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A holistic, scenario-independent, situation-awareness and guidance system for sustaining the Active Evacuation Route for large crowds

TRAINING REPORT

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Title	Training Report	
Editors	Hanneke Vreugdenhil	HKV Consultants
	Cor-Jan Vermeulen	HKV Consultants
Contributors	Nikos Papagiannopoulos	Athens International Airport
	Pierre Berseneff	STX France
	Vicente Serrulla	Real Sociedad Anoeta Stadium
	Eduardo Hernández Ledesma	Metro Bilbao
	Ivo Emanuilov	KU Leuven
	Pedro Garibi	INDRA
	Dimitris Petrantonakis	EXUS
Peer Reviewers	Dimitris Drakoulis	TELESTO
	Romain Charbit	DXT
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Executive summary

The objective of WP10 (Pilot Demonstration and Validation) is to test the eVACUATE system in real conditions. Part of the demonstration and validation process is ‘training and education of end users’ with the eVACUATE system, which is the topic of this deliverable.

The training and education of end users aims on:

1. **Introduction of new concepts, information, technology, knowledge and skills**, developed in the eVACUATE project into the end user organisation
2. assisting end users to become familiar with the Common Operational Picture (COP) and the related eVACUATE sub-systems
3. **enabling trainees to understand the eVACUATE system** and to act as ambassadors in the dissemination of the results
4. **receiving feedback on the development of the eVACUATE system**, especially the training mode, to collect new perspectives for further development and/or marketing.

The purpose of the training and education is to use the eVACUATE system to train end users on evacuation decision making during a crisis. The training organisation consists of:

- **Trainer**: responsible for the training organisation
- **Guides**: eVACUATE members explaining the eVACUATE system and demonstration event to trainees
- **Observers**: eVACUATE members observing and monitoring the training. In every training session one or more observers were present.
- **Technical eVACUATE team**: (representatives of) the technical development teams, who are responsible for the software and hardware being used
- Training participants: end users that participate in the training
- **End users**: a group of end users with interest in the project and with the required capabilities (position in the organisation) to get trained and to provide feedback to the project.

The main phases for the training and education are:

- a. **passive phase** (*to meet and get acquainted with eVACUATE*)
The trainer first explains what will happen, what tools are used, where they can be found on the screen, etc. As soon as the trainees understand the functionality they will start to find out other options and feel free to use any part of the system.
- b. **active phase** (*hands on*)
The trainees are asked to follow several consecutive steps. Each step adds a new layer of information, giving end users, at the end, a full picture of what eVACUATE is about.
- c. **operational phase** (*play a role and act*)

Depending on the time and the progress during the training session, the trainees received an operational training. They had to play a specific role and were asked to interact with each other and the trainer through the COP.

d. discussion (feedback)

The training was focussed on the education of decision makers and/or their supportive personnel, to be prepared for everyday (routine) situations and crises. The eVACUATE system offers an overview of the situation in buildings. Hands on training helps them to assess the full value of the system. Feedback from them helps the eVACUATE team to improve the system and/or the training/exercise.

The main results and outcomes of the training sessions are mentioned below:

- In general the trainees adjudged this training on the eVACUATE system, focussed on the COP functionality very useful to train personnel. In a stressful situation, an operator can feel overwhelmed and might forget the next step. eVACUATE gives the correct indications per protocol, instead of forcing the operator to fall back on a general manual or guidelines.
- The training has been set up with a focus on the 3D model and the way information is gathered and displayed in the user interface. This implicates that the questions and discussion were mainly related to the use of the Common Operational Picture and the way eVACUATE support end users in their decision making. To operate the touch screen turns out to be easy for the trainees. The interface proves to be intuitive understandable by the trainees.
- Furthermore the trainees indicated that in complex situations still (or even more) the human factor should not be underestimated in the eVACUATE system. In complex situation decision makers need support or an overview of the building, but in any case they need to take and implement their own *reasoned* decisions.
- Another conclusion from the training is that end users appreciated the open nature of the eVACUATE architecture and support the argument that with eVACUATE the investment of *existing infrastructure* is indeed protected. Trainees emphasised the desirable situation of connecting the eVACUATE wireless sensor network with the existing smoke and fire alarms.
- Although in the training simulations are used to give the impression of a building which is (over)crowded with people, it appeared to be difficult to reach a training setting with full awareness of the situation. We recommend to prepare a more extended training in which not only the functionality is trained, but after that also the role playing part is defined closer to every day reality. Thus the trainees go through a realistic session and experience the merits of the eVACUATE system by themselves as a team.

- A more detailed estimation of the number of people in a specific room is one of the main recommendations resulting from feedback during the training. The eVACUATE system works with approximate values and will in any case be able to give a prediction of the evacuation time. But end users want to have full confidence in the accuracy of the number of people after 'check in' procedures, to generate a more descriptive overview of the exact situation in the building.
- The eVACUATE system in training mode assists to find bottlenecks, both in the design of the building and in operational situations. The system helps immediately to send security staff efficiently to a specific place. The more information you have, particularly if it is useful and relevant information, the better is it for safety during evacuation processes. So to incorporate eVACUATE training sessions for security staff will give boost to awareness raising and crisis preparedness in venues with crowd, and could in all probability contribute to the safety of people.

1. Introduction

The objective of WP10 (Pilot Demonstration and Validation) is to test the eVACUATE system in real conditions. The setup and results of the pilot demonstration (evacuation exercises and simulation exercises) are described in D10.3 Exercise report. Part of the demonstration and validation process is 'training and education of end users' with the eVACUATE system, which is the topic of this deliverable. The training and education of end users has been set up within the work package aims on:

1. Introduction of new concepts, information, technology, knowledge and skills, developed in the eVACUATE project into the end user organisation
2. assisting end users to become familiar with the Common Operational Picture (COP) and the related eVACUATE sub-systems
3. enabling trainees to understand the eVACUATE system and to act as ambassadors in the dissemination of the results
4. receiving feedback on the development of the eVACUATE system, especially the training mode, to collect new perspectives for further development and/or marketing.

1.1 Scope and purpose

The purpose of the training and education is to use the eVACUATE system to train end users on evacuation decision making during a crisis. Before or after the eVACUATE system is used in the pilot demonstration, a group of users of eVACUATE are trained to use the Common Operational Picture (COP) and to acquire the knowledge to implement measures. The users thus get familiar with the system to reduce risks in a crowded building.

In the training programme we focus on the criteria on decision support from end user interviews, gathered in WP2 (D2.1).

1.2 Main objectives

The end users get trained by the eVACUATE consortium in how to use the eVACUATE system. During the final phase of the project the eVACUATE consortium has been agreed on putting the training focus on the COP, the user interface of the eVACUATE system. Different specific functionalities will be highlighted during the training, but the operational part will be mainly to operate COP before, during and after an evacuation of the end user venue.

This training helps them to understand the pilot demonstration and to assess the benefits of the eVACUATE system while working with the user interface. End users are trained to use mainly the COP within the eVACUATE system and to exploit the knowledge gathered and projected by eVACUATE system in view of taking the most efficient decisions.

The main phases for the training and education are:

- a. passive phase (to meet and get acquainted with eVACUATE)
- b. active phase (hands on)
- c. operational phase (play a role and act)

d. discussion (feedback)

In the eVACUATE team we have agreed on the fact that the only component/system used in the training is the Common Operation Picture (COP) while indicating that all other eVACUATE systems are also demonstrated through COP since they add information, alerts and alarm to the COP: RFID, TETRA Messages, Social Network Manager, MobiMesh, iSAFETY, eVAMAPP First Responders, eVAMAPP for passengers, camera feeds and connection with legacy systems. The relation between COP and the other eVACUATE systems have been demonstrated in the evacuation exercises and simulation exercises (see D10.3).

2. Training approach

2.1 Training in situ

The training focusses on the education of decision makers and/or their supportive personnel, to be prepared for everyday (routine) situations and crises. The eVACUATE system offers an overview of the situation in buildings. Hands on training helps them to assess the full value of the system.

In the first three pilots (ASRS, AIA and STX), the training has been combined with the simulation exercise (see report in D10.3), which took part after the full-scale evacuation exercise with volunteers. In the simulation exercise in Anoeta Stadium, Athens International Airport and STX MSC Meraviglia the most important features of the eVACUATE *training mode* have been presented and discussed.

For the Metro Bilbao pilot the eVACUATE team got the possibility to give an additional training. This training has been developed and performed with security personnel (operational security managers supporting the crisis decision makers during crisis situations). These persons were asked to (co)operate the system during the evacuation exercise and to provide their feedback in the simulation exercise with the decision makers.

Production of training material is part of WP 12 within responsibility of EXUS, INDRA and Telecom Italia. In WP 12 the manuals for the eVACUATE users as well as to the design and production of a tutorial concerning the approach and principles of the eVACUATE system has been elaborated (D12.4 eVACUATE user manuals).

2.2 Training process

In the eVACUATE training we distinguish several phases in the training process:

- Familiarisation of end-users with the eVACUATE system
- Demonstration of system's operational and training capabilities
- Experience with simulated evacuation scenarios
- Hands-on training with the COP

2.3 Training focus

Training is a core functionality of the eVACUATE system. It enables the end users to get to know the system and to 'play' with it, off line, i.e. without any actual crowd present in the pilot venue.

In the first pilot (Anoeta Stadium), we extended our demonstration to end users directly after the exercise by exhibiting some additional important functionalities supported by COP (Common Operational Picture) while we also focused on other important systems as well like EOC and iSAFETY. With respect to the COP, during that session, we setup COP to support collaboration between the key players of either the same or different agencies being involved into a crisis when this crisis occurs. In particular agencies were able to generate their own strategic plans through a user-friendly interface in which they were indicating how their responsible teams should be positioned on the field, where to be located and how to move in order to confront the specific crisis. After

consolidating their plan they were able to share them to other agencies in order to be informed about their intentions. The end users liked this tool and expressed their interest to adopt such a system in view of facilitating, optimizing and synchronizing their cooperation between the main persons in charge inside and outside the stadium. Currently no such capabilities are existing especially following a visual and user friendly way limiting their operations and collaboration by exploiting current communication means already existing (e.g. Tetra, phones, etc.).

During the pilot in Athens International Airport, the group of end users that received the training consisted of operational personnel, supporting the decision maker during a crisis. Apart from the eVACUATE sub-systems (EOC, Smart phone apps, iSAFETY, etc.) the operational functionality of the eVACUATE system in training mode has been also demonstrated as we did in the first pilot however we further extended the scope of this session by inviting the end-users to operate it acting as coordinators of COP. A group of end- users were chosen to use the COP working station running parallel to the COP used in the simulation. During this session, they were trained to manage and interpret correctly the messages received by the different systems of eVACUATE platform already deployed on the field (sensors, actuators, messages from smartphone applications, etc.) and hence they became familiarized with the eVACUATE system as a whole and the operations currently served by our platform. . An open discussion followed up to share their opinion and their feedback is already reported in D.9.4 and D.10.3.

During the third pilot (STX Cruise ship), our training followed the same rationale as we did in Athens International Airport. In particular the end-users apart from the COP, they were trained on the Complex Event Processing (CEP) module and how this was implemented and operated, while they were also introduced on other technologies and systems developed within the project as in the previous ones like EOC, iSAFETY and Smartphone applications. The end-users focused their attention on the added values that eVACUATE was offering to them by comparing the new functionalities developed within the project and demonstrated to them with the ones already served by their own BMS (Business Management System) that STX has. Their interest was mainly on the 3D representation of the incidents reported within eVACUATE and the friendly environment that eVACUATE offers something that their system was not able to support. In addition the various smart phone applications were of their main interest since with the usage of those applications they were able to become aware of information currently not available.

The training session in Metro Bilbao followed once again the same rationale as the previous three pilots however in a more extended version (combining all the aforementioned extended sessions that were followed in the previous three pilots) accompanied with a final workshop in which different agencies (69 persons in total) across the Basque country were able to become introduced of eVACUATE main functionalities and benefits. In particular three different instances of eVACUATE User Interface (COP) were installed and the end-users were called to follow specific instructions in order to perform the necessary actions needed to be followed during a crisis event. The trainees were educated in using the full scale eVACUATE system in

case of an emergency: assess the number of people in the building, evaluate incoming alerts from sensors and/or social networks, defining and blocking routes and indicate the right positions to first responders, before starting the evacuation.

3. Training participants and programme

3.1 Training participants

The training organisation consists of:

- Trainer: responsible for the training organisation
- Guides: eVACUATE members explaining the eVACUATE system and demonstration event to trainees
- Observers: eVACUATE members observing and monitoring the training. In every training session one or more observers were present.
- Technical eVACUATE team: (representatives of) the technical development teams, who are responsible for the software and hardware being used
- Training participants: end users that participate in the training
- End users: The eVACUATE representatives invited a group of end users with interest in the project and with the required capabilities (position in the organisation) to get trained and to provide feedback to the project. End users are the decision makers who usually work in the control room during an event or threat, but also safety managers, safety experts, field staff and first responders.

The trainees in the four pilot venues are mentioned below:

Name	Function
Antonio España	Security Officer ASRS (SABICO)
Ignacio Abendaño	Security Coordinator Basque Country Police
Oscar Covela	Basque Country Emergency Services (112)
Vicente Serrulla	End user involved in eVACUATE project

Table 1 Participants training ASRS

Name	Function
Dimitris Antoniou	Project Manager for G4S Aviation and Port Secure Solutions S.A. at Athens International Airport
Giannis Michalitsis	Duty Manager for G4S Aviation and Port Secure Solutions S.A. at Athens International Airport
George Tsatalas	Aviation Services Manager for BRINKS AVIATION SECURITY SERVICES S.A. at Athens International Airport
Christiana Gola	Quality Control and Training Specialist for BRINKS AVIATION SECURITY SERVICES S.A. at Athens International Airport
Theodoris Boukouvalas	Operations Manager for ICTS LTD at Athens International Airport
Eleni Gridaki	Duty Manager for ICTS LTD at Athens International Airport
Christos Kondyllis	Police Director at Athens International Airport
Athansios Bitsaksis	Aviation Security Supervisor for BRINKS AVIATION SECURITY SERVICES S.A. at Athens International Airport
Chrisoula Falangaris	End user involved in eVACUATE project
Nikos Papagiannopoulos	End user involved in eVACUATE project

Table 2 Participants training AIA

Name	Function
Eric Lhotellier	STX safety and security manager
Gerard Chaussee	STX safety and security manager
Thierry Albert	STX Electrical and ICT department manager
Gilles Castanie	STX ICT manager
name not to be mentioned	Saint-Nazaire Firemen brigade managers
name not to be mentioned	Saint-Nazaire Firemen brigade managers
name not to be mentioned	Bureau Veritas classification society
name not to be mentioned	Bureau Veritas classification society
Pierre Berseneff	End user involved in eVACUATE project
Francois Drezet	End user involved in eVACUATE project

Table 3 Participants training STX

Name	Function
Francisco Javier González Díaz de Cerio	Metro's command station manager (Supervisor de puesto de mando)
Itziar Sainz Arza	Metro's security operator (Operador de seguridad).
Jose Ramón Basterretxea	Metro's security boss (Jefe de seguridad)
Eduardo Hernandez Ledesma	End user involved in eVACUATE project

Table 4 Participants training METB

3.2 Training Program

The times mentioned in the programme are indicative and were customized for the training session in any of the four end user venues.

- 14:00 welcome end users group (decision makers, control room personnel, crew)
- 14:15 short explanation of the training session
- 14:30 guided tour through the eVACUATE system – mainly COP and simulated scenario – phase 1 and 2
- 15:00 hands on – ‘play with the system’ – phase 3
- 15:20 closing the session by evaluation round – phase 4
- 15:30 end of the training session

People who were interested in the system, but who were not directly or indirectly operationally involved in safety procedures, have been invited to participate as volunteers in the evacuation exercise (see D10.3).

4. Training organisation

4.1 Language provisions

In every pilot venue the language barrier needed accurate consideration. In the ASRS and METB venues this has been foreseen, so the pilot exercise had been prepared in a bilingual way (sentence-by-sentence translation). STX indicated that English speaking persons would participate. The translation into French has been given as a summary at the moment the eVACUATE team had the feeling that the English explanations were not understood by all participants. In AIA the language was just a small obstacle; most participants were able to understand English, although they preferred to react on questions and/or discuss in Greek language.

