1. DRIVER+ Trial Guidance Methodology

This word document contains the slightly altered section 4 of the DRIVER+ deliverable D922.11 "Trial Guidance Methodology v1.0". It is provided as a proof of concept to show how the guidance methodology will be presented on the PoS/GT site in the future. Improvement of this document is on our TODO list for the second version of the Guidance Methodology.

This document describes the steps that Trial owners must follow to carry out a Trial in a systematic yet pragmatic way. In the following sections, relevant tasks and activities are outlined for each of the different phases of carrying out a Trial (preparation, execution and evaluation). When describing these tasks and activities for the three phases, the focus is on the following main aspects:

- Objectives (in yellow boxes)
- Input and Output and
- Actions and required participation or activities

Moreover, each task is illustrated with an example to make it more understandable.

It should be noted that, this document describes only the first version of the methodology, in the sense that it illustrates the foundations of the overall DRIVER+ approach. Hence, while the TGM design is complete, this chapter revolves mainly around preparation, while the evaluation- and execution phases are described at a more general level in this first version of the methodology.

Lessons learned from the Trials (which are still in planning at the time of delivery of this deliverable) will be crucial in order to provide less generic guidelines with regards to execution and evaluation in the next iterations of the methodology.

The long-term vision is that Trial owners are supported in following and implementing the TGM by via the application of an online tool (the Guidance Tool) that will help them with performing several steps necessary for carrying out a successful Trial.

Figure 1.1 depicts the different phases which the Trial Guidance Methodology is structured along, with an emphasis on the different steps needed for each phase (e.g. during the preparation phase: formulate research questions etc.) or on the main activities implied in each phase (e.g. execution and evaluation). As described, each phase consists of several steps that result in an output. The outputs of the preparatory steps will result in a robust Trial design.

The TGM phases imply a structured and well-defined approach to carry out Trials. From a methodological perspective, Trials require a "craftsman's way of working" (Sennett: 2009). As further outlined below, *ad hoc* tools, as well as an experimental rhythm of problem finding and problem solving, makes the DRIVER+ TGM a specific work process helpful to assessing solutions in different CM settings.

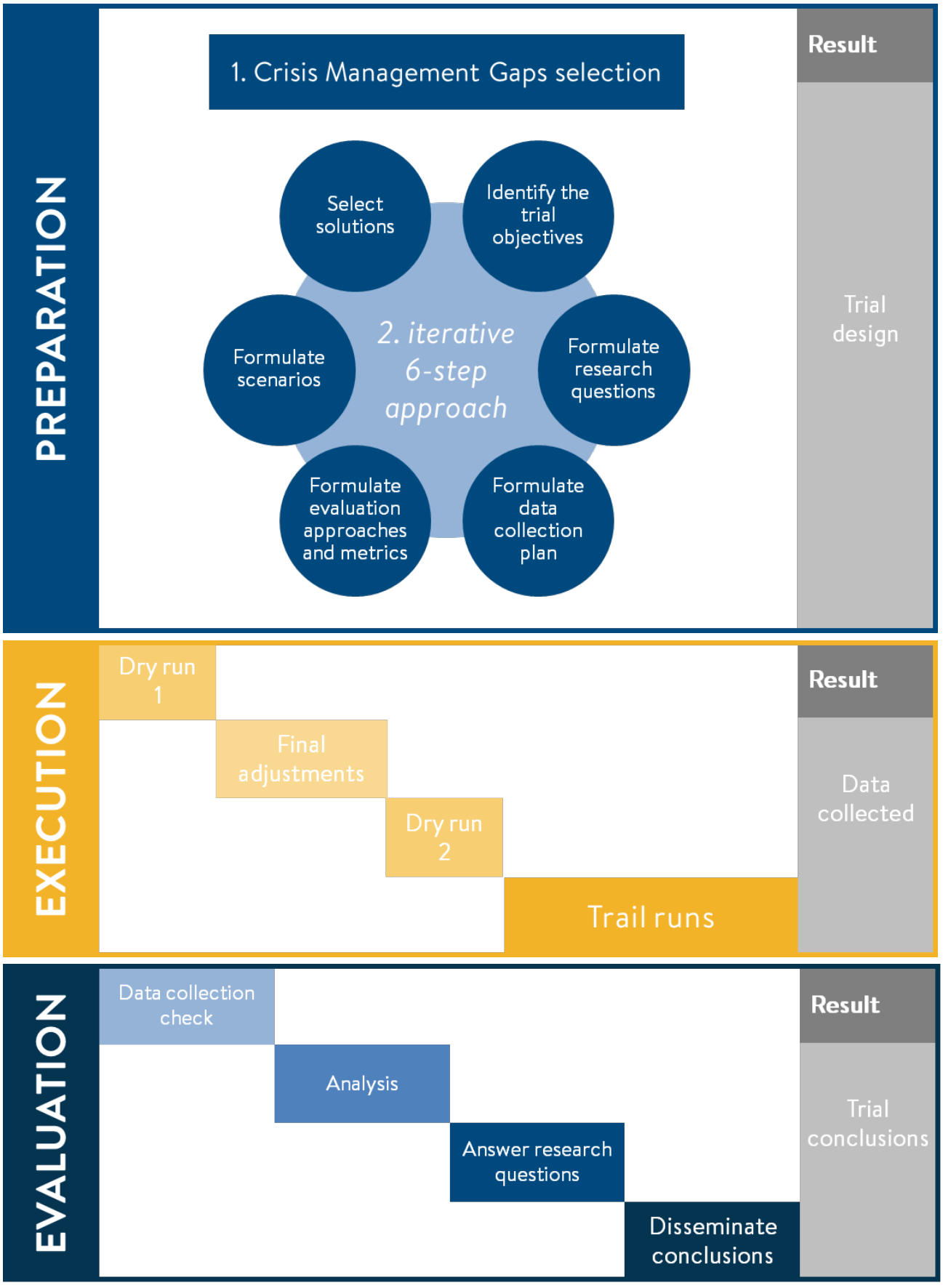

Figure 1.1: Zoom-in of the TGM phases

1.1 Preparation phase

The preparation of each Trial starts with characterizing the gaps in crisis management for which potential solutions should be investigated by conducting the Trial (**task 1**). Another important aspect is the context of the Trial itself, which refers to who, what, why and how; namely roles, responsibilities, constraints of the participating organization(s) or the facilities or the organisations hosting the Trial. Once these gaps have been specified in more detail in the context of the Trial, the actual design can start by following by following an iterative six-step approach (**task 2**).

The TGM assists the Trial owner in executing the following steps in a consistent way:

1. Identify the Trial objectives
2. Formulate research questions
3. Formulate the data collection plan
4. Formulate evaluation approaches and metrics
5. Formulate scenarios
6. Select solutions

By taking these six steps within **task 2**, the Trial design is developed and the supporting Trial materials can be developed (**task 3**).

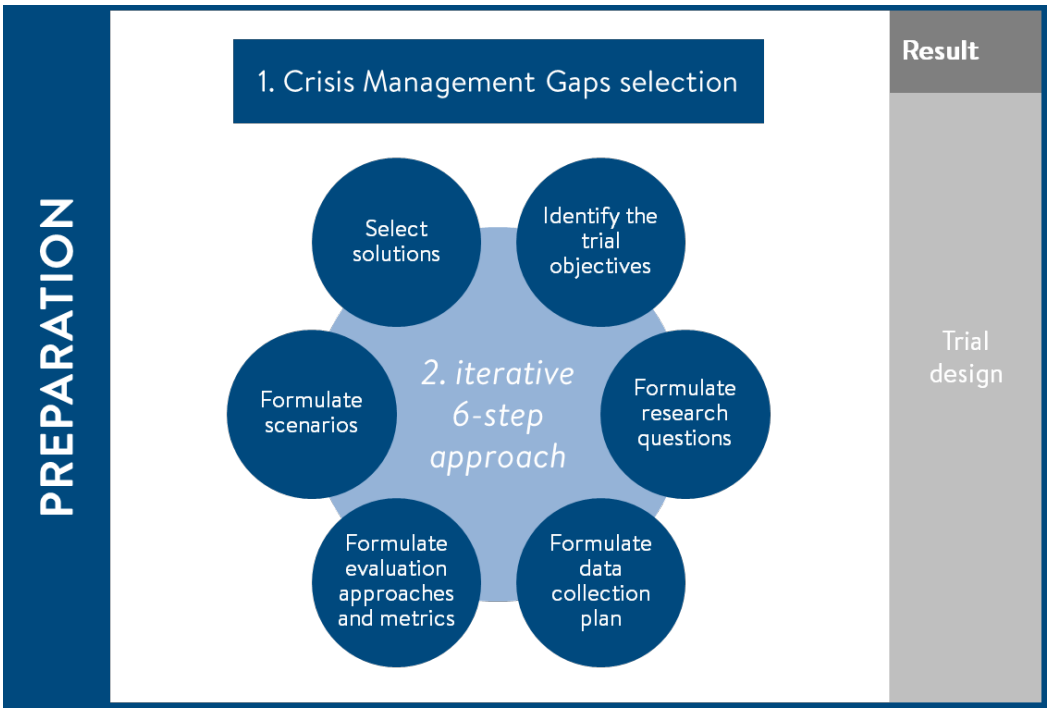

Figure 1.2: Iterative 6 step approach

1.1.1 Specification of gaps in the Trial context

Trials aim to assess the potential impact of solutions for crisis management problems (gaps) that practitioners experience in their operations. The preparation of the Trial begins with specifying these gaps before systematically addressing the relevant gaps via the 6-step approach. In the context of DRIVER+, this is done by following a specific process explained in D921.11.

This task should be executed by the Trial owner with assistance from the end-user coordinator.

The definition of a "capability gap" that was adopted in DRIVER+ draws from the First Responders study: "a 'capability gap' is understood to be the difference between a current capability and the capability considered necessary for the adequate performance of one or more disaster management tasks" (D922.11). Defining a gap is the expression of an operational (real-life) crisis management problem and should state a limit in the ability to perform a crisis management task to the adequate level of performance. The gaps can be of different natures: technical (e.g. the ability to link different systems, to

integrate data from difference sources, etc.); or non-technical, i.e. organisational, political, legal (e.g. integrating different organisational processes, or overcoming legal incompatibilities); or a combination of several dimensions (D530.1).

Gaps, or problems, are considered to be context specific and refer both to the "current capability" in terms of processes, solutions and societal and legal constraints, as well as to the "necessary capability" in order to reach adequate levels of performance to overcome the identified problem.

An in-depth understanding of the context is key to specify gaps. Gaps should not only be specific, but they are also the pre-requisite to start the work process of assessing solutions. This requires a detailed account of the setting and context in which the gap has emerged. Knowledge about how similar problems are usually dealt with, which processes are in place to solve them, and which constraints the crisis manager usually needs to relate with, all play a major role. Simply put, the definition of the context implies "*who* is doing *what, when* and *how"*. For instance, if a Trial owner is interested in assessing solutions to improve fire-fighting operations, he or she must be familiar with the way in which such operations are routinely dealt with: who is responsible for the operation, which are the tasks, processes and protocols followed by whom and when. Additionally, socio-cultural and legal aspects must be carefully considered (i.e. what can be done in a given context).

Having defined the objectives, the relevant input/ output and actions for specifying gaps in the preparation phase of a Trial are the following:

Input

The main input here is the definition of the operational problems that crisis managers experience in their daily job. In terms of scope, the gap should relate to:

- The focus of the Trial; and
- The problems to investigate throughout the Trial.

The CM system that the crisis manager is immersed in serves as the input for defining the context.

Output

The output is a clear definition of the operational problems of technical and/or non-technical nature with respect to crisis management tasks, processes, and/or roles, which should be addressed by the Trial.

Actions and Required participation

- Formulate a relevant and specific operational problem with crisis management roles, tasks, and processes of technical and/or non-technical nature in such a way that relevant solutions that can help solve the problem can be assessed in the Trial.
- Formulate the operational problem in such a way that it is *not* merely scenario specific or country specific, but specific enough that the closing of the gap can be monitored over time.
- Formulate which specific crisis management tasks, processes or roles are problematic (e.g. coordination; information exchange; situation assessment; resource management; communication; enhancement of a common operational picture; operational, tactical strategic crisis management roles).
- Formulate what is problematic about these crisis management tasks and processes (e.g. missing, slow, incomplete, inaccurate, inefficient communication, etc.).
- Formulate which actors and roles are affected by a crisis management problem (e.g. police, firefighters, ambulance, army, citizens; operational, tactical or strategic incident command teams; municipal, regional, national, cross-border, multi-national).
- Formulate to which disaster types the problem refers (e.g. fire, black-out, flooding, pandemic, cyber-attack, etc.)

To define the characteristics of the crisis management gap in the context of the Trial, enables the Trial owner to work together more concretely with other stakeholders that have an interest in the Trial, like other practitioners, decision makers and solution providers.

Participation with the stakeholders can take various forms, depending on the circumstance, such as:

- acquiring information from certain roles;
- informing certain roles;
- gathering suggestions for options;
- gathering feedback on scope and focus; or
- working on the options, scope and focus interactively in a team.

Depending on the circumstance and approach to participation, the Trial owner can follow a directive, consultative, collaborative or facilitative style of leadership. Informal consultations with decision makers, for instance, can help to clarify problems, processes and potential challenges that may arise in a Trial.

Example

The following example illustrates how the task of may look like.

Preparation phase: Crisis management gaps

Peter is a regional crisis manager in the North of Holland with a professional background in fire-fighting. In his Trial context, onsite operational command teams fight the source of fire. An offsite tactical command team manages the effects of the fire and the resources for the onsite teams. Incidents and exercises have repeatedly shown problems with the speed and accuracy of communication between onsite operational command teams and offsite tactical command teams when routing units for managing the source and effects of fires.

***The Trial context of Peter consists of**:*

- *The definition of roles and responsibilities of both the offsite and the onsite teams*
- *The definition of problematic aspects*

Communication and building up a shared understanding takes a lot of time and is accompanied by misunderstandings, for example, about the location of the incident, the direction of smoke and the drive-up routes. Ineffective decisions were a result of these facts. Problems occur when radio communication is used between multiple command teams and when teams work with different paper maps.

While defining problematic aspects, Peter asks firefighters to explain their challenges. The majority of the firefighter team agreed on one challenge: sharing locations and directions via voice-communication only, and thus keeping track of this information on two different, paper-based maps, is very slow and error-prone.

The crisis management gaps that Peter formulates are:

- *Limited ability in managing the source and the effects of fire;*
- *Shortcomings in the ability to exchange crisis-related information among onsite and offsite incident command teams;*
- *Limits in the ability to ensure a common understanding about the incident and response to it;*
- *Shortcomings in decision-making about the routing of units.*

1.1.2 Trial design – "6 step approach'

Once the context and the gaps have been identified, the preparation phase for the Trial officially starts. Each of the six steps are described in this paragraph. The elements of the Trial design that result from executing the six-step approach are ready for the next phase when all elements conform to acceptance criteria. Acceptable elements from the steps are achieved in an *iterative* manner. This means that elements of the Trial design, such as the research questions, are reformulated and refined a number of times as more information about the other elements is acquired. Although being iterative, the approach is linear: e.g. a plan to collect relevant data cannot be decided before deciding on the guiding research questions for the Trial. When elements in the Trial design conform to acceptance criteria (e.g. criteria on how to formulate good research questions), they can be developed and created.

When all accepted elements in the Trial design have been developed, such as observation lists and questionnaires, the successful application can be tested in a Dry Run during the execution phase of the Trial.

1.1.2.1 Step 1 – Identify the Trial objectives

In this step, the most important gaps that have been described in task 1 are reformulated as prioritized objectives in a Trial. In addition, it will be determined which effect(s) a solution or solutions should have in order to solve operational problems (e.g. improved decision support, uninterrupted communication even under harsh weather circumstances, etc.).

This step has to be conducted by the Trial owner and the end-users coordinator.

The DRIVER+ Knowledge base[1] can be used to gather examples and experiences of objectives from previous Trials and/or from literature.

Step 1 cannot be carried out without having an in-depth understanding of the problems and of the context (pre-requisite).

Having defined the objectives, the relevant input/ output and actions for identifying the objectives in the preparation phase of a Trial are the following:

Input

The previously identified Crisis Management gaps that have been defined in the context of the Trial owner are used as an input to formulate Trial objectives in step 1. The Trial objectives are identified by taking into account the performance measurement dimensions in terms of: the Trial dimension, the CM dimension and the solution dimension.

Pragmatically, this means that the identification of the objectives depends on:

1) which tasks and processes are required to fulfill a specific objective (e.g. number of volunteers needed) – