Funded by European Union Civil Protection

EUROPEAN COMMISSION

Directorate-General for European Civil Protection and Humanitarian Aid Operations (ECHO) Disaster Preparedness and Prevention Knowledge Network and Evidence-Based Policy

B.03 – Knowledge Network and Evidence-Based Policy

Training and Knowledge Sharing Platform for First Responders and Educational Tools for students' and citizens' awareness and preparedness against Natural and Manmade Disasters and Risks

D2.4 *RESISTANT*'s educational and training infrastructure

Workpackage:	WP2 – Observatory of existing initiatives and training infrastructure
Authors:	Konnekt-able Technologies Ltd.- Greek Branch [KTGR]
Status:	Final
Due Date:	30/06/2021
Version:	1.0
Submission Date:	15/06/2021
Dissemination Level:	PU

RESISTANT Project Profile

Grant Agreement No.: 101017819

Acronym:	RESISTANT
Title:	Training and Knowledge Sharing Platform for First Responders and Educational Tools for students' and citizens' awareness and preparedness against Natural and Manmade Disasters and Risks
URL:	http://www.RESISTANTproject.eu/
Start Date:	01/01/2021
Duration:	18 months

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Document History

Version	Date	Author (Partner)	Remarks/Changes
0.1	28/02/2021	Manuela Titorencu (KTGR)	Table of Contents
0.2	10/03/2021	Manuela Titorencu (KTGR)	1st Draft ready for internal review by IHU
0.3	09/04/2021	Prof. D. Emmanouloudis (IHU), Prof. N. Kokkinos (IHU)	First round of inputs
0.4	06/05/2021	Manuela Titorencu (KTGR)	2nd Draft for internal review by IHU
0.5	20/05/2021	Prof. D. Emmanouloudis (IHU) Prof. N. Kokkinos (IHU), Prof. A. Tsinakos (IHU)	Second round of inputs
0.6	31/05/2021	Manuela Titorencu (KTGR)	Consolidated version sent for quality control
0.7	15/06/2021	Kalliopi Angelaki (KTGR)	Quality Control
1.0	15/06/2021	Manuela Titorencu (KTGR)	Final Review, FINAL VERSION TO BE SUBMITTED

Abbreviations and acronyms

Operational Objectives	OO
Strategic Objectives	SO
Expected Outcomes	EO
Virtual Control Room	VCR
Control Room Operations and Emergency Responses	CRO & ER
Emergency Shut Down	ESD
Emergency Management Services	EMS
Decision Support System	DSS

Executive Summary

RESISTANT is an 18 month duration project co-funded by the Union Civil Protection Mechanism Programme (UCPM-2020) under grant agreement no. 101017819.

The overarching objective of the RESISTANT project is to build the first European Crisis Training Platform to train first responders through threefold comprehensive training: educational training with the state-of-the-art knowledge in safety, including tools for characterisation of hazards and associated risks, operational training on mock-up real scale transport, and innovative virtual reality training reproducing the entire accident scenarios, intervention strategies and tactics, including the whole chain of command and communications between all members of the first responders team, facility managers, and public (e.g. volunteer fire fighters, school children, citizens with disabilities). RESISTANT will also put in place a virtual 'agora' for first and second responders, academia, market practitioners, volunteers and other civil protection stakeholders to share knowledge and exchange best practices, especially in cross-border crisis management. The 'agora' will facilitate discussion and contribute towards the development of a common prevention and protection culture.

The main purpose of this document is to present the RESISTANT's educational and training infrastructure that mobilise the existing emergency management infrastructure of the International Hellenic University (IHU) enriched with Konnekt-able Technologies Limited, Greek Branch's (KTGR) COncORDE emergency management platform.

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1 Introduction

1.1 About the project

RESISTANT (Training and Knowledge Sharing Platform For First Responders and Educational Tools for students' and citizens' awareness and preparedness against Natural and Manmade Disasters and Risks) is an 18 months project that has been started on 01/01/2021 and is implemented by a consortium led by the International Hellenic University – IHU (Greece) in cooperation with the Association of officers and sub-officers with university degrees of Hellenic Fire Corps -E.P.A.Y.P.S. (Greece), Konnekt-able Technologies Limited, Greek Branch – KTGR (Ireland), Military academy „General Mihailo Apostolski", Skopje – MAGMA (North Macedonia), Croatian Crisis Management Association – CCMA (Croatia), Evia Rescue Team – S.A.R. 312 (Greece) and Rescue Team DELTA – RTD (Greece). The project is co-funded under the **Union Civil Protection Knowledge Network: Network Partnership (UCPM-2020-KN-AG) call of the Union Civil Protection Mechanism.**

RESISTANT aims to build the first **European Crisis Training Platform** to train first responders through threefold comprehensive training:

- educational training with the state-of-the-art knowledge in safety, including tools for the characterization of hazards and associated risks,
- operational training on mock-up real scale transport, and
- innovative virtual reality training reproducing the entire accident scenarios, intervention strategies, and tactics, including the whole chain of command and communications between all members of the first responders' team, facility managers, and public (e.g. volunteer firefighters, school children, citizens with disabilities).

RESISTANT Operational Objectives (OO)

OO.1: Support civil protection and disaster risk management actors that promote and facilitate the development, dissemination, and exchange of knowledge, good practices, and expertise.

OO.2: Update and expand a training program through further development of emergency scenarios to reflect the latest state of the art

OO.3: Implement an educational platform**,** where educational and training programs for primary, secondary schools, residents of endangered areas, citizens with disabilities of the aforementioned areas and tourists, as well as, for municipalities' employees, could be demonstrated with the help of Augmented Reality (AR) Techniques.

OO.4: Mapping and status of current initiatives, procedures, and resources for coordination, education, and training for natural disasters and technological risk mitigation.

RESISTANT Strategic Objectives (SO)

SO.1: Support new and consolidate existing partnerships in civil protection and disaster risk management that enhance cooperation and synergies in prevention, preparedness and response.

SO.2: Establish a European network of trainers for first and second responders, supported by stakeholders from EU and beyond, to share best practices and facilitate dissemination of knowledge

and experience generated within the RESISTANT project and relevant follow-up projects from EU to national level.

SO.3: Educate and train tomorrow's responder trainers through established and regularly updated comprehensive educational, operational and virtual reality training.

SO.4: Establish strong links between first responders' activities from different countries and constituencies and research and educational projects; Valuing the responders' experience and their feedback to enrich and harmonize harm criteria, models for hazards and risk assessment**,** expand communications to other stakeholders, including but not limited to legislators, technology experts, insurance companies, citizens and students to raise awareness and increase preparedness.

RESISTANT Expected Outcomes (EO)

EO.1: The implementation of a Trans-European Network of trainers for first and second responders.

EO.2: Design and implementation of innovative training programs for natural disaster and technological risk prevention and mitigation especially focusing on cross-border events that will be implemented in Virtual Control Room (VCR) with an integrated state-of-the-art emergency management system.

EO.3: Implementation and deployment of a dual-purpose platform which will incorporate the training programs for natural disaster and technological risks prevention and mitigation along with a series of educational and awareness programs enhanced with AR techniques for students', citizens' and tourists' preparedness.

EO.4: Mapping of current activities in Croatia, Greece, and North Macedonia in the areas of disaster management and disaster education and training. A comprehensive report with data derived from the mapping training exercises will allow decision and policymakers to evaluate the current state, challenges and opportunities for collaborative disaster management across Europe. Results and the mapping itself will serve as a basis for collaboration, knowledge sharing/exchanging, and training among the network member countries.

1.2 Purpose of the document

The purpose of this document (**D2.4 RESISTANT's educational and training infrastructure**) is to present the RESISTANT's educational and training infrastructure that mobilize the existing emergency management infrastructure of the International Hellenic University (IHU) enriched with Konnekt-able Technologies Limited, Greek Branch's (KTGR) COncORDE emergency management platform. This document is the output of **Task 2.4: Setup of the educational and training infrastructure.**

1.3 Work Package Objective

D2.4 RESISTANT's educational and training infrastructure is a deliverable of Work Package (WP) 2: Observatory of existing initiatives and training infrastructure. The objective of WP2 is to analyze European and national research projects regarding their technical innovations, their tactical and operational recommendations, and their potential to develop new guidelines and operational procedures within the field of emergency and crisis management.

1.4 Relation to other deliverable/Work Package

The current deliverable **- D2.4 RESISTANT's educational and training infrastructure** - is released in two forms (types), the current report (Type: Report) and the educational and training infrastructure (Type: Demonstrator). The educational and training infrastructure will be used during the WP3 RESISTANT Validation and Demonstration within the use cases implementation phase. D2.4 is related to the Deliverable 3.1 RESISTANT Use case guidelines and User's Handbook of the WP3 that will be released by Month 6 of the project (June 2021) and will define the use case scenarios to pilot and evaluate RESISTANT educational and training infrastructure described in the current deliverable.

