COPE – COMMON OPERATIONAL PICTURE EXPLOITATION

SEVENTH FRAMEWORK PROGRAMME

GRANT AGREEMENT No 217854

Collaborative project

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Evaluation Methodology

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Summary

<u>This deliverable specifies the methodology to be applied to the evaluation and assessment of the results of the main COPE trials to be performed in May and in September 2010.</u>

The theoretical approach and the complexity of the trial environment are discussed and the rational for the selected evaluation methodology is given.

The core elements of the trial setup are described in chapter 4 with reference to the detailed COPE source documents. The logic and structure of the evaluation methodology is described in chapter 5 and the detailed evaluation matrices are contained in Annex1. The methodology is based on the principle of evaluating the COPE system from four different points of view:

- The command and Control,
- The technology,
- The first responders and
- The research view

Furthermore, important feedback and assessments are expected from external stakeholders participating in the final trial. They are expected to address the chances and possibilities of exploiting the COPE technologies to real applications far beyond what could be demonstrated in the COPE trials.

A critical discussion of the chosen methodology, of its strengths and possible pitfalls contains chapter 6.

Contents

Definitions

Remark:
Definitions described should be a common reference for all COPE activities concerning the evaluation of cope outcomes and the underlying processes.
Definitions as described here are valid for the COPE project and may deviate from general lexical definitions.
Definitions are not ordered alphabetically but grouped according to context.

Experiment:
An operation or procedure carried out under controlled conditions in order to discover an unknown effect or law, to test or establish a hypothesis, or to illustrate a known law

Use Case:
A set of circumstances or conditions appropriate to demonstrate usability
Trial:
The action or process of trying or putting to the proof
Demonstration:
An act, process, or means of showing the merits of a product or.....
Exercise:
The act of bringing into play or realizing in action... performed or practiced in order to develop, improve, or display a specific capability or skill
Scenario:
A sequence of events especially when imagined; *especially*: an account or synopsis of a possible course of action or events to which persons, organizations, technologies and procedures will be exposed to in the exercise(s)
Vignettes:
Selected sub-parts (in time and/or contents) of a scenario which can serve the purpose of selected investigation. Vignettes should be a realistic self-contained smaller sub-scenario of the total scenario
Testing:
A critical examination, observation, or evaluation, of technologies, procedures, human interactions
Verification:
To establish the truth, accuracy according to specifications
Validation:
To recognize, establish, or illustrate the worthiness compared to reality
Evaluation:
To determine the significance, worth, or condition of data/information by careful appraisal and study
Assessment:
To determine the rate or amount of; to determine the importance, size, or value of....
COP:
The definition of COP according to D2.1:
Common Operational Picture (COP) is the description in time of the emergency situation that supports the emergency responders within and between different agencies to act appropriately.

COP is described as the pool of information

- that is registered and stored in a database
- concerning past, present and expected future events
- that is available for presentation in a user interface
- that is suitable for emergency responder work
- the form of presentation of which is consistent and unambiguous, but not necessarily similar to all stakeholders
- the content of which is structured around operational processes of the emergency responders
- that needs to be interpreted and acted upon by the emergency responders
- that is meaningful in the context of emergency responder work

1 Introduction

As can be seen from the definition of terms usually used in complex evaluation activities, terms describing the process or subtasks of the process can be used. They can be defined, however their interpretation allows for significant overlap and synonymous use of term. The evaluation methodology described in this report will use most of these terms also in some overlapping manner, but will at least not use terms in a way which is conflicting or contradicting to the definitions above.

COPE produces a highly complex system of technological components and procedural support with a varying degree of integration. The operational evaluation of the COPE products will have to address the performance of the system from very different stakeholders' points of View: A few examples:

- An end-user/first responder will need technology directly supporting his tasks and not detracting him from his duties
- A commander will need well filtered and displayed information for effective planning and fast and qualified decision support
- A technology manufacturer will want to see his technology work and find good arguments for marketing his products
- A researcher wants to work on tasks or problems not solved today and prove the practicability of his ideas and approaches

The evaluation also will have to take into account the context in which the information and technology will be used and in which phases of the whole process it shows its performance. The necessary process-oriented approach as outlined in chapter3.3 will have to be refined and reflected in the evaluation methodology as soon as the scenario (D6.2) and the setup of the experiments (D6.3; D6.4) will be finally defined. The evaluation methodology of COPE will address these different views and combine the results of the assessment of various aspects and components into higher aggregated results and recommendations. The evaluation, thus, will be more than simply evaluating a number of technologies alone. It will evaluate the effects of a "system of systems" consisting of different innovations in IT components, communications and procedures, as seen from different perspectives of expectation and use.

The COPE exercises have been planned as a series of events with increasing complexity, in 3 phases as illustrated in fig.1:

Phase 1:

- Testing of selected individual components in the trial environment
- Familiarization of staff with technologies and procedures
- Gather experience for the larger scale trials, including for
  - The planning process
  - The evaluation methodology
  - The acceptance of COPE technologies
  - The adequacy of the technologies for the overall COPE task
- To test smaller scale scenario "vignettes"

Phase 2:

- To pre-evaluate technology development and integration status
- To gain experience for the final trial in terms of
  - Resources required

  - Organizational matters
  - Failures and pitfalls to be avoided
- Removal of failure sources, bugs, deficiencies
- Streamlining for the final trial
- To test the adequacy of the trial setup and trial support tools
- To test the adequacy of the evaluation methods
- To test the adequacy of the complex scenario

Phase 3:

- To give final demonstration of the COPE system
- To include external stakeholders from industry, the public sector, and from the research community
- To prepare final evaluation of the complete system
- To acquire feedback from stakeholders

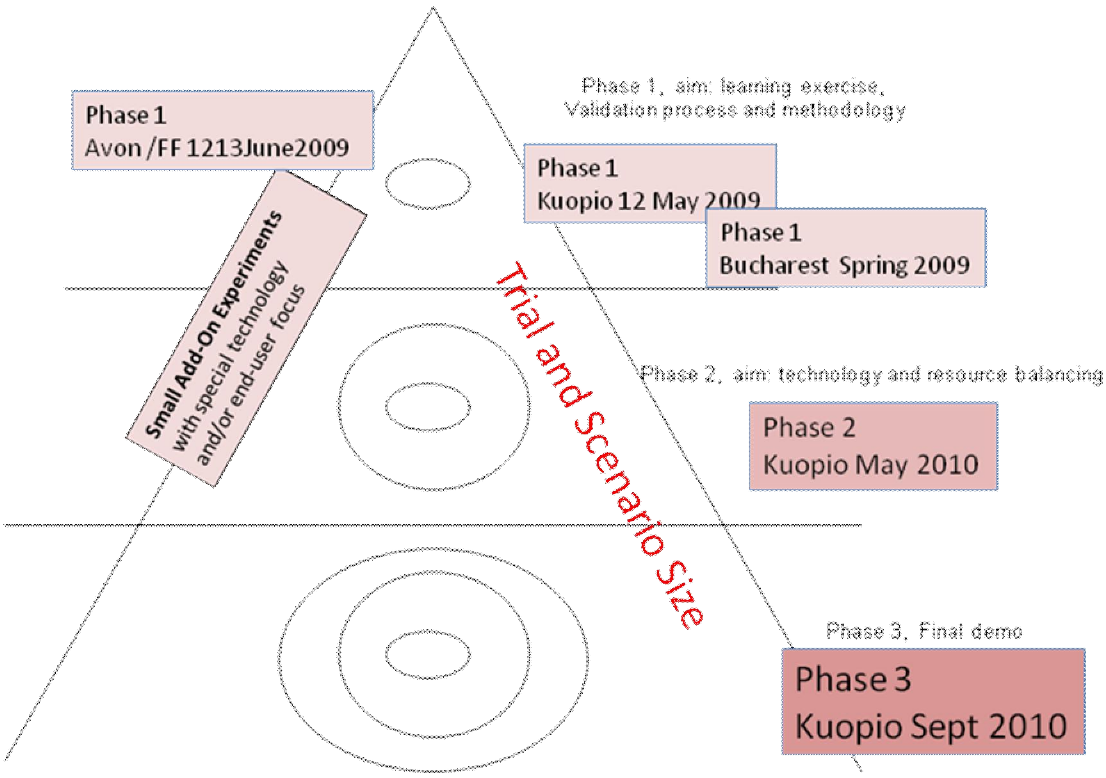

Figure 1: Phases of COPE Experiments

Experiments of this type are usually carried out in a simulated environment. Particularly in the area of security, real scenarios are neither desirable nor practicable. Beside practical feasibility, the degree of reality, of granularity and detail of the scenario and the experiments are mainly driven by the available resources. COPE has chosen a mixture of real exercise terrain, infrastructure and equipment, where the COPE system will be integrated, and experienced disaster management personnel. Several functions will have to be simulated in a generic way, either by software or personnel.

At the time of delivery of this document, several details o the technologies to be finally used, on the layout of the scenario, and on the setup of the trials are not finally fixed yet. They to some extent depend on work and decisions to be made in the coming months before the main trials in May and in December 2010. Therefore, the assessment method so far developed describes the basic approach, methodology and the detailed assessment criteria to the extent possible by mid Jan. 2010. It will undergo further refinement and adaptation as the technology integration proceeds. The basic structure and logic of the methodology, however, will not change.

2 Goal of the Evaluation Methodology

2.1 The Overall Goal of COPE

The overall and agreed goal of the COPE project is:

“to achieve a significant improvement in command and control performance, reliability and cost by the integration of COTS solutions and novel technologies to achieve a step change in information flow in both from and to the first responder in order to increase situational awareness across agencies and at all levels of the command chain. A usage-driven approach will be taken to develop new technologies for supporting user information requirements at the scene of the event.”

2.2 The Goal of the Evaluation

The COPE system and its technologies will be evaluated in different contexts:

- Against the end-user requirements as developed in WP3
- Against the system requirements as set forth in the COPE project
- Against performance criteria relevant in the scenario(s) developed for the trials
- From the first responders point of view participating in the Trials

The results will be evaluated by the team and by end- users in the context of realistic simulated scenarios. Conclusions will be drawn from the assessment results addressing the potential of the COPE technologies, recommended future improvements and future utilisation of the system and its components
COPE technologies will be demonstrated to interested stakeholders with the objective to convince stakeholders that COPE technologies have a benefit for them as demonstrated in successfully executed COPE use cases. The stakeholders should be involved as active players in the overall scenario or as qualified observers, and will also be invited to contribute their views to the overall evaluation.

2.3 The Characteristics of the Methodology

The methodology described here and to be used in the COPE evaluations condenses a highly complex set of requirements to a methodology which is

- Transparent
- Easy to handle
- Easy to understand
- Consistent throughout different phases of trials

It will, however, be fully exploited only in the 2 trials of trials phases 2 and 3 (see figure 1).

3 Description/ Approach

3.1 Evaluation in the Project Context

WP6 contains the tasks where almost all information generated in previous work packages will be integrated in final evaluation rounds:

- The requirement will be transferred into measures of effectiveness or performance indicators
- The concept of operations will be reflected in the layout of the scenarios and the operational rules of the trials
- The human factors analysis (WP2) will substantially contribute to the evaluation from the end-user's point of view and will develop an appropriate evaluation scheme, and
- The technologies integrated into the operational and technical environment of the trial site and the scenario will be subjected to operation in realistic environments.

Figure 2 illustrates how the individual WPs feed into the trials and evaluation tasks of WP6.

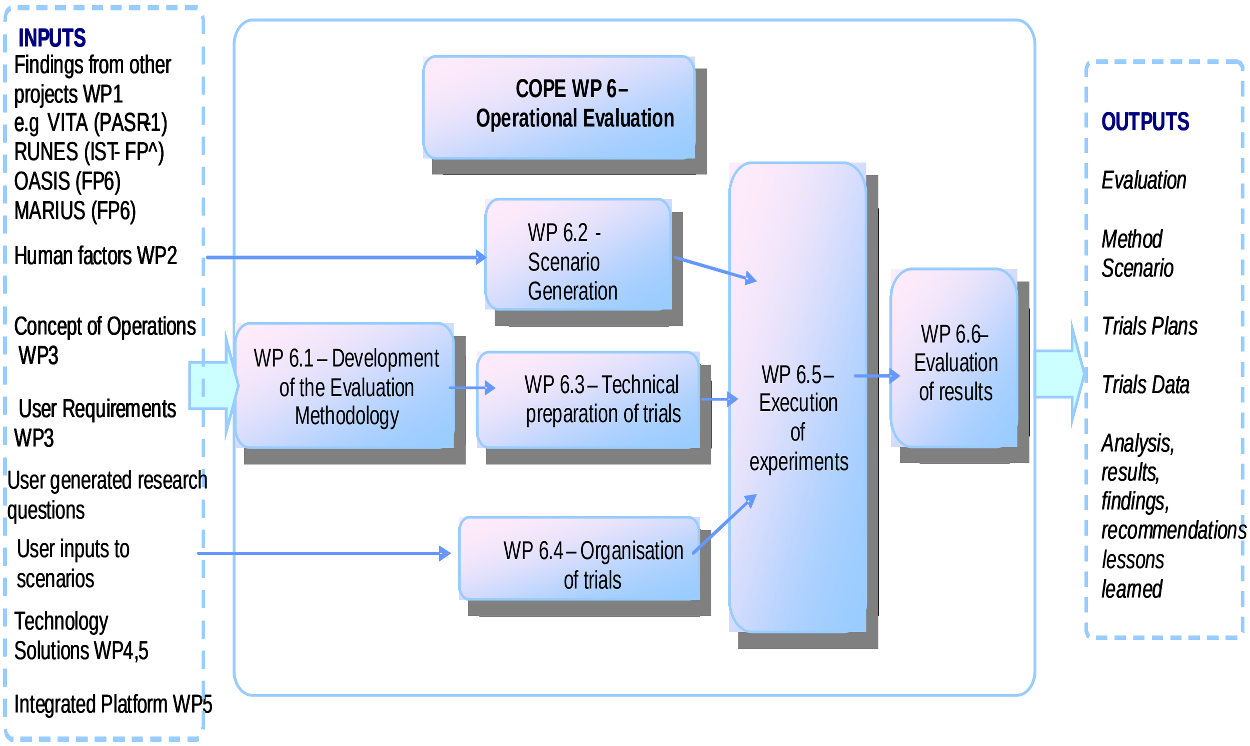

Figure 2: WP6 in the Context of the COPE Project

3.2 The Framework

A typical trial setup includes the establishment of an evaluation framework which allows demonstration and evaluation in a systematic way. The setup will consist mainly of the following elements which will cooperate in the simulated scenario or as subset of the scenario over the time span of the scenario. Whereas exercises of higher abstraction may be run accelerated in quick motion, all except one COPE-trials will run in real-time in the realistic organisation and infrastructure of the Finnish Emergency Service College ESC (PELASTUSOPISTO) in Kuopio. One sensor experiment will be performed in March 2010 in Bucharest. The main components working together in the setup include

- Scenario
- Trial scheduling options
- Performance and functions of the technologies
- Simulations by people (usually called the White Cells), e.g. representing organizations not available on site like media or a higher level command
- Simulation by simulators (usually software), e.g. representing equipment or processes not on site
- Roles and tasks of participants
- Staff for directing, coordination & control of the trial (DiStaff)
- Staff for controlling and maintaining the functioning of the technologies
- Staff for monitoring and facilitating the evaluation process
- Interfaces (to data logging, repositories, communication of players)
- Supporting and accompanying functions (e.g. infrastructure, help service)

The roles and tasks of trial participants will be described in detail in D6.3 and .4.
A typical setup of functions as represented in realistic disaster management exercises is given in fig 3. A more detailed description of the trial layout will be given in D6.2 (Scenario), D6.3 (Trials Plan), and D6.4 (Trial Organisation).

