules for the combination of those assets to develop multimedia information at a specified level of emotional affect. This has been combined with empirical models of the use of multimedia information to create emotional ambience from

film and TV, combined with information management rules based on issues identified for research within the information and data management community. The combination of these different sources provides Pandora with a unique mechanism for the creation of emotionally affective presentations of information which can directly impact the stress levels of the trainees using the system either at an individual or group level, and can be used therefore to create more realistic training impacts.

- Immersive virtual reality – In addition to the rich multimedia environment created for in person, co-located training events, which provides an augmented reality experience, the project has also developed an immersive VR model for crisis management training. This model utilises games and avatar technologies to provide a virtual crisis room in which the trainees, represented by human avatar characters, can carry out the set of actions, processes and procedures that represent the actual training event. The project has attempted to ensure consistency between the augmented reality and virtual reality scenarios, with a view to achieving a reasonably common learning experience for trainees utilising either model. The Pandora approach has extended the capabilities of immersive VR, both in the use of the timeline event network model described earlier, and in extending the use of emotional affect within such an environment building on work that has already been done within that community.
- Software Engineering – as part of the integration process carried out for the project a new and extended middleware facility has been developed to support component level integration, readily allowing the Pandora box to be extended by the integration of open source and proprietary technologies and facilities. For example, within the multimedia environment provided by Pandora two background utilities provided by partners, namely a GIS tool provided by XLAB called GAEA, and a multi-screen display tool provided by ORT France, are both integrated into the Pandora prototype demonstrator. The middleware utility allows for these components to be readily replaced by other components, such as Bing for the GIS system and some other multi-screen display system, with limited or no reconfiguration of the Pandora Box. As with the other tools and utilities developed within the project, the middleware utility will be made available to the wider scientific community as an open source tools.
- The crisis management community – whilst this community may be seen as the end users of the Pandora system, there is clearly a significant body of scientific research that has been and is taking place in relation to all aspects of crisis management. Therefore the Pandora system does contribute a considerable scientific impact into the research in this community, not least in considering the use of a rich multimedia augmented reality system to provide training support, thereby enriching the existing table top models and providing a greater level of generality than existing simulation models. Pandora has also developed a recording and feedback utility, which will be used to capture and feedback on trainee performance, offering the potential for a greater level of selectivity for crisis manager roles, and the potential for more specific and targeted training to improve individual performance. The impact on this community can therefore be said to straddle both a scientific impact and a societal impact.

4.1.3 Societal Impact

Crisis management is an extremely important service necessary to maintain the integrity and capability of social and industrial operations in extreme circumstances. As such, it has a major societal impact, particularly when poor or ineffectual. It can therefore be argued that any system which improves the performance of crisis managers will have significant positive societal and industrial impacts as a result. This can be argued as:

- Economic impact – reduced down time for industry and major services, plus reduced cost for deployment of emergency services through better planning and more effective and efficient use of resources during a crisis.

- Industrial impact – reduced downtime through crisis leading to greater profitability, reduced loss of production, and reduced diversion of manpower.
- Societal impacts – more effective and efficient crisis management will lead to:
 - Reduced loss of life in life threatening crises;
 - Reductions in interruption to normal life patterns in wider society;
 - Less disruption to transport infrastructure and technological failures;
 - More robust critical infrastructure;
 - Better policing and management of terrorism events;
 - Improved epidemiological and disease control.

These benefits, amongst others, can be directly attributed to the provision of an improved crisis management service through better, more effective crisis management training. The Pandora system can offer these improvements in training, and therefore result in these impacts.

- An additional benefit of improved crisis management training for Gold Commanders will be in an enhanced understanding of the role and activities of other Gold Commanders leading to improvements in inter-agency operation and reducing the societal impact of inter-agency conflict and mismatch. It can also be argued that the improved feedback and reflection process provided in the Pandora system as part of the crisis management training will enable individual Gold Commanders to become more effective decision makers and have a clearer understanding of their own strengths and weaknesses, with commensurate benefits in their normal roles and activities.
- The wider potential of the Pandora system is that it has been developed as a generic methodology and toolset, to support event network-based training scenarios, and then instantiated for a crisis management scenario. This means that the development of better authoring capabilities discussed at the end of section 1.1 will enable the system to be applicable to a large number of different application areas as well as crisis management e.g. transport, military strategic planning, health service delivery planning, organisational strategic planning, local government service delivery planning, stock portfolio planning. As a result, the potential market for the Pandora system is extremely significant and its impact could be far wider than the crisis management community.

The discussion above on the capabilities of the Pandora system has to a large extent already been realised, in the sense that an existing demonstrator prototype is available and has just been thoroughly tested and evaluated with real trainees and we are confident that the test and evaluation results demonstrate that it achieves the improvements in the provision of a training scenario and the impact on trainees that we anticipated. However, the larger scale scientific and societal impacts described above will only come about through the widespread deployment of Pandora and its use to train significant numbers of Gold Commander crisis managers. Therefore the next stage of the project is in the widespread dissemination of information about the system, exploitation and further development of the Pandora system, and the development of a large user community supporting the user of Pandora across the EU and further afield. If we can achieve this, in the next two to three years, then we are confident the societal and scientific impacts we have described above will be realised.

4.2 Main Dissemination Activities

The partners have undertaken considerable dissemination in a variety of forms, briefly described below:

1. The Pandora website was developed for the project and can be found at: <http://www.pandoraproject.eu/>

2. A 7 minute 48 second YouTube video about the Pandora project can be found at <http://www.youtube.com/watch?v=WBtABSPaW9s>
3. Two leaflets advertising the Pandora Project were generated during the lifetime of the project, written in the four languages of the partners: English, French, Italian and Slovenian.
4. Two newsletters advertising the Pandora Project were generated during the lifetime of the project. These were printed in English only.
5. Throughout the lifetime of the project the consortium published the following:
 - 2 Journal paper
 - 13 conference papers
 - 6 conference workshop papers
 - 1 conference poster
 - 1 book chapter
 - 2 news articles
 - 1 report

Further papers are under development, and will be published by individual partners, and by the consortium as a whole, as the exploitation and further development of the Pandora system continues.
6. Other publicity activities include:
 - 3 demonstrations of Pandora at conferences
 - 6 invited talks at conferences
7. A major symposium to dissemination the work of Pandora, alongside 9 other EU projects was held in London on 29th March 2012.

4.3 Exploitation of Results

4.3.1 Business Models

To support the business planning of the Pandora Consortium, we can identify two generic types of business model within the “Serious Games” industry, the B2B (Business to Business) and B2C (Business to Consumer) models.

In the **B2B model** we further identify two methods of product/application delivery:

1. **The order-based model**, where a client organisation (either a business, association, or public or private institution) hires a contractor to design and develop a “Serious Game”. This product/application is for the exclusive use of the client, as it is designed according to its needs, and can have a range of applications, such as in education, communications, health, security etc.
2. **The licence-based model**, where the Serious Game is produced by an organisation specialised in the field of serious games, and is made available for a fee. The application can be either a ready-to-use Serious Game (customised or non-customised), or a serious Game integrated within another application or product. Within the framework of a commercial licence, the entity that acquires the licence is able to make use of the application functionalities within its own activities. However, the acquisition of the licence does not generally allow the entity to modify, distribute or profit from the application source code, or even part of it.

The **B2C model** is where a publisher, company, independent, association or public or private institution designs and develops a Serious Game, and then offers it for sale directly to all types of consumer, without any prior demand or order.

The Pandora Consortium is applying the **B2B** model, operating primarily with an annual licence fee but also by providing pay-per use learning applications in the form of certified on-line or co-located one-day workshops. Furthermore, since Pandora will be offering training to service bodies governed by public law, such as civil protection organisations, public academic institutions and first responders, it is also applying a **B2G** (Business to Government) model.

4.3.2 Consortium Agreement

The consortium has decided that it will proceed to develop an exploitation model for the project outcomes on the basis of an extended and formalised Consortium Agreement. This agreement will be formulated by the consortium over the next few months, based on a shared-profit model and a dual licencing approach to the promotion and marketing of the Pandora product, named the Pandora Advanced Training Environment (PATE). Each partner will sign a Statement of Intent to form the Consortium once the project ends and all the subsequent final reporting is complete. Each partner will then be entitled to an equal share of the income generated from the product as it stands at that date.

Further development of the PATE can then be undertaken by direct investment by the partners in the consortium, or by seeking external strategic partners with funding to support or undertake this work, with associated income and profit share agreements. Fundamentally, the existing Pandora product would become background to such further work, with an associated licence cost, and the foreground development would then generate a further income to be shared on the basis of agreements and licences signed off by the Pandora consortium.

Individual partners in the Pandora Consortium can also exploit the project outcomes in terms of their own business models and activities, subject to agreement and, where necessary, licencing from the consortium.

Immediately post-project, a Pandora Consortium Committee (PCC) will be formed, with one official representative from each partner. The purpose of this committee is to monitor the exploitation, licencing and further development of the PATE and any associated use or activity generated from it, and to develop and manage the profit-share model for partners. This committee will meet at least once a year face-to-face, and may meet more frequently using on-line video conferencing tools. Each partner in the Pandora project is entitled to an official representation on the PCC, subject to signing a Statement of Intent. However, this does not imply any specific future commitment of resources, funds or activities by partners, other than those identified in this plan and the Statement of Intent. All such future commitments will be subject to negotiation and agreement, including licencing, where necessary, and profit-share agreement through the PCC.