1.5 Intended audience

The intended audience of this deliverable consists of the following target groups:

- Trainers and students who indent to become future trainers for first responders
- UCPM National Training Coordinators
- Representatives from civil protection and risk disaster management community - First responders (firefighters, law enforcement, emergency services, etc.), civil protection experts
- Civil society organizations / NGOs and their networks with interest in the Crisis Management domain, Humanitarian organizations
- International and national networks of civil protection and disaster management actors
- Members of the projects funded under the same call as the RESISTANT project (Union Civil Protection Knowledge Network: Network Partnership (UCPM-2020-KN-AG)
- Information Communication Technology entities (industry organizations and SMEs)
- Primary and secondary schools, Vocational Education Training Institutions, Universities, and research centers with interest in the training and education for civil protection and disaster management
- Civil protection authorities and public health authorities of European countries
- Policymakers at the local, national, EU, and the wider Neighbourhood level
- RESISTANT project partners and Advisory Board
- The Project Officer at the Knowledge Network and Evidence-Based Policy (ECHO.B.3) Unit in the Directorate-General for European Civil Protection and Humanitarian Aid Operations (DG ECHO) of the European Commission

1.6 Structure of the document

The structure of this report is as follows:

- Chapter 2 provides a general overview of the scope of RESISTANT's educational and training infrastructure.
- Chapter 4 describes the components of the RESISTANT's educational and training infrastructure
- Chapter 3 presents an analysis of the first responder's needs concerning their training and the software technologies they use in their work

- Annex 1 presents the Questionnaire submitted to First Responders to identify the current situation and needs concerning their training and the software technologies they use in their work

2 Scope of the RESISTANT's educational and training infrastructure

RESISTANT's educational and training infrastructure will be used to train first responders through threefold comprehensive training: educational training, operational training, virtual reality training:

1. **The educational training** aims to equip first responders with state-of-the-art knowledge in safety, including tools for the characterization of hazards and associated risks.
2. **The operational-level training** consists of practical exercises (table-top and Full-Scale Exercises) based on different emergency scenarios
3. **The virtual reality training** is based on a virtual reality facility that will expand training potential and the effect of educational and operational training. It will reproduce the entire accident scenarios, intervention strategies, and tactics, including the whole chain of command and communications between all members of the first responders' team, facility managers, and public (e.g. volunteer firefighters, school children, citizens with disabilities).

The RESISTANT project will update and expand a training program through further development of emergency scenarios to reflect the latest state of the art (e.g. develop intervention strategies and training tactics for search and rescue, tools for assessment of hazards and risks focusing on cross-border situations, and using Southeast Europe as the reference area for the development of a case study). This training program will be integrated with the facilities of VCR (Virtual Control Room), which is installed in the International Hellenic University and is unique in Greece. The operational training will use an integrated state-of-the-art emergency management system (COncORDE).

The training scenarios will be designed in a way that they capture the current needs of the key stakeholders defined in the target groups: First responders (police officers, fire brigades, civil protection, and public health authorities), Humanitarian organization, Search & rescue organizations, Students, citizens, and tourists.

The educational and training infrastructure will also support education and training programs for civilians such as pupils of primary and secondary schools, residents of endangered areas, citizens with disabilities and tourists, as well as municipalities' employees. The aim of the educational and awareness programs for civilians is to facilitate awareness and preparedness, helping them to create permanent knowledge on how to protect themselves and their families from natural disasters and technological hazards. The educational and awareness programs for civilians will focus not only on the prevention or the initial actions to be taken after an event but also on how to proceed. The ultimate goal is to complete the training by drawing up action plans, as well as setting up specific groups of tasks/responsibilities that will complete the training program.

3 Components of the RESISTANT's educational and training infrastructure

RESISTANT's educational and training infrastructure consists of:

I) RESISTANT Training Platform: a dual-purpose platform developed by this project and which incorporates: a) training materials for first responders; b) training materials and videos for civilians.

II) Virtual School infrastructure and technology: Mixed reality which combines elements of both AR and VR and is currently used by IHU to educate pupils of primary schools on how to deal with natural disasters and to protect them from such hazards).

III) A Virtual Control Room (VCR): it is installed in the International Hellenic University and is unique in Greece. (a detailed presentation of VCR is provided below at chapter 3.3)

IV) A state-of-the-art emergency management system (COncORDEA more detailed description of the components of the **RESISTANT**'s educational and training infrastructure is presented below.

3.1 RESISTANT Training Platform

The RESISTANT training platform provides access to teaching materials and videos and will be accessible via the project website at the address: https://www.RESISTANTproject.eu/

The platform will feature two sections according to the purpose of use:

1 Training of first responders
2 Education and awareness-raising for civilians

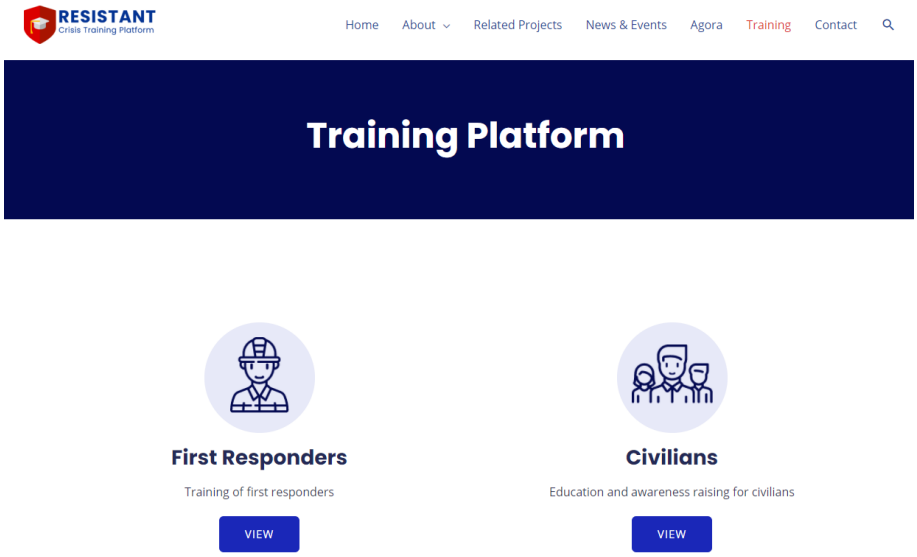

Figure 1. The section of Training Platform

3.1.1 "Training of first responders" section

Target audience:

a) First responders (police officers, fire brigades, civil protection, public health authorities)
b) Trainers of first responders

The "**Training of first responders'**" section of the platform consists of the 3 different sub-sections:

1. **Educational Training** – consisting of training materials uploaded by the project partners. Main topics: Forest fire risk assessment, the development process of a civil protection operational forces, Evacuation planning of critical infrastructures in case of an earthquake or a fire for people with disabilities; Evacuation of vulnerable guidelines.
2. **Operational Training** – describing the operational training that will be implemented by the RESISTANT partners during pilot use cases
3. **Virtual Reality Training** – describing the virtual reality training that will be implemented by the RESISTANT partners during pilot use cases. This training will reproduce the entire accident scenarios, intervention strategies, and tactics, including the whole chain of command and communications between all members of the first responders' team, facility managers, and public (e.g. volunteer firefighters, school children, citizens with disabilities).

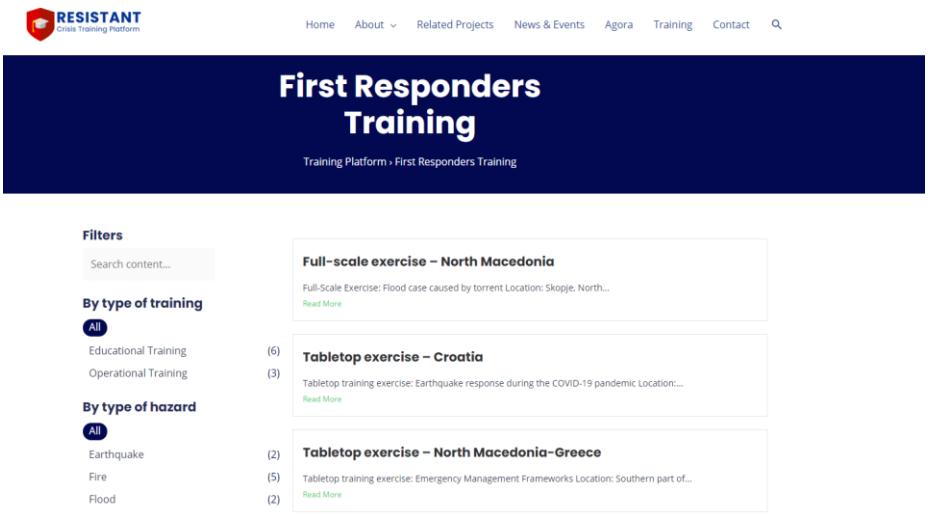

Figure 2. The section of the Training for first responders

3.1.2 "Educational and awareness programs for civilians" section

Target audience:

a) Civilians (Pupils from primary and secondary schools, Residents of endangered areas, Citizens with disabilities, Tourists)
b) Trainers (Educators from primary and secondary schools, Civil Protection Authorities staff, and Municipal employees)

The training materials for children (pupils of primary schools aged 6 to 11): The topics of the training materials are related to how to react in case of natural disasters.

The training materials for adolescents aged 12 to 18 years: These are innovative educational material related to the labeling and risk management of groups of children or individuals aged 12 to 18 years from natural or technological disasters.

The training materials for adults: The topics of the training materials are related to how to react in case of natural disasters as well as safety checklists in these cases.

The training materials for people with disabilities: There are videos on how to react in case of natural disasters

The training material for trainers: The topic is on "Disaster risk model for local authorities".

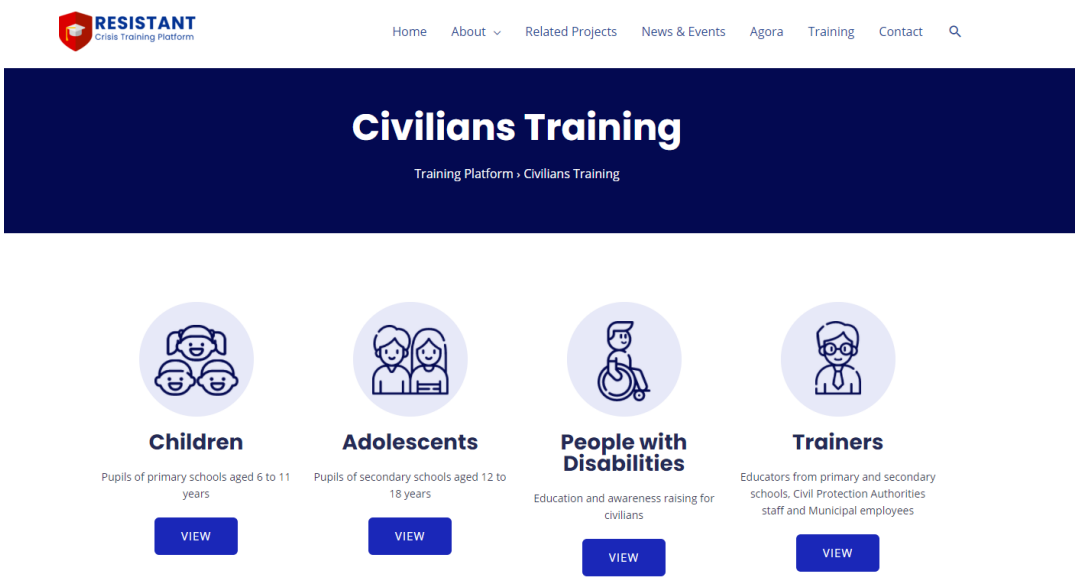

Figure 3. The section with the target audience

3.2 Virtual School infrastructure and technology

Virtual School is a training approach of- IHU, based on the educational framework "Inclusion for All", which aims to educate pupils of primary schools on how to deal with natural disasters and to protect them from such hazards by using Mixed Reality technologies, and training them on the use of three-digit emergency numbers.