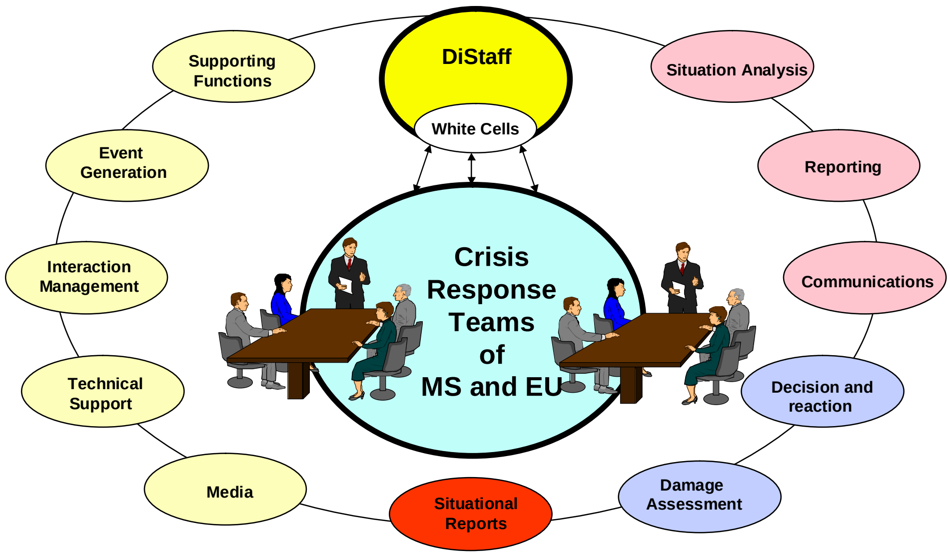

Figure 3: A Typical Exercise Setup

3.3 The General Approach and Characteristics of the Methodology

The methodology is based upon three main elements:

- The definition of the objects to be evaluated, mainly technical components and processes

- The identification of Measures of Effectiveness (MoE) and Key Performance Indicators (KPI) for these elements
- The identification of data sources by which the MoEs/KPIs can be quantified or somehow measured. These sources generally are
    - Data repositories & logs.
    - Data communications traffic/messages; mail records
    - Audio records
    - Video records
    - Results from briefings and structured questionnaires

Above these assessment metrics, a method will be provided to combine the detailed results into aggregated evaluation figures and recommendations.

The figure 4 sows a typical breakdown of emergency management functions to a level where detailed MoEs can be defined. In the scheme of weighted factors, the evaluation can be aggregated into combined assessment values for the evaluation of the fulfilment of higher level goals.

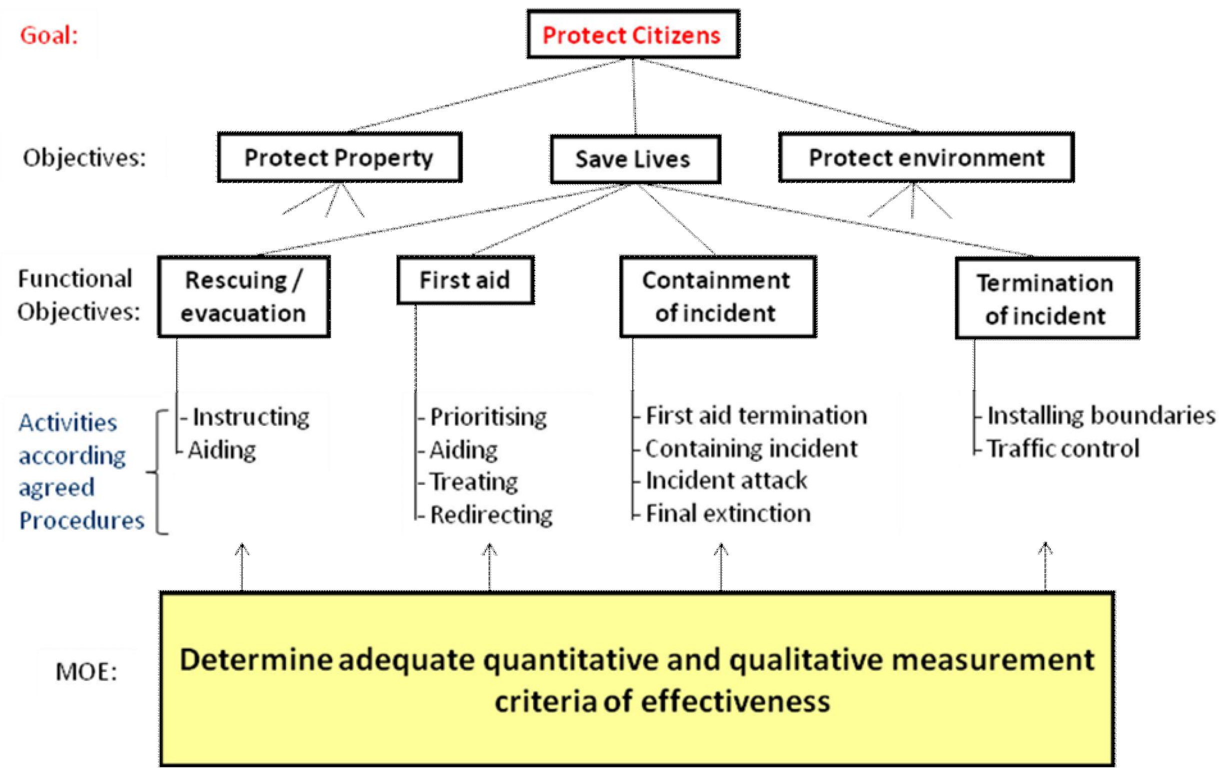

Figure 4: The Basic Evaluation Logic based on Functional Tasks

This kind of functional task model will be refined and described in detail when the scenario activities of Task 4.4 and of task 6.2 will be completed and the setup of the trials will be specified in detail (Tasks 6.3 and 6.4).

3.4 The Main Steps to the Final Trials

The evaluation process of the rather complex COPE system and its components in a rather complex operational scenario and environment has to be clearly structured in working steps which will build upon each other:

- Step 1: Formulate the typical key questions to be answered (from the D3.2 requirements document)
- Step 2: Set up experiments which have the potential to answer these questions
- Step 3: Verify with end-users and other stakeholders the setup and the scenario
- Step 4: Perform adequate trials and experimentation
- Step 5: Collect and evaluate adequate experimentation data
- Step 6: Collect feedback from participants
- Step 7: Perform final assessment and aggregate results
- Step 8: Draw Conclusion and formulate recommendations to stakeholders

An exercise of this complexity should allow for experimenting over several days or even weeks. But if we want to engage external stakeholders, which is strongly recommended, they usually are not willing to spend more than 2 days at such an event. Also, the required infrastructure and personnel of the trial site will only be available for a short period of time due to organizational and cost limits.

Furthermore, when it comes to demonstrate reality, certain events like life fires or spreading of a toxic cloud (which will be included in our scenario) will be feasible only for a limited and shorter-than-real time span and their number, size and intensity (e.g. concentration) will be reduced compared to reality. This, in addition to the formal evaluation methodology presented in this report, will require additional scaling and interpretation of the results.

Some functions and organizations like police or upper command are not available at the trial site. They will have to be simulated by role players and partially by software.

These artificialities and limitations have to be taken into account in the evaluation process.

A critical assessment of the evaluation methodology itself is given in chapter 6.

4 The Overall Methodology and its Elements

4.1 The Main Elements of the Methodology

The main components to be integrated in the final Trial (Phase 2 and 3) will include

- The trials demonstration organisation setup (operational Concept, main trial layout and functionalities, organizational provisions – described in D6.4)
- The participants / “players” and their roles (also described in D 6.4)
- The scenarios (described in detail in D6.2)
- The technologies setup and integration at the trial site (described in D6.3)
- The measurements (data logs, processes, tasks performed, event logs, recordings, debriefings, questionnaires, interviews)
- The evaluation and assessment process and tools (application of Measures of effectiveness (MoEs) and aggregation of assessment results)

4.2 The Setup Site and its Facilities

The Emergency Services College (ESC) situated in Kuopio, Finland, provides education and training under the supervision of the Ministry of the Interior. The College provides basic vocational training and further training in rescue services including emergency response centre dispatchers. In addition, the College provides courses and consultancy in

- Emergency preparedness for authorities and persons responsible for civil defence
- Civilian crisis management missions
- International humanitarian operations together with UN, EU and NATO PFP
- Special emergency tasks tailored for different organisations both nationally and internationally

Research

The College has a long experience of different national and international R&D projects (Currently 5 EU-level projects). Its expertise areas are ICT within emergency services, CBRNE and dealing with cross-border emergencies. The ESC R&D Unit is in charge of the coordination of all the research activities within the Rescue Services in Finland. The Unit has 15 employees and in addition there are 10-15 persons taking part in various research projects annually.

Facilities

The simulating and testing environment at the College includes following main building blocks:

- TETRA radio network both real and simulated (TETRASim)
- Emergency Response Centre simulator (10 dispatcher work stations with full functional CAD)
- Incident Command Simulator
- Three Computer Classrooms, Language studio, Laboratory etc.
- Paramedic simulators
- Training Ground (30+ hectares) with various training fields and testing facilities including
  - various emergency surroundings
  - hazmat field,
  - meteorological station,
  - Sensor network with open platform for environmental monitoring
  - WLAN/ZigBee wireless network
- Fire trucks, command cars, ambulances & other vehicles (70 units)

The emergency service college area is shown in fig. 5.

Figure 5: The Trial Site

It has been offered by ESC management and selected by the COPE team as the most adequate facility for the execution of the project's major trials. Its basic characteristics and how it will be used for the COPE trials will be described in D6.3 and .4., including:

- The regular purpose and characteristics
- Staff site size and qualifications
- Infrastructure
- Rules and regulations of impact to the trials
- Provisions for COPE
- Prerequisites for use

The main elements used in the COPE trials

- Planning and organizing capability
- First responder personnel and organization
- Command and control structure and means: Hardware, software
- Training, exercising, recording, evaluation capabilities
- Infrastructure (Terrain, buildings, vehicles etc.)
- Equipment and supplies

Special prerequisites which will have to be regarded:

- Language/ Translations
- Functions to be simulated
- Integration/ interfacing of the COPE system and technologies
- Interference with the regular training programs

4.3 The Scenarios

Figure 6 shows the principle scenario layout agreed upon by the COPE team already in June 2009.

The findings of COPE will be demonstrated and evaluated in Phase 2 and 3 against the background of a challenging scenario and a scenario- based test environment appropriate for demonstration and evaluation of solutions for first responder capabilities. The scenario will have to provide a sufficiently comprehensive environment for rescue operations. The resolution should be high enough to respond to the investigated systems and the scenario should allow “zooming”: i.e. to investigate special sensitivities in greater detail, if required. To meet these requirements, a high intensity large scale scenario was developed by CESS on the basis of major European disasters, in particular the Enschede disaster in May 2000 and the Toulouse disaster in September 2001.The scenario consists of a major disaster event with a subsequent modular set of individually described follow-on events (“Vignettes”).

The major event happens in D-City located in Westland, close to the border between Westland and Eastland and close to the neighbouring G-City located in Eastland. [1] The major scenario event and catalyst for the follow-on events (“Vignettes”) is the explosion of a Chemical Factory (Fireworks Factory, “FF”), located in D-City, as a result of a night-time terrorist attack. Several containers with fireworks explode and set the whole factory on fire (see ”Sector 3” of the principle scenario layout, shown in Figure 6, agreed upon by the COPE team already in June 2009.), 52 of the 59 workers of the FF of the early shift were deadly wounded as a result of the incident, seven suffered from severe injuries. Follow-on effects occurred in the vicinity of the FF:

[1] The Scenario will foresee cooperation between the neighbouring countries Westland and Eastland upon request, if the resources of Westland to manage the disaster and to provide sufficient fire fighting, ambulance and medical treatment capability,are not sufficient. Past incidents such as the Enschede disaster showed that cooperative efforts were often bureaucratically overruled or were lacking appropriate rules for fast and pragmatic ways of support and intergovernmental agreements. As a consequence countries and their neighbours which suffered from major incidents improved their regulations and transferred them into bilateral agreements on disaster management and support. In January 2006, the EU Commission proposed to reinforce the existing European Civil Protection Mechanism on the basis of past experience and to provide a suitable legal basis for future action in this area.

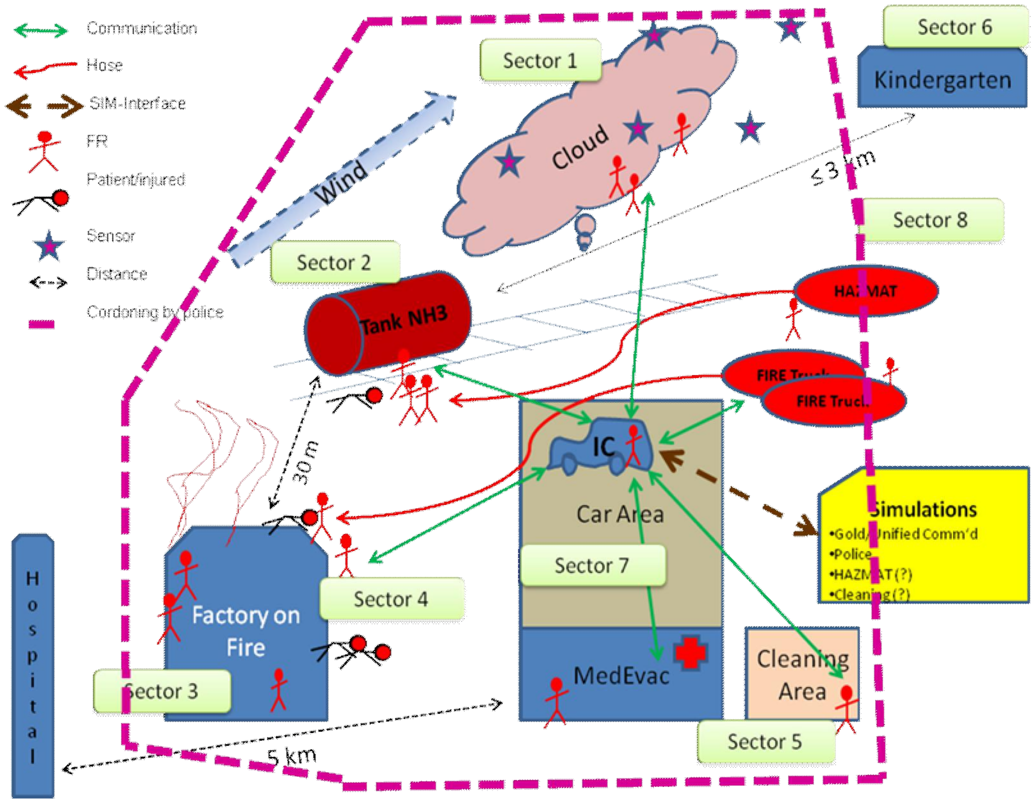

Figure 6: The rough Scenario Outline

(1) By the force of the explosion of the Firework-containers, bricks and debris of all size were catapulted in a circle around the FF, hit people on the roads, destroyed cars, smashed the windows of the buildings around, spilled the circumjacent roads and made them impassable even for fire-fighting vehicles. 36 casualties were distributed along the roads around the FF, 6 of them dead, 30 with injuries of all degrees of severity. The immediate recovery of the injured people as well as intensive fire fighting was challenging, because of the impassable roads. Heavy equipment to clear the roads will have to be employed.

(2) The intensity of the explosions and the initial fire immediately ignited the neighbouring buildings, in particular the buildings of a brewery and the associated ammonia tank ("Sector 2") of its cooling system. From the 52 Brewery workers only 14 suffered from severe injuries, the others remained uninjured. When the Ammonia tower exploded, a poisonous cloud was set free ("Sector 1") and threatened a Kindergarten ("Sector 6") close by.

(3) The pressure wave of the explosions and subsequent glowing fragments hit the south-west edge of the housing area and destroyed and ignited several houses. Many people left their houses and were killed or severely injured by fragments. 5 people died, 19 suffered from severe injuries.

(4) When the ammonia cloud hit the housing area, people left their houses in panic and rushed on the road, heading towards north or east. Some used cars, all struggling to leave the area quickest possible. Immediately the road was blocked in both directions by left accident cars, waiting traffic and panicking people. Seven people were injured, one person was killed. The evacuation of the Kindergarten was interfered!

A fire fighting infrastructure of eight fire fighting posts of different types was distributed over the area of D-City, the region and the neighbouring villages of Westland. The fire fighting capability of Eastland close to the border comprised two posts to be available upon pre-regulated interagency request, if resources in Westland were not sufficient. The medical infrastructure relevant for the disaster comprises 6 hospitals in D-City/ Westland and additional medical facilities in Eastland, available upon request. It was also assumed that six ambulance units were located at the same locations as the hospitals.

To execute the scenario, a Command Structure was assumed: The key persons are the Incident Commander (IC), the Sector Commanders (SC) and the First Responders (FR). IC will be responsible to conduct the rescue operations, the recovery of injured persons, to fight the fire and to clear the situation. He will be supported by SC and FR. The Incident Commander disposes police actions such as barricading the disaster area, blocking and clearing of road traffic, installing preferred access routes, preventive evacuation measures, managing the disaster tourism etc. He also will request ambulance and medical support.
The IC will also request and obtain additional resources from the “Unified Command”, a body of representatives, respectively expert knowledge of Fire Brigade, Police, Ambulance and Medical Service Command as well as of Public Authorities.
The Scenario is described in detail in D6.2
It is obvious that a scenario of such dimensions cannot fully be represented in a life demonstration. Accompanying simulation is required for a full scale representation of the events.

Compared to the capacities of the site, the scenario covers a much larger scope of number of injuries participating staff, geographical area etc., which means that only a fraction of the scenarios can be represented by real staff personnel, the remainder has to be simulated. Type ant tools of simulations still have to be decided.

Table 1 gives an indication of the size of the directly involved staff:

Unit	Min Number	Max Number	**Remarks**
IC/ CS (Incident Commander / Command Support)	1 IC 2 Support	1 2	
2 x FF-Units (1+2 & 1+4) = 4 units	4 Drivers 12 FFs	4 12	
HAZMAT	3	5	
Cleaning	2	3	
Head of KMS (?)	1	1	
Sensors Operation	2	3	
EMS / Tank (Emergency Medical System)	4	6	3 Patients walk 2 Patients to carry
EMS / Factory	8	10	4 Patients walk 4 Patients to carry
Total	28	47	

Table 1: Expected Staff Involved in the Scenario

Figure 7 describes how the synthetic scenario will be transferred into the environment of the real site in Kuopio (from D6.2).

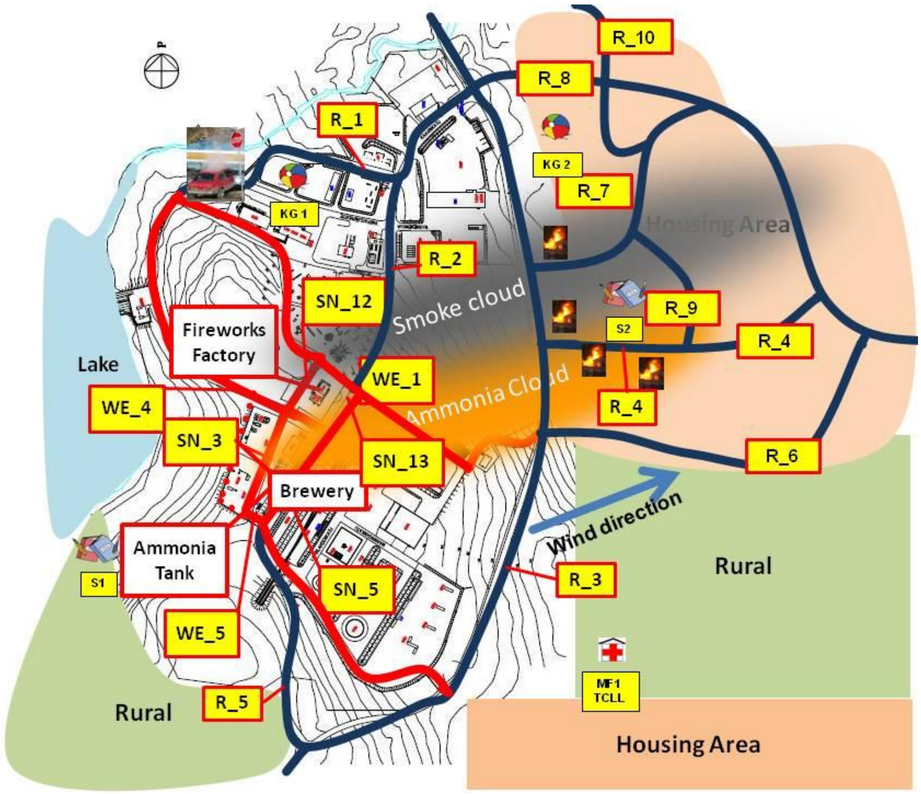

Figure 7: Transformation of the Scenario to the Real Site

The figure displays the topography and facilities of the Kuopio Site. The allocation of the major facilities of the synthetic scenario such as the Fireworks Factory and the Brewery with its associated Ammonia Tank is a matter of "renaming" of available facilities at the site, which easily can fulfil the appropriate functions of the scenario elements. The road network of the industrial area and its access roads has been easily transformed into the reality of the Kuopio site, using the available road network. The two housing areas of the scenario, located south and north east of the industrial area, separated by a rural area, are plotted in the map, but they are notional areas only, as is the according road network. The vignettes (3) and (4) described above are therefore a matter of virtual simulations. The lake, west of the industrial area is real, providing fishing grounds and notional recreation facilities for the Citizens of D-City! The figure shows a slope from the industrial area down to the lake indicating that the countryside will drain to the lake. Real operating as well as simulated rescue forces will therefore have to take care of all polluted and/or poisonous water.

Two notional schools (S1 and S2) are located west and east of the industrial area. Two notional Kindergartens – Kg1 and Kg 2 – are located north-west and north-east of the Fireworks Factory close to the roads R-1 respectively R3. The notional Hospital MF_1 is mapped south- east of the Brewery at the edge of the notional rural and the housing area.[2]

[2] The rational of carrying different notional facilities such as kindergartens, schools or the hospital, though not all of them have functions in the Scenario Vignettes is related to the fact that the wind direction will be measured in reality in the course of the trials. The measured values will overwrite the presetting of the wind

To allow for a combined life and virtual simulations, the coordinates of all – life and notional - facilities and roads, relevant for the scenario and allocated or assumed to be located on the site are registered.

4.4 The COPE Trial System Architecture

In a human factor and user oriented technology mapping and identification process, established by WPs 2, 3, 4, solutions, components and technologies have been identified to support First Responder effectiveness, COPE command and control and the development of a common operational picture (COP). WP 5 has transferred and implemented the respective findings into a subsystems, systems and systems-of-systems approach, including sensors, sensor platforms, integration platforms, base station, C2 application including a COPE decision support system (CDS). All of these subsystems have an internal infrastructure and will (of course) have several internal interfaces.
Figure 8 shows the application of the technology in three areas:

1. First Responder System (FRS)
2. Cope Decision Support (CDS)
3. COPE Command and Control (CC2)

to increase efficiency of Incident Commander (IC), Sector Commander(SC) ,Fire Fighter (FF), and Command Support Officer (CSO).
The First Responder System Hardware (FRS-HW) includes: a wrist mounted display, video sensor (low light, infrared thermal), a helmet mounted display, WI-FI-(Wireless Fidelity) adapter, human wearable PC, a power supply unit (PSU). A ”Sensor Integration Platform-wearable” (SIP-W) integrates GPS for determination of location, an Inertial Measurement Unit (IMU), a gas/toxicity detection sensor.

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direction as given in the formal description, with the consequence that the Ammonia cloud may not hit the school S2. To “save” the appropriate vignette, S2 will be replaced by S 1, Kg_1, Kg_2 or the hospital MF_1 in the course of the trial, in accordance with the actually measured wind direction.

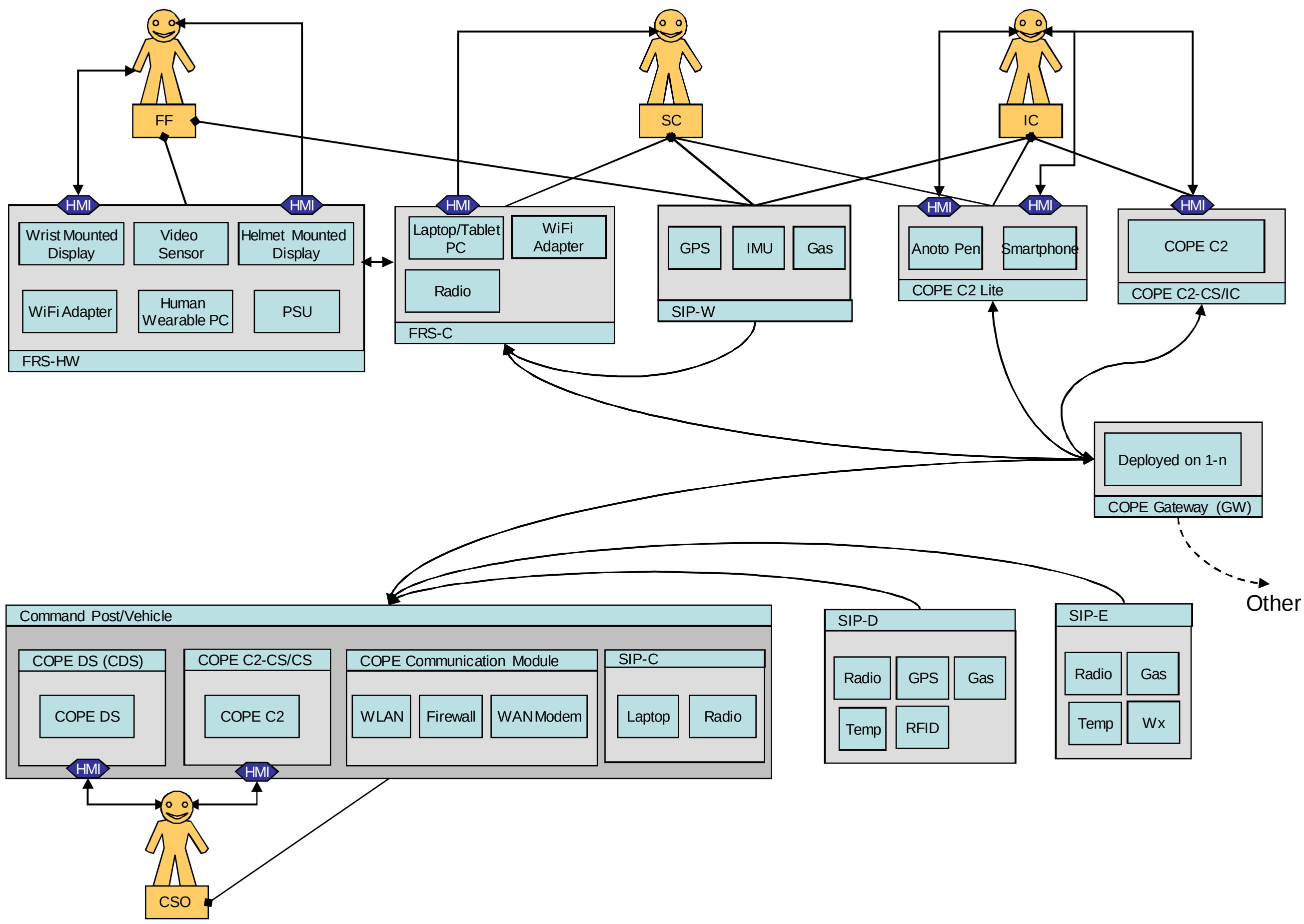

Figure 8: The COPE System Architecture Reference (from D4.3)

Sector Commander (SC) and Incident Commander (IC) are equipped with a ”Sensor Integration Platform – Wearable” (SIP-W) as well. SC is equipped in addition with a First Responder System Control (FRS-C) Package, including a Laptop/Tablet PC, Breathing Apparatus Entry Control Officer (BAECO) Support, Radio and a Wireless Fidelity (WI) adapter. SC and IC are also equipped with a COPE C2 Lite package, comprising Anoto Pen and Smartphone.
IC uses the Command & Control Command Support System (C2 CS/IC). FF, SC and IC use the accordant displays via Human-Machine Interfaces (HMI).

The Command post vehicle hosts the Cope Decision Support (CDS) technology, the Command & Control Command Support/Command Support (C2 CS/CS) modules, the COPE Communication modules, including Wireless Local Area Net-work (WLAN), Wide Area Network (WAN) and IT Security such as Firewalls and the Sensor Integration Platform Command and Control (SIP-C) including Laptop and radio.

Via inter-technology data transfer the deployable sensor integrated platform (SIP-D) and Environmental Sensor Integration package (SIP-E) is connected, providing Radio, GPS, air toxicity, temperature, radio frequency identifier (RFID) information. Through the COPE Gateway (GW), the Command Post Vehicle and the Command Support Officer(CSO) is linked with Command & Control Command Support System (C2 CS/IC), COPE C2 Lite and First Responder System Control (FRS-C).

Detailed descriptions of the technologies and functionalities of the COPE Technical System Architecture will be given in D4.3 and D5.1.7.

4.5 Role(s) of "Players" in the Trials

There will be different categories of persons/ staff involved in the exercise:
Roles will typically be played bay COPE team members and for some tasks also by external Stakeholders.

Role Name	**Typical task**	**To be featured by**
Emergency management staff	Incident command IC Sector command SC Command support CS	Original Kuopio Staff (trainers and trainees)
First responders in the field	Mainly Fire fighters FF	Trainees
Simulated FR-Staff and their commands not represented in the trial and their commands	First responder roles not or not fully staffed; Medical service Ambulance services Police (may also be represented by White Cell personnel. Details in D6.3)	COPE team and/or invited Stakeholders
Simulated high level ("unified" or "Gold level" command) incl. political level, local mayor and representatives of the individual services involved	Play higher level planning and coordination	COPE team and invited Stakeholder
"Operators"	Technical staff to operate COPE system and instruct/train and advise Kuopio personnel	COPE team
Directing Staff	Conducting and supervising of the trials	COPE team
White Cells	Individuals acting in roles not directly portrayed in the exercise (e.g. police, media, political level)	COPE team
Observers	Individuals paying attention to specific areas of interest (e.g. usability; cooperation, specific communication)	Invited Stakeholders and COPE team

Table 2: Main Roles and Tasks in the COPE Trials

Roles and tasks are defined and described in more detail in D6.3 chapter 5.4.
A typical setup contains Fig. 9 (from D6.3):

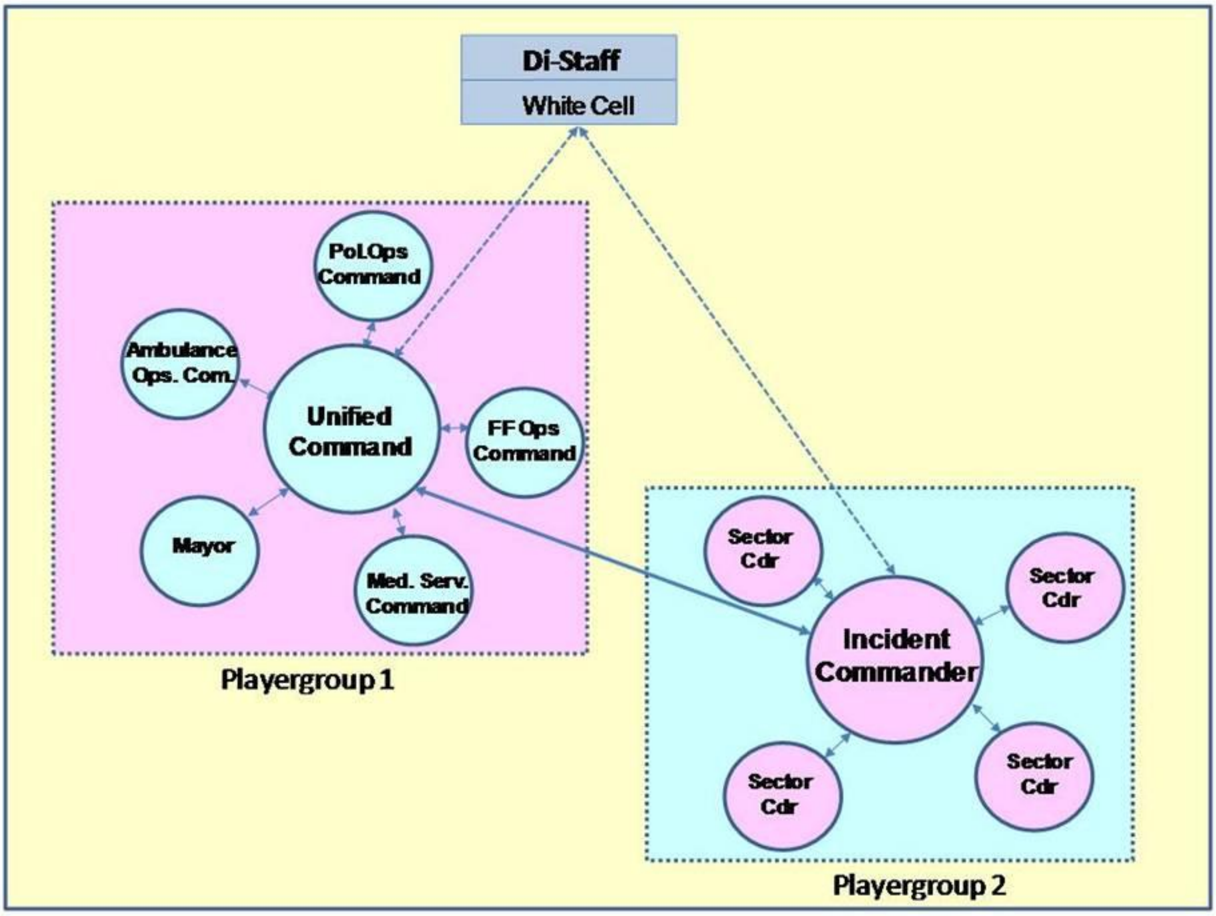

Figure 9: Trial Exercise Player Groups and Actors

5 Possible Evaluation Scheme(s) and Methods

Schemes needed for the COPE evaluation are multi-dimensional. The main ordering categories can be, just to mention a selection:

- Technical performance of components or systems,
- Procurement prices,
- Operating cost
- Political and/ or societal acceptance
- Environmental, human or technical risks involved
- Usability by the end-users
- Improvement of the supported processes (e.g. Command and Control, FR actions)
- Innovation and research challenges
- Improvement of market position
- Satisfaction of stakeholders

When using these criteria, the evaluation results of the same object may widely vary depending on the category of evaluator ("Stakeholder"). In order to level out this risk of bias, for COPE decision was made to use the as ordering principle different stakeholder categories embodying rather different views on the same subject (Fig.10).

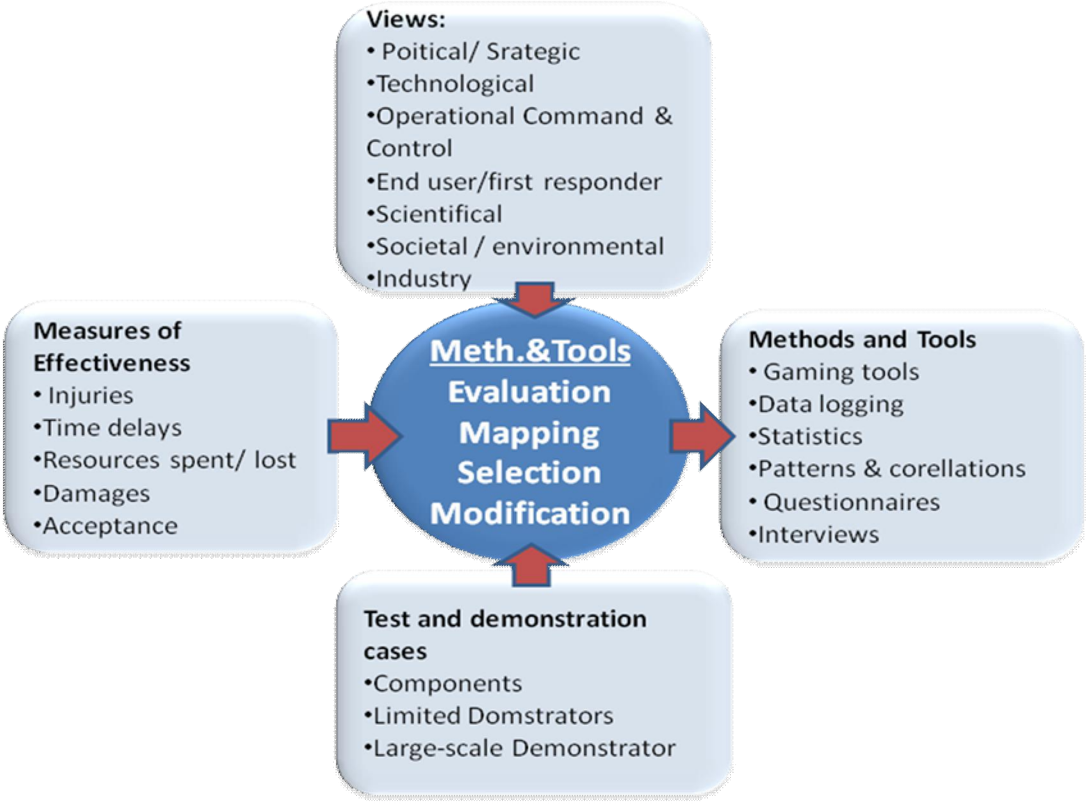

Figure 10: View on the overall Evaluation Problem

The substructure of the COPE evaluation methodology is determined by the different views of the different stakeholders involved in COPE, and stakeholders from outside COPE which have stakes in the generation and the use of a Common Operational Picture and in COP enabling technologies.

For the typical COPE scenario, 7 stakeholder categories have been identified (Table 3):

	Stakeholder Category/View	**Relevance w.r.t. COPE**	
1.	Strategic planners & decision makers in the security domain (public and private)	minor	
2.	Operational /tactical Command and Control (C2) organisations	high	
3.	Providers of echnologies for generation and application of COPs	high	
4.	First responders on site (e.g. firefighters; police; ambulance)	high	
5.	Researchers / scientific community including EU	high	
6.	The EU's as a potential applicant of COPE technologies	medium	
7.	Society and and environentalist view	minor	

Table 3: Differnt Stakeholders' Views

The relevance of the different stakeholders with regard to the scope and objective of the COPE project has been evaluated as to how importent the COPE results are expected to be for their field of activity.
For purposes of COPE and for the sake of limiting the complexity and effort of the evaluation process, the evaluation process will use the categories with the highest relevance in COPE (numbers 2, 3, 4, and 5, marked green). There will also be side results on the categories 1 and 6 from the evaluation of command & control (View2.) and on societal and environmental impacts (category 7) from the environment and personnel risk assessment in the C2 section.. Typical result categories to be addressed when assessing the performance from the different stakeholder perspectives are shown in Table 4.

Addressee	**Typical results will address:**
A) **Command& Control**/ Planning and decision making	▪ Management of resources ▪ Assessment and management of risks ▪ Procedural successes and deficits ▪ Cooperation and coordination ▪ Standardisation & harmonization of processes and supporting technologies
B) **Technology** provider	▪ Technical interoperability of solutions; components ▪ Performance of technical solutions ▪ Failures & deficiencies ▪ Acceptance of solutions by end-users
C) **First Responder** in the field (FR)	▪ Effectiveness of solutions (for the FR) ▪ Usability of solutions ▪ Quality and timeliness of information ▪ False information rates and consequences ▪ Detraction from main tasks by technologies
D) **Research** community	▪ Investigation and application of advanced theories and methodologies ▪ Improvement of key technologies ▪ Advances in human factors research theory ▪ Improvement and verification of standards, e.g. the ontology ▪ Handling an assessing complex processes and technologies in complex situations

Table 4: Typical Assessment Criteria of Different Stakeholders

For each of these 4 stakeholder categories above, the following elements are defined:

1. The main objects to be evaluated in the scope of the stakeholder: a brief description and characterization of the function and the relative importance in handling this incident scenario
2. Measures of effectiveness (MoI) and key performanc indicators (KPI) which allow to appropriately describe the objectives and expectations

3. The required data and/ or information and sources to quantify or sufficienty measure the MoI/KPI

These 3 elements, specified for each stakeholder categoty, will form the basis for developing and executing the evaluation tasks of WP 6. They highly correspond or correlate with the human factors input as genertated in WPs 2, the end-user requirements analysis of WP3 and the technology mapping of WP4 and documented in D 2.2, D3.2, D4.2, and D4.4, respectively. This way, consisency will be kept between the earlier anlytical work in COPE and the final evaluation methodology.
Some sample extracts are given in the following chapters.

The total **Assessment Matrices** are attached as a separate **Annex1.**

5.1 Operational / Tactical C2 (Section “A” of assessment matrix)

C2 Function	Supporting technology	MoE/ KPI	Source of information
Updating of the COP	Sensors Communications Voice input	Update rates; Availability of relevant information	Data logs Screen shots Interviews of the commander
Assessment of First Responder Risks	Risk assessment tool Decision support tool	Injuries and fatalities; FR capacities on site	Data log Number of incidents Reports from FR
Setup of organization, communication, span of control	C2 and CDS	Time and effort to set up communications; Ability to generate plan in time	Data logs Voice recordings Questionnaire

Table 5: Sample Command & Control View

5.2 Technology View (Section “B” of assessment matrix)

Technology	Function supported by technology	MoE/ KPI	Source of information
COP human-machine-interface	Size-up of situation; Maps for sectorization; Filtered COP for FRs	Adequacy of resolution; Symbology used	Interviews of IC; Reports from FRs
Chemical sensor	Detection of toxic cloud	Correctness of concentration measurements	System data logs; Comparative measurements
Communication	Voice C2 to FR	Quality of	Recordings

	Data from scene to C2	transmission Update speed; False messages	Data logging

Table 6: Sample Technology View

5.3 First Responders View (Section “C” of assessment matrix)

Technology	**FR task supported by which technology and information**	**MoE/ KPI**	**Source of information**
HUD; Mini-PC; GPS; Chemical sensor	Risk assessment info COP information; Location info to IC Gas cloud measurement	Ease of use; Weight; Detraction from main tasks; Reduction of own risks	System specification; FR-reports and interviews

Table 7: Sample First Responder View

5.4 Scientific/ Research Community (Section “D” of assessment matrix)

Research view	**Typical questions to be answered**	**Who should give the answer**	
Theories & methodologies applied	How does Bayesian networks application perform in the decision support tool?	IC; Researcher	
Technological innovation	How did the sensor integration with the communications network perform?	FR Comm’s provider	
Overall trial challenges	How did exercise support tools perform?	DiStaff	

Table 8: Sample Researcher's View

5.5 The Generation of Results from Analogue Sources (section “E” of assessment matrix)

5.5.1 Analogue Sources

The majority of the information to be analysed will be digital data. In addition, analogue information sources will be generated and evaluated, including

- Questionnaires
- Structured interviews
- Debriefings and reports from participants, e.g. observers
- Evaluation of audio and audio-visual recordings

5.5.2 External Stakeholders

Evaluations in the four sections above, 5.1 to 5.4 (Sections a to D in Annex1) concern primarily the proof-of-concept and performance. In these sections A to D the evaluations will be mainly provided by the COPE team members, in particular after the first of the two main trials which will be restricted to COPE team members (phase2).

In section E mainly analogue information will be inquired and evaluated. This section will generate additional input to the proof-of-concept. But it will focus primarily on the exploitation of the COPE system, primarily after the second trial (phase 3). To that end the invited participants are particularly important, provided they bring experience w.r.t. the applicability of COP systems (i.p. of existing COP systems) to the table.

Given this envisaged role of invited participants, the selection of externals will be especially relevant: this group should be heterogeneous and include expertise on higher level applications of COP systems, comparisons of the COPE system with other existing or developing COP systems, the utility of COP systems in varying circumstances, e.g. hostile environments, multiple crises, transnational crises and consequences etc. This involvement of invited participants will add to the desirability of a special conference on COPE exploitation in late 2010 or early 2011.

The results in Section E will be inserted into the assessment matrix wherever possible and appropriate, but they will also require special separate documentation and usage.

Invited participants will have a variety of chances to share their information and observations with the project management and team: via questionnaires, interviews, informal communications, possibly an exploitation conference.

A more detailed guide is presented in Annex6. It points out on which issues (in addition to Sections A to D) inputs from invited participants are considered as especially important w.r.t. exploitation chances and efforts. Respective inputs from the COPE team members on these issues are, of course, also needed.

The annex also elaborates on how the assessment by external stakeholders will foster the dissemination and exploitation of COPE results.

5.6 The Aggregation of Results

A scheme of weighted factor utility analysis will be superimposed on the evaluation matrices of Annex 1. This aggregation scheme can only be developed after all MoEs will be specified and all related data sources identified (see also chpt. 6.1).
Usually a scoring and weighting scheme is developed, e.g. along an AHP process[3]. The aggregation scheme/model will reflect the scheme of the valuation matrices of Annex1.

6 Critical Discussion of the Evaluation Scheme and Methodology

Emphasis will be given to the process of validating the result outcomes of the COPE trials. This is particularly necessary in cases like the COPE environment which is characterized by a large system complexity, expected different quality and availability of measurement data, the in some areas expected lack of a sound comparison basis, and the possible bias involved in the evaluations from the different viewpoints.

6.1 The Evaluation and Aggregation Process

For transparent evaluation, the overall objective of disaster or emergency management has to be broken down into measurable units. Figure 4 in chapter 3.3 is a possible structure which is reflected to some extent in the assessment matrices (as discussed in chapter 5 and laid down in Annex 1). There are 4 limiting factors when elaborating a detailed evaluation scheme:

1. The ability to logically evaluate the elements at the lowest level, the MoEs (Evaluation function; degree of fulfilment etc.)
2. The availability of data to calculate the evaluation
3. Regarding of the assumption which is implicit in the methodology, that the measured elements are independent from each other (avoidance of double counting etc.)
4. The possibility to aggregate the low-level MoEs into composite evaluation results, (see also chpt. 5.6).

The methodology developed in chapter 5 is a pragmatic approach regarding these deficiencies to the extent practicable within the framework of the COPE project.

6.2 Availability of Data/ Information and Sources

The availability of data allowing evaluation along the individual MoEs / KPIs is mandatory. Otherwise, evaluation is impossible or left to speculation and individual interpretation. At the time of deliverable of this document, many data sources are still unknown. There will be a major update and completion of the assessment matrices in Annex 1 when the technical system will be fully and finally specified. Nonetheless not everything can be quantified (e. G. user acceptance). But even qualitative statements of trial participants will not just be taken. At least the rationale and indicators behind the statements will have to be realized, and they need to be confirmed by as many as possible, at least by more than one person / expert.

6.3 The Complexity of the Trial

The driving factors of the complexity of the trial setup, execution and evaluation of outcomes are manifold and include:

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[3] The ”Analytical Hierarchy Process”, e.g. to be supported by a computer tool like EXPERT CHOICE

- Various technologies
- Varying degree of integration
- Varying maturity of solutions
- A multi-facetted scenario
- Various processes
- Different groups of responsibilities and action
- Differing interests and views of different stakeholder groups

The developed evaluation methodology tries to come to concise and agreeable overall evaluation results even though complexity of the system and diversity of the views may and in some cases will lead to differing assessments in detail.

6.4 The Evaluation Reference and Basis of Comparison

6.4.1 The full scale Reference case

A fairly ideal evaluation would consist of a rather large number of tests, both for isolating individual MoE/KPI's and for statistical reasons. It is a fact that the project has limited resources for evaluation, but the chosen methodology is considered the best one available.
The evaluation should consists of running one reference case with existing legacy technologies and procedures and repeat the identical run with the application of the COPE technologies (see also discussion in Annex 5). The improvements achieved by the COPE technologies could then directly be compared to the outcomes of the reference case, leading fairly to a set of quantified assessments. This will, however, not be possible basically by reasons of limited time and resources. First, the reference case would require duplicated time to perform the "double" exercises. Furthermore, the whole exercise personnel would have to be duplicated. Otherwise, in the second run, the staff would be totally biased as they would know the scenario details already from the reference run.
There are several methods to produce some generic references without having to duplicate the whole work: first it can be tried produce reference performance data by evaluating the existing legacy systems with the same evaluation scheme without actually running the reference case. This will require analytically competent disaster managers and first responders to perform this reference evaluation mainly based on their experience and qualified guesses. Because of resource limitations, this process may be limited too, e.g. to a brainstorming session in which the participants give their qualified estimates.

6.4.2 Possible References for Comparing COPE Achievements to

The basic improvements in disaster management the COPE project is aiming at are

- Application of advanced technologies (sensors, various ICT) contributing to a better quality and of the common operational picture
- Application of advanced decision support tools for improved decision making
- The combination of all in a COPE "system of systems" allowing for improved disaster management processes and reduction of risks and damages to lives and properties

There are several typical effects which can be expected by the application of COPE technologies, each of which may be measured against different references either available from the past or to be generated in the COPE trials:

Performance of COPE	**Possible Basis for**	**Expected availability**

	comparison (reference)	
Global improvement of the whole disaster management cycle	Exercising of a full reference case	Not feasible
New performances not feasible without COPE Technology	Zero	Yes
Direct measurement of individual COPE technology performance	Technical performance data of comparable legacy ("old") systems/ technologies	Should be available at technology providers
Reduction of probabilities of certain risks and failures (e.g. number of casualties to FRs)	Experience from historic cases or training programs	Expert knowledge of team members and invited stakeholders
Increase of probabilities of success (number of rescued victims or evacuated people and their health condition)	Experience from historic cases or training programs	Expert knowledge of team members and invited stakeholders
Improved quality and speed of decisions	Comparison to legacy cases of the past	Data base may be partially available
Synergy effects (improvement of a process although not directly supported by COPE technologies, e.g. because a commander can better concentrate on most important tasks	Expertise of decision makers	Some qualified decision makers and qualified interviews should be possible
Extension potential of COPE results to the application in different and even much larger and more serious scenarios, higher decision level and complex international environment	Combined expertise of decision makers, researchers and system developers/manufacturers	Should be an outcome of a final COPE conference/ seminar
The balance of solutions (in cost and performance): E.g. between FR technology upgrade, communications and improved C2 capabilities: Do they really match?	Assessment by COPE team experts with some assistance of external Stakeholders	Feasible

Table 9: References and bases for comparison

6.5 The Risks of Evaluation Bias

When it comes to analogue information sources and evaluation via expert knowledge, estimations and guesses, there is a risk of evaluation bias: The scientist loves his ideas and may overrate them, the manufacturer wants to advertise and sell his products, and the end-user community may be over-critical or sceptical upon new ideas and technologies and about possibly expensive investments.

There is no easy way of avoiding evaluation bias. It was done with intention to assign the evaluation task to a consulting company (CESS) which is independent of any of the above strands of interest. Together with all team members and external experts we will do our best to eliminate bias from the assessment results – be it deliberate or accidental.

6.6 Hedging the results

There are several ways of making results as objective and meaningful as possible. Measures to assure most objective and reliable results will include:

- Double or multiple assessment by experts
- Check of consistencies/inconsistencies of results on the same os similar objects (technologies, system components, processes) within the scenario
- Identification of doubtful outcomes and critical reassurance by experts
- Review of core results by the advisory board
- Generation and validation of sound reference information (see also discussion in chpt.6.4)

This last point can be addressed by an aggregated evaluation scheme including the main processes as described in Annex1, section A and partially in section C. With this scheme, the present (non-COPE) situation should be evaluated by a selected number of operators, FRs and external Stakeholders. After the trials, again the non-COPE and the “COPE-enhanced” system objects will be evaluated by the same scheme. This will result in basically two outcomes:

1. The existing system will be evaluated twice, once before and once after the knpwledge about the COPE enhancements, which will improve the solidity of the so-called reference (see chpt. 6.4) and
2. The difference between COPE –improvements and the situation today becomes transparent and much better traceable.

7 Results of this Deliverable D6.1

This deliverable D6.1 does not deliver project end-results. The product of WP-Task 6.1 is a methodology to evaluate the COPE end-products which are mainly software, to some extent adapted hardware, and gain of knowledge of the participating organizations and individuals. The evaluation methodology will be supported by transparent, easy-to-handle and efficient tools for performing the evaluations. The results of D6.1 are mainly described in Chapter 5 and its Annexes.

8 Validation of Results of D6.1

The validation of results of task 6.1 is contained in chapter 6 above.

9 Conclusions

As already stated, the methodology described here is framed by the complexity of the problem on one hand, and on the other hand by the need to be easily perceived and handled by the different stakeholders participating in the evaluation process, with different background and different task profiles in their daily professions.

References

Some valuable references of methodologies on how to assess measures taken to improve security by utility theory models:

[1] A Survey of the Economics of Security, April 2008, Economics of Security Working Paper 1, DIW Berlin, Tilman Brück, Marie Karaisl, and Friedrich Schneider

[2] RAND MG705: Securing America's Passenger-Rail Systems, 2007

[3] T. Aven _, R. Flage, Use of decision criteria based on expected values to support decision-making in a production assurance and safety setting, Stavanger University, 2009

[4]Aven, T. and Kørte, J. (2003) On the use of cost/benefit analyses and expected utility theory to support decision-making. Reliability Engineering and System Safety, 79, 289-299.

[5] Expert Choice: Collaboration and decision-support software: http://www.expertchoice.com/

Annexes to D 6.1:

Annexes are be attached as separate WORD or EXCEL files

Annex 1 to COPE deliverable D6.1 Chapter 5 The Evaluation Matrices

This Annex contains the detailed Matrices as a tool for the evaluation of COPE Phase 2 and trials from the 4 different stakeholders points of view as discussed in chapter 5 of D 6.1:

- Command and Control view (section A)
- Technology view (section B)
- First responder view (section C)
- Research view (section D)
- And a system of questions to the different categories of trial Participants (section E).

Annex 2 to COPE deliverable D6.1 Chapter 5 Matrix Input

Input to Annex1 Matrix section D3

Annex 3 to COPE deliverable D6.1 Chapter 5 Matrix Input

Input to Annex1 Matrix sections A1x; A6x; B1x; B2x; B3; D14; D24

Annex 4 to COPE deliverable D6.1 Chapter 5 Matrix Input

Input to Annex 1 Matrix sections B51; B52; B53

Annex 5 to COPE deliverable D6.1Comments and recommendations

Comments and recommendations on methodology and harmonization

Annex 6 to COPE Deliverable D6.1 Matrix Section E

Supplement to section E of Matrix
Guide for invited trial Participants

Annex 3 to COPE deliverable D6.1 Chapter 5 and its Annex1-The assessment Method Matrices

Input to sections of the Matrix:

Contributor: BAE-CITS

A: Command&Control (C2) View : Mainly IC; CS

A1: Planning functions Generate, establish and control plans & organizational means

A11: Setup of organisation, communications means& procedures, span of control
A12: Size up of situation
A13: Sectorization
A14: Cordoning
A15: Functional areas

The first minutes after arrival to a real emergency situation is critical and the primary tasks as allocating teams and ask for more resources is recorded afterwards. In the COPE exercise a lot of these things can be prepared so some of the supporting tasks can be reduced to focus on other tasks.

The communication infrastructure with radios for speech, and data transmission are pre setup in the exercise. The exercise will demonstrate what's possible not solve the technology procedures that needs to be handled to support these features.

The intention of the COPE systems is to help the commanders to setup a command structure that will be distributed among all participants with as little effort as possible.

The main enablers for this are:

- The use of a standard for a security ontology and data base, the TSO.
- The infrastructure with a distributed network using an access point, the COPE Gateway
- The use of event and organization identifiers to allocate recourses and people to incidents and sectors.

To measure the performance, effectiveness, and improvement a way of comparison with the normal of working would be preferable.

If this is not possible, questions to the commanders regarding the estimated time to setup the structure, and distribute this information to all involved in the trial can be compared with the recorded data (in the COPE Gateway) of the resource allocation and the assignment to the sectors. Questions about the possibility to track the intended structures compared with the recorded structure can also be compared.

The system to support this allocation of resources is the COPE C2 system, but the data will be stored inside the COPE gateway.

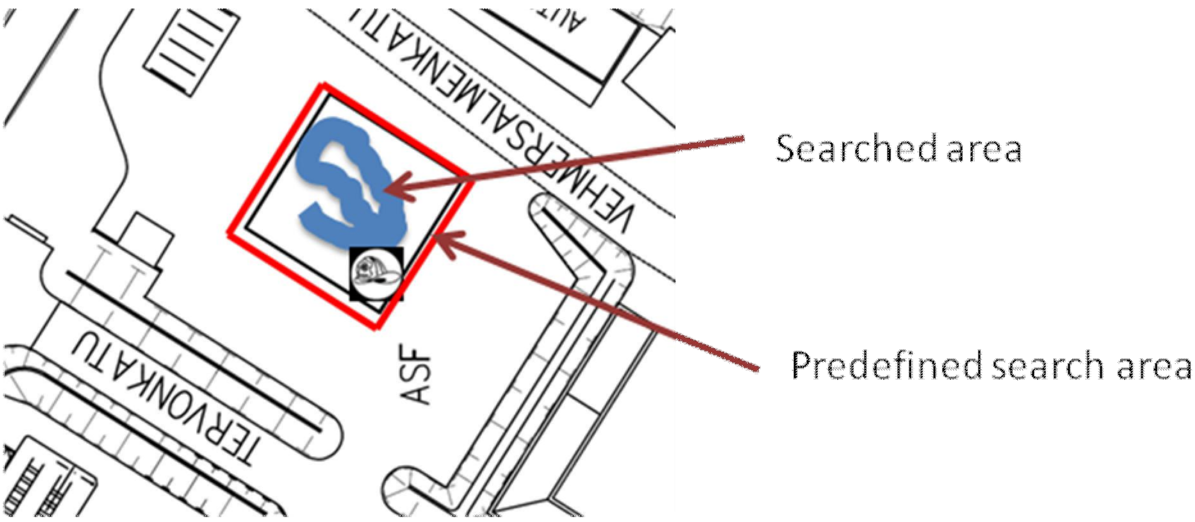
A61: Monitor declared Control measures

The task assigned to the teams can be tracked regarding the status, started, in-progress or completed. The actually progress is more complex to measure. The source for this information is the sector commanders. What they report back to the incident commander will be progress to measure. This can be done by logging the radio traffic and the TSO message sent back to the commander. The incident commander can be asked to describe his view of the progress of the work and compare this with the sector commander's view of the progress. This information can then be compared with the radio traffic information and the TSO messages to see if there any discrepancy between the different actors views and the distributed information.