4.2 Content and scope of the training participation

As stated in recommendation REC_LITER_IT_14¹, we used observations from end users for defining general and scenario-specific training scenarios. We have incorporated context-specific comments and observations from descriptions of typical training or real scenarios, received from the end users.

By training with the eVACUATE system, the decision makers have the opportunity to encounter crisis situation or emergencies, that are highly realistic. This enables the eVACUATE system to be a relevant training tool. Although the pilot venues are entirely different in many aspects, contribution from earlier sessions has been iteratively used to add context-specific observations from actual scenarios. This includes comments on safety or security, crowd behaviour that is recognized as usual or unusual/suspicious. Comments provided by the observers will be used as recommendation for future versions of the eVACUATE system.

The scenarios in the training session were derived from the scenarios defined in D2.3 and were adapted from real cases that had already happened in the venues.

4.3 Involvement of eVACUATE team

The complete eVACUATE team has been involved in the training preparation. During the testing session before the pilot exercise and during the end users programme, the training has been discussed and updated several times. The input from the eVACUATE partners and their technologies has been incorporated in the training programme.

¹ REC_LITER_IT_14: "Use observations from end users for defining general scenario-specific feedback or typical training scenarios It is recommended to elicit context-specific comments and observations from descriptions of typical training or real scenarios, received from the end users."

5 Training realization

The training was executed in different phases, in which the trainees were guided to work with the COP and to understand the complete eVACUATE system through the alerts and messages. In this report we focus on the training session in Metro Bilbao, which was the last and the most complete elaborated training. This is the reason that in this chapter only the training material (tutorial) from the metro station is displayed.

Phase 0: explanation eVACUATE system + corresponding subsystems

This phase enables the trainees to understand the full scale of the eVACUATE system. Although the training is focused on the operational part of COP, the trainer starts with one slide in which the eVACUATE system and all the subsystems are indicated with easy to understand icons and symbols.

Phase 1: passive training

Every time we start a new element in the training, the trainer first explains what will happen, what tools are used, where they can be found on the screen, etc. This will cause a 'safe' environment for trainees, before they go the active phase and perform the actions individually hands on. As soon as the trainees understand the functionality they will start to find out other options and feel free to use any part of the system.

Phase 2: active training (hands on)

The trainees are asked to follow several consecutive steps. Each step adds a new layer of information, giving end users, at the end, a full picture of what eVACUATE is about. The trainees are first presented with an empty operational picture, displaying only the building. This way, they start with learning how to navigate into the 3D environment with the touch screens interactions. Then they discover how to gather information from the system, how to analyse field and high level data provided by the different eVACUATE components. Following this analysis, end-users are asked to respond to these stimulus by plotting their decisions into the COP. The annotations are then shared to the system, making the operational picture a common picture through all the agencies participating in the crisis resolution.

Phase 1 and 2 alternate with every training topic mentioned below. The training elements are illustrated with different screen dumps from four pilot venues.

1. Navigation on the globe

- *Navigate through the 3D Globe with touch screen interactions.*

The user is asked to interact with the touch screen, pan, rotate and zoom on the 3D view to apprehend how to navigate in the GIS environment.

- *Locate and navigate to the pilot venue.*

The user is asked to use its just learned skills (pan rotate and zoom) to go near the pilot location (e.g. in Spain).

- *Use the “Places” interface to go directly to the venue.*

The user is asked to use the Places interface on the top right of the screen. All the pilot places are mentioned and the user must choose the Appropriate one (e.g. Metro). The COP directly goes to the selected location.



Figure 1 **Navigation on the globe**

2. Navigation in the venue

- *Discover underground navigation metaphors (touch screen).*

The user is asked to use its previously learned skills (pan rotate and zoom) to navigate within the venue.

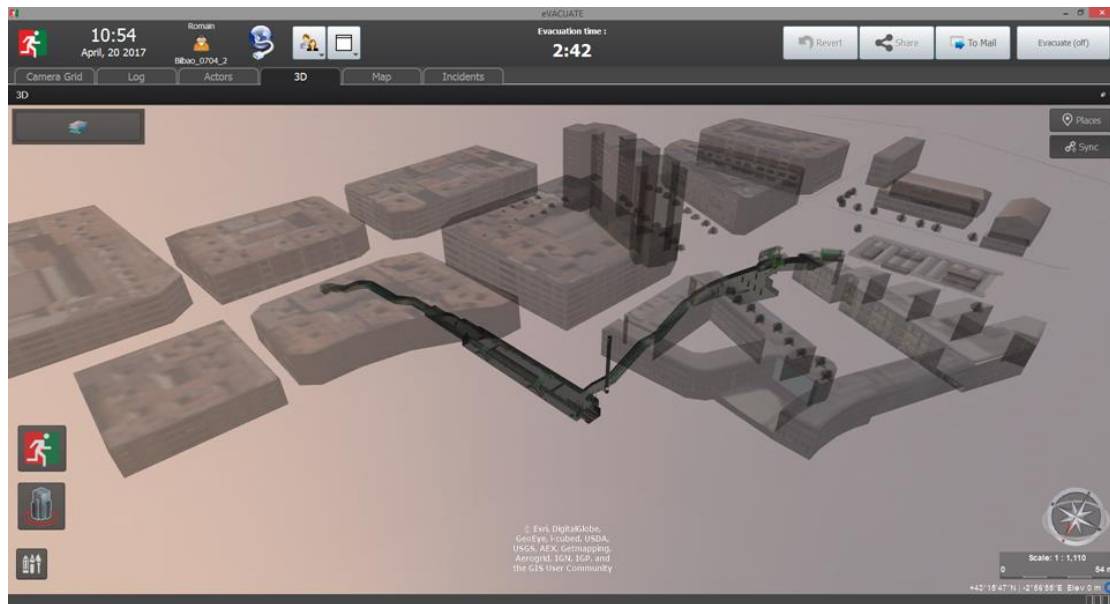


Figure 2 **Navigation in venue METB**

- *Navigate within the venue.*

The user is asked to go through the building, and discover how the system presents underground building in a GIS environment (layer blending, floor identifications...)



Figure 3 Navigation in venue AIA

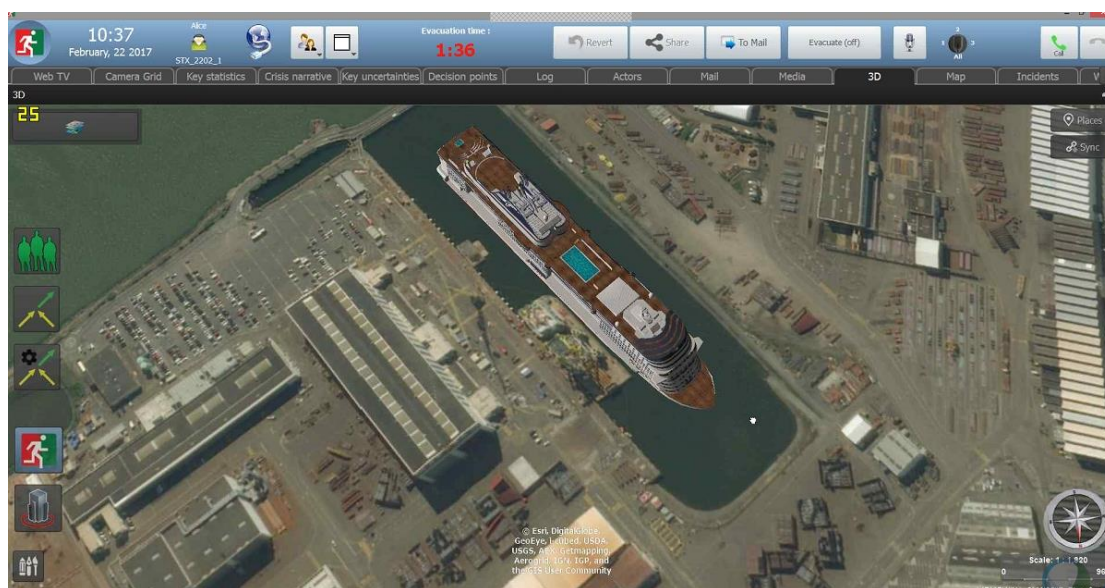


Figure 4 Navigation in venue STX

3. Crowd information

- Discover “Prediction” interface.

The user is asked to look at the prediction interface, discovering all of its elements (Crowd density display, AER display, AER modification)

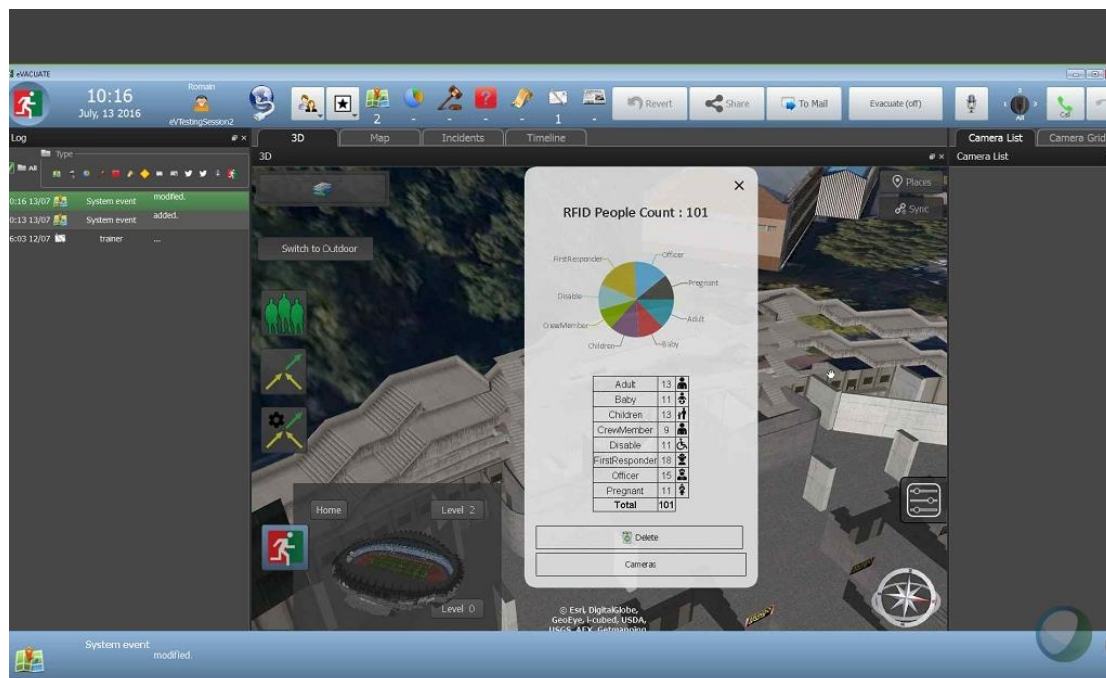


Figure 5 Crowd information by RFID in venue ASRS



Figure 6 Crowd information by crowd simulation in venue ASRS

· *Activate crowd display.*

The user is asked to activate the crowd density display. The COP then displays coloured silhouettes inside the building representing crowd densities inside the building.. The user can switch from current or predicted densities. While displaying predicted densities, the user can also navigate in time to see how the evacuation unfolds.

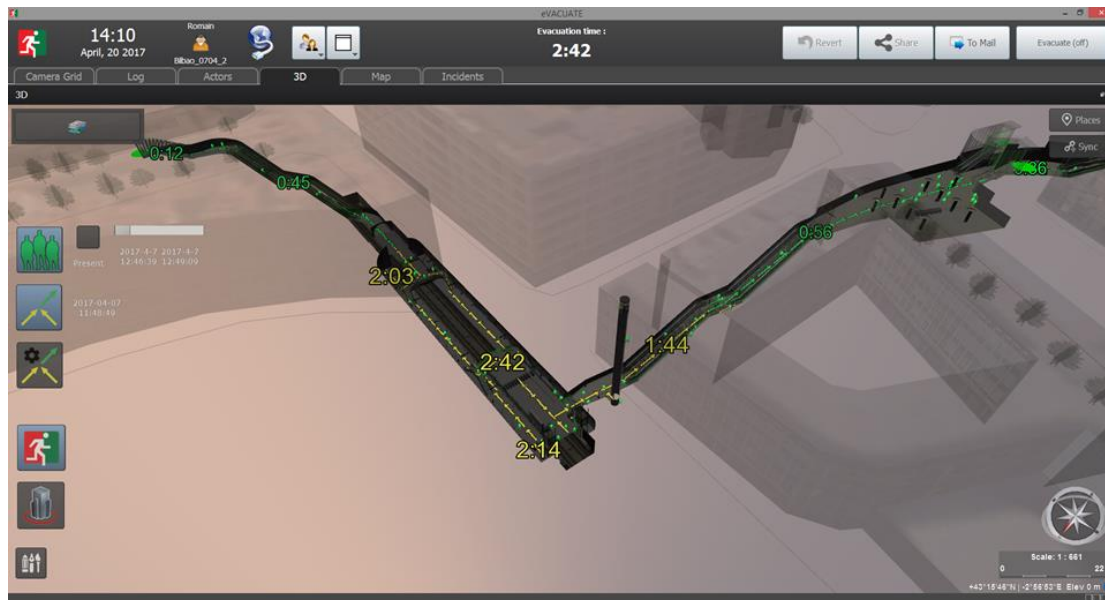


Figure 7 Crowd information by hyperspectral cameras in venue METB

· *Activate AER display.*

The user is asked to activate the AER display. The COP then displays coloured arrows representing the current AER with its timing at every places of the building. The user is asked to assess the current values.



Figure 8 Crowd information by crowd modelling in venue AIA



Figure 9 Crowd information by crowd modelling in venue STX

4. Alerts and alarms

- A fire has been reported, locate it.

The trainer adds an incident to the system somewhere in the building. The user is asked to locate the incident either by navigating inside the building or by clicking on the incident list.

