Trialing a Common Operational Picture in a simulated environment

a DRIVER project trial

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Abstract—This paper presents the "Operational Data Lift" trial conducted within the DRIVER project which aimed at assessing the operational benefit that a COP (Common Operational Picture) solution could bring to the coordination of a complex crisis in terms of vertical dissemination of information in the command chain and horizontal sharing of information with cross border partners and other domains (e.g: Health, Police...). The objectives, design, set-up and results of the trail are presented. Based on the CESIR simulator of Entente-Valabre, the Operational Data Lift trial has been a learning-by-doing experience bringing together organizations from the Civil Protection agencies, industrial tool providers and researchers, and a is a step forward towards making coordination easier between these various organizations.

Keywords—Common Operatinal Picture, Situation assessment, Command chain, Simulator, Trial, Interoperability, DRIVER project

I. INTRODUCTION

The DRIVER project (Driving Innovation in Crisis management for European Resilience) is an FP7 crisis management demonstration project which started in 2014. DRIVER has three main objectives:

- Develop a pan-European Test-bed for crisis management capability development,
- Develop a well-balanced comprehensive portfolio of crisis management solutions,
- Facilitate a shared understanding of crisis management across Europe.

The concept of a Common Operational Picture, which initially came from the military world, is defined as "a single identical display of relevant information shared by more than Frédérique Giroud, Alice Clemenceau CEREN ENTENTE VALABRE Gardanne, France f.giroud@valabre.com

one command. A Common Operational Picture facilitates collaborative planning and assists all echelons to achieve situational awareness."[1]

This concept of COP has since been adopted by the Civil Protection world, the idea is well known, several research projects have addressed this issue, including for example the FP7 COPE project [2], or the IDIRA project [3]. Some COP solutions are already in operational use, for example the LCMS (Landelijk Crisismanagement Systeem) in the Netherlands.

During a DRIVER workshop held at the I4CM event in Berlin (December 2015), many Civil Protection officers expressed that they considered COP as a direction to follow, but because of its technical and organizational complexity, considered it necessary to hold some preliminary investigations and trials.

A COP needs to be fed by other Command and Control systems (e.g: field, local Command and Control systems). This requires systems interconnections. But, as mentioned in [4] "for many reasons (political considerations, concern about the confidentiality of the information, competition or conflicting objectives between organizations, human behavior, lack of financing, etc.) there is no willingness to establish direct interconnection (between systems), but rather a need to utilize liaison officers between organizations."

Moreover, on the technical side, interconnecting current Command and Control systems often proves to be difficult (e.g: no import/export functionality available) or very poor (i.e: only pictures of the situations can be sent). The current lack of European standard in the representation of Emergency Management information does not make things easier.

For all these reasons, technical solutions should be incremental solutions, "in a step by step approach, as enablers of communication needs, and require training and experiments." [4]

The "Operational Data Lift" trial we present in this article implemented a learning-by-doing experience to mature the concept of COP in the Civil Protection community and assess its potential operational benefits.

II. PARTICIPANTS

Hosted by Entente-Valabre, at the CESIR (Centre Euroméditerranéen de SImulation des Risques) training center, the "Operational Data Lift" trial was led by Thales, co-organized with Valabre and Safe-Cluster, and involved Frequentis, MSB, Valabre and JRC as tool providers, and XVR as simulation provider.

The following Civil Protection organizations have been involved as players: French fire-fighters from BMPM (Marseille firefighters), from two other fire departments of South of France (SDIS13 and SDIS83), and from the Zonal Headquarter (EMIZ: Etat Major Interministériel de Zone) with a contribution of BSPP (Paris firefighters)

On the Swedish side, a former professional firefighter officer now working at MSB was in charge of the Swedish local Command cell.

Three evaluators -from Institut der Feuerwehr Nordrhein-Westfalen (D), Norfolk Fire Brigade (UK) and CESS (partner of the FP7 ECOSSIAN Project [5] - were involved in the trial as well as three DRIVER project internal observers from FhG-IAO, MSB and JRC.

