CascEff

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D5.4 - Report on validation of implemented incident management methodology.

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Executive Summary

D5.4 Report on validation of implemented incident management methodology deals with the creation, preparing, Implementation and evaluation of the validation workshops. This validation was performed in order to assess the ability of the Incident Evolution Methodology (IEM) to support managers to plan, prepare, and cope with crisis or emergency situation dealing with cascading effects. This was done by validating the IEM based on defined criteria.

Within the CascEff project, the validation workshops are the culmination of the research and a first test to put the developed methodology theory into practice. If the validations result in a positive uptake of this methodology, it validates the research approach and results, and thus bring to the emergency response organisations a new insight and improved risk management practice for cascading effects. The main objective of the validation was to assess, in the context of risk management involving cascading effects, usability and applicability on one hand and credibility and added value of the IEM on the other hand.

The validation method was to run multiple table top sessions:

- A blind table top emergency situation to gauge the cascading effects consideration level of the participants using their current practices & tools.
- A learning session introducing the methodology steps and an application based on the previous session emergency situation.
- A knowledgeable table top emergency situation to assess improvements over the baseline with the new knowledge of the methodology

During and in between sessions a questionnaire was answered by participants to collect their perception about the IEM based on the selected criteria. These answers were associated with observations of external observers and assessments of CascEff validators.

The overall findings and conclusions both for the preparedness and the response phase are:

- The IEM is perceived, by most participants, as bringing added-value in particular because it provides a global structure for identifying and modelling cascading effects.
- It is recommended to use the IEM during the preparedness phase and on small scale scenario's in order to get familiar with the concepts and to build a geographically specific database of systems, timelines and impacts.
- Once familiar with the IEM and once having existing data, it is then easier to use the IEM in response phase.

Since the IEM is a central result of the CascEff project, the results from validation sessions and the experiences gained from the presentations, its use and discussions during the validation workshops are also useful for other parts of the project,

Specifically, feedback gained from the validation workshops has been included in the design of the training material on the IEM, taking into account experiences made while presenting and explaining the methodology to participants (see the D6.6 deliverable report and the training material presented on the CascEff website). Also, feedback from practitioners has been an important part of the elaboration of the recommendations on improved incident management that are presented in D1.5.

The Incident Evolution Tool (IET) was demonstrated (not validated) during the validation workshops. Its presentation to the participants enabled them to understand how an IEM based support tool could facilitate the application of the methodology. Furthermore, the results from sessions and discussions on how to use the IEM and IET together with e.g. incident management tools is described in deliverables D4.5 and D5.2.

Nomenclature

Symbols, abbreviations

CV	Campus Vesta
EEAB	External Expert Advisory Board
IEM	Incident Evolution Methodology
IET	Incident Evolution Tool
IMT	Incident Management Tool
UL	University of Lorraine

Glossary

Added value
The degree to which the methodology improves both awareness and recognition of cascading effects and incident management decision options in dealing with these effects in crisis situations.

Credibility
The reliability of the Incident Evolution Methodology outcomes from expert's point of view

Incident Evolution Methodology (IEM)
A structured Methodology for predicting and listing cascading effects, their impacts and emphasizing critical points as support to crisis and emergency managers.

Observers
Staff present for assisting the validators in their job through the observation and report of interesting moments during the validation sessions. They could be CascEff Consortium members or outside experts.

Participants
Invited people attending the validation workshops, getting the methodology presented and then applying it to the scenario used for the validation. They fill in various feedback moments to support in the data collection for the validation

Preparedness phase
Phase of training, exercise and planning whose aim is to prevent and/or get prepared to a crisis or an emergency situation.
Activities dealing with building knowledge and developing capacities to effectively anticipate, respond to, and recover from the impact of likely imminent or current hazard events or conditions. (ISO 22315:2014)

Response phase
Phase of crisis or emergency situation management dealing with resolving an existing crisis.
Immediate and ongoing activities, tasks, programs, and systems to manage the effects of an incident that threatens life, property, operations, or the environment. (ISO
22300, 2012)

Usability / Applicability
The degree to which the methodology can be applied as designed to real-world situations. Being understandable and applicable within an acceptable level of required effort.

Validators
Consortium members only, who rate the added value, credibility and the applicability of the IEM as well as combine the various observations and feedbacks, while taking into account observer observations.

Validation workshop
Both meetings held at University of Lorraine and Campus Vesta which welcomed participants to discover and evaluate the IEM. A validation workshop is divided into validation sessions.

Validation session
Within the framework of a validation workshop, validation sessions have been carried out for participants focusing on specific objectives.

1 Introduction

1.1 Main goal of this task

The ultimate goal of the project is to enhance the knowledge of cascading effects, resulting in better analysis, preparedness, response actions and understanding for first response and other disciplines involved in incident management. One part of this has been to develop an Incident Evolution Methodology (IEM). The validation of this methodology is the core activity of this task and deliverable.

According to the DoW this task:
"will test applicability of the final Incident Evolution Methodology, how it can be used in combination with various incident management tools and how it will improve incident management of cascading effects. Participating incident commanders will have the opportunity to follow and manage an incident as it evolves, including the impact of their own decisions on the incident timeline.
This task will also focus on testing the methodology in a range of contexts: in pre-incident planning; in incident response; in a post-incident debrief; and in a training context. At least one simulation will be organized using iCrisis and XVR as simulation support tools and existing IMT's, especially dedicated to test the implemented methodology."

"The XVR and iCrisis simulation platforms will be used to enhance the observation of the behaviour of first responders in a controlled, measurable but realistic setup."

1.2 Short description of the Incident Evolution Methodology

One of the main objectives of the CascEff project has been to develop a methodology (the IEM) to support cascading effects modelling for emergency responders, competent authorities, critical infrastructures operators, and others needing to understand and determine dependencies, vulnerabilities and the risk for cascading effects. The IEM was developed to be able to be used in different phases (planning, preparedness, response, recovery) of emergency management of small and large incidents with cascading effects in a specific region (case area).

The methodological framework of the IEM constitutes of six steps:

1. Set the case area and the individual systems in a given territory. All the systems are described in terms of functionality/provision services, vulnerability and potential outgoing effects;
2. Identify dependencies between systems. Dependencies are identified in regard to systems' proximity and functionality,
3. Propagate the effects between systems. An initiating event is set in the case area, threatening the systems which can be impacted and which can impact, through cascading effects, other dependent systems,
4. Determine temporal aspects. Buffer time, time-delay and overviews of timeline and tree-view are assessed in order to evaluate the potential time interval emergency responders have for mitigating effects,
5. Assess the impacts. Social, human, economic, environmental and infrastructure impacts are evaluated for each impacted system in order for the emergency responder to compare impacts of cascading effects,
6. Identify the key decision points. The combined assessment of timeline (step 4) and impacts (step 5) help the emergency responders to prioritize mitigation actions.

More details on the IEM and the different included terms and parameters are presented and discussed in D4.2.

The IEM was validated during the validation workshops described in this report rather than the Incident Evolution Tool (IET).). While the IEM also formed the basis for the development of IET, as described in another section in this chapter, the IET was not an integrated part of the validation workshops.

1.3 Validation objectives

To ensure applicable end results from the IEM and create buy-in with future end-users, practitioners were involved at different stages of the project: ongoing through the EEAB, through focus group meetings when developing the IET and in validation workshops on the IEM. The two validation workshops held near the end of the project aimed at collecting external feedback from practitioners in order to validate the applicability/usability, credibility and added value of the IEM versus the current practices for managing cascading effect scenario's.

Although not a validation objective, the IET was presented at the validation workshops to evaluate the time-gain and flexibility of using an IT tool based on the IEM. The results from sessions and discussions on how to use the IEM and IET together with e.g. incident management tools (IMTs) are described elsewhere (see D4.5 and D5.2).

1.4 Initial expectations on the use and applicability of the IEM

The most optimistic expectation is that the methodology enables (1) to teach about cascading effect modelling and decision making; (2) to provide an understandable and effective step by step guide; (3) to enhance understanding of cascading effects (4) to integrate cascading effects modeling into existing incident management practices. One goal is to improve current incident management practices, especially emergency planning and incident response, for incidents involving cascading effects.

The minimal expectation is that the methodology enables teaching about cascading effect modelling, resulting in an enhanced awareness of cascading effects but no integration into current incident management practices.

1.5 Validation scope

The scope is focussed on validation of the developed methodology as described in D4.2. The number of workshops was limited by the available validation period according to the project plan and the participants' availability in that period. The validation is geared towards a participant profile representing a mix from different first response disciplines and supporting actors (differing according to the scenario at stake), involved emergency planning and/or incident response.

The validation covers two sessions on the preparedness phase without and with the IEM held at both the University of Lorraine (UL) and Campus Vesta (CV), and one response phase session held only at the University of Lorraine (UL).

1.6 The validation history

In the original description of work for CascEff, one objective of the project was to develop a methodology in the form of an incident evolution tool (IET). The IET would be made available so that it can be implemented by others in already existing tools, e.g. incident management tools (IMTs). The methodology and its implementation in existing tools would have been validated by implementing it in tools supplied by partners in CascEff. This objective has been somewhat changed during the course of the project as described below.

One important part of the project has been to communicate with possible end users and stakeholders on different issues concerning management of incident with cascading effects. This communication has included surveys, (e.g. Task 1.2 and Task 4.1) interviews and discussions with end users/stakeholders (e.g. the EEAB) and IMT product managers from consortium partners. One of the results from these studies and discussions at an early stage was that the IET would be of much better use if developed as a standalone tool with the potential to communicate with existing IMTs, rather than needing to be implemented into an existing tool. This was particularly the result from the project meeting at INERIS in France in March 2015.

In parallel with the development of the standalone IET, the methodology (IEM) was further developed and described in D4.2. During the project meeting at RISE (SP) in Borås in Jan/Feb 2017, it was concluded that it would be an advantage to validate the methodology (IEM) instead of the IET. This would mean a broader validation of the underlying methodology and also avoid the getting stuck in technical discussions on specific technical requirements from the perspective of each particular IMT.

1.7 Deliverable outline

The general outline and basis for the validation workshops, the main objectives and associated criteria and the workshops themselves are explained in Chapter 2 of this deliverable. The matrix with the developed validation criteria is presented in Appendix 1.

In Chapter 3 more details on the practical preparations and performance of the two validations meetings (at University of Lorraine and Campus Vesta, respectively) are given. This includes a description on the selection process for the scenarios used. The detailed schedules of the validation workshops are presented in Appendix 2 and Appendix 3, respectively.

The results from the validation workshops are presented and summarized in Chapter 4. Supporting results for Chapter 4 can be found in Appendix 4. Specific observation during the different validation sessions are summarized in Chapter 5 while some general conclusions are given in Chapter 6.

The PowerPoint presentation of the IEM used during the workshops is included in Appendix 5. In Appendix 6, the questionnaires used during the validation sessions, to be filled in by observers, validators and participants, respectively, are presented. Finally, the lists of participants in the validation workshops are included in Appendix 7.

2 Incident Evolution Methodology validation process

One of the challenges of research leading to the development of methodology is to provide objective evidence on whether the steps of the methodology as well as the whole methodology are sound. Hence, such research commonly treads through various steps including the methodology design, its development and its validation.

The process to prove the credibility, applicability and value add of the IEM is shown in Figure 1. It started with the selection of the validation criteria and ended with the analysis of the data obtained during the validation tests conducted with respect to those criteria. If all criteria are met, the IEM can be considered as valid. Otherwise, the validation process should allow for identifying suggestions for improvement of the IEM in order to meet all the criteria. Methodology validation is a complex and challenging activity. Fulfilment of the stated criteria can be very difficult and in this case often subjective. Often it is impossible to meet them all. This section discusses the selection of the validation criteria and the definition of the validation steps.

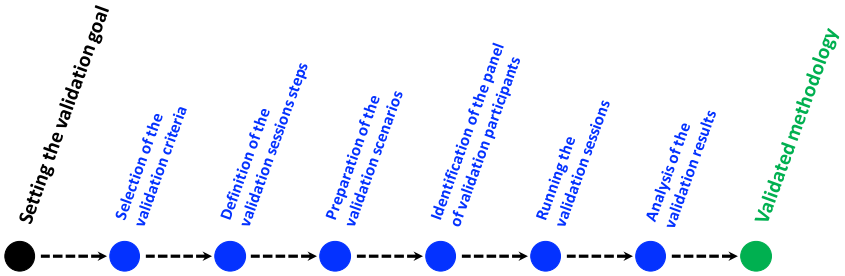


Figure 1: The IEM validation process

2.1 IEM validation criteria

The criteria against which a methodology, model or tool is judged are of paramount importance. A criterion defines what aspect of the methodology, model or tool one wants to examine. Literature review shows that possible validation criteria of a methodology could be classified in three groups) according to the following methodology criteria (Kitchenham *et al.*, 1997; Olewnik and Lewis, 2003):

- its basic characteristics (being logical, complete, understandable, usable, internally consistent, etc.);
- its use (being helpful, producing the specified, usable and relevant results, using meaningful reliable information, not biasing the user, etc.); and
- the provided gain (it must provide added value).

Because validation criteria are context dependent, their selection depends upon the specific purposes of the methodology under validation. Therefore, when choosing appropriate criteria one must ensure that the criteria are relevant from the validation objective perspective.

2.1.1 Set validation objectives

Based on the DoW and on previous work in the project (see CascEff D1.4, 2016), three objectives have been retained as the most significant for the validation of the IEM: **applicability**, **credibility** and **added value**. Acceptance and adoption of the IEM by the target audiences would mostly rely, on its applicability and added value. In the context of the IEM,

- applicability refers to the degree to which the methodology can be applied as designed to real-world situations (being understandable and with an acceptable level of effort).
- Credibility is the reliability of the IEM outcomes from expert's point of view.
- Added value corresponds to the degree to which the methodology improves both awareness and recognition of cascading effects and incident management decision options in dealing with these effects in crisis situations.

The main expected results of the IEM validation process are (1) to demonstrate that the IEM can be easily and successfully used; and (2) that the IEM offers incident management practitioners a tool that helps them conducting a rigorous analysis of incidents with cascading effects and supports effective decisions-making.

2.1.2 Define validation criteria

For each of the three objectives, validation criteria have been defined depending on the context of the specific emergency management activity in which the IEM was to be evaluated during the validation process: pre-incident planning, training and incident response). The criteria have been created (see Appendix 1) based on the objectives of each of the six steps of the IEM.

2.1.3 Establish Questionnaires

To ensure consistent evaluation of the criteria across all exercise roles and across both workshops, criteria have been converted into questions per role. Questionnaires by role (see Appendix 6) have been distributed during both validation workshops. Besides the team, responsible for the organisation of the workshop and the setting of the exercises, three categories of exercise roles contributed actively (based on CascEff D1.4, 2016):

- **Participants**: invited people playing the exercise. They receive training on the methodology and apply the steps to the scenario used for the validation. They fill in various feedback moments to support in the validation.
- **Validators**: CascEff consortium members evaluating the application of the methodology by the participants without taking an active part in it. The validators take into account observer observations about key moments.
- **Observers**: staff present assisting the validators in their job through the observation and report of interesting moments during the validation sessions. They could be CascEff Consortium members or outside experts.

2.2 IEM validation exercises steps

2.2.1 Introduction to the different sessions

The validation process was organised around the relevant two incident management phases: preparedness and response. Based on these, the activities to undertake were defined. The initial idea was to have a generic process, lasting two days, to be applied for both validation workshops.

Finally, it was decided to validate the IEM for both preparedness and response phases at University of Lorraine and, in line with feedback from the Belgian Focus groups, only for the preparedness phase at Campus Vesta. As the first validation workshop comprised two perspectives, a generic process combining these perspectives were developed with the idea to after the first workshop adjust if for the second workshop. Thus, for the first validation workshop (in University of Lorraine), it was decided to conduct 3 sessions to validate the IEM. The activities of the two first sessions were linked to the preparedness phase, and the third one to the response phase. The second validation workshop (in Campus Vesta) was performed following the same steps, except that the session 3 was not included.

The three sessions can be described in the following way (for more details see Sections 2.2.2 - 2.2.6:

- ✓ Session 1 (both UL and CV) corresponds to a control case to which the outcomes of the use of the IEM will be compared. The main goal of the activities of this session is to ask the participants to identify cascading effects and key incident management decision for a given incident in a specific location. In this session participants are asked to use their existing practices and Incident planning and management tools.
- ✓ Session 2 (both UL and CV) consists of using the IEM as a standalone methodology to identify cascading effects and key decision points of the same incident as in session 1. Comparing the outcomes between the first and the second sessions allows demonstrating the improved effectiveness of decision making with the IEM. The participants applied the IEM step by step via an instructor lead ok training session.
- ✓ Session 3 (only UL) deals with training for incident response. It consists of running a simulated incident, supported by some of the partner's simulation tools incorporated into the project (iCrisis and XVR) to support decision-making during the exercise. Participants were free to utilize the known IEM during this session.

The activities of the two validation workshops were based on two of the scenarios provided in CascEff Deliverable D5.1 (see chapter 3): the cross-border blackout scenario between the Netherlands and Belgium and the Séchilienne scenario in France. During sessions 1 and 2 of the UL meeting, each participant team had to work on a "mini scenario" (storyline; different from the one depicted in the deliverable D5.1) related to an incident with cascading effects within the context of the Séchilienne scenario. This was chosen to introduce the territory to the participants. In the case of session 3, the entire Séchilienne scenario (depicted in the deliverable D5.1) was used. For the CV meeting, only the complete Blackout scenario was used for session 1 and 2. The two teams (Belgium and the Netherlands) both worked separately on those aspects of the scenario that impacted their territory. Information exchange between both teams was allowed, similar to how the teams operate in reality.

The full validation process is presented in the following paragraphs.

2.2.2 Session1 – step 1: General introduction

The participants were introduced to the CascEff project, as well as to the process and objectives of the validation exercise.

2.2.3 Session 1 – step 2: Determine the baseline

The participants were split into different groups of participants, representing different crisis management policy levels or regions. (municipal, provincial/prefecture or region bound) for Session 1.

The objective of Session 1 (control case) was to define a baseline using participants' existing practices, processes, tools and expertise. The assignment was to determine what the potential cascading effects were for a given scenario in a planning context. Participants were free in the organisation of the exercise structure and the tools they use. The same context and event was reused in the second session. Following the exercise, participants were requested to fill out a questionnaire (see Appendix 6).

2.2.4 Session 2 – step 1: IEM presentation

The second session started with the explanation of the IEM: terminology, concept and a high-level overview of the 6 steps using an example incident of a flooding with cascading effects on roads, electricity infrastructures, an industrial plant and a school. The PowerPoint used for the presentation of the IEM is available in Appendix 5. In UL this presentation was conducted by team, at CV both teams were grouped together.

2.2.5 Session 2 – step 2: Application of the IEM

The participants were divided again in the different teams. The participants were requested, within a given time frame, to apply the IEM steps to the same scenario from session 1. At the end of each step the participants, validators and observers were asked to complete a questionnaire on that specific step. This allowed evaluating the applicability, credibility and added value of each step and get detailed feedback on where there is space for improvement in the explanation of the methodology. Conclusions are used to create training materials (D6.6) and provide input to D1.5

2.2.6 Session 2: demonstration of the IET

Finally, the IET was demonstrated as an application of the IEM. The 6 steps were demonstrated using a limited number of systems in a specific area. The incident was then simulated and the visualisation of the system tree and geographic area were shown. The simulated impact of mitigation decisions was also demonstrated. The objective was to demonstrate that with the IET the speed of simulations can be brought back to a much more workable level than with a manual application of the IEM.

2.2.7 Session 3: Application of the IEM in association with another tool

The purpose of session 3 was to observe how the IEM would be used in a training simulation of a crisis situation. Hence, the participants were immersed in a crisis situation simulated with iCrisis™ supported by XVR. They were split into different crisis units where they intended to steer this situation at a strategic level. The instructions given to them were to use any tool they would need. By doing so, the decision to use or not use the IEM was left to the participants. Following the simulation, participants and observers were requested to fill out a questionnaire (see appendix 6).

We used iCrisis, visually supported by XVR images of the scene of the incident, to create the context of a crisis situation in order to immerse the participants. This setup enabled the observation of the behaviour of risk and crisis stakeholders within a simulated situation that has been scientifically proved to be psychologically realistic. The added value of such simulation approach was also that it allowed the CascEff validators to be present and make observations and assessment of the use of the IEM.

The consolidation of all responses in the questionnaires of the different IEM steps provides data for the validation targets. An analysis of these results can be found in Chapter 4.

3 Preparing the Validations

3.1 Inviting participants

The participants of the Validation workshops should ideally represent as broad a spectrum of emergency response practitioners and risk managers. This includes besides the first response disciplines, also representatives from critical infrastructure, competent authorities and policy/law creating bodies.

All partners in the consortium from the three involved countries in the validation workshops (France, Belgium and The Netherland) were asked to reach out to their contacts that might be interested in partaking in the validation workshops.

At a later stage we learned that the Government of Antwerp city was holding a large scale outside real life exercise on the same dates as the CV validation. Re-scheduling was discussed but deemed no option due to the tightness of the project planning.

For the UL validation, 19 people partook including: the mayor of a local municipality, managers of local infrastructures, local and regional risk managers, risk expert, crisis situation consultants, social media specialists, policy makers, researchers and finally several higher officers (management level) of the fire and rescue services, police departments and army.

In the CV validation, 11 people including: several officers (boots on the ground level) of the fire, police and medical branches, as well as some government liaised policymakers and advisors.

See Appendix 7 for both the participant lists.

3.2 Preparing two separate scenarios

The scenarios used to validate the IEM needed to be relevant, i.e. being within the scope of the methodology. The incidents to manage needed to be similar to the intended problems for which the IEM had been designed: crisis situations with cascading effects. Therefore, they have been selected within the scenario elaborated during the project (see deliverable CascEff D5.1, 2015).

3.2.1 Scenario selection

During the scenario selection process, first and foremost thought was given to which scenario would be credible for the participants. A foreign scenario would most likely feel like a random exercise with virtual data, requesting participants to imagine the possibility of cascading effects instead of them realizing there are cascading effects.

Also, the methodology would have to be about the actual data, or as close to the truth one could get. We concluded that it was better to run with scenarios close to the participants' daily operations, also neatly omitting any language barrier problems.

Secondly, thought was given to the locations of the validations in relation to the in D5.1 developed scenarios. Also on request of the Commission and reviewers stated at the review meeting in December 2015, we were asked to incorporate a large scale cross border situation in the validation workshops.

Taking into account the previous criteria, The Dutch, Belgian and French scenarios were selected as possible options from the scenarios developed in the framework of the project (see D5.1.

Thirdly, thought was given to which scenarios were realistic given the above constraints. Small scale and close to home for UL and large scale cross border for CV resulted in the selection of the 2 scenarios from D5.1 to be run during the validations:

- ✓ Séchilienne scenario

This scenario is a fictitious but realistic scenario that considers natural and man-made issues. Due to the important potential consequences, the site is well documented and monitored by INERIS[1]. The nature of the site and events makes this scenario very interesting in a perspective of cascading effects.

- ✓ Cross-border blackout scenario

This scenario considered all relevant aspects the Commissions asked for in the review report: cross border, not only large scale but explicit cascading effects, combination of natural and man-made, realistic scenario to be expected in the future.

[1] COCCIA, Stella ; KINSCHER, Jannes ; VALLET, Aurélien, 2016. Microseismic and meteorological monitoring of Séchilienne (French Alps) rock slope destabilisation. Proceedings of the International Symposium Rock Slope Stability 2016, 31-32

3.3 Other preparations: Logistics, agendas and organization

Besides the preparation of the scenarios during the validation and the invitations to participants, the logistical aspects also had to be prepared. Both hosting partners prepared initial and final agendas (see Appendix 2 and 3)

Thought was especially given to the time and pacing of these agendas. As participants were new to the whole methodology, time was needed for it to sink in. Instead of doing the whole introduction in one go, it was decided to stage the introductions per step and break it up with questionnaire questions. These questions both served as breaks and as observation on how well the material came across. This made it possible to get overall observations, as well as study the understanding and use of each step of the methodology. As well as providing valuable input to the development of training materials in T6.5.

The UL validation placed various groups in different rooms that were separated throughout the university, aiming to help participants to place themselves in a context of a regular situation. For the CV validation, care was taken to assure the used rooms were adjacent, as lessons learned at UL showed closer proximity allows for better staff communications enhancing the flow of the validation as a whole.

4 Evaluation of the IEM validation objectives

As previously explained in Chapter 2, the validation criteria retained were: (a) usability/practicability, (b) credibility from a scientific point of view and (c) added-value compared to existing methods and tools.
The validation questionnaires were then elaborated in order to be able to assess these 3 criteria and validate the IEM in the preparedness phase (tested both in University of Lorraine and in Campus Vesta) and the response phase (tested only in University of Lorraine).
The results are firstly analysed for the preparedness phase and secondly for the response phase. The conclusions are drawn based on both results and on the validators' comments.

4.1 Validation of the IEM in preparedness phase from participants' inputs

Twenty-six participants of the thirty participants during the two validation workshops at University of Lorraine and Campus Vesta answered the Session 1 and 2 questionnaires. This number allows dealing statistically with the answers.

(1) The first step was to gather the Campus Vesta and University of Lorraine validation workshops participants' score answers of the questionnaires in a common database for which the variables are the questions, the variable attributes the quantitative scores to the questions and the individuals the 26 participants;
(2) The second step was to analyse whether statistically the composition and conditions of this validation workshop of IEM in preparedness phase influence the results;
(3) The third step was to provide a final answer on the IEM validation for preparedness phase considering the results of the previous step.

Each step is elaborated in more detail in the following sections.

4.1.1 Questionnaire database preparation

To make a robust analysis of IEM validation, the University of Lorraine and Campus Vesta meeting session 1 and 2 questionnaire results were gathered in a common database. The questions were then classified through a deep analysis of the content according to the following criteria: (a) credibility, (b) usability, (c) added-value (as presented in Table A4.1of Appendix 4).
For each question of the questionnaire, the score was between 0 and 10 (highest being the most satisfaction). Associated to each score, the meeting representatives could illustrate their motivation with text descriptions. The quantitative values of the scores were used for statistical analysis whereas the comments were used to interpret main statistical result analysis (see next subchapters).

4.1.2 Analysis of influence of validation workshops' conditions and composition on questionnaire results

The questions and the studied scenario (small scale vs large scale) were used to study whether the validation workshop conditions impact on the answers of the participants. The participants' activity category, which reflects their degree of experience of crisis or emergency situation management, was used to study whether the validation workshop composition influenced the answers to the questions.

The **influence of conditions** is first analysed.

(a) Regarding the analysis of the conditions and more specifically the questions, some questions like "Did we miss a specific aspect that could make this step more effective or more credible?" were difficult to score and interpret since a high score can mean either "we miss a lot of aspects" either "we do not miss any aspects" (the last being compliant with the other questions scoring).

To check if these types of questions behave statistically differently than the others, we made a Principal Component Analysis on all the questions, i.e. the 72 variables. A Principal Component Analysis (PCA) is a common technique for finding patterns in data of high dimension[2]. It can also be defined as a statistical technique that completely reproduces an interrelationship amongst many correlated variables with a smaller number of "principle components" that are mutually independent of one another. The variables are then transformed into a set linear combinations of the variables that are the principal components.. This transformation is defined in such a way that the first principal component has the largest possible variance (meaning the highest degree of information), and each succeeding component in turn has the highest variance possible under the constraint that it is orthogonal to the preceding components (but with less degree of information than the first principal component). The resulting vectors are an uncorrelated orthogonal basis set. PCA is sensitive to the relative scaling of the original variables[3] but in our case, the scaling of the variables is the same (between 0 and 10).

Location of the questions (variables) on Principal Component Axes F1 and F2 is shown in Figure 2.

[22] http://www.cs.otago.ac.nz/cosc453/student_tutorials/principal_components.pdf
[3] https://en.wikipedia.org/wiki/Principal_component_analysis

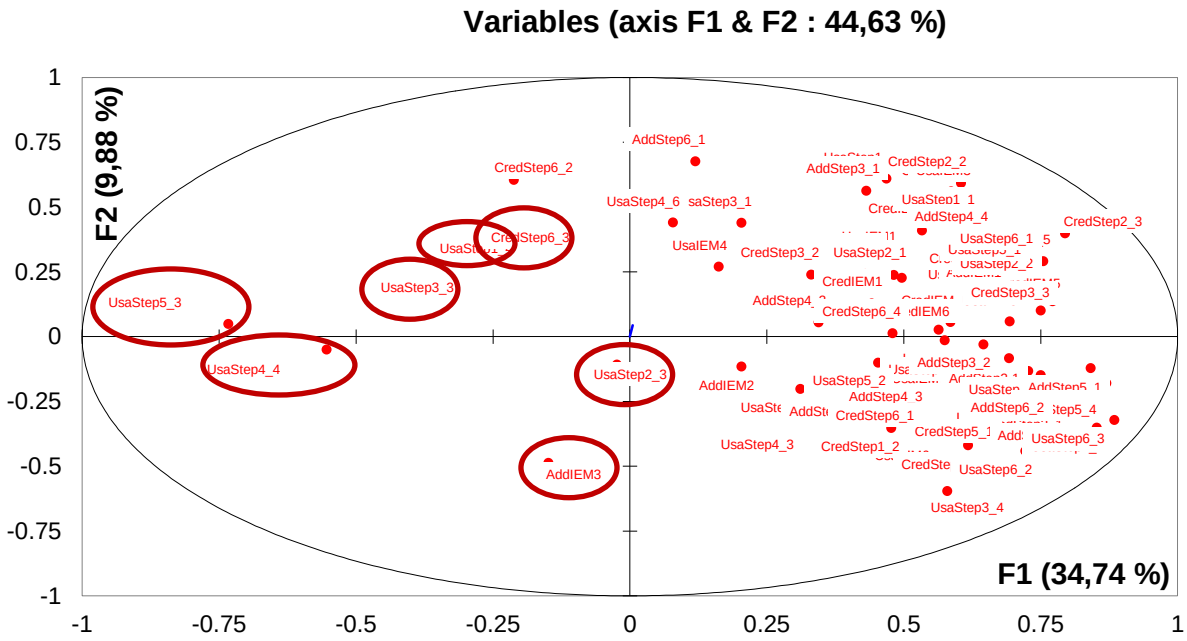


Figure 2 – Principal component axis 1 and 2 on all the questions (variables)-representation of difficult to score questions (in circles)

Over the 71 axes which represent 100 % of information, the first axis (F1) represent 35 % of information and the second (F2) represent 10 %. This high percentage of information contained by F1 means there are a lot of correlations between variables.

On F1 axis, the variables which are the closest to value +1 and -1 are the ones which explain the most the F1 axis. Figure 2 shows that the majority of F1 (-) axis is explained by questions difficult to score such as “do we miss specific aspects?” (UsaStep5.3) or “Did we miss a specific aspect that could make this step more effective or more credible?” (UsaStep4_4), meaning that these questions are very different from the others and bring more noise than signal for the analysis. Indeed, some respondents put a “0” score for saying “nothing is to add” while others put a “10” to say the same thing. These variables are then not taken into account for the rest of the analysis. By the opposite, the F1(+) axis deals only with the other questions for which answers can be graduated easily as score between 0 and 10.

(b) Regarding meetings conditions and more specifically the scenarios, the validation workshop at Campus Vesta was dedicated to a large scale scenario contrarily to the one of University of Lorraine dealing with smaller scale scenario. This could have influenced the answers to the questions. To test this hypothesis, a statistical ANOVA test was done on all questions except the ones leading to potential misleading answers which have been identified with the Principal Component Analysis (see part (a)). The ANOVA test allowed comparing, for these questions, the Campus Vesta answers with the University of Lorraine ones. The results are presented in Table A4.2 of Appendix 4.

This table shows significant difference ("Yes" for the column "significant") between the two validation workshops only for the question "Does this step help you to consider the appropriate geographical scope for the scenario?" (see the "UsaStep1_3" question in Table A4.2of Appendix 4). For this question, Campus Vesta participants who used large scale scenario generally answered with lower scores than University of Lorraine participants who used smaller scale scenario. This result means that a first test of the IEM is maybe more appropriate to smaller scale scenarios for which the local experts have already deep knowledge. The analysis of the comments highlighted in yellow in Table 1 confirmed this hypothesis.

The **influence of participants' panel composition in terms of people background and daily life** activity role is secondly analysed.

To this aim, the participants were classified according to 2 groups: the first one involves people dealing in their daily life with crisis management like gold, silver and bronze commanders (fire rescue, police, military, health care commanders and managers, all dealing with crisis management in their daily life) and the second one involves the other ones (researcher, academic professors, local/regional/national authorities, trainers). As previously, an ANOVA test was also done on the two groups to test whether the two categories significantly provide different answers.

No difference was found between the two groups, and it can be concluded that the background of meeting representatives does not influence the answers to the questions. The detailed results for each question are provided in Table A4.3 of Appendix 4.

Concluding the analysis of condition and composition the results,, the results of the two tests are:

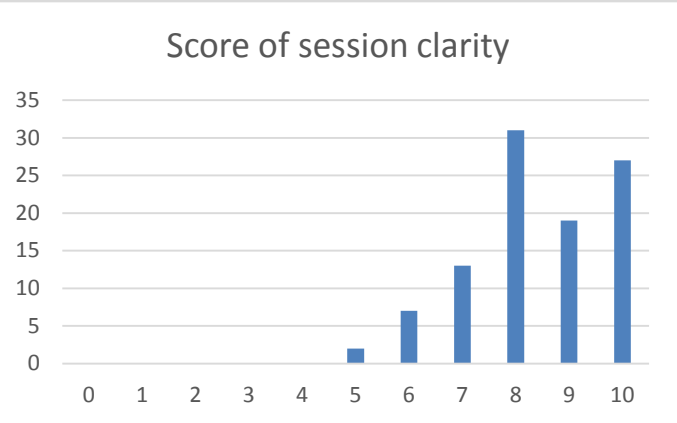
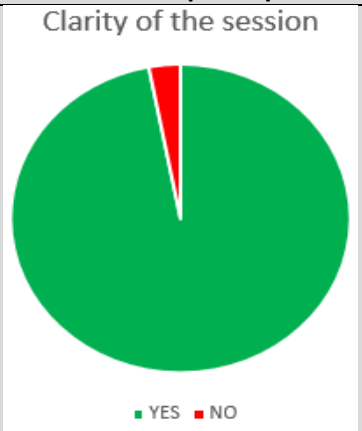
- The questions difficult to score do not have the same behaviour as the others; it would be better to remove them;
- The scenario scale does not influence the questionnaire answers, except for usability of Step 1 which focuses on the identification of systems which can be involved in cascading effects over a specific area that depends on the scenario scale;
- There is no influence of participants' background on the answers to the questionnaires. As a result, there is then no need to discriminate people background when analysing the questions' scores and comments;

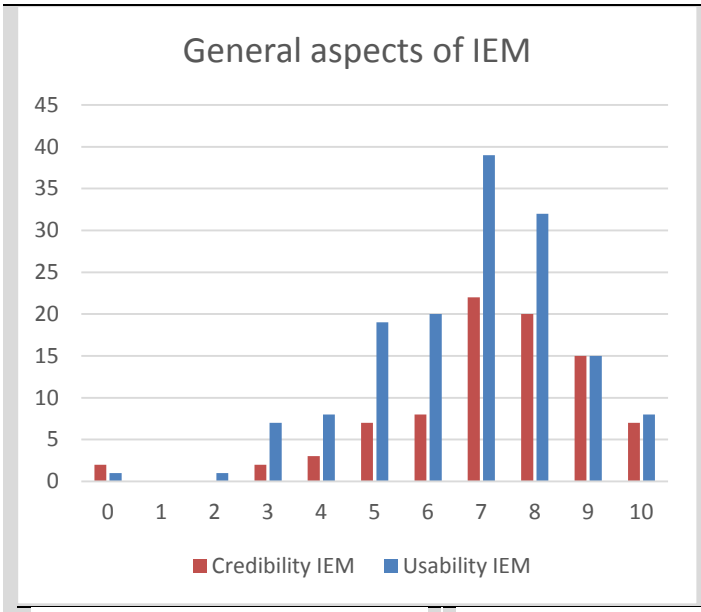
The detailed analysis of the questionnaire answers is done in section 4.1.3.

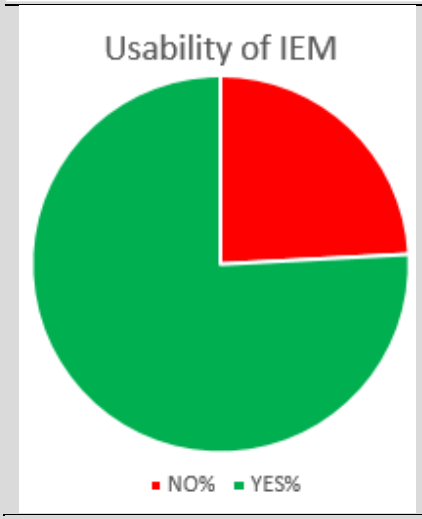
4.1.3 Final results of IEM validation for preparedness phase

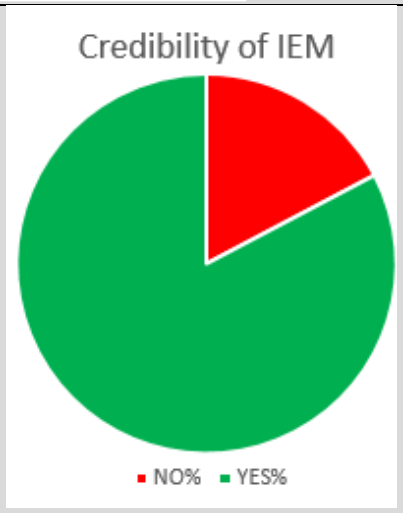
For each validation criteria, the scores equal to or below 5 have been counted as “NO” validation whereas the scores equal to or above 6 have been counted as “YES” (validated). The percentage of Yes and NO have been represented for the global evaluation of the IEM and the different steps The quantitative scoring and general comments on the different steps of the methodology and on the IEM in general have been represented in Table 1.

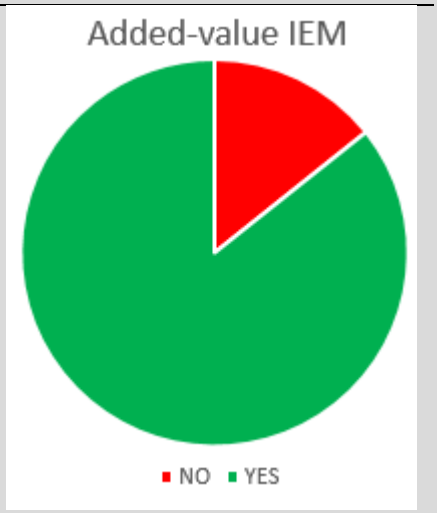
Table 1 Histogram of quantitative scoring and Validation rate of IEM and its steps for each validation criteria associated to general comments

Score histogram and general comments of the participants
 
For most of the participants, the session targets appeared to be clear enough meaning that the validation criteria of the IEM and the different steps are not biased by a lack of understanding from the participants.





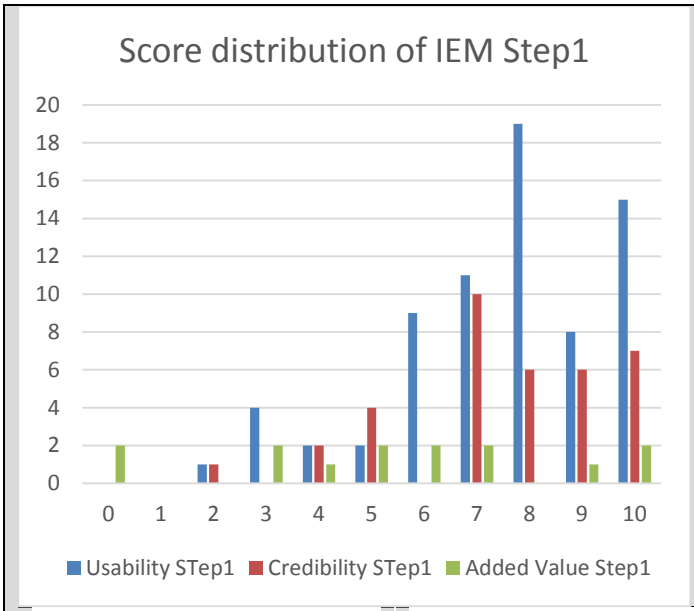


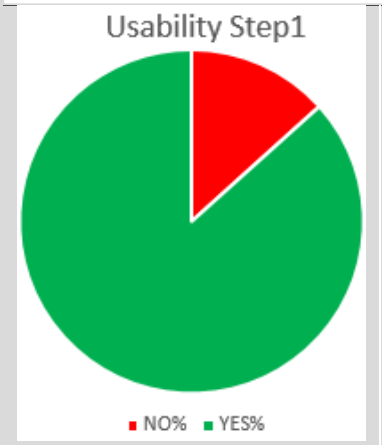


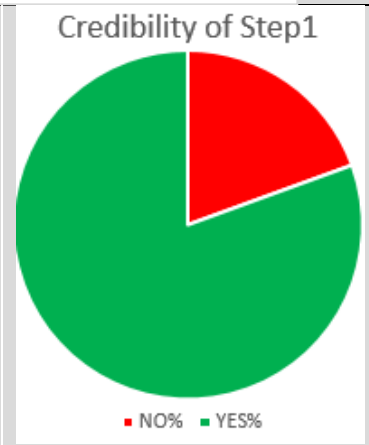
The predominant answers regarding usability, credibility and added-value of the IEM are “YES” meaning that the IEM is globally perceived as usable, credible and providing added-value. Positive comments on *usability* are that the IEM appears to be useful for small scale scenarios with low kinetics and specific risks. It allows to frame a decision during preparedness phase and it is interesting as additional methodology of a tool.
The small number of negative comments are that the IEM is a cumbersome process, difficult to implement in current software. SConsequently, it requires strong support and training, with a more readable flowchart to be more user friendly.

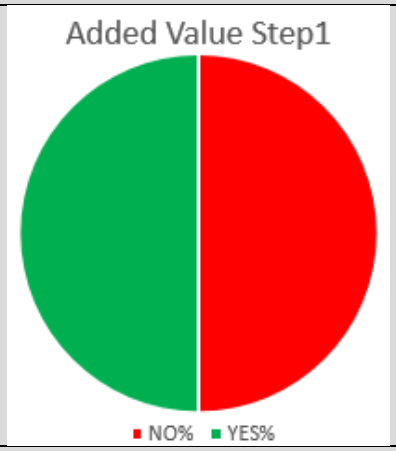
With regards to *credibility*, the positive comments are that IEM reflects well the impact of intuition.
Negative comment: since it requires a lot of data, it is only interesting in the preparedness phase.

The *added-value* positively perceived in comments is the systemic approach, a good decision support during planning and prevention phase.
Negatively perceived, the IEM seems redundant to the French MOSAR* method.







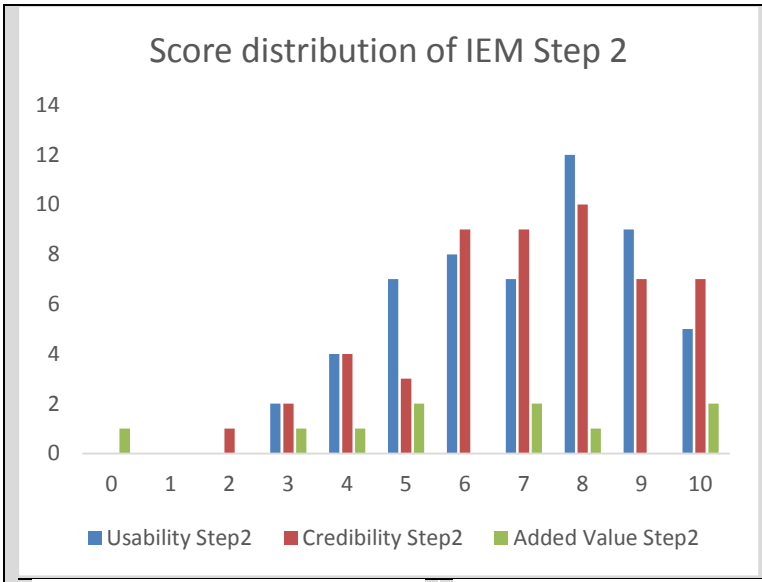


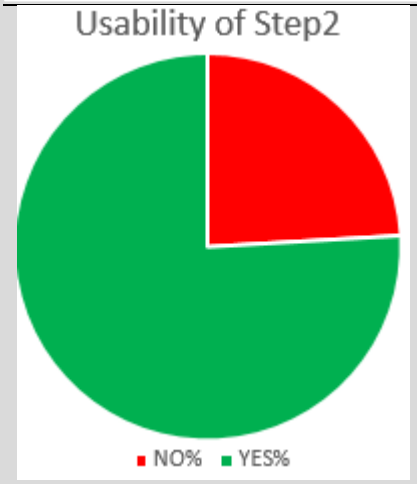
The validation items of Step 1 have most "YES"answers for usability and credibility. The added-value of the IEM has the same number of "YES" and "NO" answers although the comments on the added-value are quite positive (see below).

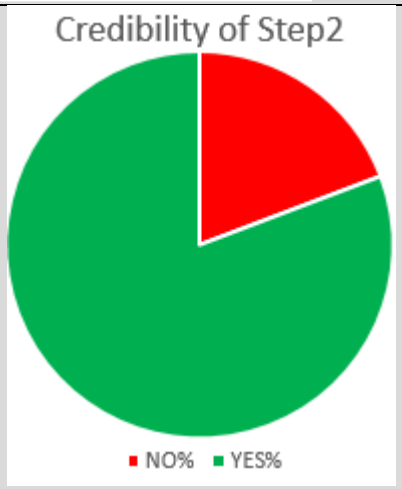
With regards to *usability*, the positive comments are that the concepts are clear.
Negative comments are that Step 1 needs to be practiced first on small-scale scenarios before being able to further enlarge the scenario territory. Furthermore the systems should be more expanded with a category "other", and there's a need to distinguish physical system and process system.

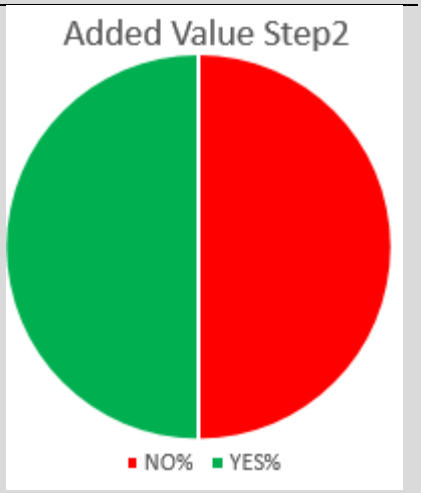
With regards to *credibility*, there are only positive comments: "Step 1 allows risk analysis".

With regards to *added-value*, while one person stated that there is no added-value, the others were more positive, saying that Step 1 is useful in risk analysis and worthwhile to assess the potentially impacted sectors (via checklist).







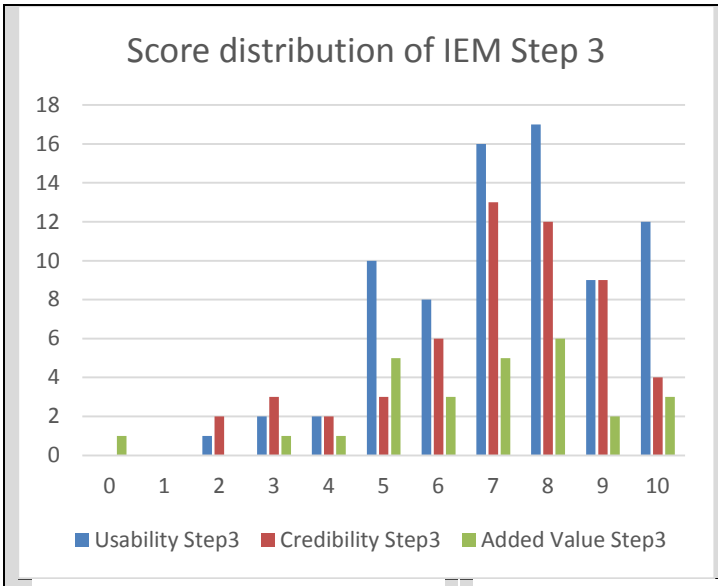


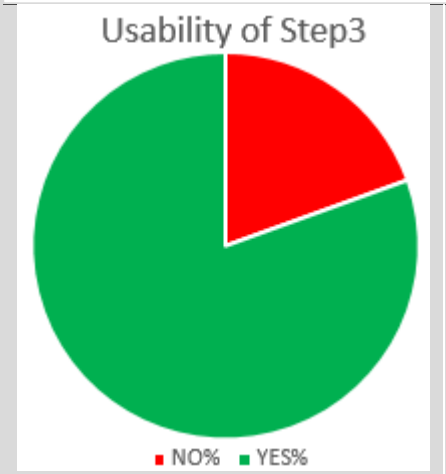
Step 2 items have most “YES” answers for usability and credibility. For the added-value, there are as many “YES” and “NO” answers

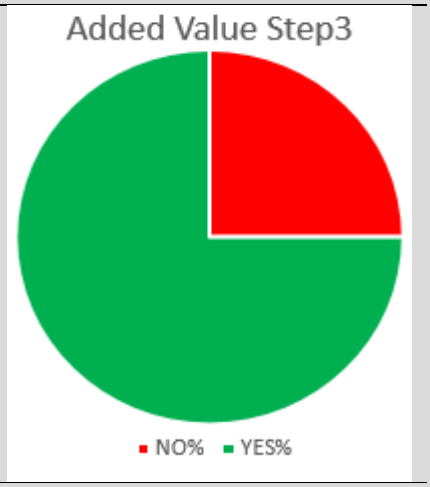
With regards to *usability*, Step 2 is positively perceived as being clear, applicable for small scale incidents.
Negative comments are that too many systems can be judged as being dependent, leading to complex cascading effects scenario. To improve the usability, the participants proposed to insert pre-filled systems which can restrict the choice of systems and to prioritize the selection of systems according to their functions.

With regards to *credibility*, for Step 2, the IEM is positively perceived as being a suitable and collaborative tool, good for planning with good categorization of effects and a perfect practical application of the theory of Perrow*.
Negative comments are that Step 2 is perceived as being very dependent of users' knowledge.

There are no further comments on the *added value* of Step 2 except the positive one on visualization as an advantage and a negative one on the fact that exercizing it does not allow to perceive te added-value.





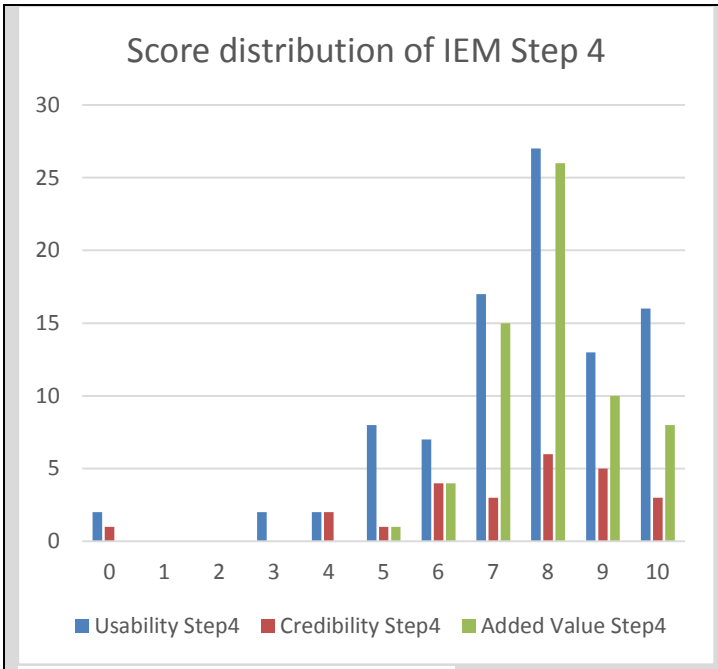


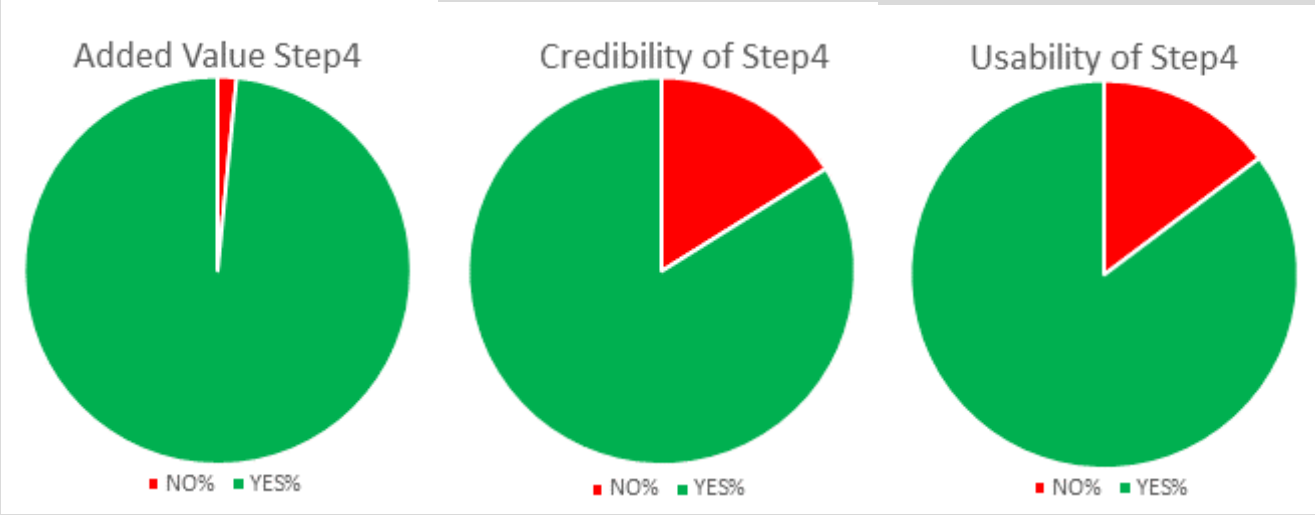
Step 3 has most ”YES” answers, meaning that it globally appears to be usable, credible with added-value.

With regards to *usability*, Step 3 is positively perceived as being clear and logical.
Negative comments state that step 3 requires simplification as it is too complex to implement. One person asked to have Step 3 before Step 2.

With regards to *credibility*, positive comments are that Step 3 is relevant for the federal crisis centre since it deals with techniques already used for hazard analysis.
Negative comments are that it requires a lot of data and there is a risk of considering only pre-established scenarios (disregarding unlikely scenarios).

Positive comments on *added value* are that it allows a prioritization.
Negative one is that Step 3 is identical to the MOSAR* method.



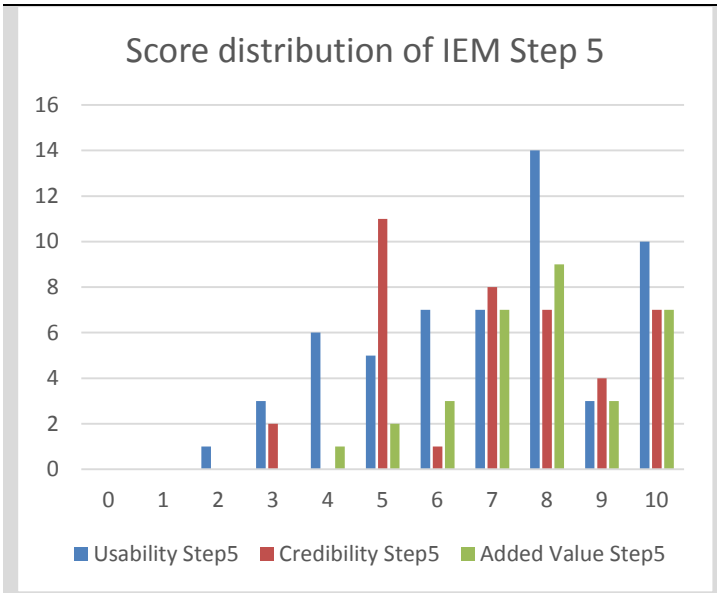


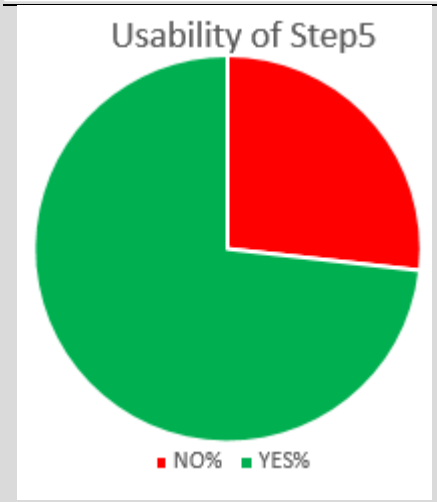
Step 4 has most of the scores above 6, meaning this step is usable, credible with added-value.

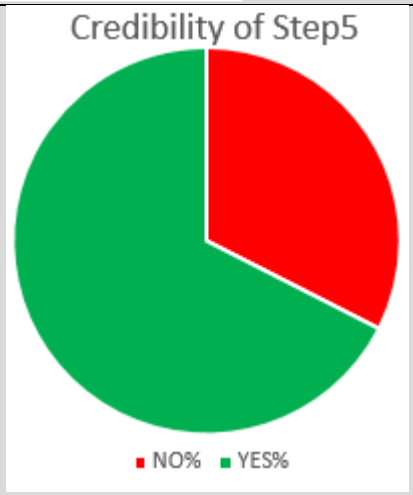
Positive comments with regards to *usability* are that it is very clear, very useful, do-able with research data and experts.
Negative ones are that “buffer” and “endurance” times are difficult to understand and need clarification.

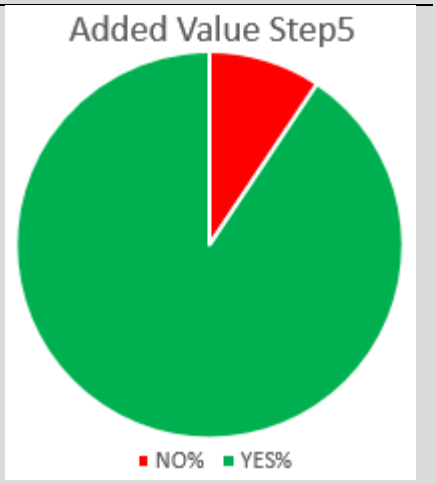
With regards to *credibility*, Step 4 is generally perceived as being a “guess work”, dealing with too many uncertainties or variables that could have an impact on the effects propagation tree view. The IEM then does not appear as being credible at municipality level.

With regards to *added value*, Step 4 positively appears to be helpful as far as the times are correct/realistic for prioritizing within a timeline. It allows for raising the notion of acceptable/tolerable risk. It appears to bring little operational added value but is useable in preparation of a BNIP (the emergency response plan for one specific risk, BE).







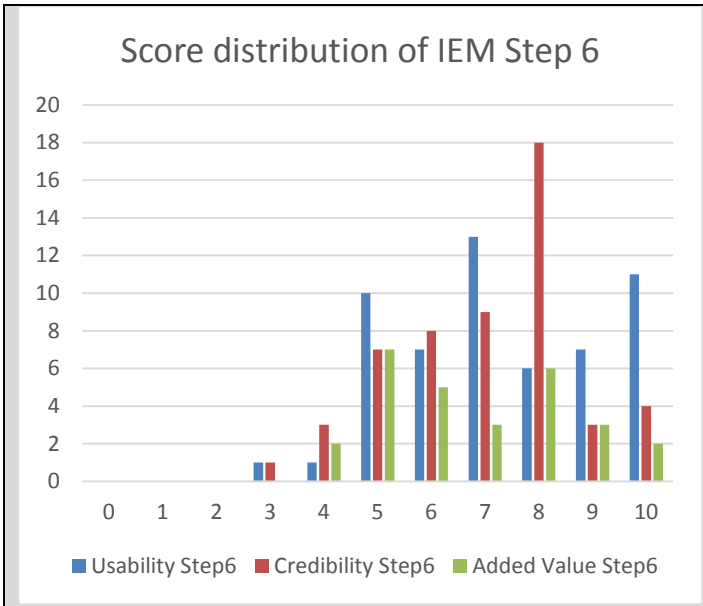


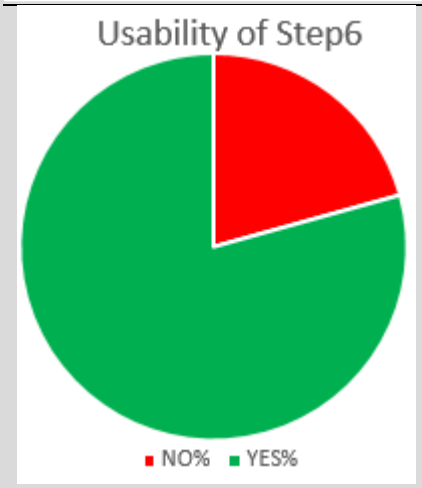
Step 5 items have most "YES" answers.

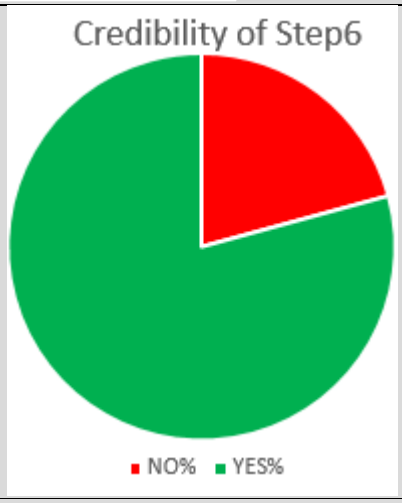
With regards to *usability*, it is positively perceived as being useful for the planning phase, but negatively as being difficult to evaluate the scorecard of impacts, requiring too many data. The needs are:
*a table with reference values;
*long-term vs short term effects;
*standard terminology for victims.

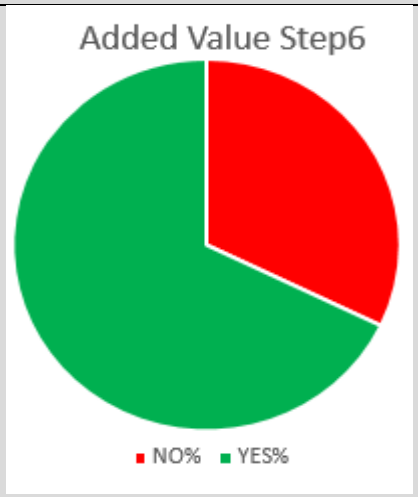
With regards to *credibility*, Step 5 is positively perceived as bringing a logical process and being useful for gaining insights.
However, the user also needs to estimate the probabilities with the impacts in order to perform risk analysis, and the impacts are not necessarily comparable on a common scale.

With regards to *added value*, it is positively perceived as bringing quantification of the costs saved and the costs required to stop the spreading process.









Step 6 items most “YES” answers.

With regards to *usability*, comments were made that for Step 6 it is required to simplify the graphic presentation. Other comments stated thattoo many data should be obtained by experts.
If not, Step 6 can appear to be not *credible*.

With regards to *added value*, Step 6 is positively perceived as being useful for creating a regional risk profile, for managing complex situations.If the plan is available beforehand it can be an added value to endorse risks.
Negative comments are that "Key decisions" depend on political choices and are thus difficult to anticipate.

The analysis shown in Table 1 allows validating the IEM and the different steps in terms of usability, credibility and added-value. The overall indications are all positive on all criteria with a minor fluctuation on the perceived added value in step 1 and 2.

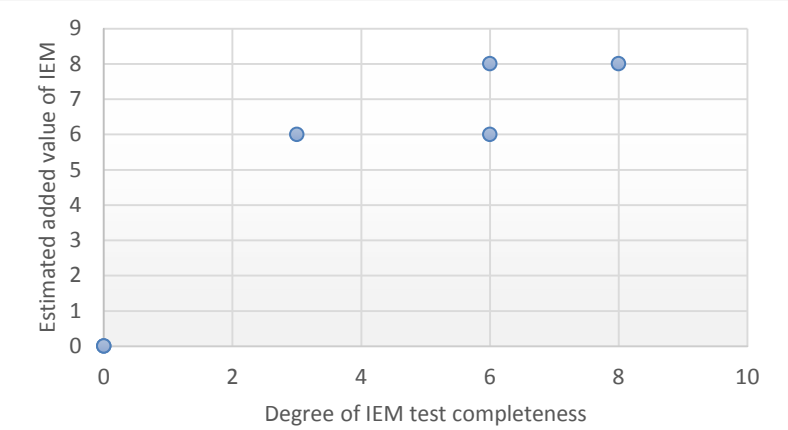
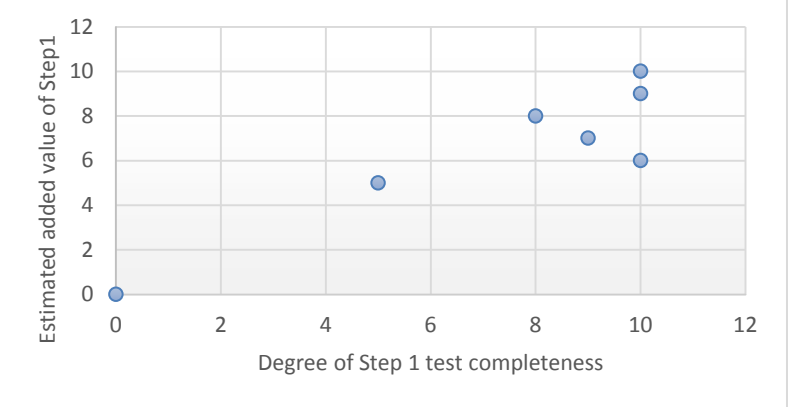
Integration with user-friendly tools gathering reference data on systems and potential impacts could alleviate the mixed perception on added value for step 1 and step 2. As well as that most of the participants of the validation workshops ask for further practical exercises and training for a better use of the IEM during the preparedness phase

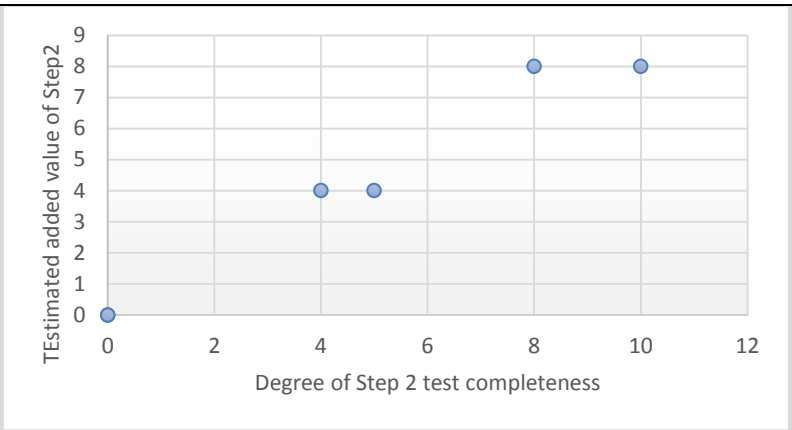
4.2 Analysis of the participants' inputs to the questionnaire in response phase

The questionnaire on the IEM validation test during response phase was answered by 9 participants, all at University of Lorraine but not all answered to all questions.

The added-value of the IEM and its different steps has been analysed each time the participants answered to the questionnaire. This was done according to the degree of test completeness (degree of performed application of the IEM or of each step) as to provide more relevance of estimated added-value for high degree of test completeness. The results are presented in Table-2.

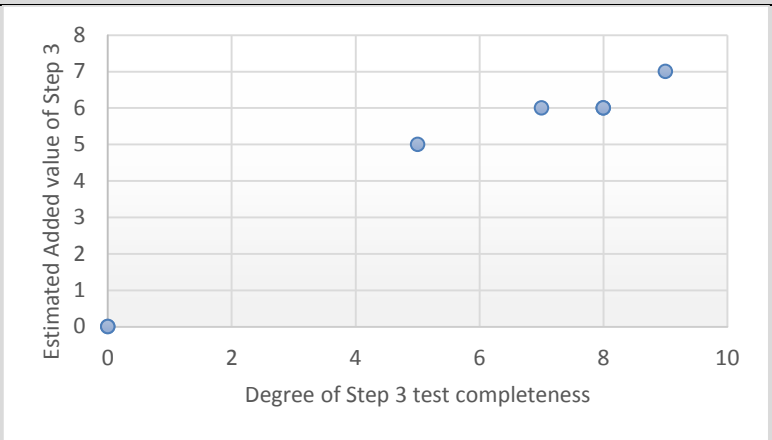
Table 2 Score of added-value (Y) according to degree of IEM used during the session (X) associated to quantitative comments of the participants

Estimated added-value according to test completeness	Comments
	The 4 participants who answered to this question scored the added-value above 5, meaning there is added-value in using the IEM during response phase. The more participants used the IEM completely? during the test (X) the higher the estimated added-value of the IEM (Y), meaning that the added-value of the IEM is better perceived by the participants who succeeded testing at least the IEM 4th step (ie 60% of 6 steps). the added value is mainly: providing a structured analysis during crisis management, useful above all during the tested initial steps (the final ones could not been tested).
	There were 6 participants who completed Step 1 of the IEM for more than 50% and who scored Step 1 with an added value above 5. Meaning Step 1 added-value during response phase is validated. No qualitative comment was associated to the evaluation of Step 1. One participant did not apply Step 1 at all and put a “0” score. .



Two participants completed Step 2 at 50% and scored the added-value less than 5 (No added-value). Unfortunately, they did not motivate their score.

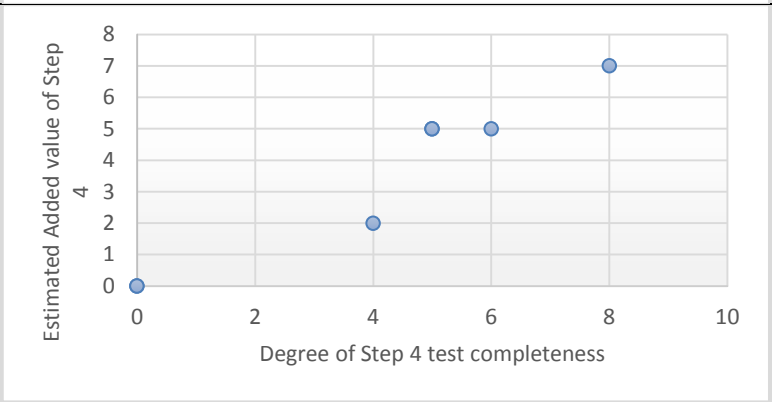
For the two participants who almost completed Step 2, the added-value was scored at 8 (i.e.; added-value validated). The main comments are that Step 2 is useful to forecast mainly geographical dependencies and potential cascading effects.



For the four participants who completed Step 3 at least at 50%, the added-value was scored at least with a 5,

meaning the Step 3 added-value is validated.

The scores were not commented.



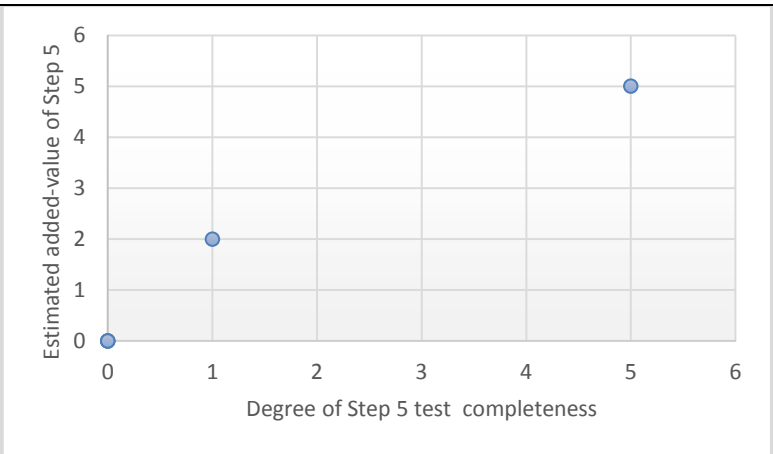
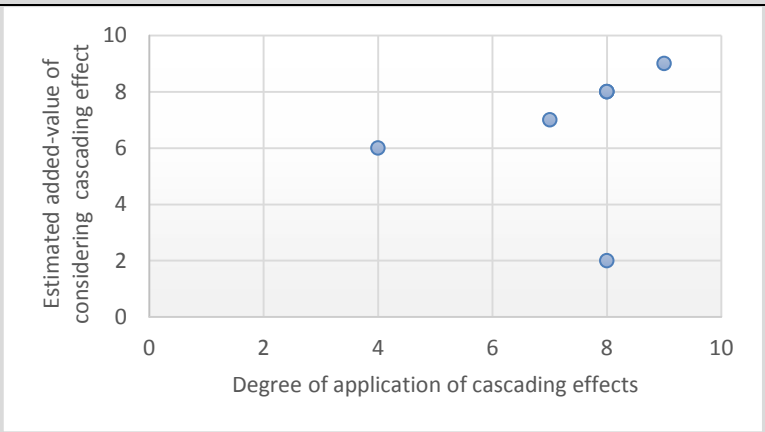
For Step 4, the three participants who completed Step3 at least at 50%, the added-value was scored above 5,

meaning the added-value is validated.

For the other one, the added-value is scored at 2, meaning the added-value is not validated.

The main difficulty was on predicting the results due to fast kinetic propagation effects.

Since the majority highly scored Step 4 added-value, it is validated.

	Step 5 was 50% completed by one participant who gave an added-value score of 5 (validation). Another one, completed Step5 at 10% and scored the added-value at 2 (no validation). **It is then difficult to validate the added-value of Step 5.**
	This graph shows that usually, the more the participants applied cascading effects, the higher the added-value on considering cascading effects. The motivation of the participant who provided a "2" score despite a "8" score of degree of completeness was unfortunately not explained.

To conclude, it seems the IEM application is perceived as globally providing added-value for crisis management in the response phase, mainly by providing a globally structured approach of the situation analysis. The main difficulties in using the IEM come from fast kinetic propagation effects which limit the capacity to run the IEM until the final steps. These results are in line with the comments of the observers of this validation test who found the IEM as providing a global structure for crisis analysis. However, they perceived that, except for one participant, they were not able to use the IEM step by step. They recommend toas a first step become familiar with the IEM by using it during planning and prevention phases in order to be able to use it appropriately during response phase.

4.3 Conclusion on the IEM validation targets

During the preparedness phase, the validation criteria (usability, credibility and added-value) are usually validated. For response phase, the added-value is validated mainly by the participants who succeeded to go deeper in the application of the IEM. We can thus consider, the added-value as being validated.

5 Observations and general discussion on the validation workshops

In additions to the results from the questionnaires and the statistical analyses of them, valuable observations were made during the two validation workshops.

The statistical analysis did not show any significant difference between the two meetings (UL and CV) and the different types of participants. Still there were some differences in how the sessions during the meetings were performed, due to the time available, the type of scenario used and the roles and backgrounds of the participants. Furthermore, the experiences from the meeting at UL could be used for the meeting at CV, e.g. some pedagogical ideas regarding the presentation of the IEM. Despite of this, there were many general observations that were very similar between the two meetings. These observations are the focus of this section, even if some specific observations are also given.

All participants were observed to be enthusiastic and open minded to try out the new way of thinking presented to them. A positive attitude and spirit was present at both the validation workshops from the outset.

As it was the first time the participants saw the IEM, it was not easy for all participants to change their current crisis management mind-set to the content and logics of the IEM. This led to that step 1 including the selection of case area and systems took much effort and time. With more experience of the methodology, it will probably be clear that the exact boundaries of the case area are not very important and can be changed. Furthermore, in reality the case area is probably to a large extent already known or apparent from the issues of earlier studies or risk analysis. Participants showed that as the IEM introduction proceeded to the later steps, more and more adaptation of the mind-set in line with the IEM.

It was observed that in the first session of both validation workshops the baseline resulted in some cascades to be identified by participants; , these cascades hardly went beyond direct dependencies or first order cascades. In the second session using the IEM everyone found more cascades and higher order cascades; proving the added value the IEM could bring.

Another general observation was that the participants very soon entered a “solution oriented mode”, immediately wanting to define how to mitigate or respond to the different vulnerabilities and dependencies that were identified. This made it more difficult for them to have and keep the discipline to exactly follow each step as they wanted to come to decisions before doing all the steps. Furthermore, this solution oriented mode was often based on experience, rather than on the information given. In some cases this led to a too early removal of some dependencies. Again, this will probably be overcome with more experience of the IEM or by a strict following of the IEM steps.

In the base case session without the IEM the discussions became relatively unstructured and several participants already during this session expressed the need and usefulness of a tool that could help structuring the work.

Even if the participants themselves did not notice the value of the different steps, there were several cases where observers noticed that the content in a step helped the participants both to understand the cascading effects and to identify more systems and dependencies to include in the analyses then before the IEM introduction.

Furthermore, for many of the participants the steps 1-3 became clear and useful first once arriving to step 4 when the temporal aspects were to be identified and analysed. They could start thinking in chronological order. This can of course depend on how the methodology is presented and maybe the objectives of each step can be presented even more clearly. This was also added to the presentation at CV. Furthermore, this should also be affected by the experience of using the IEM.

Step 5 was found logical and important, but many of the participants did not found it useful. That was for several reasons. One important reason was that it can be very difficult to find relevant values to be able to estimate the impacts. Some were also very reluctant to put exact numbers on the impacts; they would prefer to only use some kind of non-number severity scale: very low, low, medium, high, and very high. Furthermore, some participants refused to estimate impacts at all. In summary one can say that there was a mixture of difficulties in finding correct information, questioning about the reliability and credibility of this type of information and the fear of being held liable if the incident command has to use this information for decision making. This led also to an internal project discussion on step 5 and one suggestion was to move the part where the input of possible impact from a specific system is moved to step 1, while the calculations/assessment based on the scenario with a specific initiating event is kept in step 5. This will not save the issue with reluctance to put exact numbers on the impacts, but could still increase the understanding of the methodology.

At Campus Vesta where the large scale blackout scenario was used, the scale might have affected the results as it in some instances was difficult for the participants to focus on the overall picture. The participants are used to work with specific responsibilities, and in reality information on other systems would be the responsibility of someone else, even though there is a risk that the effect of the incident (via cascading effects) can turn out to become their own responsibility. To get an overview of a case is of course more difficult if it is a large-scale scenario. It also seemed easy to get lost in details.

Step 6 was apprehended somewhat different in different groups. Some participants where stuck in initial ideas, and opinions formed during the discussions of the early steps, while others now finally got the point with the IEM and how it can be used and be useful.

Some general comments from the participants were that much data is needed to follow the methodology and that it is best to start using the IEM for small incident. When one is more experienced, one can use it for large-scale incidents as well. The participants found the IEM logical in theory, but had some difficulties putting it into practice. However, it should be kept in mind that this was the first time the participants saw the complete methodology and as for any methodology or tool experience and training are necessary to reach useful results. Furthermore, it should also be noted that during the sessions the participants played roles they were not used to. Therefore, a final conclusion can be that the IEM as methodology to a very large extent is fine, but it is important how it is presented and taught.

6 Conclusions

The Incident Evolution Methodology has been tested by external participants -representatives of emergency stakeholders- in the Consortium activities in Campus Vesta (Belgium) and University of Lorraine (France) by using:

- A blind table-top emergency situation to gauge the knowledge level of the participants;
- A learning session introducing the methodology steps;
- A knowledgeable table-top emergency situation to gauge improvements over the baseline with the new knowledge of the methodology.

The Campus Vesta scenario was dedicated to the trans-border black out scenario already used for calibrating the IEM; providing a large-scale scenario. The University of Lorraine scenario dealt with a smaller scale case study, called “Séchilienne scenario”, initiated by a mountainous slope movement impacting a river followed by impacts on roads, chemical industry and surrounding population.

The validation tests aimed at evaluating the performance of the methodology in terms of:

- Applicability: the degree to which the methodology can be applied as designed to real-world situations (being understandable, usable in terms of ergonomics and with an acceptable level of effort).
- Credibility: the reliability of the results of IEM application.
- Added-value: what the IEM brings compared to current existing methodologies or/and knowledge.

Reports of the participants related to the validation criteria were in questionnaire forms. The results show that, for both the preparedness and the response phase, the IEM is perceived, as bringing added-value mainly because it provides an applicable global structure for modelling cascading effects which appear to be credible. More specifically, it is recommended to use the IEM during preparedness phase and on small scale scenario in order to familiarise with the concepts and to build a geographically specific database on systems, timelines and impacts. Once familiar with the IEM and once having existing data, it is easier to use the IEM in the response phase.

Furthermore, the presentation of the IET during the validation workshops, which is the operationalisation of the IEM through an IT tool, allowed the participants to understand how the application of the IEM could become lighter and easier with such kind of tools. Even if the issue of data integration still remains to be fixed, the participants saw the benefits of enabling an automated prediction of the cascading effects.

7 References

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Appendix 1 Validation criteria details

Validation objectives

OBJ 1	Added value of the IEM
SMART definition	The knowledge provided by the 6 steps of the IEM is considered by the end users as relevant insight in cascading effects that guides the end user inmaking better informed decisions-compared to existing knowledge/methodologies -for dealing with preparation, planning, response, recovery, both at operational and strategic level, including for cross border

Criteria

Step 1	Creating the Case results in more identified systems Creating the case results in identification of previously overlooked systems
Step 2	Creating the dependencies results in more and previously unknown dependencies
Step 3	Initiating a specific case results in correct cascades
Step 4	Creating the timeline overviews enhances the perception of the cascading effects
Step 5	Adding impacts to the Cascade allows for better insight into the gravity of the cascades
Step 6	Finding the Key descision points results in better choices for responders which lead to less impact results.
Global Criteria	The methodology provides added value by providing new insight and a better operational picture of the crisis situation and its cascading effects.

OBJ 2	(Direct) Applicability of the IEM
SMART definition	The IEM (as it is) is directly applicable for educational purposes (information/awareness/training), for preparing appropriate response, for emergency planning, for improved decisions during response

Criteria

Step 1	Creating the Case can be incorperated into current methodology in use by participants. Creating the Case could be linked to current in use tools
Step 2	
Step 3	
Step 4	
Step 5	
Step 6	
Global Criteria	The methodology provided is applicable in the current response methods in use

Vaidation Participants

SCORING ROLES

End Users	the invited people form the field, playing thorugh the validation situation, getting the methodology presented and then reaplying that to a specific case. Also fill in various feedback moments to support in the validation.
Observers	Staff specially present to observe and report interesting moments during the validation session. Staff can be CascEff Consortium members or specific personnel added for this role. Assisting the validators in their job
Validators	CascEff consortium members only staff that combine the various observations and feedbacks into the final validation. Also lead the validation session and instruct observers about upcomming key moments.

NON SCORING ROLES

Host	The host of the validation location. Has final say in all matters logistically as were are a guest at their location and need to abide by their rules and regulations
Leaders	CascEff consortium members only staff that lead and regulate the entire Validation
supporters	Staff that is present to support the leaders in running the validation, be it IT support, brinigning in new papers for taking notes, handing out feedback forms etc.
Roleplayers	Partaking in the validation as counter to Participants, the other side of the phone line, red teams, specific non present authorities
Simulation staff	The staff in charge of running and adjusting the simulations in use during the validation

FLOW of the VALIDATION

Flow is split in the pre-IEM regular incident baseline where assessment is about the initial way the participants deal with the situation. Followed by the explenation of the IEM, which is checked step by step to keep the replies fresh from memory, rather than at the end having to think back on the newly learned IEM and think hard about remarks on step 1. After the explenation comes the IEM situation which will serve as the did we find new or added value over the baseline situation. this is also evaluated step

		General key observations			Role Objective 1: added value			Role Objective 2: apllicability		
HIGH OVER Introduction	**Detailed**	**End Users**	**Observers**	**Validators**	**End Users**	**Observers**	**Validators**	**End Users**	**Observers**	**Validators**
		? Is the flow of the Validation clear to evryone	Note any questions end user might have at this point							
Initial Regular Situation						Did the end users already do parts of the IEM in this regular scenario			Did the end users already do parts of the IEM in this regular scenario	
		? Did you understand the initial situation	Note down the flow of what the end users do with the situation							
End of Regular Situation										Note down if parts of IEM were already in use for re-questioning after the IEM situation
		? What did you think of the situation	Note the review remarks	Note down the base line of response in the regular scanrio			Note down if parts of IEM were already in use and how that might affect finding added value			
		? Did you experience dificulties in dealing with the situation	Note the review remarks	Note down the difficulties to re-verify after the IEM situation						
Introduction of IEM	**Intro on IEM**	? Did you understand the IEM overview	Note any questions end user might have at this point							
	Step 1							? Did you understand Step 1 ? What could be explained diffrently to make things more clear	Note all questions and remarks	
	Step 2							? Did you understand Step 2 ? What could be explained diffrently to make things more clear	Note all questions and remarks	
	Step 3							? Did you understand Step3 ? What could be explained diffrently to make things more clear	Note all questions and remarks	
	Step 4							? Did you understand Step 4 ? What could be explained diffrently to make things more clear	Note all questions and remarks	
	Step 5							? Did you understand Step 5 ? What could be explained diffrently to make things more clear	Note all questions and remarks	
	Step 6							? Did you understand Step 6 ? What could be explained diffrently to make things more clear	Note all questions and remarks	validate if the IEM explenation is done properly or needs adjustments
Start of IEM situation		? Did you understand the start situation	Note down questions							
	Step 1				? Did you identify new systems of interest by using the IEM	Note the case created by the ens users	validate if added value is percieved in the case setup	? Does step 1 feel as the correct start point	Note the proces of aplying step 1	validate if step 1 would be useable

			? Did we miss a specific aspect that could have added more value	Note the diffrence with the regular situation		Do you feel this step is usable in your current incident response?	Note irritations and deviations from aplying step 1		
Step 2			? Did you identify more connections between systems by using the IEM	Note the dependencies created by the end users	Validate if added value is percieved in the dependencies setup	Does step 2 feel as a logical next step from step 1	note the process of aplying step 2	validate if step 2 would be useable	
			did we miss a specific aspect that could add more value	Note the diffrence with the regular situation		Do you feel this step is usable in your current incident response? Based on step 2, did you revisit the outcome of step 1	Note irritations and deviations as well as revisits of step 1		
Step 3			Given the initial event did you identify unforseen cascades	Note the process taken once the initiating event is introduced	Validate if added value is percieved in chekcing the flow from the initating event	Does step 3 feel as a logocal next step on step 1 and 2	Note the process aplied in this step	Validate if step 3 would be usable	
			given the initial event did you identify unforseen aspects in regards to buffer times	Note the specific systems the end users look at in dept		Do you find It usefull to eliminate cascade options and limit the scope thot he initiating event	note irritations and deviations as well as revisits of previous steps		
			Did we miss a specific aspect that could ass more value	Note diffrences with the regular setup		Did you revisit previous steps to finalize step 3 Do you feel this step is usable in your current incident response?			
Step 4			Given the outcome of the previous steps, do you feel the timeline creation is adding insights into the cascade possibilities	Note the proces taken to come to a timeline	Validate if value is percieved in creation of a timeline	Does step 4 feel as a logical next step from the previous one's	Note the proces taken to come to a timeline	Validate if the step is applicable	
			Given the outcomes did you feel it was helpful to be able to visualize on a timeline the flow of the cascades	not the specific systesm and dependencies the users look indept at		Do you find it usefull to be able to find the tempora aspects	Note if previous steps were revisited		
			did we miss a specific aspect that could add more value			Do you find it usefull to be able to create a timeline overview Would you be able to implement the timeline into the regular response workflow	Note irritations and irregulations of following this step		
Step 5			Now that the cascade flow is known did you find adding the impacts usefull	Note the flow used to adress the impacts	Validate the added value of finding the impacts	Does step 5 feel as a logical next step	Note the flow	Validate if the step is applicable	
			Do you feel knowng the impacts give you a better understanding	note the systems that impact is added to		Would you be able to adde the impacts finding method to your regular process?	Note if irritations occurred		
			Did we miss a specif aspect that could add value				Note if earlyer steps were revisited		
Step 6			Do you feel that with all the information from previous steps the methodology allows you to find new or unexpected key decision moments?	Note the flow of assesment the user do	Validate the added value of finding the Key desciison point	Does step 6 feel like a logical end point for the methodology	Note the flow	Validate if the step is applicable	
			Do you feel the found key descision moment would allow a better aproach to the situation			would you bre able to incorperate the step 6 into your regular aprach	Note if irritations occurred Note if earlyer steps were revisited		
End of IEM situation	What did you find of applying the IEM?	note down questions and remarks	final step based aditions	note remarks combine feedback of all steps	validate allsteps as a whole	final step based questions	note remarks combine feedback of all steps	validate all steps as a whole	
Final Review			Did you feel following the IET steps you adressed all aspects of cascading effects	after end users have left have an observer discusion and compare resuts	final validation result	Did you find the iem easy to use	after end users have left have an observer discusion and compare resuts	final validation result	
			did we miss a step that would add more value to the IEM do you feel the IEM as a whole adds value and insight			do you think the iem is applicable in thecurrent workflow			

Appendix 2 Setup of the UL Validation workshop

This appendix depicts the validation workshop setup in University of Lorraine. It contains first a General Agenda as conveyed to participants, followed by a detailed Staff agenda based on which role should do which part at which time, its hence named the Role Agenda.

Planning and General Agenda
The first validation workshop was held from 24 to 27 April, 2017 at University of Lorraine (Nancy). The validation exercises were conducted in French since the consortium decided to use the native language of the host country to allow all the participants to properly play their role, as practitioners do not necessarily speak English very well.

The general agenda was as follows:

- Monday 24 April
  - 13:30 - 17:30: Internal CascEff meeting

- Tuesday 25 April (validation day 1)
  - 09:00 - 12:30:
    Participants briefing on the validation workshop (objectives, criteria, etc.)
    Session 1: Table top exercise on planning phase (without the IEM)

  - 12:30 - 13:30: Lunch

  - 13:30 - 17:30:
    Presentation of the IEM
    Session 2: Table top exercise on planning phase (using the IEM)

  - 19:00 - 22:00: Social diner

- Wednesday 26 April (validation day 2)
  - 09:00 - 12:30:
    Session 3: Crisis simulation with iCrisis in combination with 3D views provided by XVR (using the IEM)

  - 12:30 - 13:30: Lunch

  - 13:30 - 17:30:
    Demonstration of the IET prototype
    Final debriefing with participants and overall evaluation

- Thursday 27 April
  - 09:00 - 12:30: Internal CascEff meeting (lessons learnt, follow up actions, etc.)

Role based agenda

Monday 24 April 2017

13:30 - 20:30: Internal CascEff meeting

Participants: Anders Lönnermark (SP), Maurice Sammels (XVR), Xavier Criel (SCE), Tom d'Oosterlinck (SCE), Clément Judek (UL) Abla Mimi Edjossan-Sossou (UL)

Tuesday 25 April 2017

09:00	Participants welcome & coffee
09:15	Introduction of Participants & Staff
09:35	Project introduction presentation by Abla Mimi Edjossan-Sossou (on behalf of Anders Lönnermark)
09:55	Validation context presentation by Clément Judek
10:10	Coffee break
10:25	Split of participants into 3 groups for parallel sessions
10:30	Session 1: exercise for incident management planning where participants were asked to identify the systems potentially impacted by a given incident and the cascading effects using their own information sources, tools, etc. This exercise was led by Xavier Criel, Abla Mimi Edjossan-Sossou and Clément Judek. The validators were Anders Lönnermark, Tom D'Oosterlinck and Maurice Sammels. The observers were Marianne Conin, Elio El Kahi, Jana Jaber and Alice Tonnelier.
11:15	(Optional) Validation staff inject information to guide the participants through the exercise if necessary
12:15	Joint debriefing of session 1
12:30	Lunch
13:35	Session 2: exercise for incident management planning with the same incident as for session 1, using the IEM. It consisted of an initial presentation of the IEM (by Xavier Criel, Clément Judek, Abla Mimi Edjossan-Sossou) followed by its explanation step by step, exercise step by step, and questionnaire filling. The explanation of each step lasted 10 min, then the participants applied each explained step during 20 min and the answered the questionnaire for 5 min.
15:15	Coffee break
15:35	Continuation of session 2
17:10	Joint debriefing of session 2
19:00	Social diner

Wednesday 26 April 2017

09:00	Participants welcome & coffee
09:15	Presentation of the context of the iCrisis simulation within the framework of the IEM validation by Clément Judek
09:50	Split of participants into 3 crisis units
10:00	Session 3: iCrisis simulation running using the IEM, and in combination with 3D views provided by XVR. Alice Tonnelier, Anders Lönnermark, Tom D'Oosterlinck and Xavier Criel were in the crisis units in association with iCrisis simulation observers (Frédéric Verhaegen, Stéphanie Cano, Alison Demangeon, Aurore Morel, Laurie Pacini) to observe the use/or not of the IEM during the simulation.
12:00	Survey on the use of the IEM for the response phase (questionnaire filling)
12:30	Lunch
13:30	Joint debriefing of session 3
15:00	Demonstration of the Incident Evolution Tool by Clément Judek
15:45	Coffee break
16:00	Final joint debriefing on the IEM validation with participants

Thursday 27 April 2017

09:00 - 12:00: Internal CascEff meeting

Participants: Anders Lönnermark (SP), Maurice Sammels (XVR), Xavier Criel (SCE), Tom d'Oosterlinck (SCE), Clément Judek (UL) Abla Mimi Edjossan-Sossou (UL)

Appendix 3 Setup of the CV Validation workshop

This appendix depicts the validation workshop setup Campus Vesta. It contains first a General Agenda as conveyed to participants, followed by a detailed Staff agenda based on which role should do which part at which time, its hence named the Role Agenda.

Planning and General Agenda

The second validation workshop was held from 9 to 11 May, 2017 at Campus Vesta (Belgium). The validation exercises were conducted in Dutch since the consortium decided to use the native language of the host country to allow all the participants to properly play their role, as practitioners do not necessarily speak English very well.

The general agenda was as follows:

Tuesday 9 May (Room 3.09)
13-17u Internal CascEff meeting

Wednesday 10 May (Room 3.09 en 3.10)
10:00 - 18:00 Validation day 1
18:30 Social diner

Thursday 11 May (Room 1.09)
9-13u Internal CascEff debriefing

Role based agenda

Tuesday 9 May (Room 3.09)

13-17u Internal CascEff meeting
Participants: Anders Lönnermark (SP), Maurice Sammels (XVR), Xavier Criel (SCE), Tom d'Oosterlinck (SCE), Cornelie Van Hunnick (SCE), Clément Judek (UL) Kathleen Van Heuverswyn (CV), Ronald Ackermans (CV)

Wednesday 10 May (Room 3.09 and 3.10)

10:00	Welcome & coffee
10:10	Welcome by Koen Milis, CEO CV, hosting the Validation Workshop Practical information by Kathleen Van Heuverswyn (CV)
10:15	CascEff project presentation by Anders Lönnermark, project coordinator
10:35	Presentation on the validation methodology by Maurice Sammels (XVR), Task leader 5.3
10:45	Presentation of the exercise scenario by Ronald Ackermans (CV), Exercise Director Split into 2 groups for parallel sessions with Dutch and Belgian participants.

10:50 Exercise 1: planning session where participants make a risk analysis, incl. identification of cascading effects, based on current practices, using their own information sources, tools, etc.

The whole morning session aims that creating a baseline for comparison for the validation of the IEM. The output of a simulated planning session 'as usual' will be compared at the end of the day to the results of the afternoon sessions, using the structured 6 steps approach of the IEM.
The composition of the participant groups (BE, NL) is multidisciplinary, as is the current practice for emergency planning teams.
Exercise 1 is led by Maurice Sammels (NL) for the Dutch Group and Xavier Criel for the Belgian group

11:50 Debriefing Exercise 1 & Lunch

12:30 Introduction to the Incident Evolution Methodology by Maurice Sammels (NL) and Xavier Criel (B)

12:40 Exercise 2: explanation of the IEM step by step, exercise step by step, participants' questionnaire per step.
The afternoon session is a simulated planned session, using the structured approach of the IEM.
Each step is explained to the participants (5-10'), they are asked to put the explanation into practice (10-20'), they are asked per step to fill in the participants' questionnaire

14:45 coffee break

14:55 Continuation Exercise 2

16:30 Joint debriefing with the Dutch and Belgian participants, round table to share their experiences, feedback and comments

17:30 Demonstration of the Incident Evolution Tool using Exercise 2

18:00 End Validation workshop

18:30 Social diner

Thursday 11 May (Room 1.09)

9:00-13:00 Internal CascEff debriefing

Participants: Anders Lönnermark (SP), Maurice Sammels (XVR), Xavier Criel (SCE), Tom d'Oosterlinck (SCE), Cornelie Van Hunnick (SCE), Clément Judek (UL) Kathleen Van Heuverswyn (CV)

Appendix 4 Results table questionnaire classification

This appendix related to the results presented in Chapter 4 on the evaluation of the IEM validation targets. It contains classification of the preparedness phase questions (Table A4.1), an ANOVA test comparison between Campus Vesta and University of Lorrain participants' answers (Table A4.2), and an ANOVA test comparison between two different types of participants (Table A4.3).

Table A4.1 Classification of the preparedness phase validation questions

Questions	Classification	Class Name
Is the flow of the Validation clear for you?	Validation Session	ValidSession1
Did you understand the goal of the session?	Validation Session	ValidSession2
Did you understand the initial situation?	Validation Session	ValidSession3
Did you understand the IEM overview?	Validation Session	ValidSession5
Did you experience difficulties in dealing with the situation?	Validation Session	ValidSession4
What did you think of the situation?	Feeling	Feeling1
What are the main conclusions you have come to and why?	Feeling	Feeling2
What level of detail did you use to assess the cascading effects?	Technical assessment	Assess
At this stage do you perceive the IEM as a credible methodology?	Credibility of IEM	CredIEM1
Is the IEM a credible tool to manage this situation?	Credibility of IEM	CredIEM2
Is the IEM credible as a whole?	Credibility of IEM	CredIEM3
Did you feel that following the IEM steps you addressed all aspects of cascading effects?	Credibility of IEM	CredIEM4
Did you feel that all aspects of cascading effects were addressed while following the IET steps?	Credibility of IEM	CredIEM5
At this stage do you perceive the IEM as a usable methodology in general?	Usability of IEM	UsaIEM1
At this stage do you perceive the IEM as a usable methodology regarding your plans and procedures?	Usability of IEM	UsaIEM2
What did you find of applying the IEM?	Usability of IEM	UsaIEM3
Would the EIM be usable regarding your plans and procedures?	Usability of IEM	UsaIEM4
What are your conclusions on the application of the IEM?	Usability of IEM	UsaIEM5
Did you find the IEM easy to use?	Usability of IEM	UsaIEM6
Do you think the IEM is applicable in the current workflow for planning phase?	Usability of IEM	UsaIEM7
Do you think the IEM is applicable in the current workflow for preparation (training)?	Usability of IEM	UsaIEM8
Do you think the IEM is applicable in the current workflow for response?	Usability of IEM	UsaIEM9

At this stage do you think that the IEM would bring added value to your plans and procedures?	Added Value of IEM	AddIEM1
Do you feel the IEM as a whole adds value and insight?	Added Value of IEM	AddIEM2
Did we miss a step that would add more value to the IEM?	Added Value of IEM	AddIEM3
Do you feel the IEM as a whole adds value and new insight?	Added Value of IEM	AddIEM4
Did you understand step 1 « Set the case area and the systems »?	Usability of IEM Step 1	UsaStep1_1
Do you feel step 1 is usable in your current plans and procedures?	Usability of IEM Step 1	UsaStep1_2
Does this step help you to consider the appropriate geographical scope for the scenario?	Usability of IEM Step 1	UsaStep1_3
Did we miss a specific aspect that could make this step more effective or more credible?	Usability of IEM Step 1	UsaStep1_4
Do you feel that this step is usable in your current plans and procedures?	Usability of IEM Step 1	UsaStep1_5
Is step 1 credible?	Credibility of IEM Step 1	CredStep1_1
Does step 1 feel as the correct start point?	Credibility of IEM Step 1	CredStep1_2
Did you identify new systems of interest by using the IEM?	Added Value of IEM Step 1	AddStep1_2
Did you understand step 2 « Identify dependencies between systems »?	Usability of IEM Step 2	UsaStep2_1
Do you feel step 2 is usable in your current plans and procedures?	Usability of IEM Step 2	UsaStep2_2
Did we miss a specific aspect that could make this step more effective or more credible?	Usability of IEM Step 2	UsaStep2_3
Do you feel this step is usable in your current plans and procedures?	Usability of IEM Step 2	UsaStep2_4
Is step 2 credible?	Credibility of IEM Step 2	CredStep2_1
Did you identify more credible connections between systems by using the IEM (i.e. geographical, functional and logical dependencies)?	Credibility of IEM Step 2	CredStep2_2
Does step 2 feel as a logical next step from step 1?	Credibility of IEM Step 2	CredStep2_3
Based on step 2, did you revisit the step 1?	Added value of IEM Step 2	AddStep2-1
Did you understand step 3 « Propagate the effects under known risk conditions »?	Usability of IEM Step 3	UsaStep3_1
Do you feel step 3 is usable in your current plans and procedures?	Usability of IEM Step 3	UsaStep3_2
Did we miss a specific aspect that could make this step more effective or more credible?	Usability of IEM Step 3	UsaStep3_3

Did you revisit previous steps to finalize step 3?	Usability of IEM Step 3	UsaStep3_4
Do you feel this step is usable in your current plans and procedures?	Usability of IEM Step 3	UsaStep3_5
Is step 3 credible?	Credibility of IEM Step 3	CredStep3_1
Given the initial event did you identify credible unforeseen cascades?	Credibility of IEM Step 3	CredStep3_2
Does step 3 feel as a logical next step on steps 1 and 2?	Credibility of IEM Step 3	CredStep3_3
Given the initial event did you identify unforeseen aspects with regards to buffer times?	Added Value of IEM Step 3	AddStep3_1
Do you find It useful to eliminate cascade options and limit the scope of the initiating event?	Added Value of IEM Step 3	AddStep3_2
Did you understand step 4 « Determination of temporal aspects »?	Usability of IEM Step 4	UsaStep4_1
Do you feel step 4 is usable in your current plans and procedures?	Usability of IEM Step 4	UsaStep4_2
Were you able to understand how fast effects spread?	Usability of IEM Step 4	UsaStep4_3
Did we miss a specific aspect that could make this step more effective or more credible?	Usability of IEM Step 4	UsaStep4_4
Does step 4 feel as a logical next step from the previous ones?	Usability of IEM Step 4	UsaStep4_5
Would you be able to implement the timeline into the regular response workflow?	Usability of IEM Step 4	UsaStep4_6
Is step 4 credible?	Credibility of IEM Step 4	CredStep4_1
Given the outcome of the previous steps, do you feel the timeline creation is adding insights into the cascade possibilities?	Added Value of IEM Step 4	AddStep4_1
Given the outcomes, did you feel it was helpful to be able to visualize the flow of the cascades on a timeline?	Added Value of IEM Step 4	AddStep4_2
Do you find it useful to be able to find the temporal aspects?	Added Value of IEM Step 4	AddStep4_3
Do you find it useful to be able to create a timeline overview?	Added Value of IEM Step 4	AddStep4_4
Did you understand step 5 « Assessment of total impacts of a cascading effects »?	Usability of IEM Step 5	UsaStep5_1
Do you feel step 5 is usable in your current plans and procedures?	Usability of IEM Step 5	UsaStep5_2
Did we miss a specific aspect that could add value?	Usability of IEM Step 5	UsaStep5_3
Would you be able to add the impacts finding method to your regular process?	Usability of IEM Step 5	UsaStep5_4

Is step 5 credible?	Credibility of IEM Step 5	CredStep5_1
Does step 5 feel as a logical next step?	Credibility of IEM Step 5	CredStep5_2
Now that the cascade flow is known did you find adding the impacts useful?	Added value of IEM Step 5	AddStep5_1
Do you feel that knowing the impacts give you a better understanding?	Added value of IEM Step 5	AddStep5_2
Did you understand step 6 « Key decision points »?	Usability of IEM Step 6	UsaStep6_1
Do you feel step 6 is usable in your current plans and procedures?	Usability of IEM Step 6	UsaStep6_2
Would you be able to incorporate the step 6 into your regular approach?	Usability of IEM Step 6	UsaStep6_3
Is step 6 credible?	Credibility of IEM Step 6	CredStep6_1
Do you feel the identified key decision points are credible?	Credibility of IEM Step 6	CredStep6_2
Are these the key decision points or should others also have appeared?	Credibility of IEM Step 6	CredStep6_3
Does step 6 feel like a logical end point for the methodology?	Credibility of IEM Step 6	CredStep6_4
Do you feel that with all the information from previous steps the methodology allows you to find new or unexpected key decision moments?	Added value of IEM Step 6	AddStep6_1
Do you feel the identified key decision moment(s) would allow for a better approach to the situation?	Added value of IEM Step 6	AddStep6_2

Table A4.2 ANOVA test comparison between Campus Vesta and University of Lorraine participants' answers regarding the potential influence of the type of scenario used.

	Difference	Standardised difference	Critical Value	Pr > Diff	Significant
ValidSession1	0.503	1.128	2.064	0.270	No
ValidSession2	0.218	0.482	2.064	0.634	No
ValidSession3	0.297	0.446	2.064	0.659	No
ValidSession5	0.188	0.368	2.064	0.716	No
CredIEM1	1.297	1.920	2.064	0.067	No
CredIEM2	0.564	0.975	2.064	0.340	No
CredIEM3	0.230	0.448	2.064	0.658	No
CredIEM4	0.915	1.200	2.064	0.242	No
CredIEM5	0.521	0.665	2.064	0.513	No
UsaIEM1	0.879	1.130	2.064	0.270	No
UsaIEM2	1.121	1.178	2.064	0.250	No
UsaIEM3	0.109	0.215	2.064	0.832	No
UsaIEM4	0.121	0.249	2.064	0.805	No
UsaIEM5	0.200	0.312	2.064	0.757	No
UsaIEM6	1.055	1.312	2.064	0.202	No
UsaIEM7	0.485	0.742	2.064	0.465	No
UsaIEM8	0.158	0.270	2.064	0.789	No
UsaIEM9	0.618	1.348	2.064	0.190	No
AddIEM1	1.224	1.553	2.064	0.134	No
AddIEM2	0.061	0.154	2.064	0.879	No
AddIEM4	0.812	1.517	2.064	0.142	No
UsaStep1_1	0.461	0.766	2.064	0.451	No
UsaStep1_2	0.570	0.760	2.064	0.454	No
UsaStep1_3	1.745	2.392	2.064	0.025	Yes
UsaStep1_5	0.018	0.032	2.064	0.974	No
CredStep1_1	0..364	0..443	2..064	0..662	No
CredStep1_2	0..309	0..454	2..064	0..654	No
AddStep1_2	0..297	0..290	2..064	0..774	No
UsaStep2_1	0..503	0.787	2.064	0.439	No
UsaStep2_2	0.418	0.534	2.064	0.598	No
UsaStep2_4	0.261	0.374	2.064	0.712	No
CredStep2_1	0.273	0.367	2.064	0.717	No
CredStep2_2	0.358	0.471	2.064	0.642	No
CredStep2_3	0.618	1.177	2.064	0.251	No
AddStep2-1	0.370	0.308	2.064	0.761	No

UsaStep3_1	0.067	0.101	2.064	0.921	No
UsaStep3_2	0.515	0.604	2.064	0.552	No
UsaStep3_4	0.158	0.199	2.064	0.844	No
UsaStep3_5	0.158	0.218	2.064	0.830	No
CredStep3_1	0.036	0.066	2.064	0.948	No
CredStep3_2	0.309	0.339	2.064	0.737	No
CredStep3_3	0.515	1.388	2.064	0.178	No
AddStep3_1	0.903	1.357	2.064	0.188	No
AddStep3_2	0.800	1.130	2.064	0.270	No
UsaStep4_1	0.115	0.204	2.064	0.840	No
UsaStep4_2	1.273	1.110	2.064	0.278	No
UsaStep4_3	0.115	0.208	2.064	0.837	No
UsaStep4_5	0.600	1.177	2.064	0.251	No
UsaStep4_6	0.133	0.209	2.064	0.836	No
CredStep4_1	0.770	0.852	2.064	0.403	No
AddStep4_1	0.576	1.763	2.064	0.091	No
AddStep4_2	0.224	0.723	2.064	0.477	No
AddStep4_3	0.042	0.101	2.064	0.920	No
AddStep4_4	0.115	0.266	2.064	0.793	No
UsaStep5_1	0.152	0.244	2.064	0.810	No
UsaStep5_2	0.127	0.166	2.064	0.870	No
UsaStep5_4	0.297	0.315	2.064	0.756	No
CredStep5_1	0.212	0.279	2.064	0.783	No
CredStep5_2	0.733	0.837	2.064	0.411	No
AddStep5_1	0.570	0.649	2.064	0.523	No
AddStep5_2	0.236	0.339	2.064	0.738	No
UsaStep6_1	0.879	1.296	2.064	0.207	No
UsaStep6_2	0.218	0.253	2.064	0.802	No
UsaStep6_3	0.473	0.606	2.064	0.550	No
CredStep6_1	1.012	1.634	2.064	0.115	No
CredStep6_2	0.636	1.421	2.064	0.168	No
CredStep6_4	0.267	0.375	2.064	0.711	No
AddStep6_1	0.509	0.782	2.064	0.442	No
AddStep6_2	0.715	0.894	2.064	0.380	No

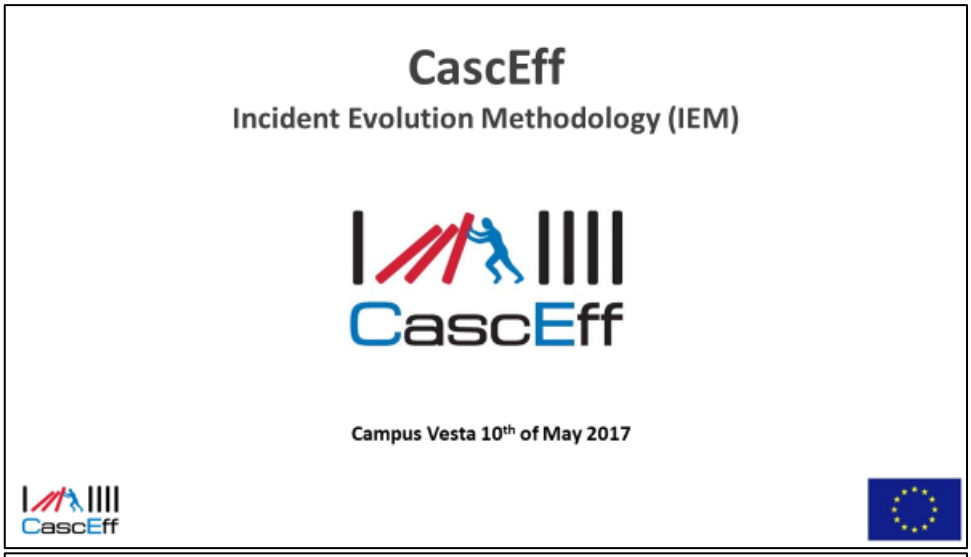
Table A4.3 ANOVA test comparison between Campus Vesta and University of Lorraine participants' answers regarding the composition of the panel of participants.

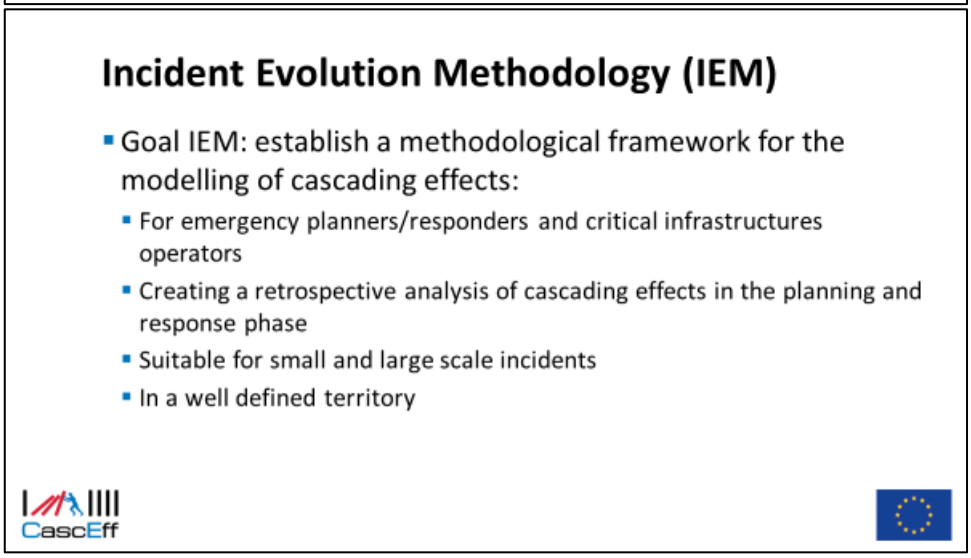
	Difference	Standardised difference	Critical Value	Pr > Diff	Significant
ValidSession1	0.167	0.274	2.074	0.787	No
ValidSession2	0.533	0.599	2.074	0.555	No
ValidSession3	0.400	0.602	2.512	0.820	No
ValidSession5	0.733	0.822	2.074	0.420	No
CredIEM1	0.100	0.130	2.074	0.898	No
CredIEM2	0.433	0.633	2.074	0.533	No
CredIEM3	1.367	1.371	2.074	0.184	No
CredIEM4	1.233	1.191	2.777	0.639	No
CredIEM5	0.867	0.848	2.074	0.405	No
UsaIEM1	2.100	1.803	2.512	0.192	No
UsaIEM2	0.000	0.000	2.074	1.000	No
UsaIEM3	0.633	0.992	2.512	0.590	No
UsaIEM4	0.000	0.000	2.512	1.000	No
UsaIEM5	1.233	1.147	2.512	0.496	No
UsaIEM6	0.133	0.155	2.074	0.879	No
UsaIEM7	0.200	0.254	2.074	0.802	No
UsaIEM8	1.033	1.766	2.074	0.091	No
UsaIEM9	1.467	1.376	2.777	0.527	No
AddIEM1	0.033	0.063	2.074	0.951	No
AddIEM2	0.933	1.312	2.512	0.404	No
AddIEM4	0.433	0.533	2.512	0.856	No
UsaStep1_1	0.433	0.431	2.074	0.671	No
UsaStep1_2	1.267	1.295	2.074	0.209	No
UsaStep1_3	0.267	0.360	2.074	0.722	No
UsaStep1_5	1.200	1.198	2.074	0.244	No
CredStep1_1	0.533	0.592	2.074	0.560	No
CredStep1_2	0.533	0.415	2.074	0.682	No
AddStep1_2	0.500	0.579	2.512	0.833	No
UsaStep2_1	0.067	0.063	2.074	0.950	No
UsaStep2_2	0.133	0.143	2.074	0.888	No
UsaStep2_4	0.167	0.165	2.512	0.985	No
CredStep2_1	0.967	0.986	2.512	0.593	No
CredStep2_2	0.500	0.723	2.074	0.478	No
CredStep2_3	0.000	0.000	2.074	1.000	No
AddStep2-1	0.200	0.226	2.074	0.824	No
UsaStep3_1	0.800	0.713	2.074	0.484	No

UsaStep3_2	0.933	0.911	2.512	0.639	No
UsaStep3_4	0.100	0.102	2.074	0.920	No
UsaStep3_5	0.333	0.450	2.512	0.895	No
CredStep3_1	0.733	0.650	2.074	0.522	No
CredStep3_2	0.467	0.926	2.074	0.364	No
CredStep3_3	1.100	1.250	2.512	0.438	No
AddStep3_1	0.600	0.650	2.074	0.523	No
AddStep3_2	0.300	0.400	2.074	0.693	No
UsaStep4_1	0.900	0.580	2.074	0.568	No
UsaStep4_2	0.233	0.312	2.074	0.758	No
UsaStep4_3	0.267	0.392	2.512	0.919	No
UsaStep4_5	0.967	1.184	2.512	0.475	No
UsaStep4_6	0.300	0.256	2.074	0.800	No
CredStep4_1	0.400	0.971	2.512	0.602	No
AddStep4_1	0.533	1.307	2.512	0.406	No
AddStep4_2	0.300	0.538	2.512	0.854	No
AddStep4_3	0.433	0.751	2.512	0.736	No
AddStep4_4	0.000	0.000	2.074	1.000	No
UsaStep5_1	0.667	0.682	2.074	0.503	No
UsaStep5_2	0.467	0.367	2.074	0.717	No
UsaStep5_4	0.200	0.194	2.512	0.980	No
CredStep5_1	0.667	0.565	2.512	0.840	No
CredStep5_2	0.300	0.252	2.074	0.803	No
AddStep5_1	0.467	0.514	2.074	0.613	No
AddStep5_2	0.733	0.800	2.512	0.707	No
UsaStep6_1	0.633	0.558	2.512	0.844	No
UsaStep6_2	0.500	0.477	2.074	0.638	No
UsaStep6_3	0.933	1.120	2.512	0.512	No
CredStep6_1	1.033	1.748	2.777	0.324	No
CredStep6_2	0.433	0.460	2.074	0.650	No
CredStep6_4	0.733	0.848	2.074	0.406	No
AddStep6_1	0.933	0.861	2.777	0.825	No
AddStep6_2	0.901	0.806	1.745	0.827	No

Appendix 5: Introductory PowerPoint Presentation of the IEM

During the Validations the IEM has been introduced to the participants using a PowerPoint. This appendix will depict only the used presentation. Take note that this is not the final Educative IEM material, that can be found in D6.6.





Incident Evolution Methodology (IEM)

- Step 1: set the case area and the systems
- Step 2: identify dependencies between systems
- Step 3: propagate the effects between systems under known risk conditions
- Step 4: determine the temporal aspects of the dependencies
- Step 5: assess the impacts: consequences system by system
- Step 6: find the key decision points of the cascade

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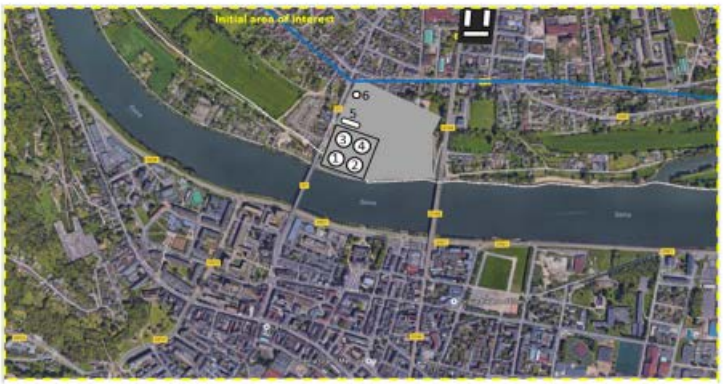
Step 1 – set the case area



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Step 1 – define the systems

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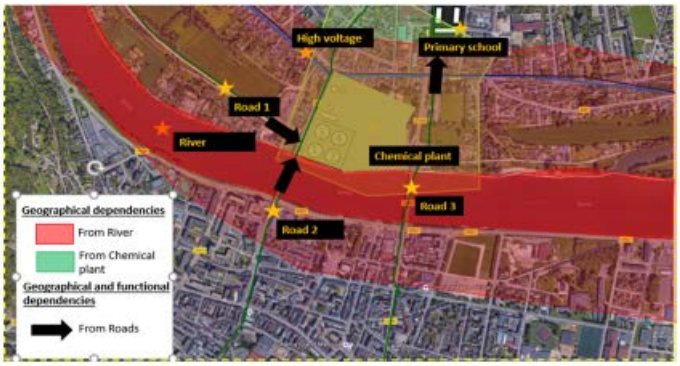
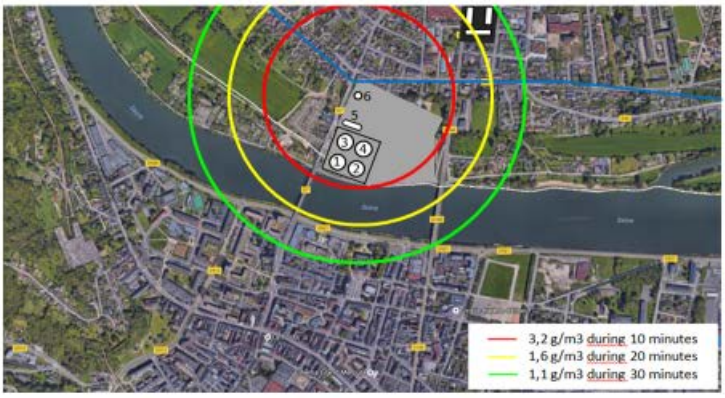
Step 1 – evaluate system vulnerabilities and potential outgoing effects

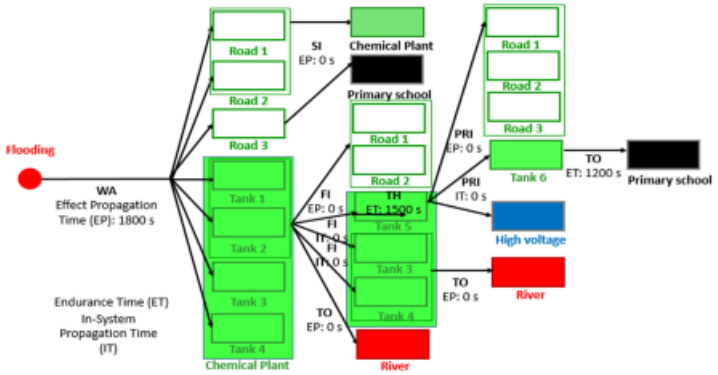
Step 2 – identify dependencies between systems



Step 3 – propagate the effects



Step 4 – determine temporal aspects



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Step 5 – evaluate impacts

Impact categories	Impact sub-categories	High Voltage	Primary School	Chemical Plant	Roads	River
Human	1-Fatalities	0	5	150	150	0
	2-Injuries	0	55	0	300	0
	3-Evacuated or confined residents >2h	0	55	0	1,000	0
	4-Mental health injuries	0	55	0	1,300	0
	5-People that has lost critical services	30,000	60	0	3,000	0
Economic	6-Direct and indirect economic costs (€)	1,000,000	50,000	2,000,000	1,000,000	10,000,000

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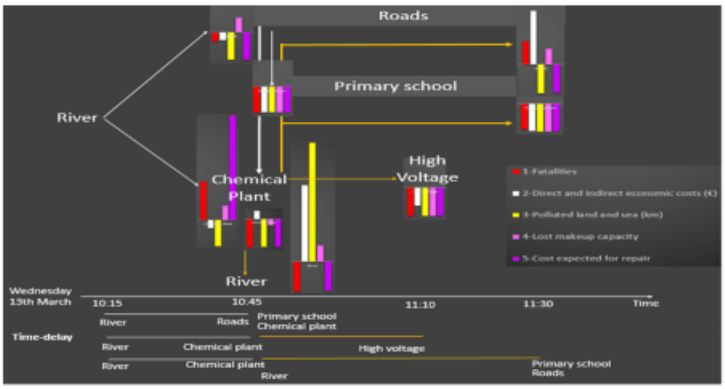
Step 6 – find key decision points



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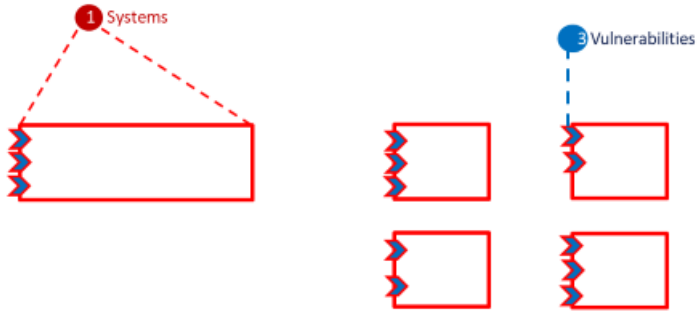
Step 1 – set the case area and the systems

Step 1 – case area and the systems

- Objective: determine all systems in scope

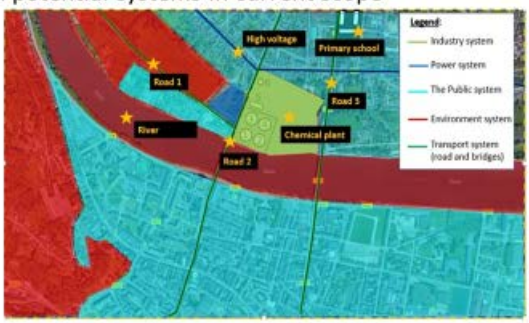


Step 1 – set the case area and the systems

- 1.1 Select the case area
  - To limit the scope

Step 1 – set the case area and the systems

- 1.2 Define the systems and their characteristics
  - ❖ To list all potential systems in current scope



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Step 1 – set the case area and the systems

- 1.3 Assessment of system vulnerabilities and potential outgoing effects
  - ❖ To predict all risks of effect propagation to other systems
  - ➢ E.g. fire (10kW/m^2)
    explosion (1km)
    toxic release (2km)

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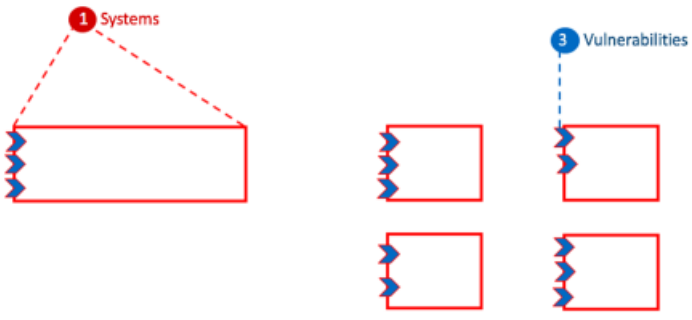
Step 1 – set the case area and the systems



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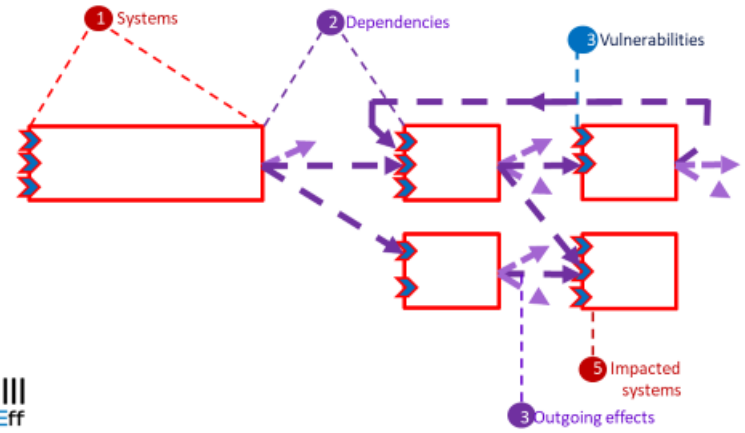
Step 2 – identify dependencies between systems

Step 2 – dependencies



Step 2 – dependencies

- Objective: identify all dependencies between systems
- Systems have implicit and explicit dependencies
- Dependencies indicate which potential systems can be affected by other systems
- 3 types of dependencies:
  - Geographical
  - Functional
  - Logical

Step 2 – type: geographical dependencies

- 2.a Geographical dependencies between systems
  - Systems located in the same area where change in local environment can create state changes in all or some of them
  - ➢E.g. river – chemical plant/roads = flooding
    chemical plant – river = river pollution
    chemical plant – roads = industrial accidents

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Step 2 – type: functional dependencies

- 2.b Functional dependencies between systems
  - State or operability of a system is dependent on the output of services or products from another system
  - ➢E.g. chemical plant – roads = incoming/outgoing service and good provisions primary school – road = student transportation

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Step 2 – type: logical dependencies

- 2.c Logical dependencies between systems
  - When a state change in one system results in a state change in another, without any of the other dependencies occurring
  - Related to the logic choices made by persons (human component)
  - Much more difficult to identify
  - ➢E.g. evacuation primary school – children climbing the overhead transmission cable pillar to avoid drowning – disruption power supply system + health hazard (electrocution)

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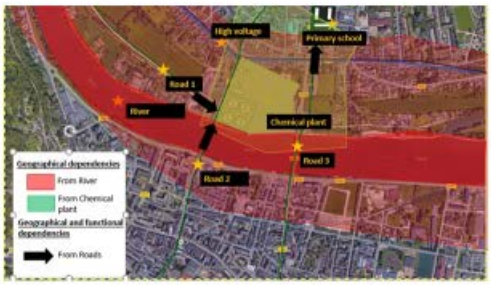
Step 2 – dependencies

- 2.1 Identify all the different dependencies between systems
  - ❖ To list all possible effect propagations between current systems



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Step 2 – dependencies

- 2.2 Revise the case area
  - Identification of other potential dependencies with systems originally not located in the initial case area
  - ❖ To revise if the current scope is still correct
  - ➢ E.g. enlarge the case area with all the systems which can be found along the entire length of the Seine river (several km)

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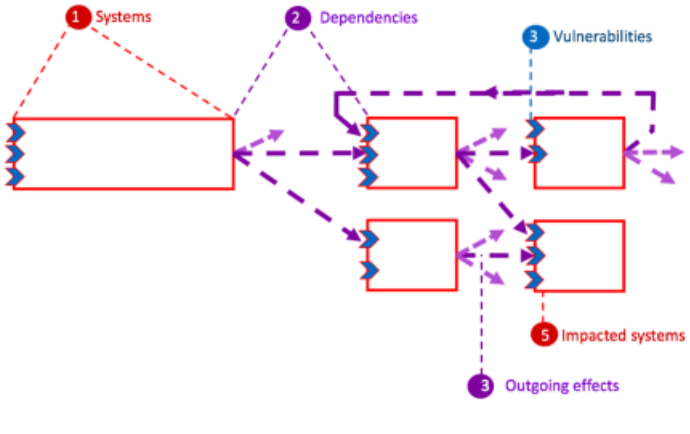
Step 2 – dependencies



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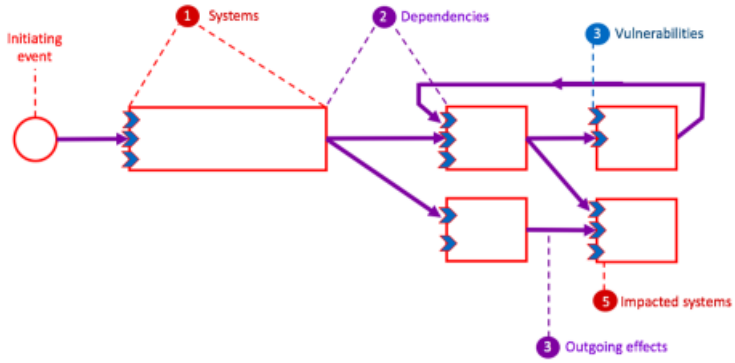
Step 3 – propagate the effects between systems

Step 3 – propagate the effects



Step 3 – propagate the effects

- Objective: identify the cascade
- 3.1 Set the initiating event
  - Define the initiating event (characteristics, outgoing effect type(s), intensity and propagation time (step 4))
  - Identify potential systems to be affected by the outgoing effects
    - ❖ To provide the initial risk conditions of the potential cascading effects
    - ➢ E.g. the initiating event = flooding of the Seine river during working hours (effect propagation time = 30 min.)

Step 3 – propagate the effects

- 3.2 Assess the risk conditions and outgoing effects of impacted systems (1st order cascading effects)
  - ❖To determine the possible cascade on the current systems
  - ➢E.g. flooding effects

CascEff

Step 3 – propagate the effects

- 3.2 Assess the risk conditions and outgoing effects of impacted systems (2nd order cascading effects)
  - ❖To determine the possible cascade on the current systems
  - ➢E.g. storage tank fire

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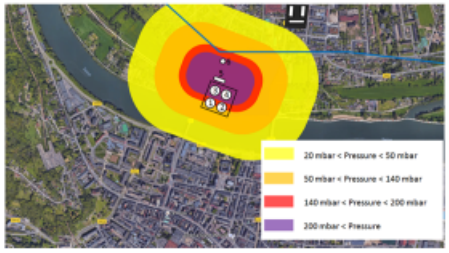
Step 3 – propagate the effects

- 3.2 Assess the risk conditions and outgoing effects of impacted systems (3rd order cascading effects)
  - ❖To determine the possible cascade on the current systems
  - ➢E.g. BLEVE



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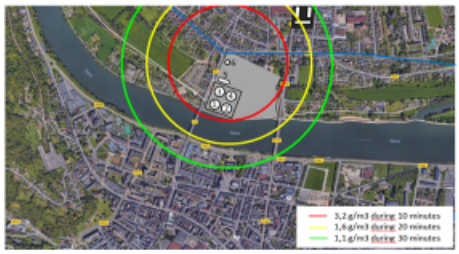
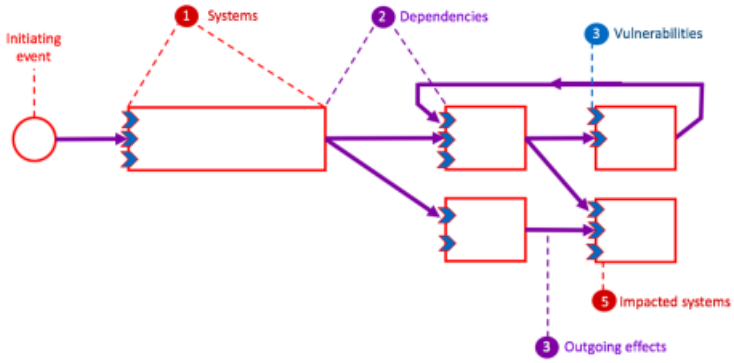
Step 3 – propagate the effects

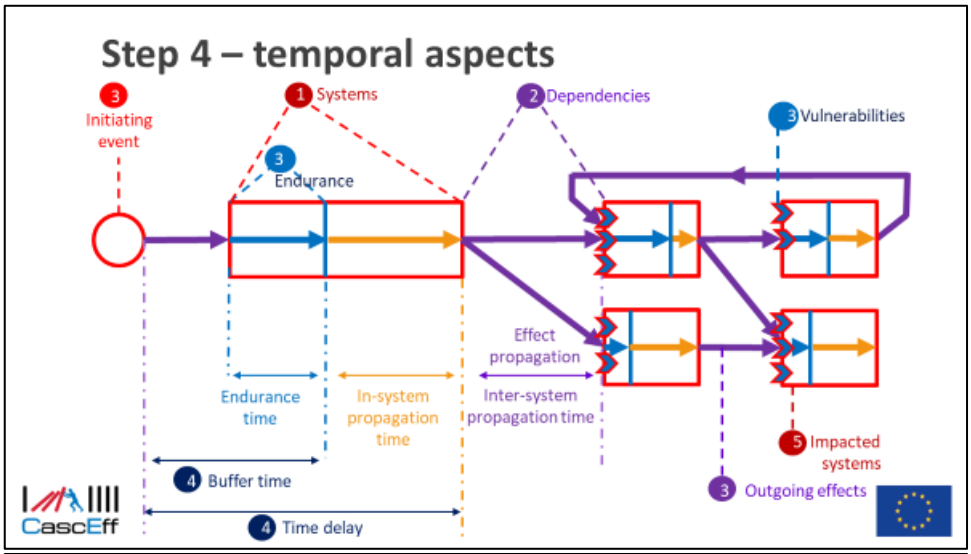
- 3.2 Assess the risk conditions and outgoing effects of impacted systems (4th order cascading effects)
  - ❖ To determine the possible cascade on the current systems
  - ➢ E.g. toxic cloud



Step 3 – propagate the effects



Step 4 – determine temporal aspects



Step 4 – temporal aspects

- Objective: determine timelines of cascade
- 4.1 Determine the inter-system propagation time
  - Assess how fast outgoing effects spread
  - List the propagation time before the next system is affected
  - ❖ To determine which system is affected when
  - ➢ E.g. 1st order cascading effects = river flooding – 1800 sec.
    2nd order cascading effects = tank 2 fire – 0 sec.
    3rd order cascading effects = tank 5 BLEVE – 0 sec.
    4th order cascading effects = tank 6 toxic cloud – 1200 sec.

Inter-system effect propagation time = 3000 sec. (= 1800 + 0 + 0 + 1200)

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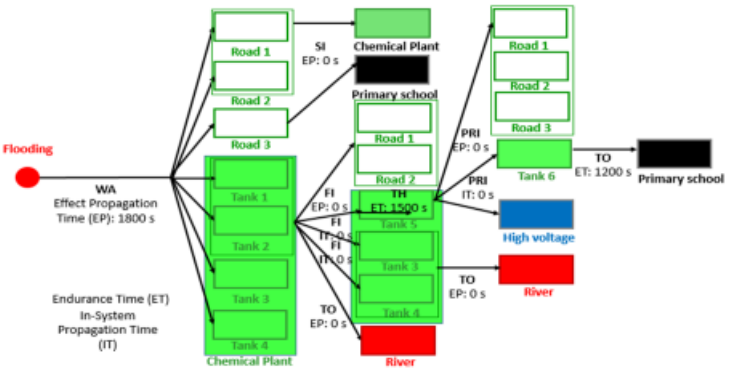
Step 4 – temporal aspects

- 4.1 Determine the inter-system propagation time



Step 4 – temporal aspects

- 4.2 Calculate the endurance-time of each system
  - Asses the resistance of a system to an incoming effect
  - List the endurance time before system failure
  - ❖ To limit the possible incoming effects to actual cascades
  - ➢ E.g. based on the tank behaviour curve of the LPG tank the endurance-time of the LPG tank in the chemical plant = 1500 sec. (= 25 min.)

CascEff

Step 4 – temporal aspects

- 4.3 Determine the in-system propagation time
  - Asses the "in" system propagation of effects until it produces an outgoing effect
  - List the in-system time before outgoing effect production
  - ❖ To limit the possible incoming effects to actual cascades
  - ➢ E.g. split the chemical plant in several systems (the tanks) and the in-system propagation time of the chemical plant = 0 sec. (fire & bleve 0 sec. & chemical cloud is outgoing effect)

CascEff

Step 4 – temporal aspects

- 4.4 Determine the buffer time
  - The time available for avoiding in-system effect propagation
  - Buffer time = inter-system propagation time + endurance time
  - ❖ To help later in finding key decision points
  - ➢ E.g. flood (1800 sec.) propagation + tank system (1500 sec.) endurance results in a 3300 sec. buffer time

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Step 4 – temporal aspects

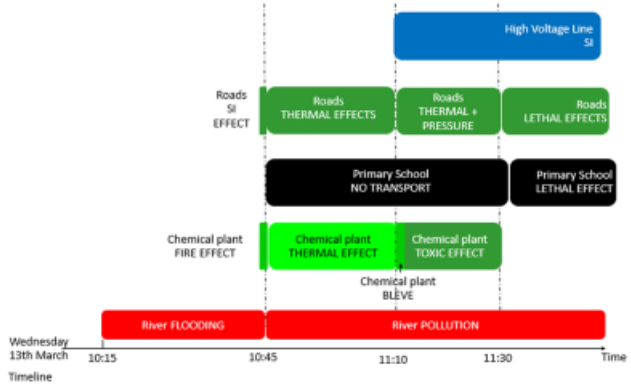
- 4.5 Determine the time delay
  - Window of opportunity for breaking chains of cascading effects
  - Time delay = buffer time + in-system propagation time
  - ❖To know the potential (maximum) available time for the mitigation of effects between 2 systems and so preventing affecting a 3th system
  - ➢E.g. flood (1800 sec.) propagation + tank system (1500 sec.) endurance + tank fire (0 sec.) internal propagation results in a 3300 sec. time delay

Step 4 – temporal aspects

- 4.6 Create the timeline overview
  - Evaluate the buffer time and time delay between systems in a chronological order
  - Draw the timeline of cascading systems
  - ❖To help later in finding key decision points (step 6)
  - ➢E.g. on next slide

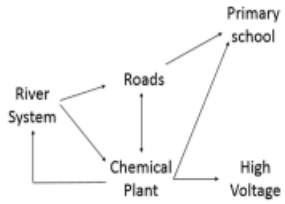
Step 4 – temporal aspects

- 4.6 Create the timeline overview



Step 4 – temporal aspects

- 4.7 Create the tree-view overview
  - The tree-view consists in representing the earliest impacted system, using arrows to represent the (inter-) dependencies + effect propagation
  - ❖To analyse the propagation model of the cascading effects



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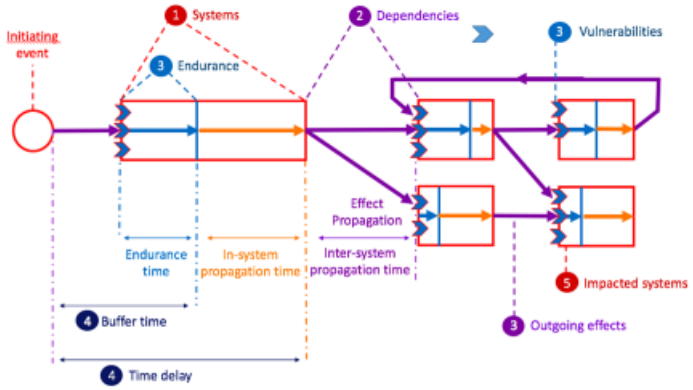
Step 4 – temporal aspects



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Step 5 – assess the impacts

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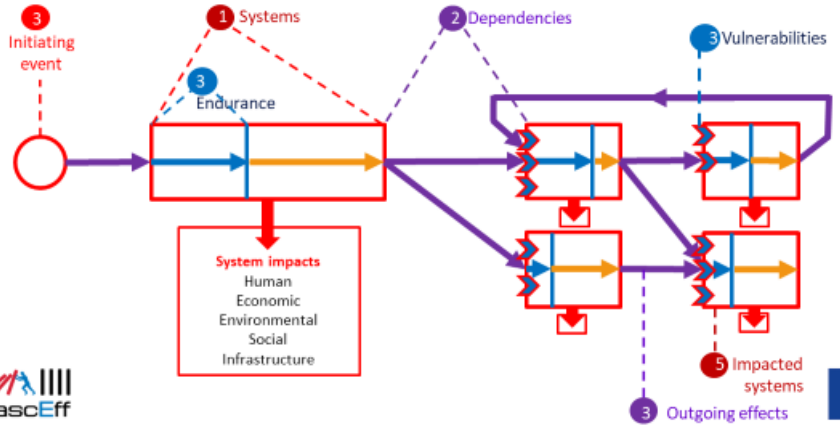
Step 5 – impacts: consequences system by system



Step 5 – impacts: consequences system by system

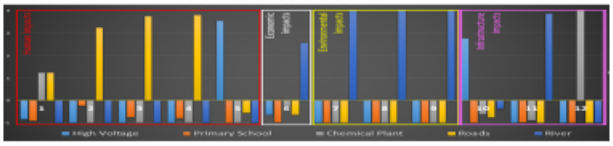
- Objective: identify the potential impact of system failure
- 5.1 List and quantify the impacts for each cascading system
  - Maximum effect by impact category upon total failure of system
  - 5 types of impacts: human, economy, environment, society and infrastructure
    - ❖ To help weigh cascades against cascade in finding key decision points
      - ➢ E.g. on next slide

Step 5 – impacts: consequences system by system

Impact categories	Impact sub-categories	High Voltage	Primary School	Chemical Plant	Roads	River
Human	1-Fatalities	0	5	150	150	0
	2-Injuries	0	55	0	300	0
	3-Evacuated or confined residents >2h	0	55	0	1,000	0
	4-Mental health injuries	0	55	0	1,300	0
	5-People that has lost critical services	30,000	60	0	3,000	0
Economic	6-Direct and indirect economic costs (€)	1,000,000	50,000	2,000,000	1,000,000	10,000,000
Environmental	7-Polluted land (km)	0	0	0	0	30
	8-Polluted sea /water (km)	0	0	0	0	???
	9-Dead animals	0	0	0	0	10,000
Infrastructure (infrastructure downtime)	10-Number of users	300,000	60	30,000	20,000	50,000
	11-Lost makeup capacity	100% of 300 kV	100% of 60 students	80% of 800L	80% of 20.000 cars/day	0%
	12-Time expected for repair (in month)	0.25	6	30	0.25	1,200
	13-Cost expected for repair (in €)	50,000	100,000	300,000,000	100,000	0

Step 5 – impacts: consequences system by system

- 5.2 create the scorecard of impacts
  - Balance sheet of impacts (results)
  - Standardised impact sub-category units for each system
  - ❖ To help weigh cascades against cascade in finding key decision points
  - ➢ E.g. roads - highest injuries and fatalities, river - most environmental impacts, chemical plant - highest economic impact and high voltage transmission line - most connected users



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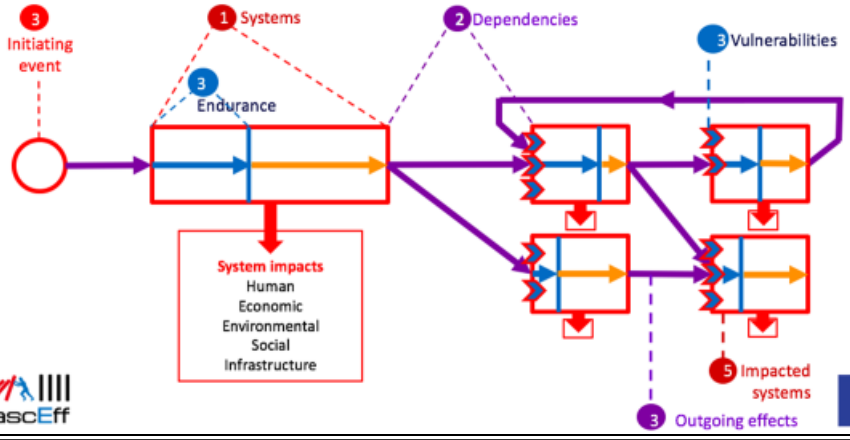
Step 5 – impacts: consequences system by system



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Step 6 – find key decision points

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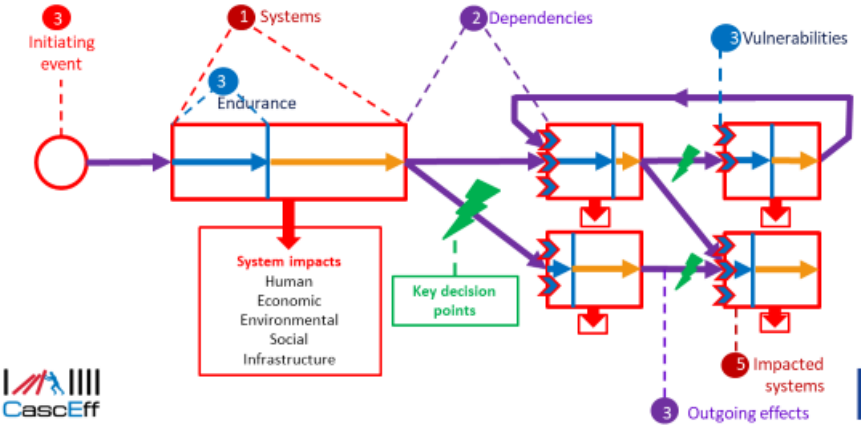
Step 6 – key decision points



Step 6 – key decision points

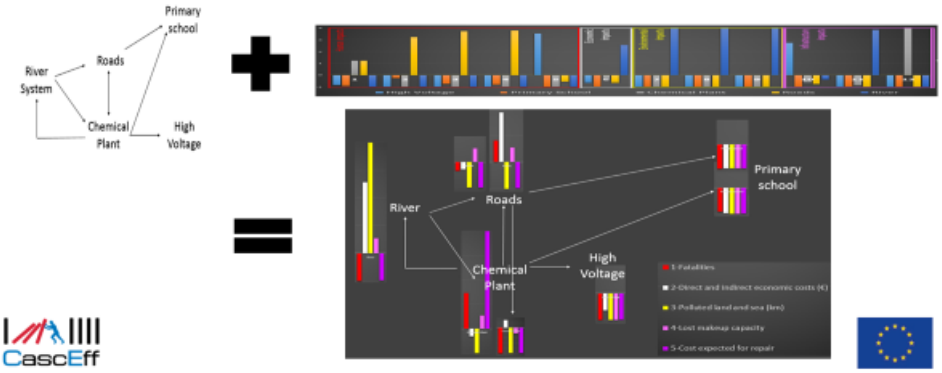
- Objective: determine points in the cascades where decisions can be taken to break the cascade
- 6.1 Compare impacts between systems
  - Use scorecard and tree view representation (step 5) for visualising the calculated impact sub-category per cascade system

❖To identify the critical/main cascades to be stopped or prevented

➢E.g. on next slide

Step 6 – key decision points

- 6.1 Compare impacts between systems



Step 6 – key decision points

- 6.2 Consider the time delay
  - Estimation of available timeframe for breaking the cascade on identified critical cascades
  - Assistance in the support of the identification of key decision points:
    - How much time does the decision-maker have to make a decision?
    - What is the latest time that a decision must be taken to have an effect?
    - What is the time needed to put mitigation measures in place?

❖To indicate the achievable key decision points

➢E.g. on next slide

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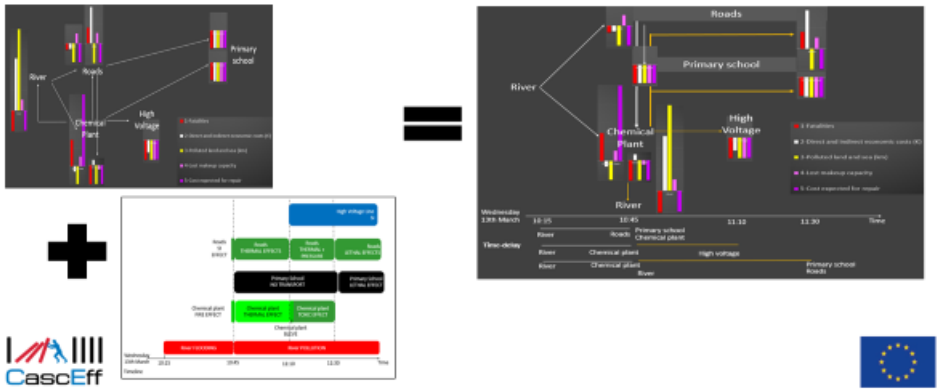
Step 6 – key decision points

- 6.2 Consider the time delay



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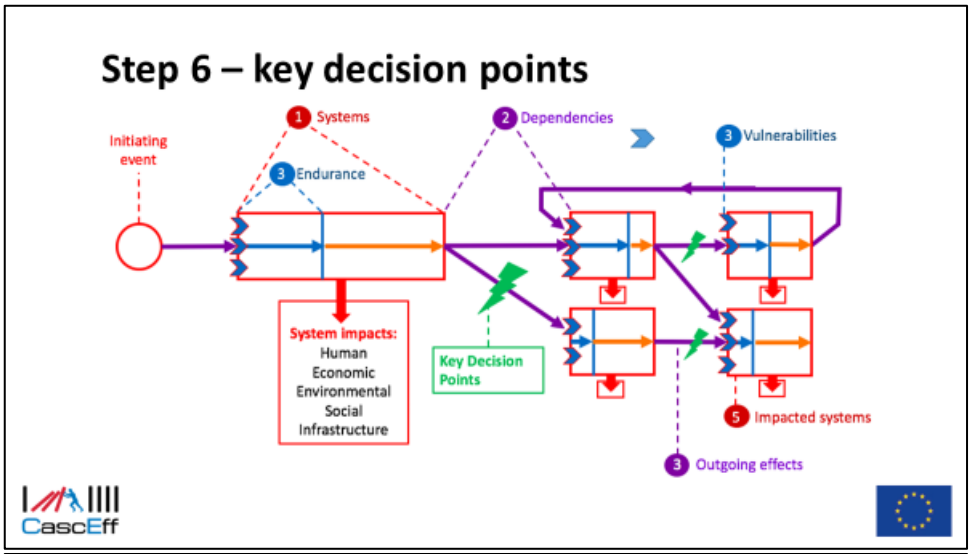
Step 6 – key decision points
Initiating event
1 Systems
2 Dependencies
3 Vulnerabilities
3 Endurance
System impacts:
Human
Economic
Environmental
Social
Infrastructure
Key Decision Points
5 Impacted systems
3 Outgoing effects
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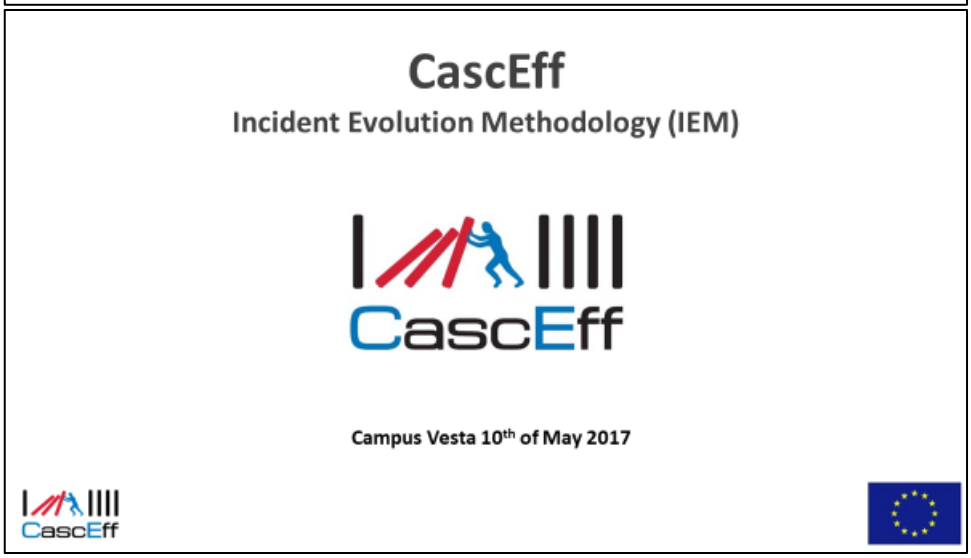
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Incident Evolution Methodology (IEM)
CascEff
Campus Vesta 10th of May 2017
CascEff

Appendix 6: The Validation Questionnaires

CASCEFF VALIDATION SESSION

Observers' questionnaire

As an observer, you will report the actions of the CascEff validation session. This document will guide your observations through both days

Observving group …….

High over introduction of the validation session

General observation

Note any questions the participants might have at this point

Planning phase - Initial and During situation without IEM

General observation

Note the flow of what the participants do with the situation

Which type of information are the participants requesting?

Which tools are the participants using?

Planning phase - End of Regular situation without IEM

General observation

Note the difficulties encountered by the participants during the session

Presentation of the IEM - General overview

General observation

Note any difficulties participant might report at this point

Step 1 - Presentation

General observation

Note any difficulties participant might report at this point

Step 1 - Situation with the IEM

Added value

Note the case created by the participants

Note the difference compared to the regular situation

Applicability

Note the process of applying step 1

Note difficulties and deviations from step 1

Step 2 - Presentation

General observation

Note any difficulties participant might report at this point

Step 2 - Situation with the IEM

Added value

Note the case created by the participants

Note the difference compared to the regular situation

Applicability

Note the process of applying step 2

Note difficulties and deviations as well as revisits of step 1.

Step 3 - Presentation

General observation

Note any difficulties participant might report at this point

Step 3 - Situation with the IEM

Added value

Note the process taken once the initiating event is introduced

Note the specific systems the participants look at in depth

Note differences to the regular setup

Applicability

Does step 3 feel as a logical next step on step 1 and 2?

Do you find It useful to eliminate cascade options and limit the scope of the initiating event?

Did you revisit previous steps to finalize step 3?

Do you feel this step is usable in your current plans and procedures?

Step 4 - Presentation

General observation

Note any difficulties participant might report at this point

Step 4 - Situation with the IEM

Added value

Note the process taken to create a timeline

Note the specific systems and dependencies the users look at in depth

Applicability

Note the process taken to come to a timeline

Note if previous steps were revisited

Note difficulties and irregulations of following this step

Step 5 - Presentation

General observation

Note any difficulties participant might report at this point

Step 5 - Situation with the IEM

Added value

Note the flow used to address the impacts

Note the systems that impact is added to

Applicability

Note the flow of actions to apply this step

Note difficulties and irregulations of following this step

Note if earlier steps were revisited

Step 6 - Presentation

General observation

Note any difficulties participant might report at this point

Step 6 - Situation with the IEM

Added value

Note the flow of assessment that the participants do

Applicability

Note the flow of actions to apply this step

Note difficulties and irregulations of following this step

Note if earlier steps were revisited

Situation with the IEM - End of situation

General observation

Take notes of questions and remarks

General feedback

Final Review

General observation

Take notes of questions and remarks

General feedback

CASCEFF VALIDATION SESSION

Validators' questionnaire

As a validator, you will assess through participants' actions whether both objectives of the validation session (added value; applicability) are completed regarding the Incident Evolution Methodology. This document will guide your observations through both days

Table of content

Cette table des matières a été générée automatiquement. Pour l'utiliser, appliquez des styles de titre (sous l'onglet Accueil) au texte inclus dans votre table des matières, puis mettez à jour la table.

Si vous voulez taper vos propres entrées, utilisez une table des matières manuelle (dans le même menu que l'option de création d'une table des matières automatique).

Validating group ……
……

Planning phase - Initial and During situation without IEM

General observation

Do the participants consider potential cascading effects in the evolution of the situation?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Do their tools consider cascading effects?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Added value

Did the participants already do parts of the IEM in this regular scenario?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Can the requesting information be found in/with the IEM?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Can the tools of the participants be used in conjunction with the IEM?

Not at all	0	1	2	3	4	5	6	7	8	9	10	*Absolutely*

Comment

Planning phase - End of Regular situation without IEM

General observation

Note down the base line of response in the regular scenario

Assess, then note down the differences in comparison to the level of details proposed by the IEM?

Completely different	0	1	2	3	4	5	6	7	8	9	10	*No differences*

Assess, then note down the difficulties to re-verify after the IEM situation?

Very difficult	0	1	2	3	4	5	6	7	8	9	10	*Not difficult at all*

Presentation of the IEM - General overview

Added value

Note any remarks participants have on the credibility of this step.

Applicability

Note any remarks participants have on the usability of this step.

Step 1 - Presentation of the IEM

Added value

Note any remarks participants have on the credibility of this step.

Applicability

Note any remarks participants have on the usability of this step.

Step 1 - Situation with IEM

Added value

Validate if added value is perceived in the case setup

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Was this step perceived as logical by the participants?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Were the participants able to execute the step using the available information?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Validate if this step would be useable

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Step 2 - Presentation of the IEM

Added value

Note any remarks participants have on the credibility of this step.

Applicability

Note any remarks participants have on the usability of this step.

Step 2 - Situation with IEM

Added value

Validate if added value is perceived in the dependencies setup

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Was this step perceived as logical by the participants?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Were the participants able to execute the step using the available information?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Validate if this step would be useable

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Step 3 - Presentation of the IEM

Added value

Note any remarks participants have on the credibility of this step.

Applicability

Note any remarks participants have on the usability of this step.

Step 3 - Situation with IEM

Added value

Validate if added value is perceived in checking the flow from the initiating event

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Was this step perceived as logical by the participants?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Were the participants able to execute the step using the available information?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Validate if this step would be useable

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Step 4 - Presentation of the IEM

Added value

Note any remarks participants have on the credibility of this step.

Applicability

Note any remarks participants have on the usability of this step.

Step 4 - Situation with IEM

Added value

Validate if added value is perceived in creation of a timeline

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Was this step perceived as logical by the participants?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Were the participants able to execute the step using the available information?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Validate if this step would be useable

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Step 5 - Presentation of the IEM

Added value

Note any remarks participants have on the credibility of this step.

Applicability

Note any remarks participants have on the usability of this step.

Step 5 - Situation with IEM

Added value

Validate the added value of finding the impacts

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Was this step perceived as logical by the participants?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Were the participants able to execute the step using the available information?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Validate if this step would be useable

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Step 6 - Presentation of the IEM

Added value

Note any remarks participants have on the credibility of this step.

Applicability

Note any remarks participants have on the usability of this step.

Step 6 - Situation with IEM

Added value

Validate the added value of finding the Key decision point

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Was this step perceived as logical by the participants?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Were the participants able to execute the step using the available information?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Validate if this step would be useable

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Planning phase - End Situation with the IEM

General observation

Were the participants able to apply the methodology?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

What went well? What was more difficult/wrong?

Added value

Validate the credibility of all steps as a whole

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Validate the usability of all steps as a whole

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Final Review

General observation

Were the participants able to apply the methodology?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

What went well? What was more difficult/wrong?

Added value

Validate the credibility of all steps as a whole

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Validate the usability of all steps as a whole

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

CASCEFF VALIDATION SESSION

Participants' questionnaire

You have accepted to be part of the validation session of the CascEff Incident Evolution Methodology. As part of the validation process, we need your opinion and feedback. A questionnaire has been set regarding validation criteria that have been identified based on the steps of the methodology as well as as on the objectives of the validation which are: « the added value of the tool » and « the applicability of the tool ».

Time has been defined to fill up the questionnaire that will accompany your actions through both days. You will be instructed when to answer the questions.

Table of content

First name ……

Last name ……

Name of your organisation ……

Position in your organisation ……

Name of your group ……

High over introduction of the validation session

General observation

Is the flow of the Validation clear for you?

Not at all	0	1	2	3	4	5	6	7	8	9	10	*Absolutely*

Comment

Planning phase - Initial and During situation without IEM

General observation

Did you understand the goal of the session?

Not at all	0	1	2	3	4	5	6	7	8	9	10	*Absolutely*

Comment

Did you understand the initial situation?

Not at all	0	1	2	3	4	5	6	7	8	9	10	*Absolutely*

Comment

Planning phase - End of Regular situation without IEM

General observation

What did you think of the situation?

What are the main conclusions you have come to and why ?

What level of detail did you use to assess the cascading effects?

Did you experience difficulties in dealing with the situation?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Presentation of the IEM - General overview

General observation

Did you understand the IEM overview?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Added value

At this stage do you perceive the IEM as a credible methodology?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

At this stage do you think that the IEM would bring added value to your plans and procedures?

Not at all	0	1	2	3	4	5	6	7	8	9	10	*Absolutely*

Comment

Applicability

At this stage do you perceive the IEM as a usable methodology in general?

Not at all	0	1	2	3	4	5	6	7	8	9	10	*Absolutely*

Comment

At this stage do you perceive the IEM as a usable methodology regarding your plans and procedures?

Not at all	0	1	2	3	4	5	6	7	8	9	10	*Absolutely*

Comment

Presentation of the IEM - Initial of situation

Added value

Is the IEM a credible tool to manage this situation?

Not at all	0	1	2	3	4	5	6	7	8	9	10	*Absolutely*

Comment

Step 1 - Presentation

General observation

Did you understand step 1 *« SET THE CASE AREA AND THE SYSTEMS »*?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Added value

Is step 1 credible?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Do you feel step 1 is usable in your current plans and procedures?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Step 1 - Situation with the IEM

Added value

Does this step help you to consider the appropriate geographical scope for the scenario?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Did you identify new systems of interest by using the IEM?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Did we miss a specific aspect that could make this step more effective or more credible?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Does step 1 feel as the correct start point?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Do you feel that this step is usable in your current plans and procedures?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Step 2 - Presentation

General observation

Did you understand step 2 *« IDENTIFY DEPENDENCIES BETWEEN SYSTEMS »*?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Added value

Is step 2 credible?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Do you feel step 2 is usable in your current plans and procedures?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Step 2 - Situation with the IEM

Added value

Did you identify more credible connections between systems by using the IEM (i.e. geographical, functional and logical dependencies)?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Did we miss a specific aspect that could make this step more effective or more credible?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Does step 2 feel as a logical next step from step 1?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Do you feel this step is usable in your current plans and procedures?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Based on step 2, did you revisit the step 1?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Step 3 - Presentation

General observation

Did you understand step 3 *« PROPAGATE THE EFFECTS UNDER KNOWN RISK CONDITIONS »*?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Added value

Is step 3 credible?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Do you feel step 3 is usable in your current plans and procedures?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Step 3 - Situation with the IEM

Added value

Given the initial event did you identify credible unforeseen cascades?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Given the initial event did you identify unforeseen aspects with regards to buffer times?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Did we miss a specific aspect that could make this step more effective or more credible?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Does step 3 feel as a logical next step on step 1 and 2?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Do you find It useful to eliminate cascade options and limit the scope of the initiating event?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Did you revisit previous steps to finalize step 3?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Do you feel this step is usable in your current plans and procedures?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Step 4 - Presentation

General observation

Did you understand step 4 *« DETERMINATION OF TEMPORAL ASPECTS »*?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Added value

Is step 4 credible?

Not at all	0	1	2	3	4	5	6	7	8	9	10	*Absolutely*

Comment

Applicability

Do you feel step 4 is usable in your current plans and procedures?

Not at all	0	1	2	3	4	5	6	7	8	9	10	*Absolutely*

Comment

Step 4 - Situation with the IEM

Added value

Given the outcome of the previous steps, do you feel the timeline creation is adding insights into the cascade possibilities?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Given the outcomes, did you feel it was helpful to be able to visualize the flow of the cascades on a timeline?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Were you able to understand how fast effects spread?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Did we miss a specific aspect that could make this step more effective or more credible?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Does step 4 feel as a logical next step from the previous one's?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Do you find it useful to be able to find the temporal aspects?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Do you find it useful to be able to create a timeline overview?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Would you be able to implement the timeline into the regular response workflow?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Step 5 - Presentation

General observation

Did you understand step 5 *« ASSESSMENT OF TOTAL IMPACTS OF A CASCADING EFFECTS »*?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Added value

Is step 5 credible?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Do you feel step 5 is usable in your current plans and procedures?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Step 5 - Situation with the IEM

Added value

Now that the cascade flow is known did you find adding the impacts useful?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Do you feel that knowing the impacts give you a better understanding?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Did we miss a specific aspect that could add value?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Does step 5 feel as a logical next step?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Would you be able to adde the impacts finding method to your regular process?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Step 6 - Presentation

General observation

Did you understand step 6 *« KEY DECISION POINTS »*?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Added value

Is step 6 credible?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Do you feel step 6 is usable in your current plans and procedures?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Step 6 - Situation with the IEM

Added value

Do you feel that with all the information from previous steps the methodology allows you to find new or unexpected key decision moments?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Do you feel the identified key decision moment(s) would allow for a better approach to the situation?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Do you feel the identified key decision points are credible?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Are these the key decision points or should others also have appeared?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Does step 6 feel like a logical end point for the methodology?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Would you be able to incorporate the step 6 into your regular approach?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Presentation of the IEM - End of situation

General observation

What did you find of applying the IEM?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Added value

Is the IEM credible as a whole?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Would the EIM be usable regarding your plans and procedures?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Final Review

General observation

What are your conclusions on the application of the IEM?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Added value

Did you feel that following the IEM steps you addressed all aspects of cascading effects?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Did we miss a step that would add more value to the IEM?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Do you feel the IEM as a whole adds value and new insight?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Applicability

Did you find the IEM easy to use?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Do you think the IEM is applicable in the current workflow for planning phase?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Do you think the IEM is applicable in the current workflow for preparation (training)?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Do you think the IEM is applicable in the current workflow for response?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Do you feel the IEM as a whole adds value and insight?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Did you feel that all aspects of cascading effects were addressed while following the IET steps?

Not at all 0 1 2 3 4 5 6 7 8 9 10 *Absolutely*

Comment

Appendix 7: The Participant Lists

This appendix shows which participants took part in the validation workshops. Note that the University Lorraine Meeting was split in two days with the first handling Session 1 and 2, and the second day only the Operational Session 3. The Campus Vesta Validation workshop only dealt with the Sessions 1 and 2, hence it lists a single day.

Table A7.1 Participants in the validation workshop at University of Lorraine.

	Name	Organisation	Attendance	
			25 April 2017	26 April 2017
1	Henri Poirson	Mairie de Dieulouard	X	X
2	Bernard Modéré	Retired	X	X
3	Christiane Balle	Préfecture de Meurthe-et-Moselle	X	X
4	Vincent Remy	CEREMA	X	-
5	Emilie Rossignol	CDN La Manufacture	X	X
6	Laurent Perrin	ENSIC – UL	X	-
7	Nicolas Rameau	Campus Urbain Seine Amont	X	X
8	Philippe Bernaudin	IKARIOM	X	X
9	Nicolas Zornette	GEODERIS	X	-
10	Marie Bocquentin	EIVP	X	X
11	Mélanie Laleau	Zone de Défense et de Sécurité de Paris	X	X
12	Claude Demoulin	Zone de Défense et de Sécurité de Paris	X	X
13	Caroline Merle	Mairie d'Amiens	X	-
14	Bruno Legeard	Mairie d'Amiens	X	-
15	Pascal Deparis	Mairie d'Amiens	X	-
16	Thomas Loison	SDIS (Meurthe-et-Moselle)	X	X
17	Gilles Martin	ATRISC	X	X
18	Christophe Ratinaud	SDIS (Moselle)	-	X
19	Michel Didym	CDN La Manufacture	-	X

Table A7.2 Participants in the validation workshop at Campus Vesta

	Name	Organisation	Attendance 10 May 2017
1	Carlo Strouven	University Hospital Antwerp	**x**
2	Joris Jutten	Federal Police	**x**
3	Koen Depreytere	Federal Police - CIDSS.be	**x**
4	Lars Weckhuysen	Fire Rescue Service zone Kempen	**x**
5	Patrick Desmedt	Local police Grens	**x**
6	Philippe De Cock	Local Police Ninove	**x**
7	Pieter Backx	Campus Vesta	**x**
8	Tom De Boer	Fire Rescue Service zone Antwerp and Taxandria	**x**
9	Martin Poth	Safety Region Haaglanden	**x**
10	Lex Vroling	Safety Region Haaglanden	**x**
11	Andre de Rond	Safety Region Haaglanden	**x**