A62: Monitor S&R operations
A63: Identify & declare areas not to be searched

The COPE Systems will support the S&R by point out areas to search and areas that are searched. There could be a possibility to log areas not searched and compare it with the searched areas to generate a "coverage" factor. For this to be possible a predefined area that is reasonable to search must be specified. The time and area covered can then be calculated. These measures are hard to compare a situation without the COPE systems due to the lack of this information, but could point out the possibility for the commanders to have this type of "performance" factor as an incident review factor.

The C2 system will estimate the covered area using a sphere around each first responder involved in an S&R operation. This sphere must be defined with help from experts in the area.



Search performance factor = Searched area / Predefined search area

Input to section

B: Technology View: technical performance of systems; components

B1: C2 Technologies

B11: COP general presentation

The “COPE” COP resides at the end users interfaces, but the data are stored in the COPE gateway. The goal of the COP is to create a common understanding of the situation. The best way to measure the common understanding is to interview actors in the exercise about their view of different situations during the trail. To track the technology performance of creating the COP, it’s suitable to select some small parts of the incident and compare actors using different COPE tools view of the situation. Measure the discrepancy between their views of the situation and also compare the resolution of their views of the situation. The incident commander should have a lower resolution of a single situation then a sector commander.

One thing that could also be asked is the sector commander’s knowledge of other sectors activities and If this cluttered the situation for a single sector or enhance their work.

Expected benefits of the “COPE system” COPE are:

- Consistent situation awareness
- Well defined sub events (sectors)
- Better resource tracking (e.g. where are the nearest water supply)
- Better understanding of the tasks to perform
- Easier risk assessment
- Support for prediction of the evolvement of the incident

B12: C2-User interface
Symbology, GUI, GIS, Other display & handling

The COPE C2 system will be used by commanders in the incident, Incident commander, Sector commander and the command support system. The AIMS system will be used as a unified command view of the situation.

The symbology is not the main focus of the COPE C2 system, but it’s of interest to understand how important the symbology is for the common operational picture. Questions about the selected symbology could be:

- Are the symbols clear enough, which are / which are not?

- Is the size ok?
- Did you miss some symbols? For what?
- Coloring, is it OK?

The intention for the COPE systems GUI is to be as self explaining and support the tasks for the users with minimal interactions to reduce the workload for the users. To measure the success of these goals logging of number of interactions would be preferable, but this type of logging is complex and will not be possible during the exercise. Instead a manual counting of numbers of interactions (Mouse click) before reaching the wanted functionality could be done. The goal is to have this as low as possible. Suggested mean values are:

- 2 mouse clicks to get basic functions, (e.g get detailed view of sector, get status of single fire fighter)
- 4 mouse clicks (plotting in map not counted) to add new information into COP (e.g cordoning, allocate resource to sector)
- 6 mouse clicks to do advanced functions

The GIS tools should be intuitive to use and support the normal mapping functionalities. The questions to be answered are:

- Are the right tools available for the map. (use the Google earth/ map as reference system)
- Are the tools easy to use (use the Google earth/ map as reference system)

The map data used are dependent of the supplier of the maps. What can be of interest to ask are:

- Are the maps are OK?
- Should there be more or lesser maps.
- Is the switching of maps due to scale good.

The users of the COPE C2 system will be using different displays for the application. The goal of deploying the application on different displays is to answer the questions regarding the suitability to use small devices (small size displays, low resolution). The COPE C2 will be deployed on three different hardware platforms:

- smartphone hardware with a simple GUI, and a subset of functions, targeting the sector commanders or incident commander in small scale incidents.
- PDA like PC, medium display (7”), high resolution, Full scale user interface
- Laptop, normal display, high resolution, , Full scale user interface

The questions to be answered are using a point system 1-10 where 10 are the top score:

- How easy is it to do interactions (1-10)
- Is the GUI shown clear enough (Did you get a good overview of the COP, is the display cluttered?, Could you read the text?) (1-10)
- Did the carrying of the hardware interfere your work? (1-10, Note: 10 meaning no interference at all)
- Was the supported function enough (1-10)

By multiplying the 4 values a comparison of the 3 platforms can be done. Because there will be different users of the 3 hardware platforms the comparison can be tricky and the result must be carefully analyzed. The target value for each platform is to have a value above 24 points. (mean value of 6)

In the trial there will also be possible to attach an Anoto pen to the smartphone for free drawings on a white piece of paper. The goal of this function is to find if this type of support will add some extra support to the C2 system, by freeing the user from computer interaction. These drawings will be distributed in the COPE systems and be displayed on the other COPE C2 interfaces.

The answers to get after the trail are:

- Was the tool useful and why?
- Did you use this tool instead of another tool (e.g, drawing on the map)?
- How much of you work (in percent) was done using this tool compared with the other tools?

B2: Data handling

B21: Common data structure and definitions; use of TSO

The information exchange in the COPE system of systems will use the TSO as the carrier. The TSO was developed in an EU fp 6 project, OASIS and have after that been further developed into a version 2.0. There are still very few uses of this standard. The standard has so far mainly been used at higher levels in the command chain. To measure the suitability for TSO at the incident ground are hard. There are three areas that can be evaluated:

- Ease of use for the technology developers
- Coverage of the needs for the technologies
- Coverage of the needs for the users

The ease of use for the technology developers can only be answered by the developers of the applications. The technology coverage can be measured by counting the additions to the original standard to fulfill the requirements of the systems. The coverage for the user needs is measured by comparing the lack of information the users reported after the trail compared what's in the standard. It's not enough to just count the missing information because it could be because the system is have not implemented all of the possible support in the TSO standard.

B22: Logging system
B23: extraction and evaluation tools

Logging in the COPE systems is done at several places. But the main logger for information exchange will be the COPE Gateway where all TSO messages are stored. There will not be implemented a review application for this logged data (NOTE: We could look at the possibility, but it's not planned so far), but because the TSO messages are in XML they are human readable, but it takes some knowledge of the format to understand it. All messages can be received after the trail for a "replay" of the event, if the timestamps are handled. The technology performance to measure is if there is information missing in the log, what and how much.

B3 Simulations/ Simulators

The trail will have a limited number of actors involved. To be able to able to do a realistic test there is a need for a simulated environment. The use of TSO makes it possible to create a set of predefined messages that can be injected into the COPE systems to simulate certain conditions, like 112 call, information from higher command, resources moving to a hospital, police cordoning and so forth. These messages can also be created during the trial but then it's harder to validate the messages, even if the message can be verified, using the XML schema, for correctness.

One possibility to "move resources" is to use KML files that can be created in Google Earth and then inject the coordinates into a "simulator". The COPE GW test client can act as such a simulator. (With minor changes, not planned yet).

After the trail a measure of the users experience with this injected/simulated data through questions. Did the users think the injected data was real enough? Could the commanders use this information as input for decisions?

In the trail there will be a chemical accident with an ammonia discharge. Only a very small amount of ammonia will actually be in the air due to safety restrictions, so the sensors must be triggered with simulated values. This information will then be used by the Air quality estimation software and further analyzed by the COPE CDS. The simulated values will create a "virtual" gas cloud. The performance of this simulated gas cloud will be measured through .

D: Assessment from the view of Research

D1: New challenges in theories & methodologies

D14: Adaptation and application of a EU (pseudo) standard for a security ontology and data base

The COPE project states that it will use the TSO data model as the basis for the communication exchange. The TSO was developed during one of the COPE predecessor EU founded projects, the OSASIS project. There has been a work on how to map the TSO model to the need of information on the incident ground. The TSO has so far been used for information exchange at unified command. The use of TSO for the incident ground has created several challenges to be handled, which are of interest to be studied during the trail. Mainly there are two areas that need extra attention:

- Completeness for information exchange at the incident ground
- Data exchange performance and network load

During the development of the project the requirements where mapped to the existing version of the TSO, version 1.0. The TSO version 1.0 was exploited in a CEN/ISSS workgroup and was updated to a version 2.0 during the COPE project. The COPE implementation will be based on the version 2.0. The TSO specifies to send the information inside an envelope message structure based on the EDXL-DE standard that was developed by Oasis consortium for data exchange standards, not to be mixed with the OASIS project.

The COPE technology partners has setup a data dictionary document to identify what parts that will be used and exchanged during the trails. These data dictionary was the base for find a missing parts in the TSO model for data exchange at the incident ground. The COPE project identified some minor needs to extend the TSO model for support at the incident ground. It was possible to add these parts into the envelope message, but to be able to explore the needs for additions into the TSO structure the project suggest adding these parts into the TSO message structure and data dictionary.

The suggested additions are:

- New data dictionary value: “Unknown” added to
  - TSO://EVENT/ETYPE/ACTOR
  - TSO://EVENT/ETYPE/LOCTYPE
- Extra definition of values in TSO://RESOURCE/RGEO/FREETEXT: (values delimited by “,”)
  - SPEED =xx, The sensor current velocity in absolute value (in m/s), xx
  - TEMPERATURE=yy, The sensor ambient temperature in Celsius degrees, yy
- Extra definition of values in TSO://RESOURCE/FREETEXT: (values delimited by “,”)
  - PANIC_BUTTON_PRESSED_EVENT, Accessible panic / emergency button pressed
  - PROG_BUTTON_1_PRESS_EVENT , Programmable button 1 pressed
  - PROG_BUTTON_2_PRESS_EVENT , Programmable button 2 pressed

  - TAMPER_EVENT, Equipment tamper report
  - MOTIONLESS_EVENT, Report if is not moving for more than xxx seconds OR is moving for more than yyy seconds, where x and y can be configured
  - GAS_LEVEL=aa,bb,cc,dd, The following gas levels as integer: CH4, NH3, CO2, NO2.

- New TSO element: TSO://MISSION/HAZARDLVL
  Hazard levels, Enumerated Integer (0 = NO HAZARD, 10 = EXTREME HAZARD)
- New TSO element: TSO://EVENT/TACTICAL_MODE
  String (Max 50 chars), Current tactical mode for the event
- TSO://EVENT/STATEMENT_OF_INTENT
  String (Max 50 chars), Incident Commander's statement of intent

The data exchange performance should be evaluated regarding the delay time.

The update rate will vary depending of the type of information, but an update rate of 10 seconds will be the basis. If this update rate is not enough this can be changed. The questions to ask the operator is; how long delay can they accept from an event occur until they are informed of the event.

D2: Innovation to legacy systems and new components; integration

D24: adaptation and technical integration of various technologies into the "COPE System of systems"

One of the main focuses of the COPE project is to adapt existing solutions to the emergency management domain. One of the important constrains for the emergency management is that they should not be restricted in their work by the technology. The COPE system of system aims to demonstrate the possibilities of using new technologies and have not be designed to handle all of the requirements specified below.

- The users should not be bound to a single location (portable system), except for the decision support system and the command and control system which are bound to the command vehicle.
- The systems for the first responder should be water and fire resistant. This requirement is not completely fulfilled in the COPE systems of systems.
- The system should be able to run for at least one work shift. The COPE system of systems is not designed for that requirement.

The other part of the transformation of existing technology is to adapt the functionality to support emergency management. The technology interest in evaluation of the trail is to get answers about:

- Which technology supported the work, and how?

- Could it have been done in another way?
- What was the extra load of using the technology?
- How easy was it understood how to use the system?

Annexe 5 to COPE deliverable D6.1

Comments on D6.1 from VTT and adapted by CESS

D4.4 is delivering the following inputs to the evaluation framework.
This input will be integrated with Chapter 4 of D6.1. As the inputs of 4.4 are not yet ready the forthcoming inputs could be indicated:

The main input from D4.4 is that there must be three levels of evaluation:

1. Technical functionality
Each separate COPE-application as defined in Deliverable 4.3 must define the indicators that are needed to state that the application functions technically. (In the first Kuopio trials reported in D2.2 is an example of how the technical functionality of the WSN technology could be measured).

2. Human factors verification of COPE-technology
This evaluation refers to separate applications as defined in D4.3. The question to be asked is whether user requirements defined in 3.2. and 4.2 are fulfilled. Detailed crosscheck between D6.1 and D3.2&D4.2 has been made. In other words the focus of evaluation should be on the capability of the specific application to fulfil the key tasks that it is supposed to promote. The HF people of each of the technology mapping working groups agreed that a definition of these tasks (a crystallisation of the tasks included in the technology mapping table included in D4.2.) will take place. On the basis of identifying the key tasks each application supports there will be a definition of key performance indicators to verify the fulfilment of these tasks, as well as identification of the data needed. This information will be included in D4.4. in the "verification metrics table". Harmonization of D6.1 and D4.4 will be achieved in the final version.

On the basis of defining the verification metrics, specific task-oriented **requirements will be set on the scenarios** defined for the trials. These requirements will indicate what specific task components need to be included in the metrics so that the particular end-user functionality can be tested in the trials. The scenario requirements will have to be taken into account in the detailed planning of the scenario, especially the tasks of the personnel.

It is necessary to check that the D6.1 includes a section where the development of a functional situational task model may be indicated. Such a model is basically a more detailed level description of the scenario and has connections, to roles and tasks of participants (see bullet chapter 3.2). In the same connection, i,e., the functional situational task model, the decision making demands of the activity triggered by the scenario can be analysed. An analogue model was created for the first Kuopio trials as can be read in the D2.2. This model was later used as the reference of evaluation of the end-user performance. The Figure 4 in the draft D6.1 is connected to the functional task analysis. The analysis should however be carried out further and the standard operating procedures need to be consulted when creating the functional situation model and the decision making demands. This model should also include a description of the information that the new COPE-technology provides and of course also other relevant information that can be expected relevant in the situation. This functional model will be included in D6.3 (Scenario) and regarded in the final trial and evaluation setup accordingly.