III. OBJECTIVES AND RESEARCH QUESTIONS

The two main objectives of the "Operational Data Lift" trial are:

- To assess the potential operational benefit of a COP solution (as compared to the legacy solution) in terms of vertical dissemination of information (in the command chain) and horizontal information sharing (with cross-border partners)
- To assess the potential interest of the CESIR for the evaluation and validation/certification of new information systems and/or procedures. This new usage is seen as a potential business model for the CESIR Centre Euro-méditerranéen de SImulation des Risques) which is currently used exclusively for training.

The main expected operational benefits of a COP approach are :

- faster/easier dissemination of situational information between the various levels of command, and the various organizations involved,
- improved shared understanding,
- better decision making.

The main research questions of the "Operational Data Lift" trial are the following:

- Do the tested COP solutions bring the expected operational benefits: is information better shared, faster, with less effort?
- Does the use of the CESIR simulator bring effective support to this kind of trial?

IV. TRIAL DESIGN

The principle of the trial is to compare the information sharing offered by a COP solution (implemented with two different tools: Large Event (Thales) [6] and Life-X COP (Frequentis)) with the information sharing offered by Synergi (SYstème Numérique d'Echange, de Remontée et de Gestion des Informations) [7] the system used within the French Civil Protection for sharing and disseminating information to higher levels of command.

The same scenario was played three times by the same players. Run 1 was played with the legacy solution (Synergi) and procedure and Run2 and 3 with the Large Event tool and the Life-X COP tool respectively.

V. SCENARIO AND TRIAL SET-UP

A. Scenario

The scenario of the experiment - a forest fire followed by a chemical threat- was designed to require the sharing of information across borders, between the various levels of the command chain, as well as between various Civil Protection bodies (Firefighters and Police).

In the scenario, the fire starts close to a simulated Franco-Swedish border. The Swedish authorities are alerted. In order to fight the fire, the French fire-fighters must use water bombers which require a green light from the Swedish authorities since the lake where they intend to refill is on the border. The fire reaches a road where a truck containing chemical products is blocked. A plume model shows that the nearby village is threatened and must be evacuated.

Two threads have been selected to support the evaluation of information sharing. Firstly the dissemination and management of the warning of the Swedish authorities (cf. Tab 1) and secondly the dissemination and management of the chemical risk (cf. Tab 2). Each thread is characterized by a list of key points.

TABLE I. SCENARIO KEY POINTS RELATIVE TO THE WARNING OF SWEDISH AUTHORITIES

Nr	Thread key points
1	Water bombers sent
2	National Swedish Authorities warned
3	National Swedish Authorities updated
4	Local Swedish Authorities informed
5	Tactical situation uploaded (SITAC)
6	Tactical situation read by Swedish LHQ
7	Fire warning to Sweden

Nr	Thread key points
1	Chemical risk known
2	Plume Requested
3	Plume Uploaded
4	Leak alarm creation
5	Plume consulted by EMIZ
6	Leak alarm transmitted to Sweden
7	Message to European authorities

TABLE II. SCENARIO KEY POINTS RELATIVE TO THE CHEMICAL RISK

Each run of the scenario took approximately 45 minutes of simulated time, representing from 3 to 4 hours of operational time.

B. Chain of command

Many organizations were involved in the scenario. On the French side, the whole chain of command was involved, from field level to local, regional and national levels. On the Swedish side, the field level and the national levels were involved. Both countries communicated with JRC which played the role of ERCC (EU level).

The exchange of information in Run2 and Run3 was based on the following interfaces:

- Field level system (Asphodèle)[8] sent tactical information to the COP (Large Event for Run2 and Life-X COP for Run3)
- The COP was shared by Local, Regional and National levels
- The COP sent CAP messages to JRC (playing ERCC (Emergency Response Coordination Center)).

It should be noted that the EU current procedure for crossborder cooperation which is required to go through the national level was respected, yet some unusual information exchanges between France and Sweden was permitted in Run2 and Run3 by giving the Swedish teams access to the, COP and by directly sending them EMSI messages. In this respect the "Operational Data Lift" trial did not only assess a composite solution made of interconnected technical tools but also trialed a corresponding adapted procedure.

VI. TECHNICAL SET-UP

A. Simulation

The incident was simulated in the CESIR simulator, and located in a fictitious island ("Valabre Island" located in the middle of the Atlantic). The CESIR is a training center which includes a training simulator, a set of playing rooms and voice communication capabilities (radio). The simulator, usually exclusively used for training purposes can simulate fire propagation, firefighters' vehicles movements, aerial firefighting equipment, helicopters and boats. The fire trucks and helicopters were used in the trial.

B. Command cells

Each command cell (six cells altogether) was physically installed in a dedicated room of the CESIR, with access to the corresponding information system(s) and radio. The ERCC cell, played by JRC, was located at JRC facilities and connected through the Internet.

Each CESIR command cell was staffed by professional responders; the ERCC cell – which had no decision role in the scenario - was staffed by JRC colleagues. Commanding officers were assisted by a Command and Control (C2) officer (to assist them in the use of the C2 tools when needed or desired) coming either from first responders' organizations or from the organization providing the specific tool.

The French regional command cell (EMIZ) included (as in reality) a Police liaison officer. All other players were firefighters.

C. Command and Control tools

The Command and Control tools involved in the experiments were the following:

- Large Event (Thales) is a web based COP tools dedicated to crisis management. It includes a map view of the COP, a logbook, and an electronic document management tool.
- Life-X COP (Frequentis) is a web based COP tools dedicated to crisis management. It includes a map view of the COP and a logbook.
- Synergi (Ministry of Interior) is the Crisis Management portal of the French ministry of interior. The version used in the "Operational Data Lift" trial consisted of a secured logbook where Civil Protection stakeholders from various bodies can enter, and search for, crisis events. Other functionalities, including documentsharing facilities, are also offered by Synergi but were not used in the trial.
- Asphodèle (Valabre) is a field level tactical situation assessment tool. It is used by firefighters to manage the intervention on site. It consists of a graphic editor based on a GIS.
- LUPP (MSB) is a web-based application for situation awareness and command & control. It provides a mapbased operational picture, manages dispatching of resources and includes document-sharing capabilities. It is an operational tool of the Swedish Civil protection agencies.
- Crisis Wall (JRC) [9]: Crisis Wall is the tool used by ERCC to display various EU Crisis Management portals such as GDACS[10], EMM[11], ERCC Portal and collaborative risk systems. The software also receives and displays data from various other data sources Reliefweb [12] (disasters and updates) and

direct user input. In this trial, only the COP functionality was used.

D. Information sharing

During the legacy solution run (Run1), the technical information sharing was provided through Synergi (c.f. Fig 1) which received pictures of the situation via mail from the French field level system Asphodèle. The situation shared though Synergi was based on text and pictures. The Swedish side was only informed by telephone. The ERCC was not technically connected.



Fig. 1. Information sharing during Run 1

During the COP solutions runs (Runs 2 and 3) the technical information sharing was supported by the COP tools (Large-Event or Life-X COP) (cf. Fig 2.), which could be accessed through the web by various organizations (here from local to national levels). Other tools (field level and EU level) were connected through the exchange of formatted messages. COP tools were fed by field level tools. The COP provides map based situation assessment and a logbook.



Fig. 2. Information sharing during Run2 and 3

The "Operational Data Lift" trial followed the standards chosen by the DRIVER project: EDXL-DE (Emergency Data Exchange Language, Distribution Element) [13] for message envelopes and EMSI (Emergency Management Shared Information) [14] and CAP (Common Alerting Protocol) [15] standards for content.

This exchange of standard-based structured messages required some specific developments for Asphodèle and Lupp which did not initially include this functionality.

E. Simulator

The CESIR (Centre Euro-méditerranéen de SImulation des Risques) is a facility specially focused on a Virtual simulation environment, with an area of 600 m² fully customizable for any organization. The Simulation Center is equipped with a XVR simulator based on a Unity graphic engine. As a close partner, CESIR develops specific environments for this software with further add-ons to provide new functionality and new risks. All computers in CESIR are linked on the same network providing a realistic and interactive multiplayer environment.

- 200 computers linked
- 220 display screens, beam projectors, interactive boards and screens
- 2 helicopter cockpits
- 2 plane cockpits
- 1 boat cockpit
- 2 training rooms with next generation computer

VII. EVALUATION METHODOLOGY

Both qualitative and quantitative methodologies were used to evaluate the two main objectives.

A. Qualitative methodology

Questionnaires were distributed after the experimentation to collect the immediate feedback of both players and evaluators on the following points:

- Usability of tools (using SUS questionnaire [16])
- General satisfaction and interest for further experiments
- Relevance of experiment set-up (with regards to the objectives)
- Actual delivery of a COP function
- Overall appreciation of the benefit provided by COP solutions
- Interest of using the CESIR Simulator

In addition to the questionnaire, two focus groups were organized to collect more in-depth players' feedback (the day of the 3 runs) and evaluators' feedback (the day after).

• Open comments concerning the organization

• Requirements for further experiments

With the evaluators, the discussion was focused on the way they work and the methodology they apply to evaluating crisis management exercises.

B. Quantitative methodology

A quantitative methodology was defined in order to measure the sharing of information in terms of effectiveness, speed and richness.

The methodology was applied to some turning points of the scenario, and based on the analysis of the logs of the COP tools. For each turning point the following characteristics were collected:

- Availability (has the information been received through the information system? (y/n))
- Time (date when the information is received by the organization through the information system)
- Depth of information in the information system (is it represented by a text, an image, a geolocated image/text, a tactical object (with characteristics)

All these characteristics depend rely on the functional import/export capabilities of the information systems which constitute the COP solution, and the exchange capabilities between them.

C. Use of CESIR simulator

This qualitative information was collected by questionnaires distributed immediately after the experiment, and again a few weeks after the experiment. Two hot wash-up debriefing sessions were organized, first with players, then with observers and evaluators.

VIII. RESULTS

The analysis of the quantitative and qualitative data and feedback provided the following results.

A. Usability of tools

This usability measure questionnaire was submitted to the three players using the COP tools at Local Headquarter, Regional Headquarter and National Headquarter. Players received a simple one hour hands on training on each COP tool, and assistance was available during the runs: in French (the language of the players) for Large Event and in English for Life-X COP.

The usability of both COP tools was evaluated by players as good (cf. Fig.3).



Fig. 3. Usability of tools (SUS Questionnaire Score)

Considering that only three persons participated in this rating, the difference between the scores obtained by the two COP tools cannot be considered as revealing any significant superiority in terms of usability. This conclusion was confirmed during the qualitative feedback: both tools were described as easy to use. The section main requests for change made by the players are listed in section [E].

B. Relevance of trial set-up

This question was asked of the three external evaluators and three DRIVER observers on a scale from 0 (not at all) to 5 (completely) on the y-axis, and each evaluator on the x-axis.

The scores (cf. Fig 4) show that the trial set-up was well adapted to the objectives.

Question: Do you think that the set-up of this trial is well adapted to the objectives?



Fig. 4. Relevance of the set-up

The actors, evaluators and observers appreciated the replay of the same scenario and the comparison to the legacy tools. Players mentioned in their feedback that the comparison of each tested tool with Synergi (legacy tool) enabled users to evaluate differences and industrialists to have a better knowledge of the currently available tools and uses.

The main positive difference that was mentioned during the qualitative feedback was the ability of headquarters from Local to Regional and National levels to access a common map-based situation.