Children, supervised by their Teacher(s), are asked to build a 3D miniature model of their school and use cutting-edge technologies (Augmented Reality) to train in dealing with natural disasters (earthquake, flood, fire, injury, etc.).

Virtual School relies on Augmented Reality technology to provide a mixed reality experience to the students. In particular, the students create a model of their school through the provided instructions and simple, cheap, and easy-to-find materials, following step-by-step instructions which are provided free to each school.

To promote collaborative learning, and problem-solving, small groups of students (comprised of 2-3 members) are formed which act as the brainstorming cells and the decision-makers.

Using the provided educational material, they print the action cards and they are asked to state the actions they would take in cases of a variety of types of natural disasters or emergency cases that can happen in the school environment or their everyday lives.

Students are expected to analyze the evidence of the given scenario (i.e you are located on the upper floor of your school and there is a fire on the next classroom. How do you react?), discuss the optimum solution, and pick the appropriate action card (among the available per scenario) which is the optimum way to react

Once the group reaches a consensus the leader of the group places the selected card within the 3D miniature of the Virtual School and with the help of a mobile device (such as smartphone or tablet) they are triggering a response via the augmented reality application ARTutor (UNESCO nominated, and Education Leaders Award-winning platform). ARTutor provides feedback via augmentations, not only in the case where the correct answer is selected, but also analyses the wrong answers by explaining why the selected reaction is not appropriate. In such a case the group can reconsider their answer and try again to find the correct reaction

At the end of each action, the students receive feedback on their responses through augmented reality technology.

Virtual School is an innovative educational program for disaster preparedness and response training, utilizing educational frameworks such as gamification, inclusive learning, and problem-based learning. It is based on a mixed reality environment where students have to interact with the environment to perform the correct actions in several educational disaster scenarios.

Virtual School was awarded by the European Commissioner for humanitarian aid Mr. Christos Stylianides (October 2019), by Educational Leaders Awards 2020. Also, Virtual School was recently accredited by the Institute of Educational Policy of the Ministry of Education Greece (January 2021)

Virtual School uses **ARTutor an Augmented Reality Training Platform** developed by the Advanced Educational Technologies and Mobile Applications Lab (AETMA). AR Tutor is available free of charge to all teachers and students around the world to help them develop educational materials and improve their learning experiences. AR Tutor is a domain-independent platform, focusing on adding digital content, so-called augmentations, to traditional educational books (typically in any PDF) and other texts. ARTutor enables each educator to create augmented books easily, without any requirements of programming background. In addition, the platform serves the aim of assisting the students' independent study and ultimately improving the understanding of the educational material.

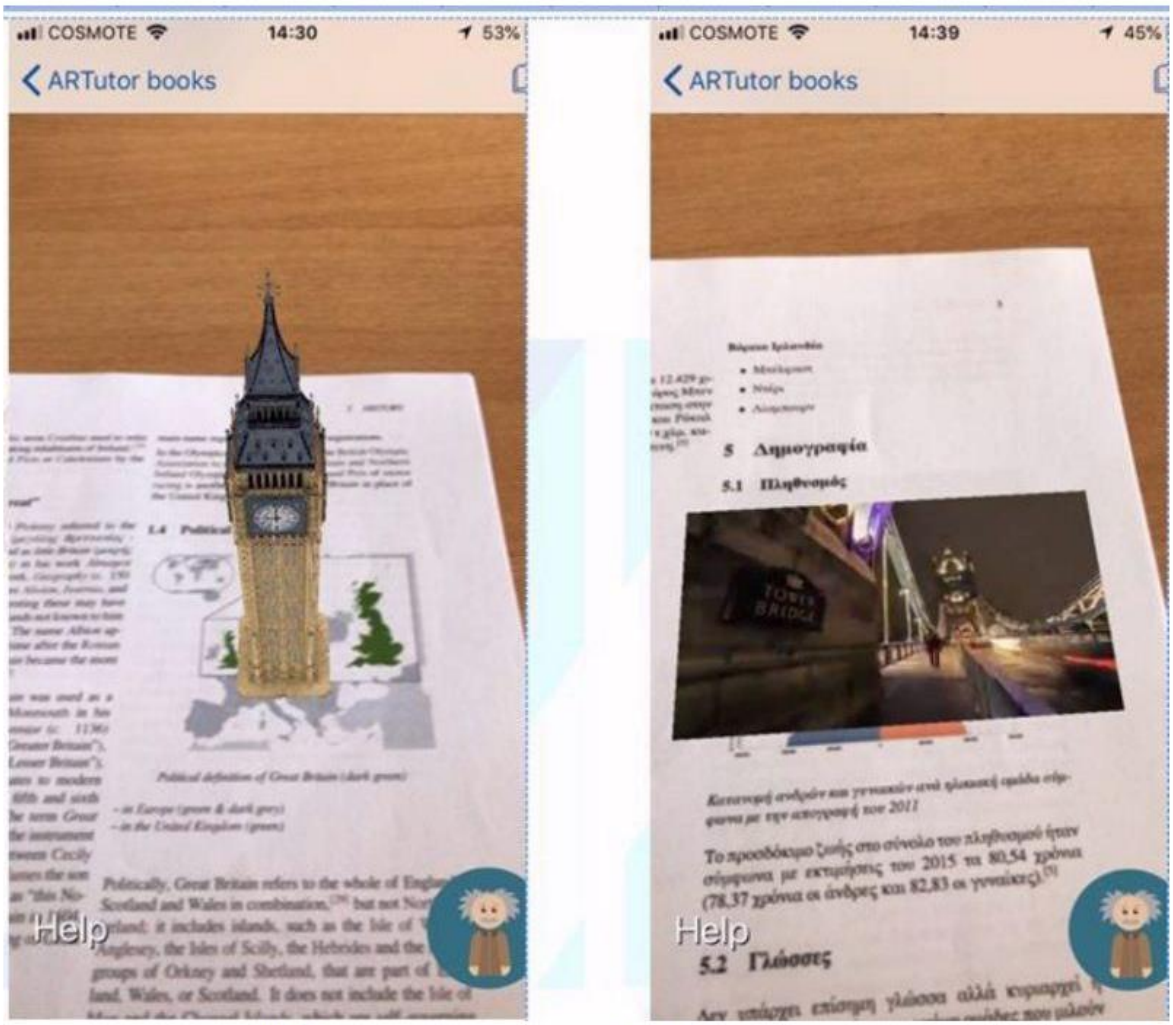

Figure 4. The ARTutor augmented reality application

To carry out the activities of the program, IHU needs the following materials and infrastructures:

1. **Virtual School electronic educational material.** The educational material is provided by the program and includes a) instructions for building a school model, b) action cards and c) educational scenarios for printing.

2. **Simple materials for the construction of the school model** according to the provided instructions.

3. **A smart mobile device (preferably tablet),** either with Android operating system and ARCore compatible or with the iOS operating system and ARKIT compatible which can utilize augmented reality technology applications

4. **The ARTutor augmented reality application** for viewing the augmentations,

5**. Internet connection** to download the necessary information to the mobile device.

Figure 5. School model

Figure 6. Implementation of Virtual School methodology in primary schools

3.3 Virtual Control Room (VCR)

The Virtual Control Room (VCR) established in International Hellenic University (IHU) is one of the most complete and modern VCR all over Europe. The VCR of IHU has been funded by the Administrative Region of Eastern Macedonia and Thrace in Northern Greece. It specializes in the fundamental and advanced training of students and professionals on control room operations and emergency responses during technological or natech accidents.

Most of the scenarios examined in the VCR are not hypothetical or fiction products, but rather the result of long-term interviews with industry executives, field operators, and control room operators to reproduce accurately, efficiently, and effectively near-misses, dangerous incidents, and accidents. This is particularly beneficial to the trainees for getting well acquainted with what-if fact-scenarios of our developed comprehensive database, and coping with difficult circumstances, often more difficult than they were. To that end, trainees have the opportunity to test and understand their limits in a highly secure environment; and on the other hand, the industrial executives to be informed about the suitability and readiness of their staff.

1 VCR Equipment

The VCR of IHU comprises a pair of rooms that are set up as a Trainer/Trainee system.

a) Trainee Room

The trainee room is an emulated industrial control room environment (Fig. 4) that allows both training and competency assessment of procedures and emergency response situations, with audio-visual recording and printed monitoring of the operators' performance. The trainee room of the VCR is equipped with real interfaces (DCS) from crucial infrastructures such as Oil and Gas Industry (onshore and offshore), chemical industry, refinery, and pipeline networks.