4.3.3 Intellectual Property

The Pandora Consortium has agreed an IP assignment strategy on the basis of the standard EU IP agreement model, which means that each partner has identified background IP brought into the project, for which they have provided an open access licence for the foreground work carried out in the project. All foreground IP generated within the project is equally owned and shared by the project partners, and this will be explicitly quantified at the end of the project, as it forms the basis

of the profit share model for the exploitation of the project outcomes. Any continued use of individual partner background IP in the exploitation of the project outcomes will be subject to licencing conditions from that individual partner. Use and exploitation of the foreground Pandora outcomes will be subject to licencing and partnership agreements with the PCC.

4.3.4 Financial Entities

There will be no financial entity that is the Pandora Consortium, it will instead be formed by a group of financial entities, namely the individual partners. They will own a shared responsibility for the maintenance and development of the Pandora outcomes, and for the development of appropriate legal and financial instruments to ensure appropriate handling of licencing, partnership agreements, and profit-sharing.

4.3.5 Consortium Development and Exploitation Plans

Each individual partner has produced their own development and exploitation plan. UoG and EPC have been working closely on an analysis of the opportunities and potential for exploitation and further development of the PATE within the UK market, as an exemplar of what might be achieved in other EU countries in which the consortium has a presence, most notably Italy and France. The analysis presented below, therefore, although it concentrates on the UK since that is the market we have concentrated on initially, should be read as setting out a strategy that can and will be applied in each country where we seek to exploit and develop the PATE. This model has been discussed and shared with the Pandora partners, to aid them in developing their own individual exploitation and development plans, and to consider consortium approaches in other countries. We will work on this exploitation model, while establishing the PCC and setting up the licencing and partnership agreement structures. As identified in the individual reports in the sections above, we will also continue to seek research funding for further development and deployment of Pandora, but this section will concentrate on exploitation and development.

Another reason for concentrating initially on the UK market is that the final dissemination event of the Pandora project, the 2nd International Symposium on Crisis Management, was held in London in March 2012, for an invited audience of predominantly UK organisations with a requirement for crisis management training. We have already followed up with the attending organisations, providing us with the potential to address a range of potential exploitation options, described later in this section.

Vision:

‘To make a significant contribution to EU resilience in general and UK resilience specifically, by providing high quality, relevant and cost-effective scenario based training for all organisations charged with the effective management of the consequences that will arise from major emergency and disaster situations’.

Groundwork:

The Pandora training system should develop and evolve to become a training product of first choice for all organisations, be they Public or Private Sector, single or multi-agency, seeking to improve their capabilities to manage the consequences that may result from major emergencies and common resilience challenges.

Constraints:

The delivery of the vision outlined above is subject to two main constraints:

Available Resources.

This is a standing constraint that is implicit in all public sector supported business initiatives within the UK during the fiscally challenged environment that is likely to pertain over the next 2-3 years at least. Thus, the obvious approach to take the Pandora product to market would be to identify a line of additional investment derived from market exploitation above or in place of the minimum annual training targets set for the UK Public Sector emergency preparedness workstream or resources set aside to manage risk and consequences within major Private Sector companies. To access existing training budgets Pandora will need to exploit value for money and additional utility against existing products and training cultures. This is very doable provided that Pandora can be demonstrated successfully to potential customers. To demonstrate that Pandora can deliver value for money to customers while also providing sufficient income to support continuous development and improvement, the Business Plan will need to have access to tight cost control; maximisation of earnings; changes in the business model (identifying additional business opportunities to utilise the training system in different and innovative ways); structural and process efficiencies; and the exploitation of partnering, teaming and other strategic alliances. This in turn will require robust fiscal management systems to be put in place that can cope easily with changed operating models.

Market Uptake.

Pandora will need to create a market in two critical areas - Training Providers and Training Users. Both of these market areas are currently experiencing a severe downturn particularly within the Public Sector. However, the fiscal situation is not only a threat to exploitation it is also an overwhelming opportunity, as both market segments are actively seeking more efficient and innovative training solutions. With the right cost model, Pandora could gain a significant market share during the downturn and be well placed to exploit the upturn in the fiscal conditions when that occurs.

Active Business Exploitation Options:

There are 4 main and one subsidiary exploitation opportunities that have been identified as having immediate potential. These are:

- a) Identify and bring on board an existing major training provider within the UK sphere of activity. The Cabinet Office preference would be for the EPC training contractor (Serco plc), to take on Pandora and use it to support the whole gambit of training that it currently provides to the UK Public sector on behalf of the UK Central Government overseen by the Cabinet Office. Serco has approximately 30% of this market (about 6,000 trainees per year) with designs on growing its market share significantly over the next 2-3 years. It also has designs upon overseas markets beyond the EU.
- b) Identify large, preferably multi-national customers to take the Pandora system for use in-house. This would give high visibility to the system, particularly if it was used by a 'blue chip' company or organisation. Of course it would have to be tailored to deliver bespoke training and this would inevitably constrain its initial further development to meet very specific and potentially narrow user requirements. The UK Civil Aviation Authority, Regional elements of the UK National Health Service (nationally the biggest employer in Europe with over 1.3 million staff) and the UK Civil Nuclear Power sector, which may be about to expand significantly have all declared their interest in having a Pandora application working for them.