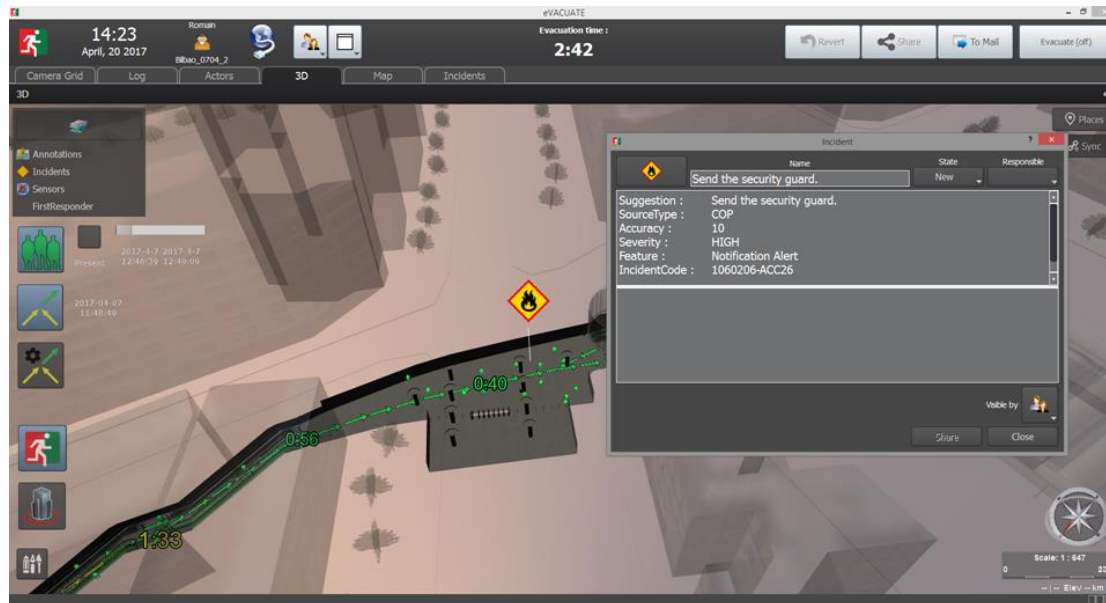


Figure 10 Manual fire alert in venue METB

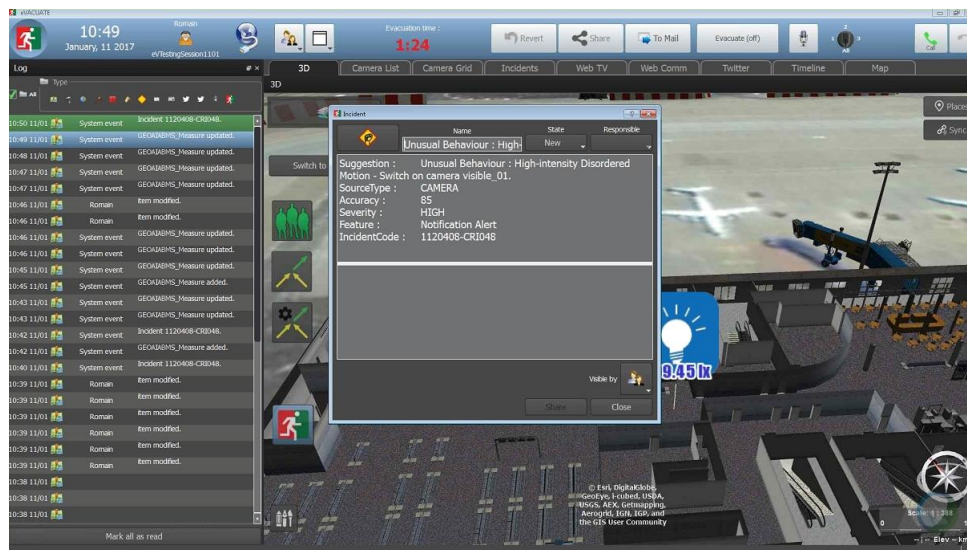


Figure 11 Unusual behaviour alert in venue AIA

- Identify the problem.

The user is asked to click/tap on the incident to display the incident content. The user is then asked to read and assess the current incident description.



Figure 12 Alerts and alarms in ASRS

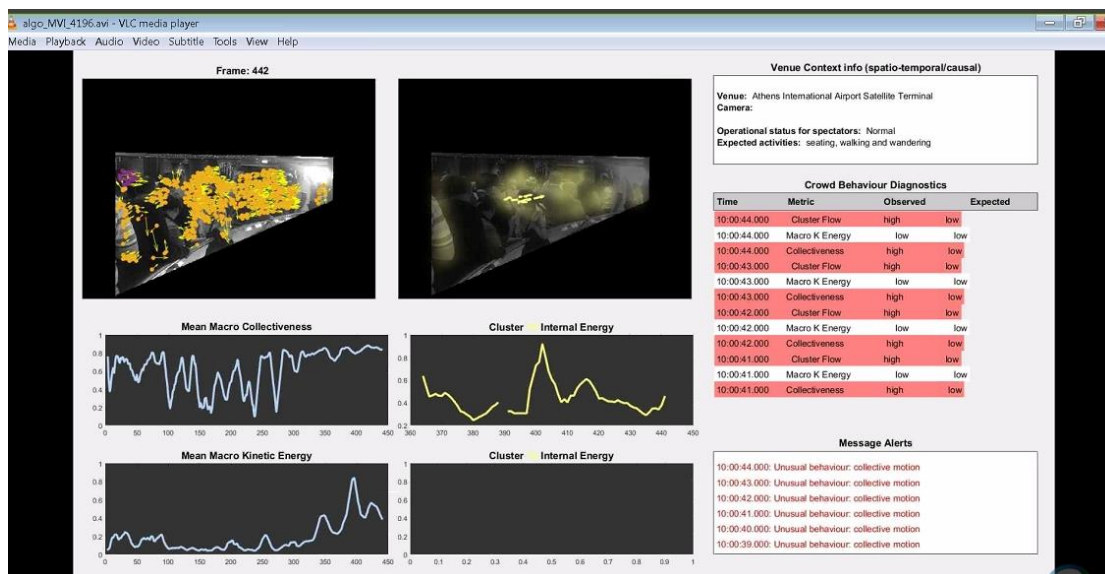


Figure 13 Alert on unusual behaviour and analysis in venue STX

5. Decision making support

- *Locate the annotation bar.*

The user is asked to locate the annotation bar and discover it. The bar is comprised of several categories including several different icons. The user is also able to draw textured lines and polygons.



Figure 14 Decision making preparation in venue METB

- *Annotate your decisions.*

The user is asked to annotate the building using the annotation bar. The user is asked to enter its decisions on how to cope with the current incident by adding the crisis actors and their movements within the 3D model.

- *Share them.*

The user is asked to share his just made annotations with the rest of the connected users by clicking on the "Share" button in the top bar.

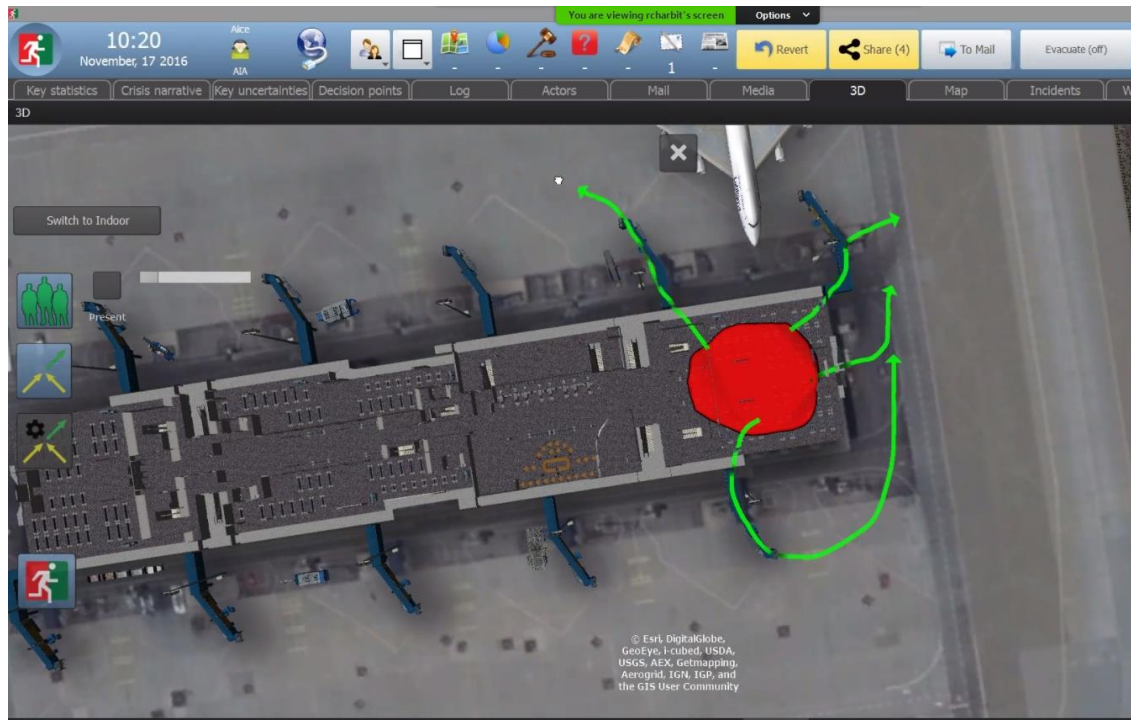


Figure 15 **Decision making support in venue AIA**

6. Information filtering

· *Display the route modification bar.*

The user is asked to click on the AER modification button. The COP then displays the passageways in green colour, meaning that all passageways are usable. A lot of information is displayed at the same time on the COP, the legibility is impaired.



Figure 16 Information filtering in venue METB

· *Legibility is impaired, locate the layer bar.*

The user is asked to locate the layer menu in the top left part of the 3D visualisation and to click on it to unroll the layer list.

· *Disable annotations.*

The user is asked to click on the annotation layer to remove temporarily the annotations from the 3D view. The user will now be able to focus on his current task.

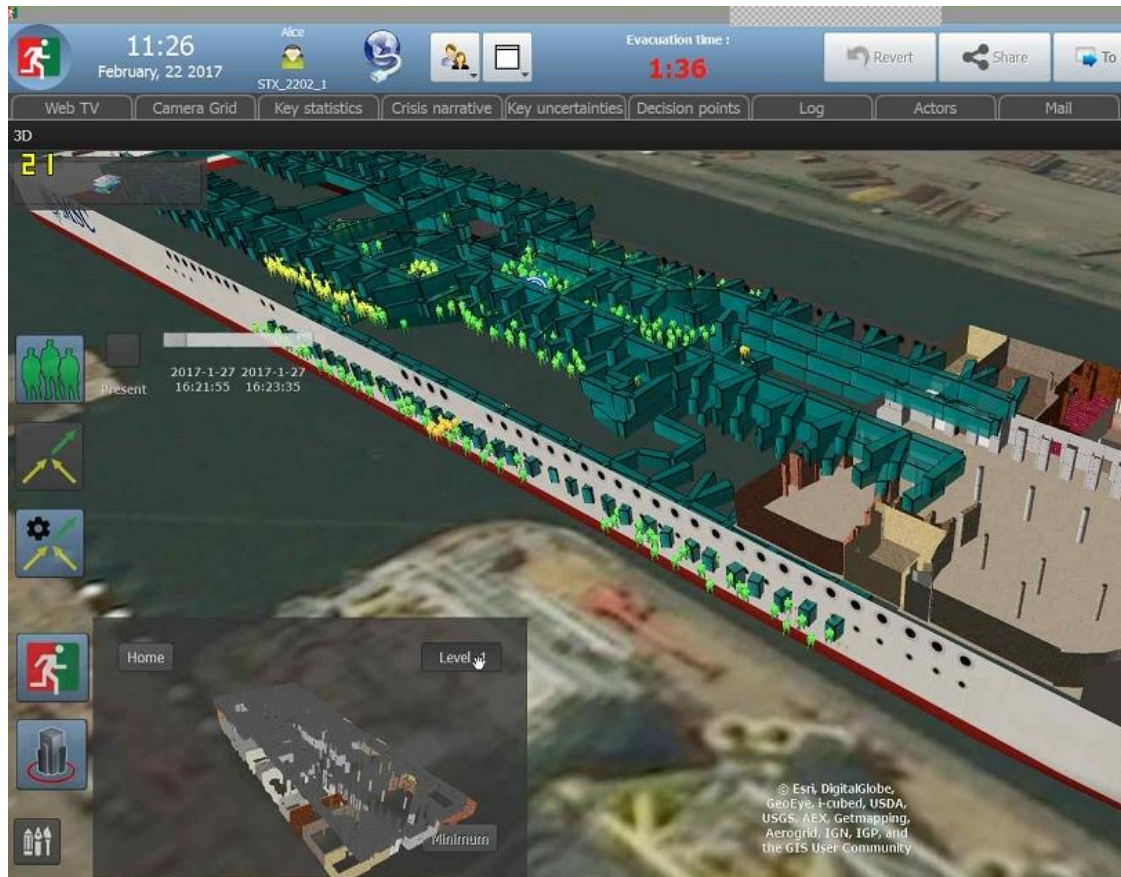


Figure 17 Information filtering in venue STX

7. Active evacuation route

- *Select the routes you want to disable.*

The user is asked to click on all the routes going in and out of the incident to tell the prediction module to avoid these paths.



Figure 18 Active evacuation route with blocked exit in venue METB

- *Close the bar to accept modifications.*

The user is asked to click again on the AER modification button to validate his inputs to be sent to the eVACUATE platform.



Figure 19 Active evacuation route with blocked exit in venue AIA

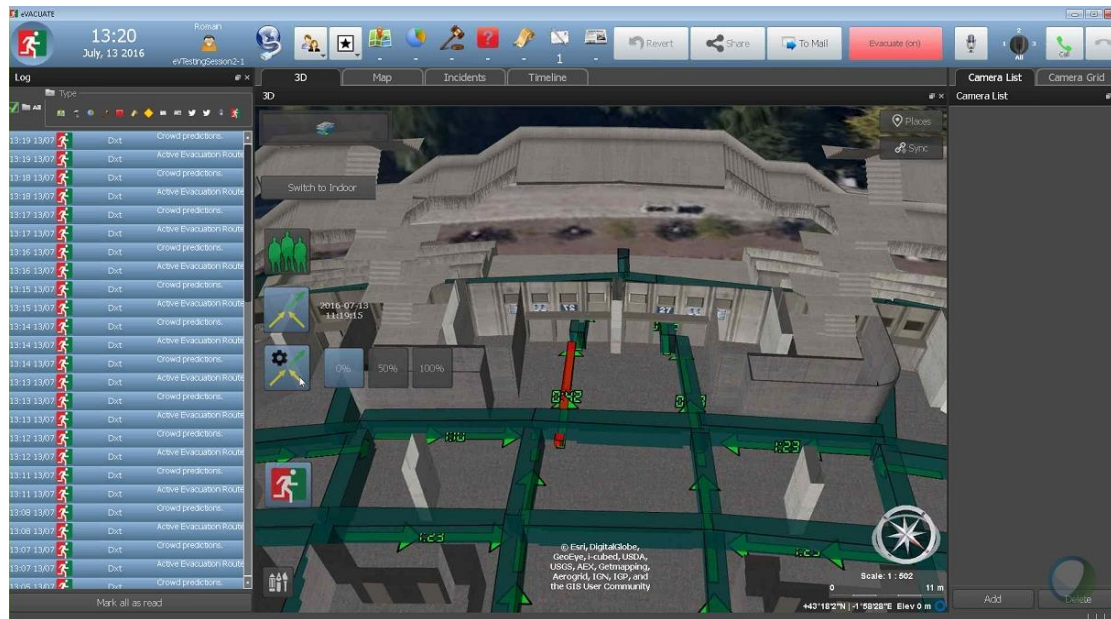


Figure 20 Active evacuation route with blocked exit in venue ASRS

8. Evacuation time

- *Your decisions impact the route calculation.*

The system has calculated a new route and the COP now displays the new computed values.



Figure 21 Display information on active evacuation routes and assembly points

- *See changes in the routes paths.*

The user is asked to assess the modification of the routes consequential to his inputs.



Figure 22 Combine alerts and routes in one overview, venue METB

- See changes in the evacuation times.

The user is asked to assess the modification of the evacuation times consequential to his inputs.

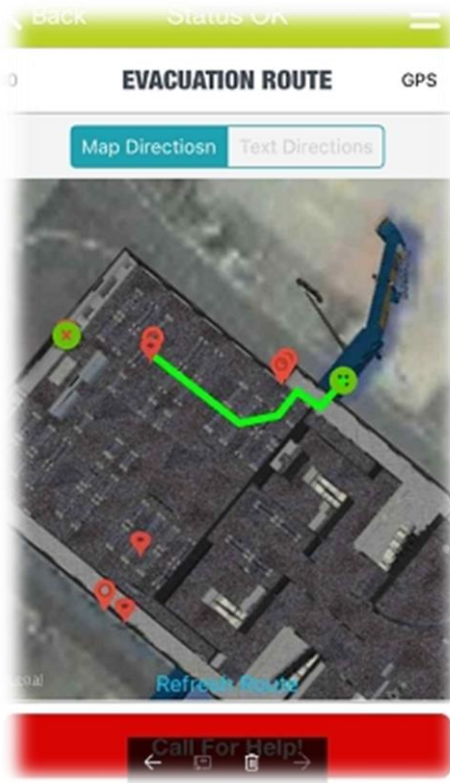


Figure 23 Evacuation time on mobile apps, venue AIA

9. Sensors and actuators

- *Activate the sensor layer in the layer bar.*

The user is asked to activate the sensor layer in the layer menu. The sensors now appear at their location in the 3D venue digital mock-up. The user is then asked to click on a sensor to display its value.

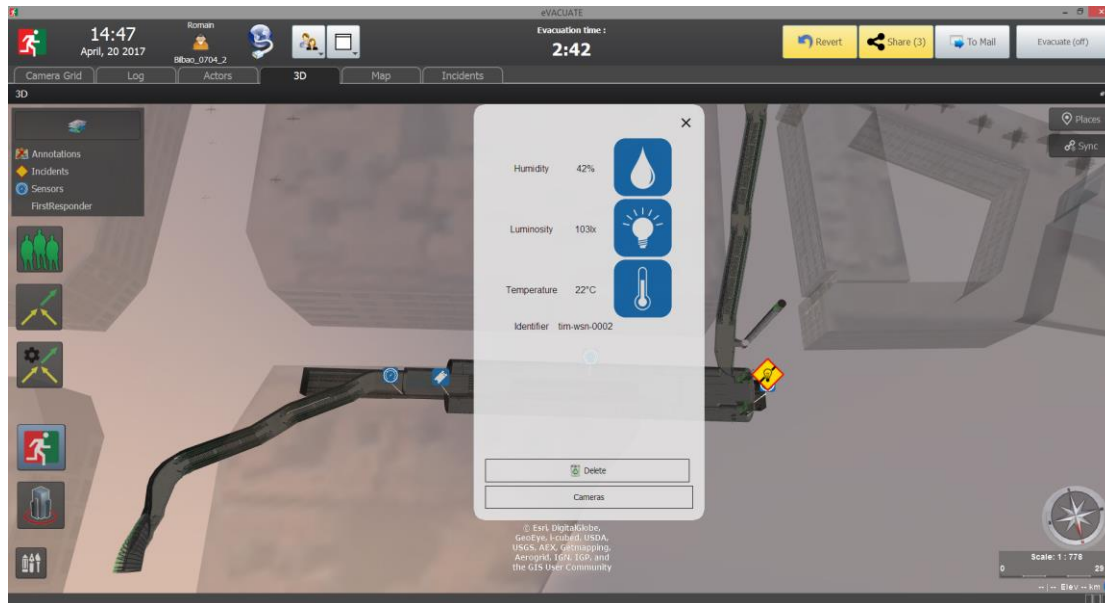


Figure 24 Information from activated sensors, venue METB

- *The sensor value confirms the alert.*

The user is asked to assess the values of the sensors that confirm the alert.