C. Interest of simulator

The interest of the CESIR was unanimously recognized by players who rated very positively the hosting of the trial and the use of the simulation that, they said, gave them a sense of thrill, which made their use of tools closer to operational conditions.

D. Improvement of the information sharing

The effectiveness of the information sharing activities was analyzed along two main threads: the cross border cooperation (cf. Fig 5: Warning of Swedish authorities) and the chemical risk (cf. Fig 6).



Fig. 5. Warning of Swedish authorities (minutes)



Fig. 6. Chemical risk thread (in minutes)°

The analysis of figures shows that the COP solution (Runs 2 and 3) did not introduce a significant improvement in terms of speed. Especially since the data transfer doesn't depend on the tool, but rather on the speed at which the information is prepared by the team in charge.

The qualitative feedback shows that the information exchange is perceived as much more seamless and that the more important "depth" of information that is conveyed by the COP solution facilitates a better common understanding. With the COP solution, it is not only text or images, but also text and images and tactical objects on a map, and the map view of the COP as a whole that can be shared.

The feedback is that it reduces the number of questions needing to be answered by radio, for example the size of the fire. As the radio communications were not logged, this improvement could not be quantitatively evaluated. As shown in Fig 7, observers and evaluators were positive about the experience and considered that is was a positive step forward. They also declared they would be interested in being involved in another trial.

Question: Do you find this trial an interesting way forward?



Fig. 7. Interesting way forward

E. Lessons learnt and requirements for future trials

Players and evaluators declared their interest for a follow up of this trial. During the debriefing they formulated the following requirements which sum up the main lessons learnt from the Operational Data Lift trial:

- A more complex scenario, for example a multi-site terrorist attack, with a risk of saturation of high-level decision makers by huge flows of information.
- The way of presenting information in the COP should be adapted to the level of command. Higher levels should see information in an aggregated way. Players mentioned that tools should be adapted to enable different representation for higher levels which should see information in an aggregated way.
- In the "Operational Data Lift" trial, only firefighters and policemen were involved. The involvement of other domains (e.g.: Health) in the COP is regarded as both possible at this point and expected.
- The sharing of information with other Civil Protection bodies requires that each organization contributing to the COP identifies the type of information that it wants to share with others.

A follow-up trial of "Operational Data Lift" will be organized in 2018. Most of these requirements will be fulfilled by this trial: the scenario will be based on a multi-incident use case, and more Civil Protection agencies will be involved, including the Firefighters, Health and Police.

The way the activity is logged (message exchanges, COP tools, radio) will be improved to facilitate the quantitative analysis.

IX. CONCLUSION

The DRIVER project "Operational Data Lift" trial can be considered a success. It gathered a heterogeneous community of industrial research institutions and Civil Protection organizations in a learning-by-doing process around the COP.

The trial demonstrated the interest in a COP as a method of facilitating the dissemination of information - both in the vertical (command chain) and the horizontal (cooperation) dimensions. It showed that giving access to the same map, and providing "richer information", facilitated a common understanding of the situation, which in turn facilitated better cooperation during the incident.

It also demonstrated the interest of using the CESIR not only for training but for also for the validation of new tools, solutions or procedures. The "Operational Data Lift" trial demonstrated the soundness of a new business model for the CESIR.

The DRIVER experimentation process does not aim to prove some abstract truth. It enables Civil Protection stakeholders, who want to try a new solution (tools and procedures), to do so in a secure environment where no life is at stake, and where it is not their proficiency that is being evaluated but the solutions and procedures.

Trial "Operational Data Lift" has created a positive feeling about the trialing process put forward in DRIVER and opens up many promising perspectives for future trials. Organizations, which were at first reluctant to share a COP with other domains, are now ready to extend the number of domains involved in the frame of a trial.

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The evaluators, with their professional experience as commanders, teachers and evaluators to this trial brought a precious methodological perspective for the evaluation, as well as an encouraging feedback.

We would like to express our gratitude to all of them.

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