3. Human factors validation of COPE-technology

This phase of evaluation refers to the future expected emergency response (ER) activity. In other words, the question asked is whether the COPE technology provides added value to future ER work. The expected future ConOps is basically the reference but further insights of the future possibilities will be acquired directly from the personnel accomplishing the activity triggered by our scenario. In the validation phase we do not primarily measure performance of individual applications. Instead we will focus on the functions that the integrated COPE technology should provide in an accident situation. Drawing on the earlier work in D2.2, D3.2 and D3.3, we are in D 4.4 defining the human factors (HF) validation metrics for the COPE technology which will be harmonized with D6.1. The intention is to exploit the metrics that VTT has previously developed for such integrated validation purposes. The theoretical basis of the metrics is depicted in the table below. Currently WP4 is working on to finalise a metrics for the key performance indicators need in the COPE trials and the data needed to evaluate the validity of the technology.

Systems Usability metrics with regard to different tool functions

Focus of analysis / Tool functions	Outcome of action	Work practices	Experience
Instrumental	Task achievement, time, errors	How tools are embodied in meaningful routines	Experience of appropriate functioning, joy of achieving intended effect
Psychological	Cognitive constructs and measures, e.g. SA, mental models	How coordination with tools, control of own activity is accomplished	Experience of fit for human use, experience of own competence, sense of control
Communicative	Amount and content of interactions and communications	How usage of tools is shared within the community and how usage conveys meaning	Experience of trust in technology, experience of shared motive, experience of support for personal style

Input to: Layout of experiments (Chapter 4.4 in D6.1), and to section E of the assessment matrix (questions)

When reading the D6.1 it occurred that probably it would be useful to consult the D2.2. In this report, especially in Chapter 5 we describe in detail how the design study was accomplished. Even though the study was much more restricted, the approach taken in the planning could be helpful in planning the trials.

In the Kuopio design study (May 2009) we solved the issue of reference to which the results of the technology trial should be compared in a particular way. We decided that since the participants did not have much earlier acquaintance of the new technology, because the technology has not been incorporated in the standard operating procedures and habits of the responders, and because the new technology was still at quite immature stage, it was unrealistic to assume that performance with the new technology would be especially informative. Hence we decided to let the personnel act as they had been taught to act in such situations. The new technical possibilities were tested in parallel by selected experienced fire fighters who were only devoted to testing and to give their insights of the promises of the new technology.

- One important question to be solved in the forthcoming trials is, is it realistic to assume that all the new technology can be adopted in use by the personnel and if it is realistic, how much training the personnel needs to be able to use the equipment.
- We also need to think what the reference is to which the results of the trials will be compared. We should examine whether the Kuopio May 2010 results could be designed so that the comparison would be the first Kuopio trials in 2009, and then, further the Kuopio May 2010 could be used as a reference the final Kuopio September tests
- Regard the role of Bucharest tests in creating evidence of the promises of the COPE technology
- The final results will be drawn from all three Kuopio trials and the Bucharest trial

The above inputs all concern the so-called HF-view of evaluation. What has been labelled as a scientific view is something that will be elaborated when reflecting the methodology and after the analysis of the results.

In the final year of COPE work the HF group is intending to contribute

- in the planning of the evaluation methodology
- in the design of the trials
- in the acquisition of data during the trials
- in the analysis of the results
- in reporting the results .

Annex6

to COPE deliverable D6.1 Chapter 5 and its Annex1-The assessment Method Matrices

Supplement to Annex 1/ Sector E

Contributor: CESS

Guide for invited trial participants

The COPE project has two goals:

- to design a COP system as end-product for possible applications, in particular in disasters with strong fire-fighter component,
- the exploitation of the end-product by identifying, assessing and exploring business opportunities for the proposed COPE system.

The project seeks to meet European Security Research objectives by exploring dissemination and i.p. exploitation, i.e. through an assessment of a pre-operational COP system with regard to future requirements, competing COP systems and possible market opportunities.

1. The evaluation of the COPE system

The evaluation of the COPE project thus has two parts:

- the proof of concept
- the potential for exploitation.

The proposed COPE Evaluation Methodology (D 6.1) provides for seven stakeholder categories (see Table 3) four of which are considered highly relevant for the first evaluation task:

- A: operational/tactical command and control (C 2) organisations,
- B: technology providers for COPs,
- C: first responders (FR),
- D: research/scientific community.

Evaluations in these four sections concern primarily the proof-of-concept. In these sections A to D the evaluations will be mainly provided by the COPE team members, in particular after the first of the two main trials which will be restricted to COPE team members (phase2).

In section E mainly analogue information will be generated and evaluated. This section will contain additional material on the proof-of-concept. But it will focus primarily on the exploitation of the COPE system, primarily after the second trial (phase 3). To that end the invited participants are particularly important, provided they bring experience w.r.t. the applicability of COP systems (i.p. existing COP systems) to the table.

This guide is intended to familiarize the invited participants (externals) with the COPE project and its end-product (see attachment = Annex 1E).

Section E will thus essentially follow the second trial. It will serve to

- feed the post-trial discussion
- enrich the COPE dissemination
- help preparing and guide the COPE exploitation (see exploitation road map)
- support subsequent marketing initiatives.

Given this envisaged role of invited participants, the selection of externals will be especially relevant: this group should be heterogeneous and include expertise on higher level applications of COP systems, comparisons of the COPE system with other existing or developing COP systems, the utility of COP systems in varying circumstances, e.g. hostile environments, multiple crises, transnational crises and consequences etc. This involvement of invited participants will add to the desirability of a special conference on COPE exploitation in late 2010 or early 2011.

The results in Section E will be inserted into the assessment matrix wherever possible and appropriate, but they will require special separate documentation and usage.

Invited participants will have a variety of chances to share their information and observations with the project managemen and team: via questionnaires, interviews, informal communications, possibly an exploitation conference. This guide will point out on which issues (in addition to Sections A to D) inputs from invited participants are considered as especially important w.r.t. exploitation efforts. Respective inputs from the COPE team members on these issues are, of course, also needed.

The guide will address these topics with a view to soliciting responses that can be fed back into COPE development and exploitations:

- The criticality of COP systems: Under what conditions and to which ends can COP systems make a significant difference?
- What are the specifics of the COPE system/ the COPE end-products? How does the COPE system compare with other COP systems? How does the COPE system figure in more demanding contexts?
- What recommendations follow for future exploitation and marketing activities?

2. The criticality of COP systems: Under what conditions and to which ends can COP systems make a significant difference?

The COPE evaluation and i.p. the trials will focus on a pre-operational COP system and it will do so under a narrow set of trial conditions: a local event with two levels and with four agents two of which will be the main objects (in particular the fire brigades).

This raises several questions which externals may be best positioned and possibly qualified to comment upon:

1.1 The COPE project was conceived with the technical vision to “support users to collect and process information from the field to get correct and helpful common operational picture for all users”[1], i.e. users “at different levels from strategic to tactical command and different agencies”. The COPE C2 was intended to “be connected to each other in a node like architecture so different agencies and nations can share the common operational picture”.[2] Three scenarios have been developed. A limited case was taken for the COPE trials because of available facilities, cost limitations etc.

[1] See Technical Overview, BAE Systens C-IST, 2008-05-28, p. 3
[2] Technical Overview, p. 9

For externals it will be important to assess what can be derived from the trials w.r.t. the applicability of the COPE system under conditions of larger events, greater complexity, higher decision levels? Can this be achieved simply by aggregation, especially in view of the following two problems: (1) vertically with each higher decision level an increasing range of additional actors and agencies becomes horizontally relevant, and (2) the higher the level and the wider the range of included actors and agencies, the more informations need to be weighed and interpreted. As a seminal study stated back in 1962, “data are not given, they are taken … The job of lifting signals out of noise is an activity that is very much aided by hypotheses and by a background of knowledge”.[3]

To complicate the issue further, different actors and agencies are guided by different hypotheses which in turn guide the selection of informations in the first place. The key question to visiting participants thus should be: While the limiting conditions for the trial are understandable, what is required for COPE applications in large, more complex, multi-level situations? And if these are demanding additional requirements, to what extent is the trial confined to a situation where a COP is least needed?

1.2 Given the size of the trial event, can the complexity of the event be assumed to allow significant differences between COP- and No-COP applications? What difference would it make if the four (or two) components would display considerable differences in technical sophistication? To what extent would the effective application of a COP depend on general preparedness levels (training, exercises, prior indicators, obsolescence of equipments etc.)? Will the reliability of the response system be different in COP and No-COP applications? Do the procurement and operational costs of an effective COP system and specifically of the COPE system compared to legacy systems justify its introduction or will it be feasible only at the expense of other capabilities needed for FRs? Can the use of the other two COPE scenarios (i.p. the Enschede-scenario, see D 6.2) be expected to display more significant differences between COP and No-COP applications? Can the limited escalatory potential of the event be taken for granted or how can the need for instant transfers to higher decision-levels be prepared for within the COPE system?

1.3 The criticality of COP systems and specifically of the COPE system is highly scenario-dependent: not only w.r.t. to the dimensions of the event, but to the type of catastrophy that caused fire, casualties etc.. The relative weight of the four components varies with the dominant catastrophic effects. Given the orientation of the COPE trials, will there be different claims to fire-brigades and, to that extent, varying requirements (depending e.g. on the vicinity of chemical industry etc.)?

1.4 The effectiveness of a COPE system will also depend on the primary goal and function of the system: Can it facilitate transfers to higher decision-making levels, even if the COPE system will be a two level system? Is it deployed in an environment where the frequency of major fires drives the planning or is it a safety measure, an insurance, e.g. to increase the effectiveness of first responses under normal, i.e. less castastrophe-prone conditions? Will it be introduced in a remote area with a few high-value and/or high-risk objects or in a densely populated and industrialized area? Not least importantly, the COP system can be highly effective in communicating crisis information, but what is it worth if, for whatever reason, FRs are inadequately equipped to make effective use of improved information flows?

It has been the standard failure in both military and homeland-security circumstances that warning or detection can get disproportionally improved at high costs, yet without the

[3] Roberta Wohlstetter, Pearl Harbor. See the classical description of the pre-COP-situation: “All of the public and private sources of information mentioned were available to America’s political and military leaders in 1941. It is only fair to remark, however, that no single person or agency ever had at any given moment all the signals existing in this vast information network. The signals lay scattered in a number of different agencies; some were decoded, some were not; some traveled through rapid channels of communication, some were blocked by technical or procedural; some never reached a center of decision.” Warning and Decision, Stanford 1962, p. 20.

means to make effective use of increased warning time. In other words, what is required to fully exploit the increased warning time, improved information flows and situational awareness? Without effective local responses a COP system may fail to add much to local crisis responses, yet reinforce familiar intrinsic proclivities toward hampering subsidiarity: to turn to higher decision-making levels only once the situation on the given level gets catastrophic and/or can no longer be kept under control without transfers to higher levels. To exploit COP and i.p. the COPE system, what then are the requirements for utilizing the advantages the COPE system is offering for effective local responses and what are the requirements for timely transfers to higher levels?

3. *What are the specifics of the COPE system and how does it compare with other COP systems used or prepared for fire brigades and rescue services?*

3.1 The exploitation of the COPE system will require at least rough comparisons with deployed or available COP systems and their applications. Generally, requirements for COP systems for civilian applications like fire brigades and rescue services are lower than for military systems-of-systems where they have first been introduced, i.e. for hostile environments and prepared to cope with surprise, deception, manipulation, secrecy, denial of information, protection of access, wide-spread spatial indicators, competing own services (e.g. intelligence vs. forwardly deployed forces). Some of these requirements can, however play a role in non-military scenarios, i.p. in cases of strategic terrorism, large-scale events at major air-ports and the like.

On the other hand, some important infrastructures and intelligence sources will be lacking in civilian applications or need to be provided. For fire brigades and rescue services typical events will start in local contingencies (or possibly multiple events or events with high escalatory potentials, e.g. major forest fires), and if they are part of a large and complex catastrophe and/ or assault, bottom-up and top-down approaches need to be combined thus posing additional challenges on the ground and top-level decision-making.

3.2 The COPE system is intended to support first responder end-user at the scene of the events. This is different from some of the existing COP systems which are designed to provide coordination of multiple agents over large distances or to serve national emergency response systems (in view of large-scale fires like in California or Australia).

This raises a variety of questions, i.p. to invited participants:

- Can the COPE systems be expected to develop into and competing with COP systems which are not intended for supporting only end-users on the spot?
- Will two trials suffice to test the capacity of the system, e.g. if not confined to local conditions? Which capacities and/ or applicabilities remain outside the trial conditions and what does that imply for future exploitation of the cope system? And will the trials, in fact, suffice to test the COPE system in view of a variety of local conditions and in view of its components (fire-brigades, police, rescue services)?
- Will the COPE end-product match the original objectives (see COPE Common Operational Picture Exploitation. May, 2007)?
- Will end-user involvement in all phases of the project suffice and allow for successive improvements due to technology advancements and/ or new kinds of risks? Note: the US DHS has urged US industry in 2009 to propose new technologies for second-generation COP systems.
- What are the distinguishing features of the COPE system? Is it the project approach: e.g. user-driven (HF)? Dynamic collection of data? The mapping of HF and technologies? The integration of technologies and results?
- What is new in relation to comparable COP systems? Is the capacity of the COPE system a significant advancement, i.p. the selection and integration of technologies

and if so, what are the specific improvements for detection, speed, integration, handling requirements, training needs, costs, reliability?
- Would more and/ or repeated testing/ trials tend to improve the applicability? Could customers expect improvements to enhance the capacity, lower costs, simplify training, ease transfers to higher decision-levels etc?

3.3 A comparison of the COPE system with other COP systems will need to take into account. How does it compare w.r.t.
- the COPE objectives?
- different sources of information?
- different time-urgencies?
- integration with legacy systems?
- local requirements?
- changing conditions (wind, temperature, rain etc)?
- obstacles (traffic congestion, breakdown of communication)?
- multiple crises and competing claiments?
- large catastrophic events with multiple impact (e.g. Catrina)?
- greater complexity of the crisis?
- multi-level decision-making/ transfer of responsibility?
- hostile environments (terrorism, organized crime)?
- trans-national/ international/ EU requirements for responses?
- cascading effects?
- needs for consequence management?
- overall preparedness levels?
- different national settings?

3.4 Given existing experience with COP systems, what would be particularly useful for COPE exploitations to be compared with

- the SICMA project in view of the DSS for the medical component of CM and the top-level design for the DSS?
- the OASIS system w.r.t. to the multiple-crises and its applicability to large-scale events and access via BAE?
- the FiReControl Project with a network planned for 14000 fire brigades and control centres in the UK?
- the Australian National COP Trial designed to provide spatial information across all Australian states and territories to support a variety of CM activities, i.p. fire fighting, i.e. a top-down approach?
- the Canadian COP 21/TD for support at strategic level?