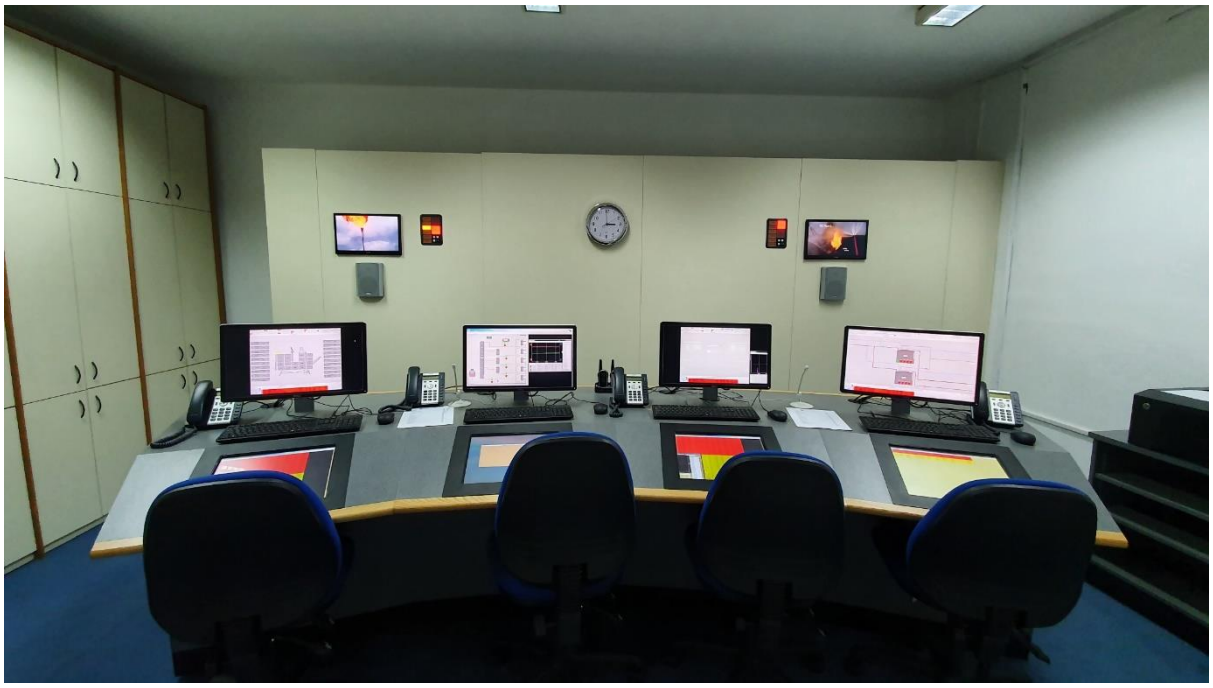

Figure 7. The VCR trainee room

It consists of the following components:

- 4 console-workstations each equipped with monitors, touch screen displays, keyboard, mouse, telephone, and radio communication.
- 2 wall-mounted 8 buttons illuminated alarm panels with lamp test and audible warning.
- 2 wall-mounted flat-screen TV showing pre-recorded videos associating with complicated scenarios.
- CCTV camera system.
- VOIP telephone system.
- Audio-visual recording system.

b) Trainer Room

All the control room operators' (trainees) responses are fully monitored from a separate room (Fig. 5) where the instructors control the training process and assess competence. The Trainer Room views the Trainee Room through a one-way window. The trainers may use the process simulation system to inject faults or to emulate operating sequences.

The Trainer Room includes:

- 2 instructor workstations with simulation software, allowing complete "failure mode" exchange.
- CCTV with HDD recording and playback facilities.
- Instructor control of Control Room Alarm Panels.
- VOIP telephone system from the control room operators to the instructors.
- 2 radio sets from each instructor to the trainee room (2 sets).
- 2 LAN printers, one in each room.
- Instructor software for full selection, control, recording, and scenario creation.

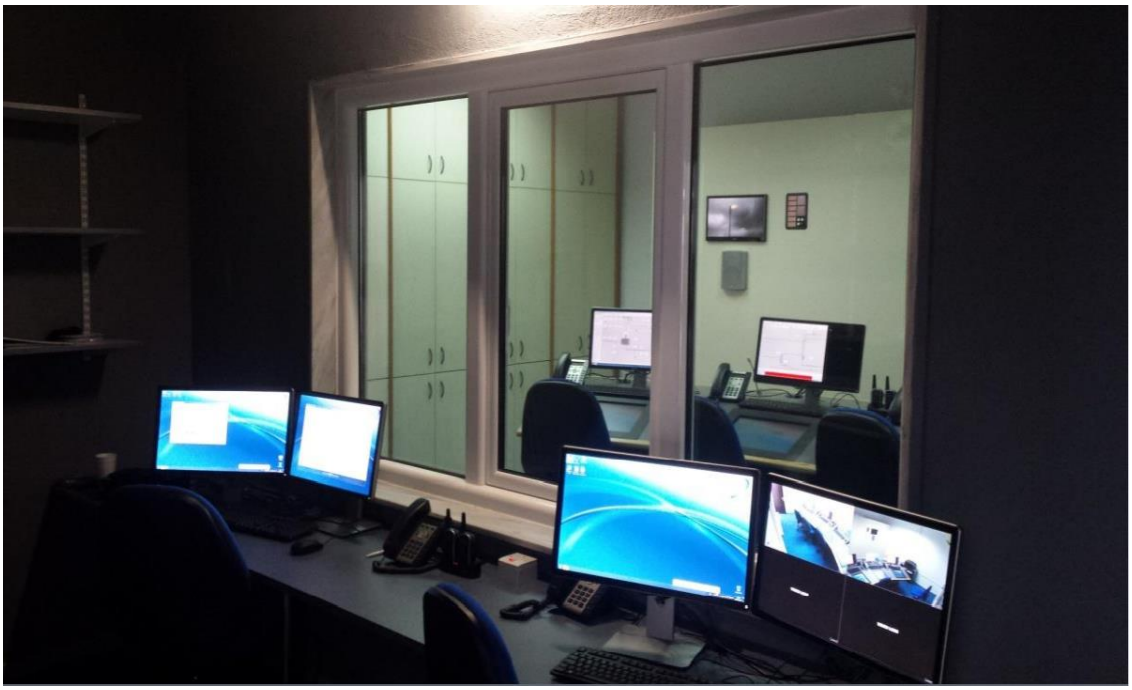

Figure 8. The VCR trainer room

2 Training

IHU organizes training seminars and certification on **Control Room Operations and Emergency Responses (CRO&ER)** in 2 levels (**L1**: Fundamental Level and **L2:** Advanced Level) for industry executives, security forces staff, postgraduates, and undergraduates. Up to date several industries and programs have been trained and certified in IHU facilities: staff from Oil and Gas Industry, staff from Chemical Industry, postgraduates from MSc in Oil and Gas Technology (IHU), postgraduates from MSc in Analysis and Management of Manmade and Natural Disasters (IHU), Trans Adriatic Pipeline (TAP) Training Program, security forces officers, facility managers and first responders (Fig. 9).

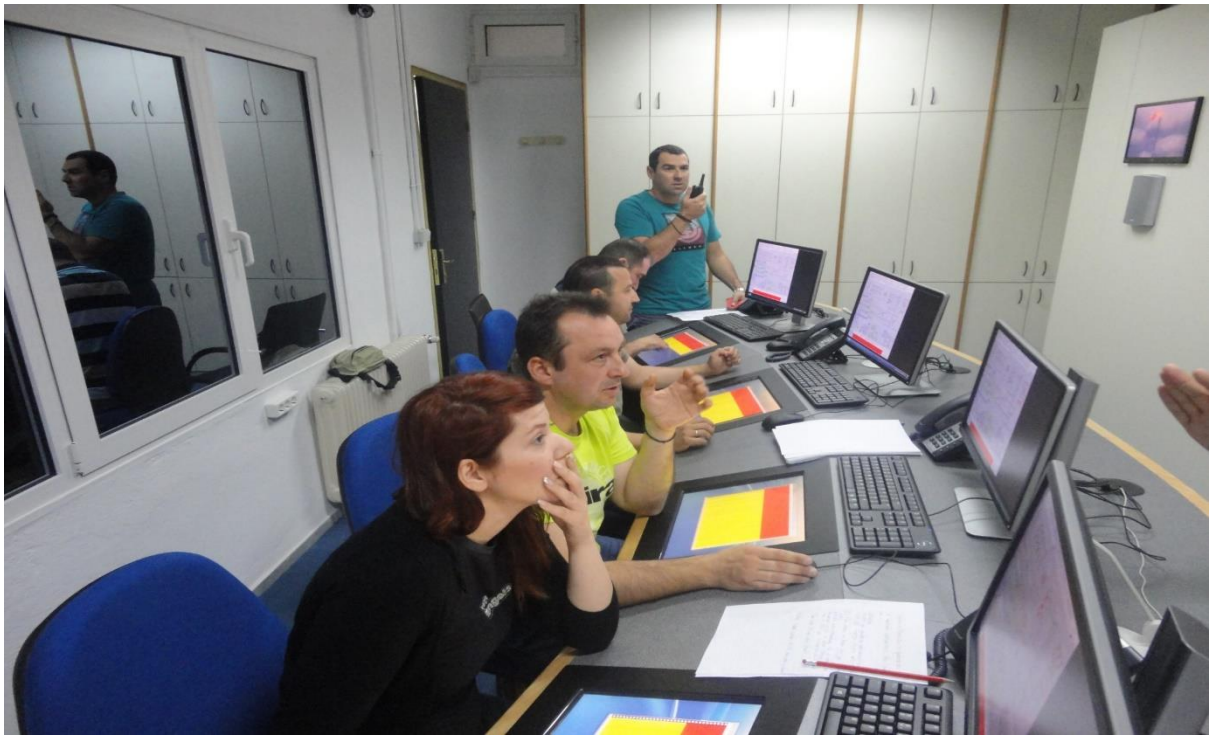

Figure 9. A typical L1 training seminar

a) Objectives

The main objectives of the training course are to:

- Familiarize trainees with all preliminary steps involved in modeling and simulation.
- Present cubic equation of states for professional use and explain their importance and role in different simulation models.
- Explain in detail industrial process engineering, operations, and protocols used for various physicochemical industrial processes.
- Familiarize trainees with the control room environment.
- Explain all requirements necessary for control room operations.
- Outline common operation problems and describe possible solutions.
- Provide information on emergency responses.

b) Syllabus

The course contents are distinguished into five sections:

A. Introduction in Modelling and Simulations (M&S)

A.1. Terminology

A.2. M&S Today

A.3. M&S Discipline

A.4. M&S Benefits

A.5. Reality vs. Simulation

A.6. Reality vs. Model

A.7. The lifecycle of a simulation study

A.8. Simulators

B. Cubic Equations of States (CEoS)

B.1. Introduction

B.2. Van der Waals

B.3. Soave-Redlich-Kwong

B.4. Peng Robinson (1976, 1978)

B.5. Mixing rules

B.6. Binary Interaction Parameters (BIPs)

B.7. Phase behaviour

C. Control Room Environment

C.1. Process Flow Diagrams (PFDs)

C.2. Piping and Instrumentation Diagrams (P&IDs)

C.3. Distributed Control Systems (DCS)

C.4. Supervisory Control And Data Acquisition (SCADA)

C.5. Faceplates

C.6. Alarms

C.7. Trends

C.8. Indicators

C.9. Controllers

C.10. Emergency Shut Down (ESD) system

D. What-If Scenarios

D.1. Operating, monitoring and remotely controlling industrial chemical plants

D.2. Faults

D.3. Maintaining the safety of process operations

D.4. Isolating and reinstating process equipment

D.5. Routine responses

D.6. Emergency responses

D.7. Managing and controlling emergencies and critical situations

E. Certification

E.1. Preliminary exam

E.2. Final assessment in the virtual control room

The first three sections refer to modeling and simulations, cubic equations of states, and control room environment and they are common for all trainees' categories. However, section D is tailor-made for the type of industry and end-users. Section E contains material for the assessment and certification process of the trainees.

3 Training Simulation Models

The VCR of IHU owns and runs several industrial simulation models. The simulation models very closely represent the performance and dynamics of actual systems. The models have similar response times, and react in similar ways during start-up and shutdown, to typical real industrial plants. The models are sufficiently accurate to allow competence assessment of the trainees in a wide range of scenarios.

The available training simulation models of the VCR are:

a) Offshore Oil and Gas Production Platform

The process includes 10 wells heads including 4 pure gas wells passing through 2 trains of 3 phase separation. There is a full water treatment system including a gas flotation system and closed drains. The gas separated during the 3 phase separation system is passed through a dehydration system where it is contacted with Tri Ethylene Glycol (TEG) removing any remaining water. The gas is then passed through 3 stages of compression before it reaches the fiscal metering system (including metering provers) and is sent on to export. This gas can also be used for gas injection. The compressors are all driven from a single shaft driven by a turbine fuelled by let-down production gas. The TEG used in the dehydration process is recovered in a full TEG regeneration system. The oil produced is pumped through storage, again through a full metering system (including metering provers) onto the oil pipeline. This pipeline can simulate blockages and waxy build-ups that can be cleared using the integrated pig system. The utilities in this model include power generation (2 power turbines) and a turbine to drive the compressor system. The hot gas from these turbines is used to drive a heat recovery system used to heat oil for various needs around the plant. The system includes full instrument and service air systems; water injection systems and utility water. Also included is a full Fire and Gas system which is integrated into the firewater system including seawater lift and reserve fire water pumps. The model includes a full Emergency Shut Down (ESD) system based on a Cause and Effect Matrix while the alarms for the system are given in area groups.

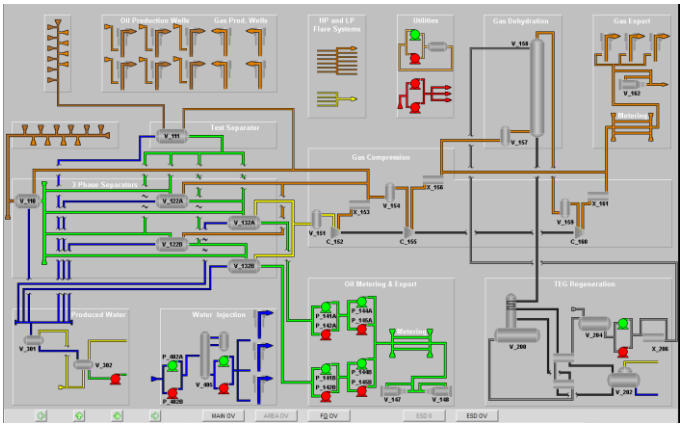

Figure 10. DCS overview of the O&G production platform.

b) Refinery Plant

The process includes a full hydrocarbon fractionation column. The model consists of a 32 tray column with the feed introduced at the base. The column feed is passed through a heat recovery system and then fed to a furnace, before entering the column. This drives a flow of gas up through the column. The temperature of the feed is controlled with a temperature controller varying the flow of fuel gas to the furnace. The column is used to split the feed into 6 major product cuts. These are off-gas, naphtha, kerosene, diesel, gas oil, and residue. Each of the product side streams has a collection vessel before each of the products is cooled using the feed stream. The model includes a detailed engineering level of information using higher-level password access to show detailed information about what is happening on each of the trays within the column.

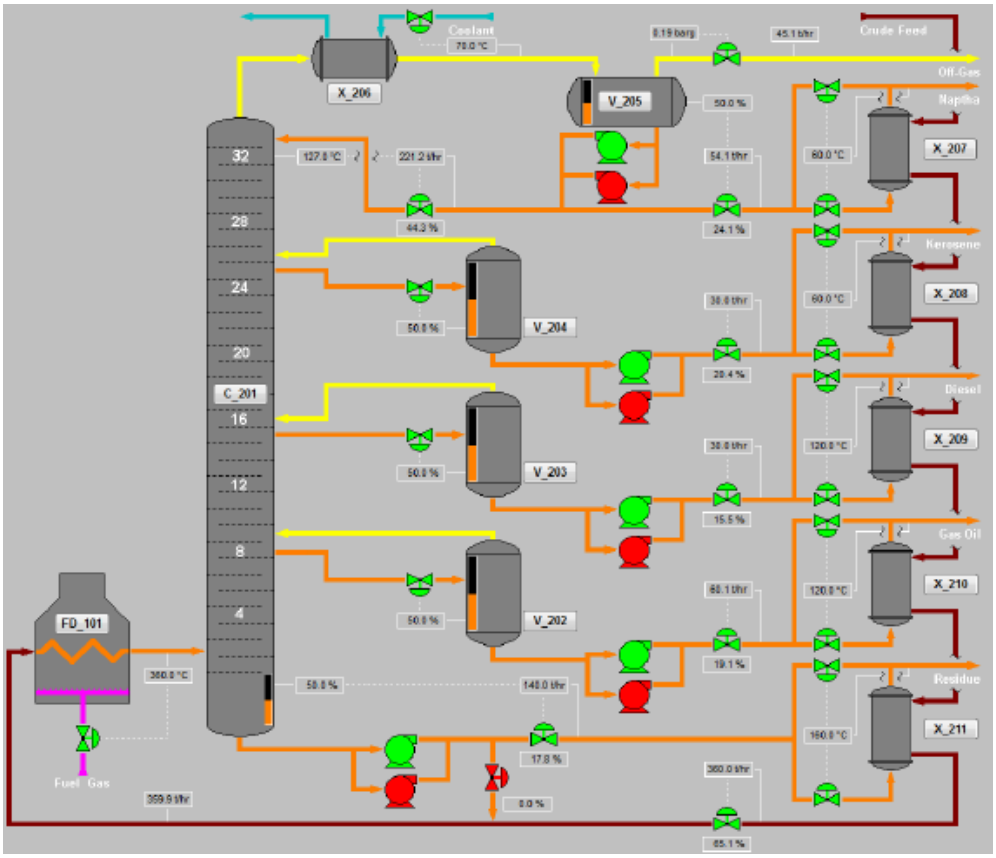

Figure 11. DCS overview of the refinery plant.

c) Advanced Chemical Reactor

An advanced generic reactor includes an option to run either a Batch or a CSTR type reactor. Both reactors demonstrate a generic exothermic reaction between 2 reactants. The batch reactor as well as the CSTR reactor consist of a water jacketed reactor with an agitator. The rate of reaction is dependant on both reactant concentrations, temperature and degree of agitation. The amount of reactant used and the product created are all measured as well the standard process readings, of temperature, pressure and flow around the reactor. An economic page allows the user to review the efficiency of the reaction using the actual economics of running the reactor.