- c) Create a consortium of Small to Medium sized training companies that will collectively pay a license fee to use the Pandora system. They would also be able to buy/ hire content or indeed populate the system with their own content. The commercial operating consortium would undertake to maintain and support their use of the system. A portion of the license fee would be ploughed back to resource programmed system development. This approach on its own is unlikely to generate sufficient income to ensure rapid and continuous development of the Pandora system at least in the initial years of operation.
- d) The Pandora team in the UK set-up and operate their own Pandora training system as a web based service that can be accessed online as a pay per play operation or as a time limited service (e.g. monthly, quarterly, annual etc).
- e) As a sub-set, it could also be possible to provide an online scenario builder that any customer could access for a fee. The use of the material would be for a fixed period of time and the rights to use would be strictly policed. This option would be available when a full menu of scenarios is available. The construction of scenarios is a key requirement for the commercialisation of the Pandora system and the use of scenario information could be marketed as a separate activity that has the potential to produce a significant and robust income source for little or no additional outlay after scenarios have been generated and on-line tools to manage the service have been created.

Discussion

All of the options outlined above are feasible. However, in order to commercialise the system and achieve uptake across a wide area as quickly as possible, options a) and b) are the preferred course. However, if option a) proves unachievable then options b) and c) would be a commercially viable route. Options c) and d) either singly or together are unlikely to produce the level of uptake and income necessary to take Pandora from its current state into a suite of commercial products. A key driver in all of the analysis is the need to achieve three main objectives concurrently. These are: Volumes of Customers, Improved Training Effect and real Value for Money for the customers in whatever sector they reside. How these components interact to provide the tangible potential benefits that Pandora can deliver is illustrated in the diagram at fig 1.

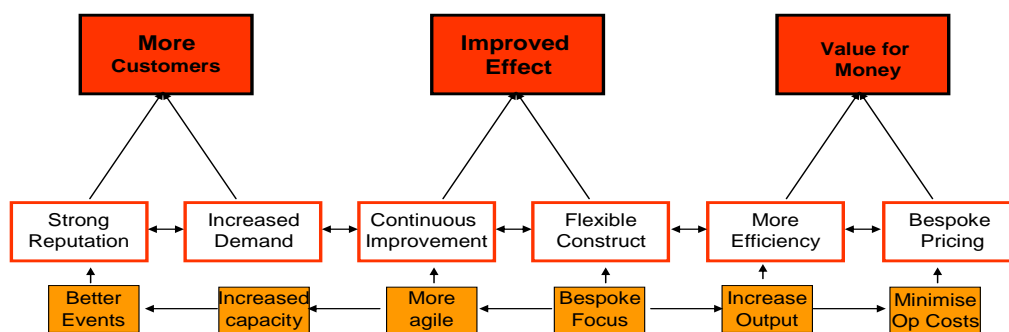


Figure 3 - Key Driver Interaction for Pandora Exploitation

4.3.6 Conclusion

Pandora offers a tangible capability that now needs to be exploited to the fullest extent in the shortest but managed timeline possible. In this way Pandora will unlock all of its potential and deliver significant improvements to crisis management performance in the future. The consortium is now moving to put the structure in place to deliver on this potential, and the momentum from the recent dissemination event and follow-up provides a real opportunity for the exploitation of the Pandora project outcomes.

5. Diagrams / photographs illustrating and promoting the work of the project

5.1 Logos

PANDORA
PROJECT



Vertical logo:

PANDORA
PROJECT

Horizontal Logo

PANDORA
PROJECT

5.2 Leaflet

PARTICIPANTS

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For more information visit our site at:
<http://www.pandoraproject.eu/>



ADVANCED TRAINING ENVIRONMENT FOR CRISIS SCENARIOS



PANDORA PROJECT

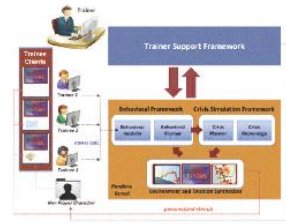
SEVENTH FRAMEWORK PROGRAMME

PROJECT FP7-ICT-2007-1-225387- PANDORA:
winner of the particular mixed call on
ICT and Security

Cofunded by the European Union under
the "Security" Programme

LA SOLUTION PANDORA / LA SOLUZIONE DI PANDORA / PANDORA RESITVEV / THE PANDORA SOLUTION

- Le projet PANDORA établit le lien entre les exercices de simulation en salle et les exercices de simulation dans un contexte réel en fournissant un environnement quasi réel de formation à un coût accessible.
- Il progetto PANDORA si propone di colmare il divario esistente tra le esercitazioni a tavolino e le esercitazioni simulate nel mondo reale, fornendo a costi accessibili un ambiente di addestramento simile a quello reale.
- Projekt PANDORA bo omogućil usposabljanje kriznih menedžerjev s pomočjo računalniških simulacij v realnem času in bo zapolnil vrzel med teoretičnimi simulacijami in simulacijami v resničnem okolju.
- PANDORA will bridge the gap between tabletop exercises and real world simulation exercises, providing a near-real training environment at an affordable cost.