- *Communicate: Evacuate now.*

The user has prepared a plan to mitigate the crisis, shared it with the other stakeholders, used field information and high-level computed data to prepare the evacuation. It is now time to evacuate the building. The user is asked to click on the "Evacuate" button on the top right.

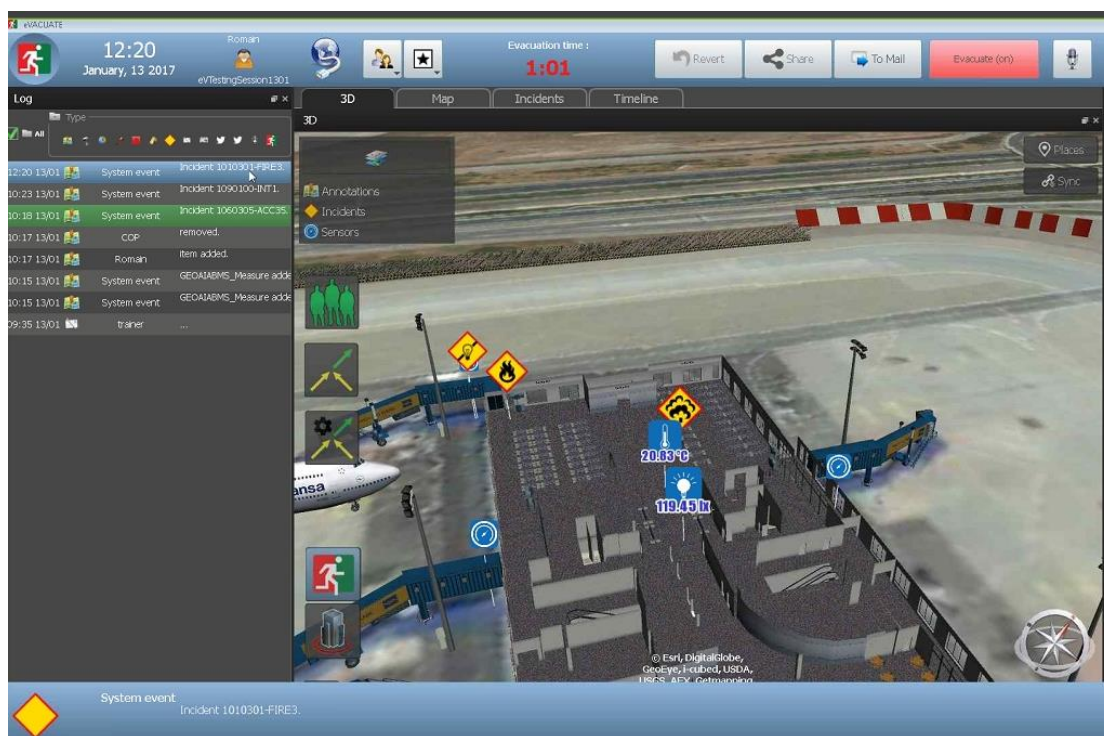


Figure 25 Sensors and actuators in venue AIA

Phase 3: operational training (play a role)

Depending on the time and the progress during the training session, the trainees received an operational training. They had to play a specific role and were asked to interact with each other and the trainer through the COP.

Phase 4: evaluation / discussion / feedback

During the last phase the trainees were asked to react on the training and to provide their feedback on the eVACUATE system.

6 Training evaluation

6.1 Principles of the evaluation

After the training, an assessment and judgment has been done, based on interviews on the quality of the training in order to conclude whether the project has achieved the learning objectives or not.

6.2 Evaluation process

The evaluation process has been planned and organised as follows:

- hands off the system
- express thanks for participation
- ask for feedback on the system
- ask for feedback on the training
- ask for general feedback or remarks

The trainer, accompanied by the observer(s), focusses on receiving feedback and only ask for clarification. Discussion is being started only after several rounds of individual feedback. Persons are asked directly for their comments in case they do not participate 'spontaneously'.

Immediately after the general feedback, the discussion starts on the main feedback or learning points. Thus we expect to gain significant and valuable evaluation results.

7. Training results (per case study)

The training results are presented in this chapter.

ANOETA Stadium (ASRS)

3D modelling turned out to be interesting from the end users point of view. The trainees mentioned the benefits of tunnel /indoor modelling (to be able to look inside a building, by removing layers). They discussed the possibility to integrate the 3D model with building management systems and/or with the outer area of the stadium (with parked cars, first responders' location, ambulance routes, large groups of spectators, etc).

Those end users working for the emergency agencies in the city (civil protection, fire brigades...), showed their interest in the integration capacity of eVACUATE with other emergency systems, as the 112. They commented that the information exchange between different safety and security actors is a crucial element nowadays, and the capacity of communicating through standardized interfaces of the eVACUATE system was a very important functionality.

After the evacuation exercise the question was raised whether this system would work with larger crowds (full scale evacuation). In the training functionality an option is implemented to fill the stadium with thousands of spectators and then experience what happens virtually in case of an evacuation. A more complex simulation software is available to create more complex scenarios. This tool enables end-users to create scenarios with initial conditions such as static exits, moving crowds rushing to the defined exits, incidents impairing or blocking evacuation routes, etc... This tool provides dynamic inputs to the whole eVACUATE system by providing live simulation data such as geo-localised crowd counts, incidents and virtual CCTVs. All these data can be modified in real-time and assessed in the COP. This enables end-users to create evolving situations and train on more close-to-reality cases.

The possibility to bypass the automatic functioning of the system is a required option, from the end users point of view. In complex situation decision makers need support or an overview of the building; they do not want a 'decision taking system'.

Athens International Airport (AIA)

The training in Athens International Airport focussed on one of the situations/scenarios already practised in the evacuation exercise: someone leaves a bag in the hall, next to chairs which are full of people. The case of an unattended bag should be projected before the luggage control, to consider it to be a threatening situation. In the training is indicated that in this situation foot patrol would be mobilized. If the situation would lead to a bomb alarm the official procedure would start. For example the availability of fire brigade and medical teams could be indicated easily on COP, to make the information more visible.

Communication between the different agencies achieved through eVACUATE would, according to the end users, significantly improve the situation.

MSC Meraviglia Cruise Ship (STX-FR)

Although the circumstances were adverse, the users had evaluated the use of COP and provided valuable feedback. The STX end users focused on the possibility of connecting with the legacy systems, already existing and implemented in the cruise ship. The eVACUATE system is able to connect to legacy systems connections with CCTV and the fire management system have been demonstrated during the pilot. The connection to DECT phones was not demonstrated as an interface to the system was not provided in time.

Connection with legacy systems is important, because it is more cost-effective to use existing soft- and hardware if already in place. Furthermore the connection highlights the open nature of the eVACUATE architecture and supports the argument that with eVACUATE the investment of existing infrastructure is indeed protected

Another comment from end users in the STX pilot was the estimation of the number of people in a specific room. The eVACUATE system can also work with approximate values and will in any case be able to give a prediction of the evacuation time. In the pilot the highly innovative chipless RFID technology has also been demonstrated, which offers an accurate number of people after 'check in' procedures, even if in the current stage of development it supports passenger classification and not actual identification.

San Mames Metro Station (METB)

In Basauri office (depot Metro Bilbao) an end user training has been performed at May 4 2017. This training has been attended by the Command Post Supervisor, the Metro's security operator and Head of Security. Also the European Commission's reviewer and one of the Metro Engineers partially participated.