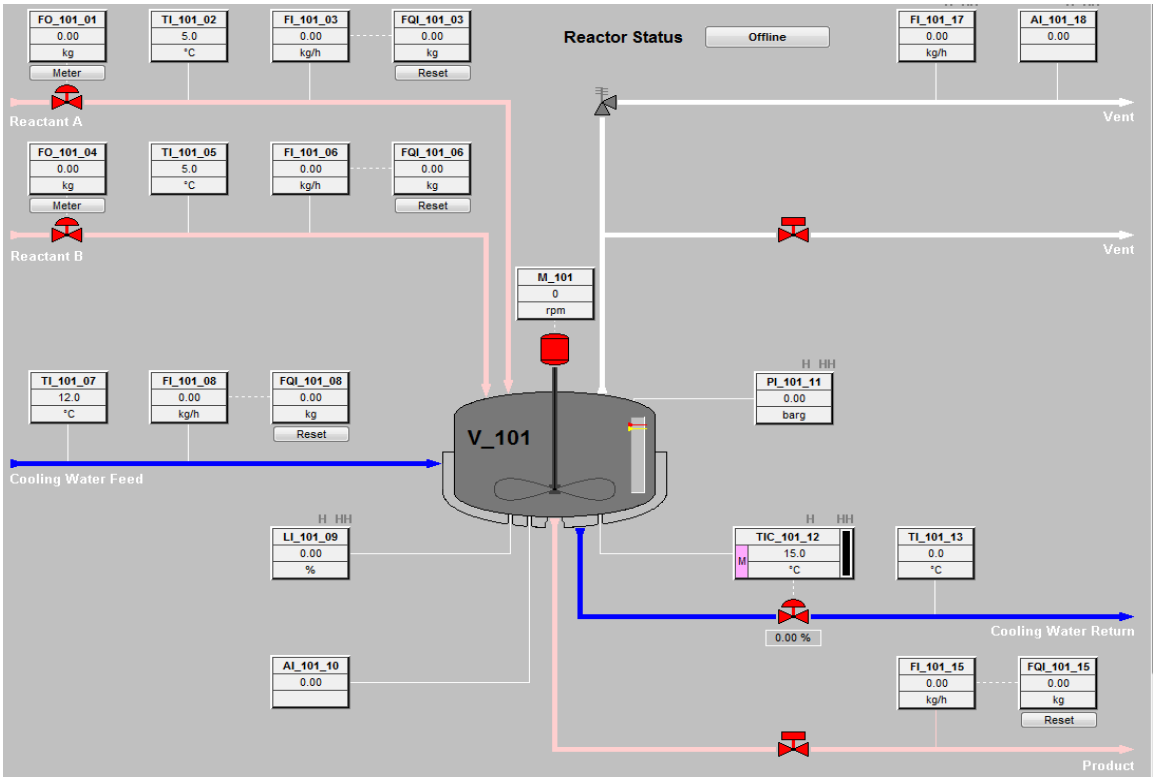

Figure 12. DCS overview of the advanced chemical reactor

d) LNG Plant

This model is an LNG production and processing plant. The trainee can start-up the plant from a fully shutdown state with all equipment Nitrogen purged to a fully operational plant producing and storing LNG.

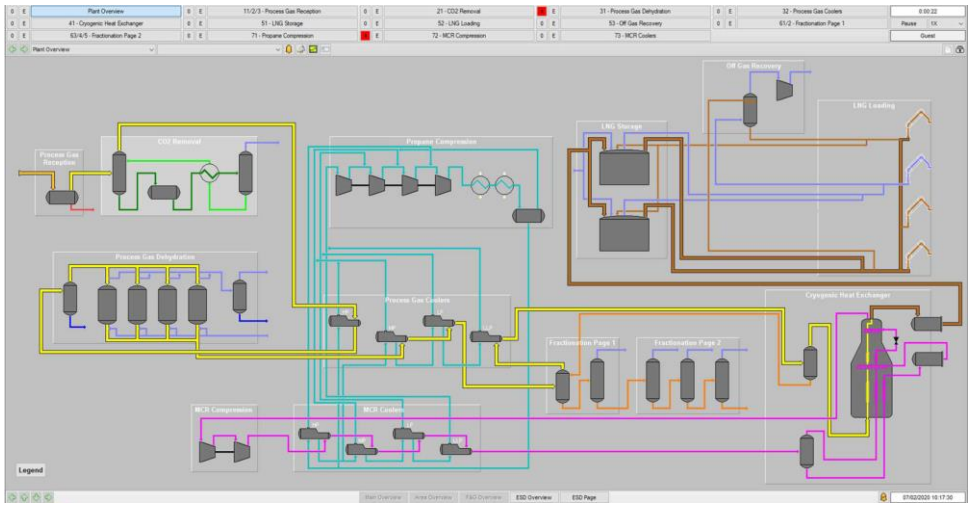

Figure 13. DCS overview of the LNG plant.

4 Simulation Environment

Each of the training simulation models incorporates the following features:

- Full thermodynamic calculations with heat and mass balance across the models.

- Complex multi-component flows, with individual pop-up tables of components at useful locations.
- Modern DCS style interface with multiple graphic screens for the larger models.
- DCS style controllers and faceplates.

Figure 14. Several pop-up faceplates associated with industrial devices

- Alarm system with acknowledge and priority listing.

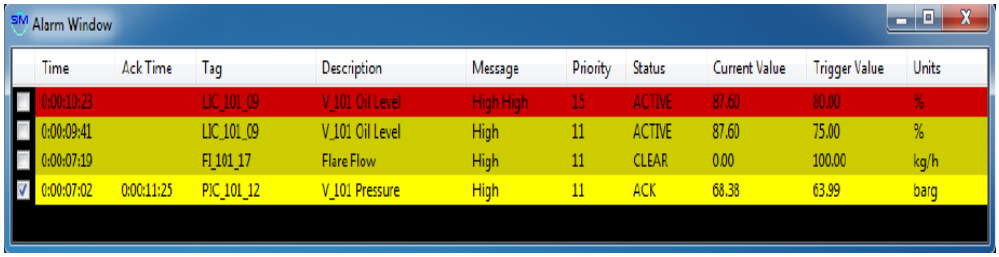

Figure 15. Alarm screen with alarms sorted by priority, status and time

- ESD Cause and Effect Matrix with inhibit and override capability.

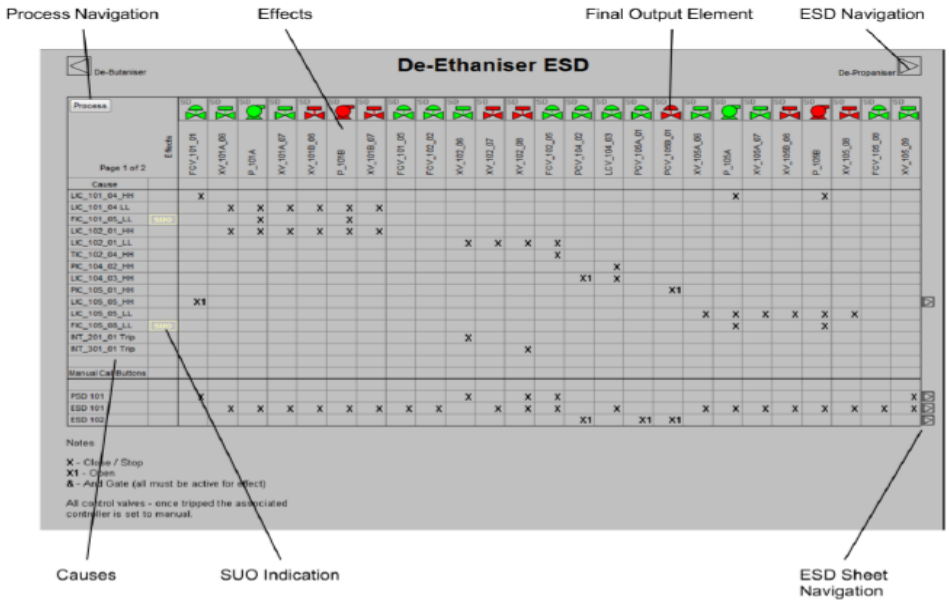

Figure 16. Emergency Shut Down (ESD) Cause and Effect Matrix

- Trend package including channel selection, scaling, and printouts.

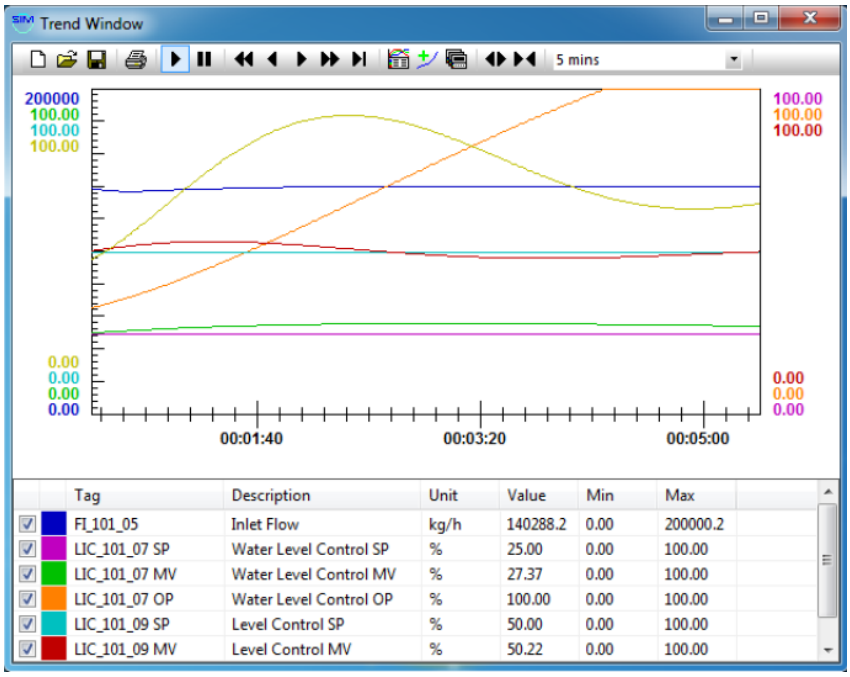

Figure 17. Trends display of selected sensors

And with the following system functionality:

- Model pause and resume run function.
- Real-time running.
- Event logging to an electronic file.
- A snapshot saves and resumes the model in any condition.
- Menu-driven model selection with the startup in design conditions or at any trainer predefined condition.

3.4 COncORDE emergency management platform

COncORDE is a state-of-the-art system of a systems software platform that supports and enhances the existing coordination and decision processes during small or large-scale crises and medical emergencies, at local, regional, and cross-border levels. By its design, the platform meaningfully connects all Emergency Management Services (EMS) participants in emergency response, which are in generic terms the Public Safety Access Point -PSAPs (112/control rooms), the dispatched EMS responders, the First receiver hospitals and any involved Higher command centers.

COncORDE provides an innovative common information space, which connects all emergency medical responders involved in the operational response to an incident and allows them to effectively exchange information related to their tasks, gain a common operational picture and make informed decisions based on this real-time information. The common information space is created per-incident and allows distributed actors across distributed spaces to coordinate through this information exchange.

This system is a result of an FP7 project called "Development of Coordination Mechanisms During Different Kinds of Emergencies"[1]. Its full version with all services added is named the COncORDE platform. The platform consists of several modular components referred to as the COncORDE tools:

1 Incident management tool

1.1 The incident information tool

This tool collects and aggregates all the information provided about the incident. The information consists of the initial dispatch information as provided by PSAP to the system, the Situational Reports (SITREPs) as entered by the field commander, and all the related other information that participants have provided about the incident.