The Pandora system architecture



PANDORA - DÉVELOPPER LA FORMATION DE GESTION DE CRISE AU NIVEAU STRATÉGIQUE

Pandora est un projet de recherche en «sécurité et TIC» de l'Union Européenne avec 9 partenaires de 4 pays visant à répondre aux besoins de formation des personnes chargées de la gestion stratégique dans des situations de crise. Les formations existantes se déroulent soit sous forme papier et d'exercices en classe, soit sous forme de simulation à grande échelle du monde réel. Le projet a développé un environnement innovant (la Pandora Box) avec des technologies assurant une formation multimédia riche.

Pandora propose une approche novatrice, basée sur une démarche temporelle et de réseau événementiel de «la planification en IA» de l'industrie spatiale, pour la modélisation de scénarios de crise. Le système fournit la modélisation du comportement et du contrôle du stress, gérée par une base de connaissances, et capable d'affecter les performances de l'élève. Le tout est présenté dans un environnement multimédia où les stagiaires expérimentent des informations adaptées et sont amenés à prendre des décisions stratégiques. La modélisation comportementale est faite via des outils de capture physiologique, questionnaires et un processus d'auto-évaluation durant la formation. Les facilités de contrôle du stress sont gérées par l'utilisation de règles combinatoires «mashup multimedia», afin de fournir aux apprenants une variété de stimulus engendrant du stress, combinée à de l'information incomplète ou manquante, dont ils devront prendre des décisions dans un temps limité. Le système assure le suivi, l'enregistrement et le compte rendu pour l'analyse postopératoire des performances de l'apprenant.

Le projet a débuté en janvier 2010 se termine en mars 2012 et voit ses développements continuer sous les auspices du Consortium Pandora.

PANDORA - ADESTRAMENTO ALLA DECISIONE STRATEGICA PER MANAGER DELLE CRISI

Pandora è un progetto di ricerca della EU nell'area mista ICT e Sicurezza in cui 9 partner di 4 paesi affrontano i bisogni di addestramento alla presa di decisione in complesse situazioni di emergenza che coinvolgono più enti responsabili. Le attuali tecniche di training si basano su esercizi a tavolino (dal limitato realismo) o su esercitazioni sul campo (fidotte nel focus e costose). Il progetto ha sviluppato un'idea innovativa usando soluzioni tecnologicamente avanzate per fornire un ambiente di addestramento ricco e coinvolgente, denominato Pandora-Box.

Pandora-Box si basa sulla modellazione di scenari di crisi attraverso timeline di eventi, una tecnologia adattata dalla pianificazione IA per applicazioni spaziali. Il sistema fornisce strumenti per creare modelli di comportamento e per controllare lo stress indotto allo scopo di adattare il training alle competenze e prestazioni degli allievi. Il contenuto della lezione è rappresentato in un ambiente coinvolgente in cui stimoli multimediali, combinati con mancanza, perdita o incompleteness di informazioni, costituiscono la rappresentazione base di situazioni entro cui gli allievi devono prendere decisioni in tempi ridotti. Le funzionalità relative ai modelli di comportamento combinano il monitoraggio di dati fisiologici con questionari somministrati durante le sessioni. Il controllo dello stress indotto si basa invece sull'uso innovativo di regole per la sintesi di messaggi multimediali e di manipolazione delle informazioni, al fine di esporre gli allievi a stimoli di maggiore o minore intensità. Il sistema supporta anche il monitoraggio, la registrazione e il feedback per l'analisi post-hoc sulle prestazioni degli allievi.

Il progetto ha avuto decorso da gennaio 2010 a marzo 2012, mese in cui sta ultimando gli ultimi lavori sotto gli auspici del Consorzio Pandora.

PANDORA - RAZVOJ TRENAGNEGA SISTEMA ZA STRATEŠKO UPRAVLJANJE KRIZNIH SITUACIJA

Projekt Pandora, na katerem sodeluje devet partnerjev iz štirih držav, je evropski raziskovalni projekt na področju varnosti in IKT (informacijsko-komunikacijskih tehnologij), usmerjen v usposabljanje strokovnjakov, odgovornih za strateško upravljanje zapletenih kriznih situacij. Trenutni programi usposabljanja za krizno upravljanje so izvedeni kot namizne, papirnate ali terenske vaje. Prve trije za pomanjkanje realizma, druge pa so ozko usmerjene in drage. V okviru Pandora smo razvili sodobno tehnološko rešitev Pandora Box, ki prinaša realizem in bogato multimedijsko izkušnjo v vadbeno okolje.