The trainer from the eVACUATE consortium (DXT) showed the COP to the trainees, asking them to "play" with the system and give feedback. They performed the full three-phase training: Assessment; Decision making and Collaboration. To operate the touch screen turns out to be easy for the trainees.

During the Assessment phase the AER was displayed to see possible evacuation routes: If people would be evacuate as that specific moment, arrows with colours display the fastest route and estimated evacuation times. The routes and times could be configured during implementation of the system, according to their Metro's needs. Maximum evacuation times are part of the metro design and thus defined by their protocols. In COP the threshold green-yellow could be redefined to fit to the end users expectations.

In the training we use a simulation of an amount of people in the station. The colours of the group of 'simulated people' represent density. In this way the interface proves to be intuitive understandable by the trainees.

Unusual behaviour detection drew immediately attention from the Security Boss; he asked whether the system would detect if someone drops and leaves a suspicious item. This situation was also planned to be demonstrated in the pilot.

In the training the evacuation process is discussed and the trainees raise the topic that walking upstairs is a slower process than downstairs. In the eVACUATE system (crowd modelling) this aspect has already been encountered: each route has a “weight”, a “difficulty”, although this modelling knowledge is not indicated in the particular interface.

Another topic in the Assessment phase was the demonstration of the Wireless Sensor Network. The humidity/light/temperature sensor were demonstrated to the trainees and an explanation has been given about how (other) legacy systems could be integrated with the eVACUATE system. The possibilities of integration with the existing alarm system has been discussed in more detail. Metro Bilbao likes the idea of checking a possible alarm directly on COP. For instance, if there's an alarm on this point, they can position the nearest camera to check the (cause of the) alarm.

The second phase of the training was aimed to perform evacuation decision making. The trainees were asked to changing possible and available routes by disabling routes in COP. The functionality of the system to consider the crowd volume in relation to the available route size (corridor width) in the evacuation routes has been discussed? In the eVACUATE system it is possible to change the “movement quality” of people: If you know for example that most people are elderly, you can tell the system they'll move at 75% of normal speed.

Adding icons manually is also part of the decision making phase. Trainees were asked to indicate the initial location of first responders and their route to the place where the alarm was raised. In eVACUATE is it possible to share this information with other systems, e.g. the police or for example EuskoTren (Train Management).

During the Collaboration phase, the trainer suggested to have in mind that the two computers are situated in different buildings. The trainees played a specific role and communicated only on necessary information. At the moment the trainees click the “eVACUATE!” button, the evacuation starts with exit signs, loudspeakers, access doors opening, all of this automatized. The trainer specified that some actions are processed automatic, others require a human validating it from a security station, depending on the protocol. This can all be configured with different scenarios. For example one scenario could be designed to be used in soccer match days (in case of an evacuation the escalators stop automatically). Another scenario could be used in working days around 12 am (station crowded with adults and teenagers). These scenario can be specified according to Metro's protocols.

In general the trainees adjudged this training on the eVACUATE system, focussed on the COP functionality very useful to train personnel. In a stressful situation, an operator can feel overwhelmed and might forget the next step. But this system gives the correct indications per protocol, instead of forcing the operator to fall back on a general manual or guidelines.

According to the trainees the eVACUATE system in training mode assists to find bottlenecks, both in the design of the station and in operational situations. The system helps immediately to send security staff efficiently to a specific place. As an operator of the station it is useful to have an idea of the total amount of people at the venue and to see persons main movements real time. To conclude the training session the trainees agree on the goal of the eVACUATE project: the more information you have, particularly if it is useful and relevant information, the better is it for safety during evacuation processes.

8. Conclusions and recommendations

General conclusions

In general the trainees adjudged this training on the eVACUATE system, focussed on the COP functionality very useful to train personnel. In a stressful situation, an operator can feel overwhelmed and might forget the next step. eVACUATE gives the correct indications per protocol, instead of forcing the operator to fall back on a general manual or guidelines.

The training has been set up with a focus on the 3D model and the way information is gathered and displayed in the user interface. This implicates that the questions and discussion were mainly related to the use of the Common Operational Picture and the way eVACUATE support end users in their decision making. To operate the touch screen turns out to be easy for the trainees. The interface proves to be intuitive understandable by the trainees

Furthermore the trainees indicated that in complex situations still (or even more) the human factor should not be underestimated in the eVACUATE system. In complex situation decision makers need support or an overview of the building, but in any case they need to take and implement their own *reasoned* decisions.

Another conclusion from the training is that end users appreciated the open nature of the eVACUATE architecture and support the argument that with eVACUATE the investment of *existing infrastructure* is indeed protected. Trainees emphasised the desirable situation of connecting the eVACUATE wireless sensor network with the existing smoke and fire alarms.

Conclusions for pilot venues training

ANOETA Stadium (ASRS)

The trainees mentioned the benefits of indoor modelling and suggested the integration of the 3D model with their building management systems and/or existing emergency systems. Also the real time connection with (first responders in) the area outside the stadium is for them one of the most promising parts of the further eVACUATE development.

Athens International Airport (AIA)

In Athens International Airport many situations/scenarios are already practised in other evacuation exercise. Every employee is fully aware of his/her role during threats or security problems. The scenario in which someone leaves a bag in the hall, next to chairs which are full of people, was too far from reality to enable eVACUATE to raise more awareness and to support decision making. If the situation would lead to a bomb alarm the official procedure would start. In that case the eVACUATE system might assist in visualising the availability of first responder teams. Also fast and unambiguous communication between the different agencies achieved through eVACUATE would, according to the end users, significantly improve the situation.

MSC Meraviglia Cruise Ship (STX-FR)

For a cruise ship the possibility of connecting (parts of the) eVACUATE system with the legacy systems, already existing and implemented, was mentioned as the most auspicious element of the training. During the pilot the eVACUATE system was connected to legacy systems connections with CCTV and the fire management system. Connection with legacy systems is significant and cost effective in ship design and building.

San Mames Metro Station (METB)

For end users from Metro Bilbao the possibility to detect unusual behaviour detection was interesting. A situation in which a passengers leaves his luggage was also a part of the pilot demonstration. The connection with CCTV and automatic detection of this situation contributes to security control and active monitoring of the station.

The possibilities of integration the eVACUATE system with the existing alarm system has been discussed in more detail. On request the humidity/light/temperature sensor were demonstrated to the trainees and an explanation has been given about how (other) legacy systems could be integrated with the eVACUATE system. Metro Bilbao likes the idea of checking a possible alarm directly on COP. For instance, if there's an alarm on this point, they can position the nearest camera to check the (cause of the) alarm.

Recommendations

Although in the training simulations are used to give the impression of a building which is (over)crowded with people, it appeared to be difficult to reach a training setting with full awareness of the situation. We recommend to prepare a more extended training in which not only the functionality is trained, but after that also the role playing part is defined closer to every day reality. Thus the trainees go through a realistic session and experience the merits of the eVACUATE system by themselves as a team.

A more detailed estimation of the number of people in a specific room is one of the main recommendations resulting from feedback during the training. The eVACUATE system works with approximate values and will in any case be able to give a prediction of the evacuation time. But end users want to have full confidence in the accuracy of the number of people after 'check in' procedures, to generate a more descriptive overview of the exact situation in the building.

The eVACUATE system in training mode assists to find bottlenecks, both in the design of the building and in operational situations. The system helps immediately to send security staff efficiently to a specific place. The more information you have, particularly if it is useful and relevant information, the better is it for safety during evacuation processes. So to incorporate eVACUATE training sessions for security staff will give boost to awareness raising and crisis preparedness in venues with crowd, and could in all probability contribute to the safety of people.

Annex A – List of Acronyms

Acronym	Meaning
AER	Active Evacuation Route
AIA	End user Athens International Airport
ASRS	End user Anoeta Stadium Real Sociedad
CCTV	Closed-Circuit Television (Video Surveillance)
COP	Common Operational Picture
EOC	Emergency Operation Centre
HMI	Human Machine Interface
LLL	Low Level Lighting
METB	End user Metro Bilbao
PA	Public Address
RFID	Radio-frequency identification
SAS	Situation Awareness System
SIB	Semantic Information Broker, component of SOFIA
SOFIA	Smart Objects For Intelligent Applications
STX	End user STX France