The incident information tool is linked to multiple other tools. The interactive map is embedded in the incident module and enables geo-location of the incident, tracking of all participants, patients, as well as finding and contacting other organizations (mainly hospitals). It also provides a link to the information on patients in the different stages of the incident, such as estimated patient numbers and initial information, physically acquired real-time data of all patients at the scene, as well as their immediate needs.

1.2 The team management tool (Team table)

This tool aggregates the information about any participant logged into the incident. It combines event logging with the responder tracking tool. A complete overview of the team is enabled, as well as role allocation (manual or via Decision Support System -DSS) and communication (i.e. link to notifications). The tool also links to the hospital management tool, since hospitals are incident participants as well who are represented by the hospital commander at the team table. The hospital information and the patient information link via the DSS to enable referral allocation. One additional feature is the ability to customize the actual content of a menu if it differs across different jurisdictions and health systems.

2 Hospital management tool

This tool provides the ability to communicate with hospitals to obtain information on hospital capacity. It aggregates information on all hospitals fitting the search criteria. It allows a hospital summary view

[1] https://cordis.europa.eu/project/id/607814

of capacity, visualising which hospital has joined the incident, inviting hospitals to join and referring patients (incl. providing patient e-form to hospitals). The information entered about type of specialties links to the semantic tool for suggestions of matching referral diagnosis from the patient status information tool to the type of hospital specialty to which the patient should be referred and to the decision support tool for allocation.

3 Patient management tool (Patient status information tool, patient e-form)

The patient status information tool (patient table and patient screens), Technology Readiness Level (TRL)[2]6, aggregates the entire information gathered on a patient during his emergency management. It starts collecting the information from the moment of the first physical encounter. The patient status information tool collects the following information: triage 1, location, ID, vital signs (from the Rescue application), gender, estimated age, medical assessment, interventions and treatment, and needs for further management. It is the equivalent of an aggregated electronic pre-hospital patient care record (ePCR), which is already implemented at various stages of completeness in some health systems. The patient information tool goes beyond current ePCRs in that it enables the provision of information on patients who are currently not monitored at all or not monitored to the point of safe practice. In addition, its information is linked to the patient icon on the map. Even after hospital handover, the patient information is still visible as long as the incident space is open, to allow accounting for all patients and tracing what happened to them. After the incident is closed, this information is retrievable for auditing purposes as well. The patient management tool allows a seamless and complete handover of the entire patient information to the receiving hospital and it also allows a prior view of the patient information, before the patient has arrived in the hospital. The tool consists of three interactive individual patient screens and the patients summary table. It is designed to be operated via a tablet for data entry.

Figure 18. Patient Management Tool accessed through a tablet

The Assess screen features the innovative "Geographical Mannequin", which "translates" via an underlying map--based service the anatomical area of injury from picture to text on the final Needs

[2] https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf

screen, see next pictures. The frame of the patient's screens shows the triage 2 colors, depending on the injury score obtained during the examination and from the sensor input.

A minimum data set of medical parameters, as well as treatments, is enabled to be produced and maintained throughout the incident.

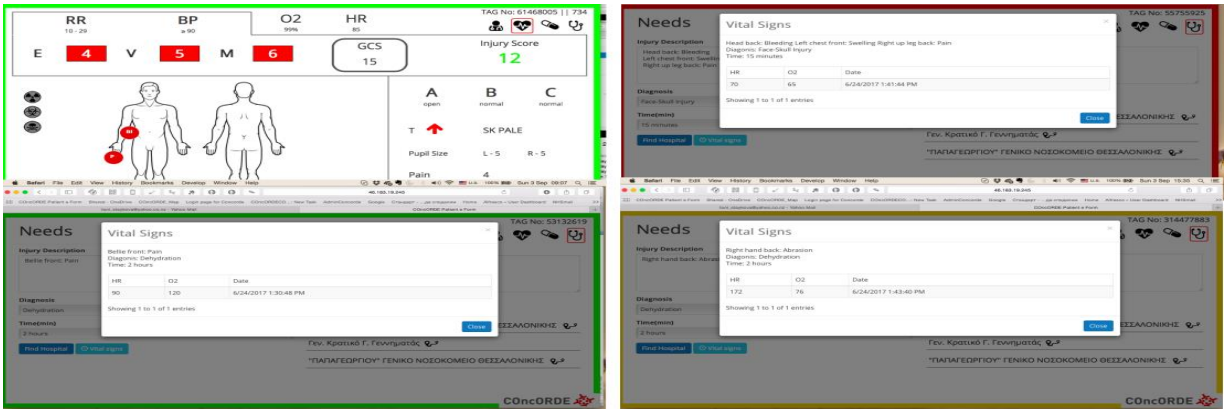

Figure 19. The patient's triage with injuring score

Figure 20. Medical Parameters regarding the situation of the patient

4 The ConcORDE interactive map

The COncORDE map (TRL6 reached of TRL9) comprises the second core tool to the entire system. It is built on pre--existing Esri map technologies as a dedicated service to support the COncORDE specific functionalities. The map integration supports not only the display of geographical maps, but it allows interactive work with the maps in real-time, drawing, messaging, viewing participant and tracked asset location at any one time, viewing the associated information with the located participant/tracked asset, as well as the conversion of the map view to tabular views of all participants and tracked assets. It also allows the integration of third-party service providers, such as weather, traffic, and social network information. It provides "best route" calculations and suggestions and provides input into the decision support services/DSS tool for patient management (hospital allocation, evacuation, and allocation to transport).

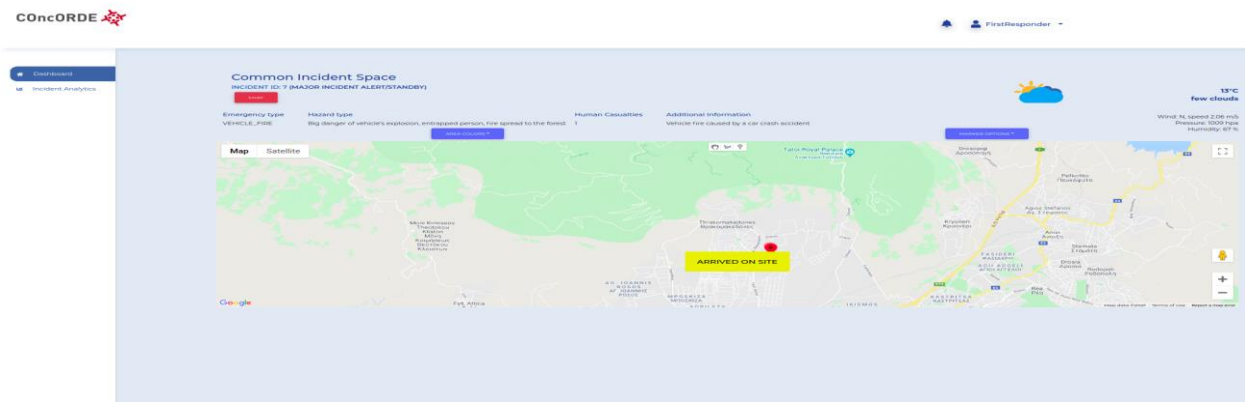

Figure 21. The interactive map with the incident's geolocation

5 Tracking tools

5.1 Rescue Light

A lightweight version (TRL6) of the Rescue Application can monitor the user's location (e.g. en-route staff, retrieval runner, transport officer, transporter crew, first receiver, bystander, etc.), seen by others in real-time in the platform's map.

5.2 Collector Application

The COncORDE Collector application (TRL6) is based on the pre--existing TRL9 Collector Application by Esri for tracking. The modification consists of an adaptation to the user management service, allowing users of the COncORDE platform to be tracked automatically from the moment they join an incident. The application links to the user ID in the specific incident, so that the map displays not only the user ID but also the role of the user in real-time. By enabling the tracking, a user can be found on the map, tasks can be assigned and messages can be sent via the map.

6 DSS tools

The COncORDE DSS tools offer specialized decision support services, the need for which was specified during the requirements analysis. Their function depends on the availability of reliable data gathered from the incident in real-time. As such the DSS tools depend on the correct function of the other/new tools developed in this task.

6.1 EMS Prediction Tool

The DSS prediction tool (TRL5) predicts Medical Resources required to be dispatched after an earthquake and flood, using historical data and machine learning techniques to satisfy the demand. The objective of the medical resources estimation service is to provide alerts and logs of a new incident and make a prediction of resources required to be dispatched so. Historical data of past incidents (earthquakes, floods) regarding the number of victims who requested medical assistance (Emergency Medical Service-EMS and hospitalization), simulation tools, web services, and machine learning techniques have been combined to do the predictions. Comparing actual and predicted victims needed hospitalization showed that the models developed can predict medical resources required to be dispatched within acceptable errors. As soon as an EMS prediction is available from the EMS prediction

service, the EMS vehicle prediction together with all incident information is transferred into the COncORDE platform via REST protocol.