Pandora Box ponuja inovativen, časovno naravnani pristop k modeliranju kriznih scenarijev s pomočjo dogodkovne mreže, razvit na osnovi strojnega načrtovanja v vesoljski industriji. Sistem omogoča aktiven vpliv na učinkovitost udeležencev: orodja za modeliranje vedenja in nadzor stresa, temelječ na bazi znanja. Krizni scenariji so predstavljeni v bogatem multimedijskem okolju, kjer udeleženci trenirajo s pomočjo primerno prikazanih informacij oblikujejo strateške odločitve. Orodja za vedenjsko modeliranje so bila razvita s pomočjo obstoječih naprav za spremljanje psihološkega profila, vprašalnikov in samoocenjevanja med samim usposabljanjem. Nivo stresa nadziramo s pomočjo pravil za združevanje multimedijskih vsebin in prilagajanje informacij, ki udeležencem predstavljajo neopnealne ali popačene informacije, ki povzročajo stres in na podlagi katerih morajo udeleženci v časovno omejenem okvirju sprejeti strateške odločitve. Sistem ponuja tudi možnost nadzora, beleženja in poročanja za poznejše analize učinkovitosti udeležencev.

Projekt je potekal od januarja 2010 do marca 2012. Po zaključku projekta se razvojne aktivnosti nadaljujejo pod okriljem konzorcija Pandora.

PANDORA - DEVELOPING STRATEGIC LEVEL TRAINING FOR CRISIS MANAGEMENT

The Pandora project is a 9-partner, 4-country, EU research project, under the security and ICT theme, focused on meeting the training needs of those responsible for strategic management in complex, multi-agency crisis situations. Existing training at the strategic level for crisis management is either delivered through paper-based table-top exercises (which lack realism), or large-scale real-world simulations (which are narrowly focused and expensive). The project has developed novel, state-of-the-art technological solutions to provide an augmented reality, rich multimedia training environment, the Pandora Box.

The Pandora Box offers an innovative timeline-based event network approach, adapted from AI planning for the space industry, to model a crisis scenario. The system also provides behavioural modelling and stress control facilities, managed through a knowledge base, to affect trainee performance. All of this is presented within a rich multimedia environment in which the trainees experience appropriate information inputs on which to base strategic decision making. The behavioural modelling facilities have been developed using existing physiological monitoring tools combined with trainee questionnaires and self-reporting during training. The stress control facilities are managed through a novel use of multimedia mashup combination rules, and information manipulation rules, to provide trainees with a variety of stress-inducing information inputs, combined with lost, missing, or incomplete information, on the basis of which they have to make time constrained decisions. The system also provides monitoring, recording and feedback facilities for post-hoc analysis of trainee performance.

The project ran from Jan 2010 to March 2012 and development work is continuing under the auspices of the Pandora Consortium.

PANDORA PROJECT



NEWSLETTER | MARCH 2012

ADVANCED TRAINING ENVIRONMENT FOR CRISIS SCENARIOS

The PANDORA project has developed a novel digital support environment and crisis simulation system to enhance and expand training exercises for Gold Commanders in crisis management.

Gold Commanders are specifically engaged in the development of strategic plans to deal with a wide range of potential crisis situations that can arise in civil society. These crisis situations could be natural events (e.g. extreme weather, earthquake, landslides), transport events (e.g. plane, train or vehicle crashes), service failures (e.g. electrical power plant failure, water supply failure), health crises (e.g. pandemics, epidemics, containment conditions), technology failures (e.g. breakdown of automated control systems, central services), policing and terrorism events, and combinations of some or all of the above.

In order to develop strategic plans to deal with such situations, individuals who carry executive responsibility for the services and facilities identified as strategically critical within these situations are expected to work together to generate them. These individuals are identified as Gold Commanders, and their role is explicitly strategic rather than tactical (Silver) or operational (Bronze), although in practice some individuals may also have tactical or operational responsibility.

For the training offered to Gold Commanders, the focus is on strategic planning of the response to the crisis as it develops rather than operational activities. Currently, the model of training offered to these individuals consists of group-based, table-top activities led by an expert trainer. The bulk of the information provided to the trainees is paper-based, with some limited audio-visual input, and the activities take place during an intensive, time constrained training event. These events can take place in a dedicated training environment or in a standard meeting room at a Gold Commander venue, as required. The purpose of these training events is:

- To develop the collaborative skills of the trainees in formulating strategic responses across a number of organisations and events
- To develop the strategic thinking of the trainees in considering the implications of their decisions and the effects on other services
- To develop the responsive skills of trainees in developing alternative stratagems and remediating actions in the event of the failure of a strategic response
- To determine the strategic planning ability, decision-making capability, flexibility and capability under pressure of the trainees

However, the existing training model has severe limitations in achieving these goals, and is almost entirely dependent on the ability of the trainer to engage and motivate the trainees, and to assess their performance subjectively in the training event.