There does in fact exist an increasing variety of COP systems offered by industry, partly introduced by public authorities (i.p. on community level, e.g. in Paris, Madrid, Singapore, Hongkong and numerous US cities like Los Angeles). For follow-on activities it will also be useful to review the large variety of COP systems for military purposes, i.p. in the US. Special attention deserves the afore-mentioned DHS initiative to develop second-generation COPs.

3.5 What follows for exploitation of COPE and specifically for evaluations by invited participants?

- If COPE exploitation is a prime objective, how can it be supported by an analysis of the increasingly competitive international market for COP systems?
- What are the criteria for presenting the COPE system: effectiveness, reliability, cost, market access?
- What will be the national or regional markets with demands the COPE system will match?

- Are partnerships beyond the COPE consortium practical in support of enhanced applicabilities and market chances?
- Should the second COPE trial be followed by an exploitation conference or workshops, and, if so, as a COPE activity or in cooperation with third parties?
- How can dissemination efforts be used in support of COPE exploitation?
- How could the COPE end-product be best documented and presented in support of COPE exploitation?

Preparing the Section E-evaluation will help developing the exploitation road map and the Section E evaluation should provide relevant support possibly for a subsequent exploitation conference and in any case significant contributions to future exploitations of the COPE end-product.

Annex 2 to COPE deliverable D6.1 Chapter 5 and its Annex1-The assessment Method Matrices

Input to section D3

D3: Preparing, setting up and executing the trials in realistic disaster conditions

D31: Identifying and development of a realistic scenario from real event data

Task: Describe the motivators of the scenario selection and implementation process
Contributor: CESS

According to the COPE DoW, the COPE exercises will be conducted in a synthetic simulated environment with realistic scenarios. The DoW outlines the scenario framework as follows:

- A terrorist attack in an urban environment (man-made disaster);
- A severe nuclear power plant accident caused by technical failure in combination with operator errors;
- A major flood (natural disaster).

Although these three scenarios are triggered by very different causes, their cause-and-effect chains are similar:

- many people are affected
- their consequences are beyond local level
- cross-agency cooperation is needed (fire brigade, police, medical services)
- Hazmat can´t be excluded
- The course of scenario covers several vignettes with specific aspects (e.g. many casualties in a short time period, conventional damage through fire or flood, unconventional damage through NBCR accident or attack).

Based on these DoW requirements, for the scenario design the following criteria were assumed:

- The scenario should provide a sufficiently comprehensive environment for cross-agency rescue options
- The resolution of the scenario should be high enough to respond to the investigated systems
- The scenario should allow “zooming”: i.e.to investigate special sensitivities in greater detail if required
- The course of scenario should be realistic enough to avoid fruitless scenario discussions.

To meet these requirements the historical disaster of Enschede, NL in May 2000 was selected as role model for the COPE scenario. The COPE scenario consists of a major disaster event with subsequent modular set of individually described follow-on events (= Vignettes). A Vignette is defined as a part scenario taken out of a coherent context. According to the technical and organizational solutions a single Vignette or combination of Vignettes may be appropriate for a particular test and demonstration scenario. The COPE scenario is documented in D6.2 “Scenario Description” and consists of:

- “The basic story”: a terrorist attack on a special chemical factory (fireworks factory) in D-City;
- the explosion of the factory and the immediate direct effects on human beings and properties (Basic event);
- Spread of the fire into the neighbouring buildings of a brewery;

- Explosion of an Ammonia tower, hosting the Ammonia based cooling system of the brewery and development of a poisonous Ammonia cloud;
- Follow-on-effects of fire and explosion of the Fireworks Factory on the surrounding streets and factories;
- Follow-on damage and spread of fire into the neighbouring housing area.

All events and injuries occur at the disaster area and its close neighbourhood and within a time frame of a few minutes.

D32: Adaptation of the scenario to the environment of the trial test site conditions and interfacing to the COPE system of systems

Task: The challenges, success stories and stumbling blocks of making the scenario run in the COPE C^2 and Pelastusopisto environment

Contributors: CESS and ESC

The most prominent challenge of COPE trials will be to execute hybrid exercises. That means, a testbed has to be establish which allows training first responders with novel but real technologies in a real test site and the testbed will be embedded into a larger synthetic environment simulating hazmat situations which endanger a notional population and demand virtual resources additional to the real first responders.

To avoid unnecessary risks and complexity, COPE experiments start with a learning exercise as simple as possible and enhance the complexity of the following experiments step by step (see Figure 1). The basic idea behind follows a bottom-up approach for evaluation and demonstration, developed in a meeting between representatives of the Emergency Services College Finland and CESS in Kuopio held March , 11, 2009 and subsequent COPE meetings in Kuopio and Stockholm in 2009.

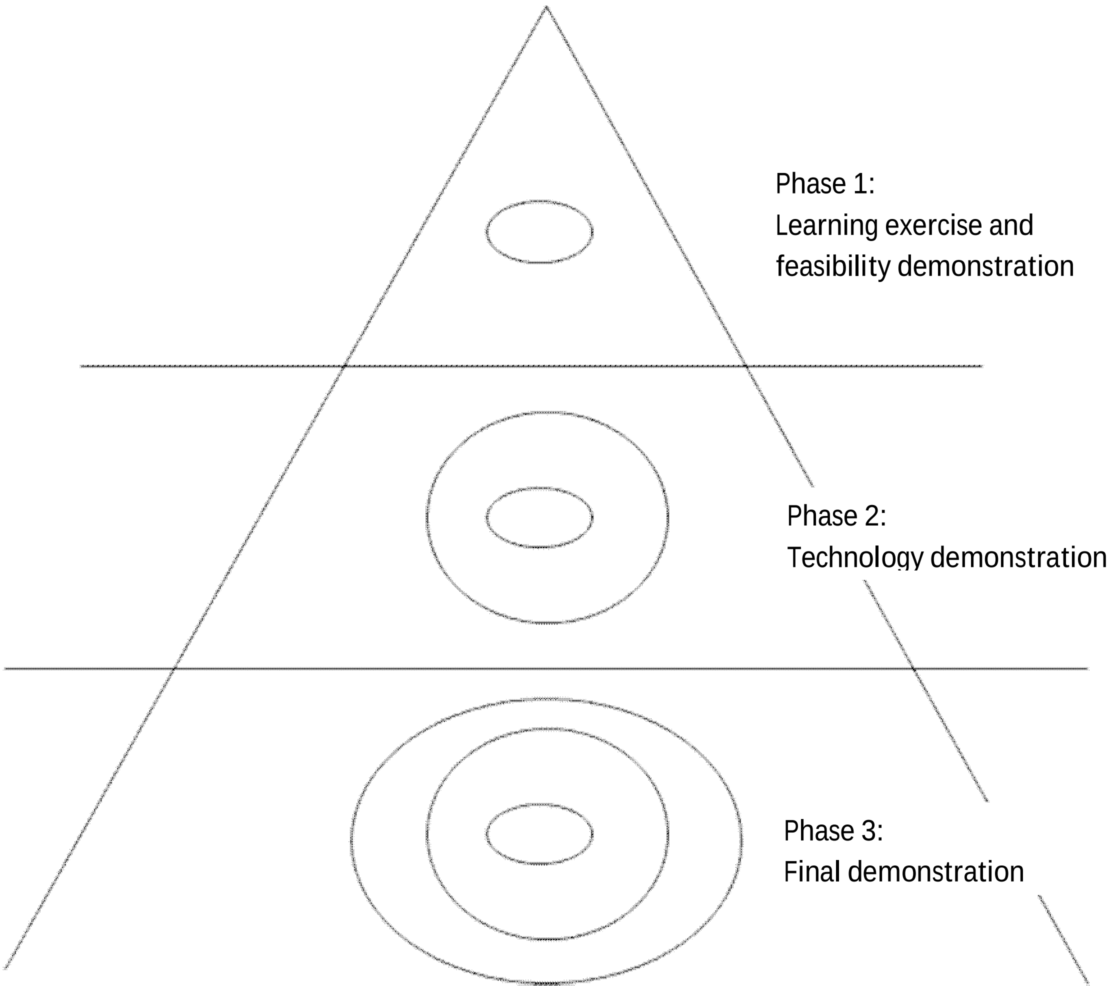


Figure 1: **COPE TEST, EVALUATION AND DEMONSTRATION EVENTS**

Phase 1 has been accomplished in May 2009 in Kuopio under the lead of the Human Factors Working Group. The results were documented in deliverable D2.2 “HF-based design inputs to COPE technology - conceptual and empirical considerations of Common Operational Picture.”

Phase 2 of the test and demonstration process will be based on the medium scale scenario with escalating potential. The scenario describes coherent major challenging events such as the explosion of the chemical factory and subsequent fire at the brewery facilities including the explosion of the Ammonia tower, imposing a high workload on rescue forces with respect to save lives and to protect properties and environment. Phase two will allow to validate and to demonstrate technology in an operational context, especially with respect to appropriate provision of information for a COP on the level of the Incident Commander and beyond. Phase 2 will also address the balance between quality and quantity, i.e. the balance between technological capability and available resources.

Phase 3 will be based on a medium to high scale scenario with escalating potential. Three mutual dependent, subsequent events will be combined with potential events in a scenario of high dynamics, challenging the technical and operational capabilities of rescue forces in saving lives, properties and the environment. Demonstration of COP related technology will be main focus. Phase 3 provides in an overall picture and the final demonstration of the findings of COPE. It combines operational and technological capabilities of first responders and their contribution to a common operational picture at incident commander and unit leader level and their impact on the efficiency of rescue forces in a complex environment.

It was agreed, to conduct Phases 1 to 3 at the Emergency Service College in Kuopio Finland (see Figure 2). The training facilities and the test area, including the infrastructure to accommodate visitors as well as personnel, are best suited for test, evaluation and demonstration.

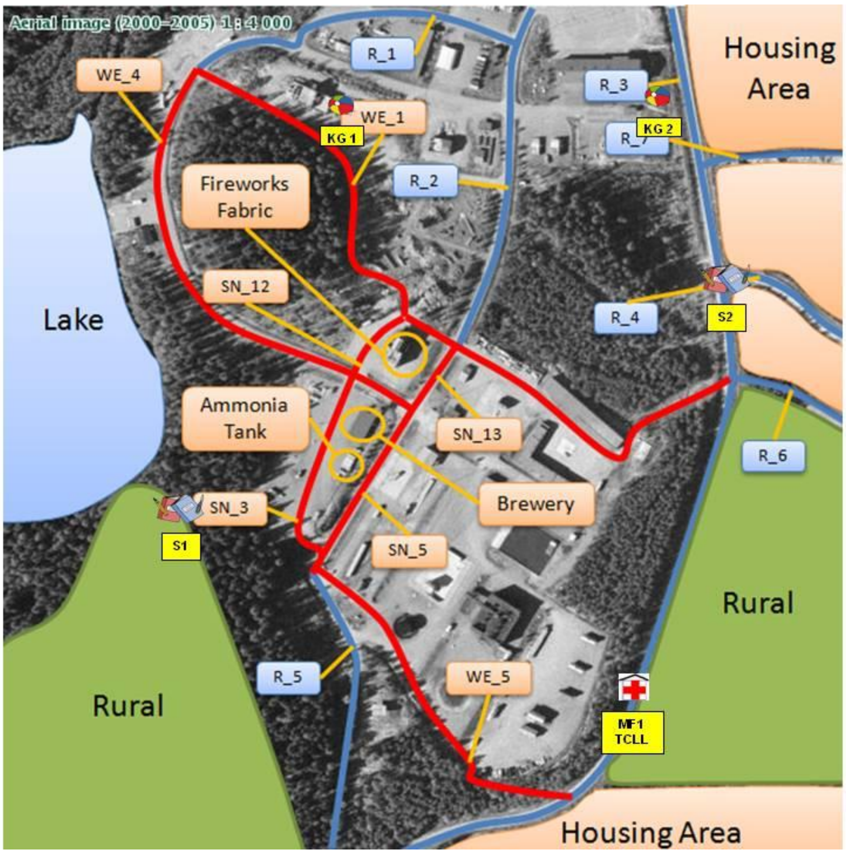
Figure 2: **AREAL VIEW OF THE ESC TRAINING AND TEST SITE IN KUOPIO**

The Environment of the Emergency Services College in Kuopio Finland

The Emergency Services College is the central education and training center for firefighting and paramedics. The Center is operating, teaching and exercising the whole alarm chain, resources management, and use of equipment, paramedics and fire fighting. For practical training an extended site for real life training and test is available, where houses, industrial buildings and equipment, cars, busses, trucks loaded with hazardous material, rail cars and coaches could be set under fire to be able to train under real life conditions. The Emergency Services College offers besides its extended training facilities conference rooms, hotel accommodation and food supply. It is an ideal location to fulfill the needs of COPE with respect to test, validate and demonstrate solutions and findings.

Figure 3 shows the integration of scenario elements into the Kuopio Site such as the Fireworks Factory, the Brewery, the Ammonia tower (“Tank”) as part of the cooling system of the brewery, the road network of the industrial area and the access roads. The two housing areas of the scenario, located south and north east of the industrial area, separated by a rural area, are plotted in the map, but they are notional areas. The lake west of the industrial area is real, providing fishing grounds and notional recreation facilities for the Citizens of D-

City! There is a slope from the industrial area down to the lake; that means that the countryside will drain to the lake; rescue forces will therefore have to take care of all polluted and/or poisonous water with respect to fire fighting activities.



Legend : KG = Kindergarten ; S = School ; MF = Medical Facility

Figure 3: **AREAL PICTURE OF THE ESC KUOPIO SITE**

Two notional schools (S1 and S2) are located west and east of the industrial area: S1 is located close to the lake at the edge of the western rural area; S2 is situated in the east close to junction R3/R4. Two notional Kindergartens – Kg1 and Kg 2 – are located north-west and north-east of the Fireworks factory close to the roads R-1 respectively R3. A notional Hospital MF_1 is mapped south- east of the Brewery at the edge of the notional rural and the housing area.

Dependent on the actual wind direction, the simulated ammonia cloud will propagate and contaminate the respective areas with their infrastructures (hospital, schools, Kindergartens). Object of investigation will be

- When does the common operational picture provide the IC with the needed information about actual danger and potential follow-on risks?
- How do the employed sensor technologies improve and speed up the COP build-up?
- How well does the COPE DST support and speed up IC´s decision making?
- Can the IC quickly and well enough assess the situation w.r.t. casualties, damages on roads and buildings, impact of chemical cloud on environment, and needed resources?
- Are the emergency plans of the neighbouring countries harmonized in such a way that additional resources can be requested and provided frictionless?

- Are the CONOPS harmonized for a frictionless cross-agency cooperation?