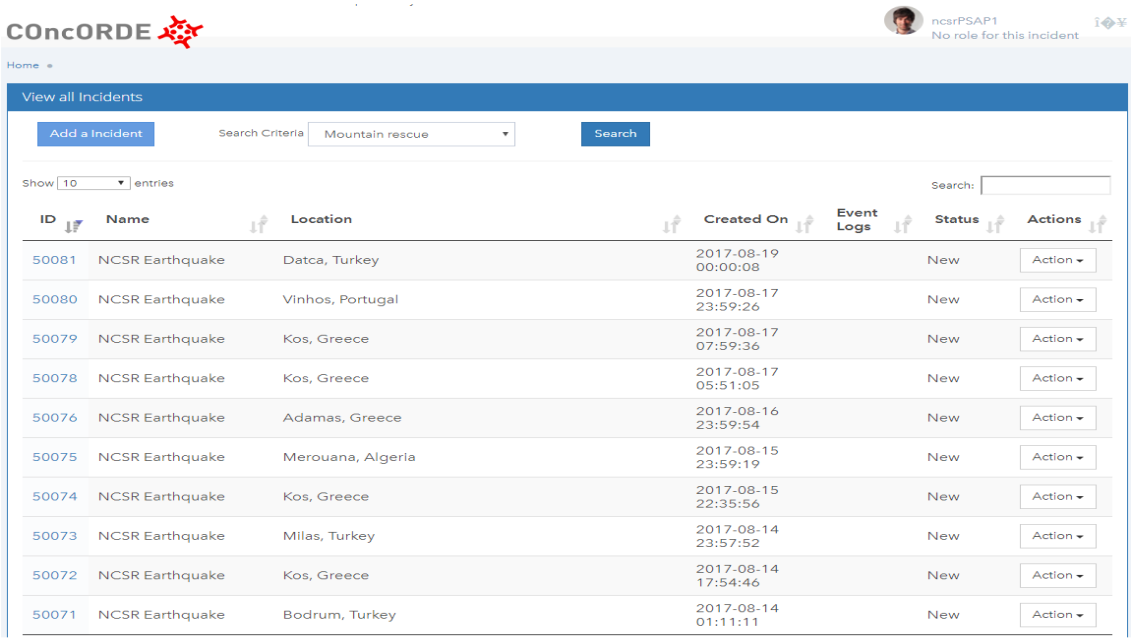

Figure 22. Emergency Prediction Tool

6.2 DSS for team management

The decision support service for team management (TRL4) deals with the role allocation on the field according to the credentials of available participants and the current resource needs.

6.3 DSS for patient management

The decision support service for patient management (TRL4) addresses the needs for transport vehicle allocation to patients during evacuation and subsequently first receiver (hospital) allocation. It addresses multiple patients, multiple vehicles, and multiple first receivers at the same time, considering their profile in terms of needs, available capacity, and expertise. The function of this tool depends on systematic gathering and providing all the information required.

7 Bystander tool

This tool (TRL4) is jointly supported by the map functionalities, which include a social map for the members of the public to participate in a specific incident and by the user registration tool. It allows bystanders to join the social space of an incident nearby and communicate with each other, as well as provide information to other bystanders, as well as responders. The information uploaded by bystanders will be propagated to the incident management tool and will be categorized and displayed to become visible that it comes from the public. The tool allows display of the information, viewing the geo--location where the information was sent from, as well as viewing bystander credentials in case any inclusion in the team is considered. This tool was not tested during the pilots, however, it will be deployed for first validation at a Citizen's resilience exercise 25.11.2017 in Twente.

8 Twitter DSS

Automatic Twitter Early Disaster Recognition: A specialized DSS that draws tweets from a specific area and determines if an incident is currently in progress before it has been reported to the local authorities.

9 Field application

The field app (testing in the Lab--TRL4) allows Field Commander or other authorized users (requires login) to monitor the patients and their condition in real-time on the field. The list containing the patients is continuously updated with new patients or/and updated information regarding already registered victims (new vital signs, new triage status, new coordinates, etc.). Vital signs variations beyond the threshold values of the corresponding triage status configuration trigger system notifications. Patients are sorted by their triage status. The application also provides access to the main COncORDE platform where more information is available regarding the incident (map showing patient's location etc.)

COncORDE addresses the following type of hazards: fire, hurricane, chemical spill, earthquake, and pandemic.

4 First responders' needs concerning their training and the software technologies they use in their work

A questionnaire (see Annex 1) has been developed and applied among first responders that are participating in the RESISTANT consortium. The scope of the questionnaire was to adjust the training requirements of first responders to the services provided by the COncORDe platform. Collecting the answers of the First Responders helps to optimize and cover the gaps in preparedness, timing, and speed of acting that utilization of the COncORDe platform may overcome during the field operations and could be demonstrated during field exercises.

We present below the analysis of responses received.

1) **The training of First Responders must take part in the phase of:**
   - **Preparedness** (plans or preparations made to save lives and to help response and rescue operations)
   - **Response phase** (actions are taken to save lives and prevent further property damage in an emergency. Response is putting your preparedness plans into action).

2) **Proposals on how to overcome challenges related to victim localization, situation awareness, and risk assessment:**
   - Continuous training and exercises of the team members
   - Standardized data collection for risk assessment/model and multi-agency incidents. The development of standardized operational procedures and joint training could overcome these challenges
   - Conducting field exercises not only between the members of the same team but also in collaboration with different involved groups is the ideal solution so that the first responders to be ready
   - Division of specialties among the team
   - There is a need for a set of commonly accepted and understood ground rules related to risk assessment. The key is to have executives who manage, support, and follow established ground rules for conducting the risk assessment.
   - Monitoring of safety protocols
   - Not waste any valuable time in coordinating.
   - Good physical condition for inaccessible areas
   - Proper equipment and familiarity with its use.
   - Awareness of the population, it is needed from elementary schools up to the universities (e.g. Rising the awareness to the population through the media, or with the delivery of materials, such flyers and another similar type of reports, will give directions to the population how to react and protect themselves in case of natural and other types of disasters)
   - training is needed in the working organizations (public and private)
   - *For North Macedonia:* Establishment of an operational center within the Protection and Rescue Directorate (in this case, according to the standard operating procedure, the situation on the ground will be clear, the required information will be processed faster, and decisions or recommendations will be provided accordingly)

3. Limitations of detection, monitoring, and reporting devices:
   - The night is a problem for forest fires, clouds/extreme weather is a problem for satellite sensors
   - Macedonian Forest Fire Information System (MKFFIS) for monitoring of forest areas and detection of forest fires has limitations in monitoring and detection because it uses satellite data and does not have ground devices for monitoring and detection.

4. Challenges of compatibility of communication systems and structures about information sharing

- In Greece, communication between stakeholder groups is achieved through a contact person in the operation center. This is due to the inability to communicate at the same frequency with the stakeholders from different groups (due to frequencies that each involved party has the right to use).
- In North Macedonia, the Protection and Rescue Directorate, as one of the leading institutions in this area, tried to establish an operational center. That operational center was supposed to connect all institutions to the directorate with one telephone number. Today, although there is no operational center, in some way the operations and logistics sector functions in that scope of work.
- During Natural disasters (ND) like earthquakes, hurricanes, and tsunamis, traditional means of communications such as fixed or wireless phones might be damaged. Thus, each country must prepare alternatives for such situations so that Disaster Management (DM) organizations can respond quickly and efficiently. Thus**,** DM teams must be skilled and provided with the latest CSs to assess losses and damages and coordinate their operations in the affected areas. Each stage of DM (preparedness, response, mitigation, and restoration) requires technological solutions. During DM actions, information and instructions may be transferred through a long series of organizations, before arriving at the right destination. As an example, pictures, real-time video, and other pertinent inputs related to the damaged areas are sent from rescuers to their management offices and other remote command centers. Similarly, relevant data and instructions are sent from headquarters to command centers and then to rescuers. Effective DM necessitates robust CS to provide a continuous exchange of information between rescuers and remote command centers. Any failure or disconnection of this can generate disorder of disaster response operations.

5. Limitations of detection, monitoring, and reporting devices under various environmental conditions:

Disruption to critical infrastructure (mostly electricity and internet)

6. Helpfulness of smart devices and real-time information sharing systems for the maneuverability of a team of first responders:

4 answers: Very much;

1 answer: Moderate

7a. The best way to locate and allocate resources

- A basic Resource Utilization Schedule is necessary for first responders to guide what they can make changes if required and taking into account other factors such as resources that maybe there are over-allocated or under-allocated.
- The software technologies are an important part not only in the training processes but also in the logistics management of the resource at the national and local/regional level.

7b. Opinions regarding how software technologies would optimize the training process for first responders:

- For gathering and presenting information
- For virtual reality training
- For scenario-based training

8. Situation awareness technologies currently used in operations:

- Drones
- GPS tracking device
- Sensors
- Cameras
- Edge computing to manage, analyze, and activate the data generated by IoT devices.
- GIS mapping
- satellite,
- in-situ/national visualized in ArcGIS/NICS- Next-Generation Incident Command System
- Small data
- Situational Awareness Platforms
- Publicly shared information such as social and other electronic media, information from the National Hydrometeorological Institute, and other information from the institutions.

9. Training platforms currently used:

Most partners don't have/use a training platform. Some technologies mentioned by participants are external platforms Microsoft teams and Zoom, ArcGIS, ESA SNAP, an internal network for the 300+ Fire Stations used for distance learning.

10. Communication technologies already used:

- VHF / UHF radios to communicate with the operational center in Greece
- INTERNET through 4G (Social Media platforms for communication between team members when it's possible -private chat rooms)
- GSM, TETRA, HF
- Next-Generation Incident Command System (NICS) tool as well as other modern tools that produce videos and images to report from the field. If manual radios are used, the person in charge of that part prepares an internal protocol with the code name and number of the radio, separately for everyone who will be in the field. Internet coverage is not the same throughout the country and that is why most of the time the information from the field is provided by phone.

Annex I: Questionnaire for First Responders on COncORDe Platform Training

1. **In which stage of response the training is most needed?**

2. **Please describe the challenges you are facing with victim localization, situation awareness, and risk assessment and how you ideally wish to overcome these challenges.**

3. **What are the limitations of detection, monitoring, and reporting devices you have already in force under various environmental conditions?**

4. **Please describe the challenges of compatibility of communication systems and structures concerning information sharing?**

5. **What are the limitations of detection, monitoring, and reporting devices under various environmental conditions?**

6. **From 0 to 3, how do smart devices, real-time information sharing systems are helpful for the maneuverability of your team?**

   0 Not at all

   1 Somehow

   2 Moderate

   3 Very much

7. **What is the best way to locate and allocate resources? Do you believe that the involvement of software technologies would optimize the training process?**

8. **What situation awareness technologies you are currently using in operations?**

9. **What type of training platform you use in your organization if there is any?**

10. **Please list the communication technologies that you are already use and state the communication protocols.**