PROJECT FICHE



Project Full Title:
Advanced Training Environment for Crisis Scenarios

Contract Number:
FP7-ICT-2007-1- 225387 - PANDORA

Area/Strategic Objective:
Security systems integration, Interconnectivity and interoperability: Modelling and simulation for training (ICT-SEC-2007-1.0-02)

Duration:
January 2010 - March 2012

Consortium:

-  - Business Flow Consulting
- ORT France
-  - CEFRIEL
- Fondazione Ugo Bordoni
- CNR, National Research Council of Italy, ISTC
-  - XLAB
-  - Emergency Planning College
- University of East London
- University of Greenwich (Coordinator)

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www.pandoraproject.eu



The PANDORA system addresses the shortcomings of the existing training model, enhances the range and scope of the training events, and offers the potential for future development by:

- Offering a fully-featured multimedia environment to provide information to the trainees, including audio, video, maps, texts, email, graphics and text
- Developing a structured, timeline-based, sequence of events, crisis scenario model running in a computer-based simulation environment controlled by the trainer
- Providing real-time operational inputs demonstrating strategic decision outcomes to trainees, asking them to dynamically revise strategic plans and decisions
- Capturing trainee behaviour and emotional state, through the use of pre-event information capture, direct sensor inputs, self-reporting by trainees, and trainer inputs, and using affective media effects to induce changes to those behavioural and emotional states
- Providing a graphical virtual representation of the training environment to support on-line distributed training events
- Providing virtual characters, in any form from textual through to full animation, to engage in the event, including replacements for missing trainees, to ensure the full scenario enactment is supported in all training events
- Providing the trainer with a full control system for the training event, including the ability to change events, add new events, expand and compress timelines, provide direct interventions into the scenario, and increase or decrease the emotional stress applied to individual trainees
- Maintaining a detailed log of the training event, to permit rerun of some or all events, modelling of individual trainee performance, and capture of relevant and useful events as exemplars for future training
- Maintaining configurable scenario models, knowledge, multimedia asset and databases to enable the system to build a wide range of crisis scenarios, to use as training events for those involved in crisis management at all levels

Following the production of the outline architecture, project partners worked on the development of the component sections of the overall Pandora system. This work has produced a number of components, which have been integrated into Pandora. The components which make up the initial system are:

- **The Behavioural Framework** – This considers the behaviour of trainees, based on a pre-determined user model, and feedback from a variety of sensors and the trainer during the training session. This component shows for the first time how a complete loop crisis-stimuli/trainee-reaction/Pandora-behaviour-analysis can be implemented and shown to work in a training environment.
- **The Trainer Support Framework** – this provides a dynamic Run Time Interaction Environment for the trainer to set up a training session, configure and manage the training scenario both prior to the start of the training session and dynamically during the training.
- **The Crisis Simulation Framework** – provides an event network to model a crisis scenario against a timeline, supporting the management of the training process including the introduction of decision points for trainees incorporated into events within the crisis scenario. The trainer, through the trainer support framework, has the ability to expand and compress the timeline, and to interject additional events, to customise a training session. Event network planning and mapping to timelines is managed through a knowledge-based approach, utilising rules stored in the crisis knowledge base.
- **The Emotion Engine** – is a middleware component within the Pandora system, providing facilities for the development, configuration and introduction of non-playing characters (NPC) into the crisis scenario to interact with the trainees, and multimedia information assets, tagged for emotional affect. The NPC framework also permits the trainer to take control of an NPC to provide direct inputs, in specific events, to the trainees. The Affective Framework, which is a sub-component of the emotion engine, manages a repository of affectively tagged multimedia assets, and uses inputs from the behavioural framework and local mashup rules to produce combinations of those assets to provide emotionally and behaviour-



rally affective information to the trainees. The output of the Emotion Engine, generated through the Environment Framework Builder, is a rendering specification describing the environmental conditions, multimedia information assets and NPCs to be generated in the training environment.

- **The Emulated Crisis Room** – is in essence the trainee environment, since the rendering of the information generated from the other components is realised within this component. The Crisis Room is modelled on a physical environment, derived from end user input and existing state of the art crisis management systems, and can be deployed in a physical, virtual or distributed mode. Work on this component is going to be integrated with the other functionalities and a separate distributed system demo has also been produced.

Integration of the above components is being managed through a middleware model that has been developed for the project, and various test beds and test harnesses have also been constructed specifically to meet the needs of the Pandora system.

USER TRIALS IN YORK

Final user trials were held at the Emergency Planning College in York (UK) from 21 to 23 February 2012. During the three days eighteen trainees and three trainers participated in the final evaluation of the PANDORA system.

Representatives from Police, Utilities, Transport, Local Authorities, Health and Fire Services with different experience levels experimented the immersive PANDORA environment in an evaluation room.

Camera recordings were taken of the three sessions.

The system performed very well and users' feedback was no less than enthusiastic.

"Really good, definitely as true to life as you can get in a training environment"

"I think it's brilliant, really good."

"What a clever bit of kit".

"Really good system overall, simple to use, I was very impressed, easy to manipulate and do what you want."

"It has massive potential".

"Emotional learning to put you under the stress, is good, we assume people can do what they can do because they have the job but it's not necessarily the case so good."

"Overall very intuitive, encourages people to respond who might otherwise be less comfortable speaking out."

"Doing things in real-time is good, potential for use in remote locations is good."

"It was realistic."

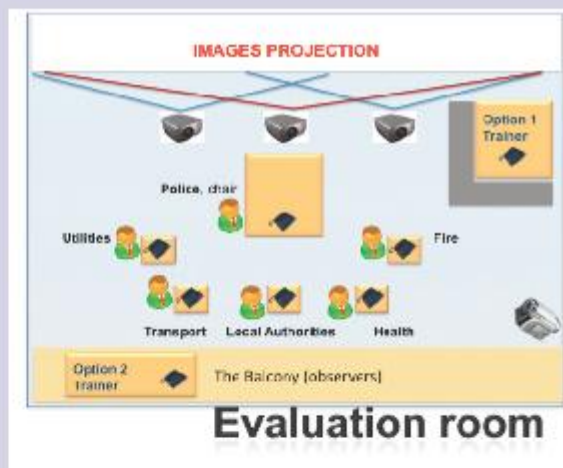
"Potential for immediate feedback is very positive"

"I liked the flexibility of it."

"I liked the multimedia flashing up"

"It enables real decision making"

"Being able to let people see consequences of their mistakes in advance is valuable experiential learning"



Evaluation room



International Conference on
Automated Planning and Scheduling
**2011 Best System
Demonstration Award**

presented to

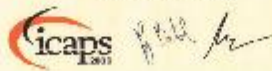
**Ghillo Bernardi, Amadeo Costa, Luca Corni,
Gabriella Cortellessa, Riccardo De Benedictis,
Francois Mohier, Jure Polutnik, and Mina Vuk**

for the system demonstration

**"Only Hope remains in the PANDORA's Jet -
Personal user's planning in a waiting environment"**

For more details
see ICAPS

ICAPS 2011 System Demonstration Certificate
Presented to: Ghillo Bernardi et al.



*The award certificate for the
Best System Demonstration
at ICAPS 2011*

FINAL EVENT

ISCM

2012 | 2nd INTERNATIONAL SYMPOSIUM
ON CRISIS MANAGEMENT

*IET London Savoy Place,
Thursday 29th March 2012*

The 2nd International Symposium on Crisis Management is a one-day presentation, demonstration and consultation event covering a range of current EU funded research projects on crisis management. It will provide practitioners from a wide range of sectors with information on the current state-of-the-art technologies in crisis management training, control and command, prediction and preparation, and response management. The symposium follows a successful 1st ISCM event run in Greece in 2011. ISCM 2012 is being run at the Institution of Engineering and Technology in London:



ISCM 2012 is being run by the Pandora project, a consortium consisting of a multidisciplinary group of academic, industrial and scientific pioneers. The symposium will also feature presentations and demonstrations from a number of other EU projects (see Program page for details), and a consultation discussion run by a senior Project Officer from the EU. Attendance at the symposium is free and by invitation only, and details on how to obtain an invitation are provided on the Request Invitation page in the official PANDORA website:
<http://www.pandoraproject.eu>


The consortium is planning to take forward Pandora development after completion of the project and we welcome anyone interested in getting involved to get in touch!

5.4 Barracuda Posters:



PANDORA PROJECT

- **Advanced Training Environment**
- Bridges gap between table-top training and simulation exercises
- **Near-real training scenarios offer realistic stress and emotive impacts**
- Rich multimedia, augmented reality and virtual reality environments
- **Deployed for local or distributed delivery, so can support existing and web-based training models**
- **The Crisis Room -real and virtual**



PANDORA PROJECT

■ Scenario loaded

■ Trainee interface

■ Trainer Interface

■ Behavioural Control

■ Modifying Resource Values

■ Missing Trainees

■ Heart Rate Monitoring

■ Trainee Data for Trainer

■ Resource Request



5.5 Photos from the user trials





5.6 Photos from the Final Dissemination Event – ISCM 2012





5.7 Contact details:

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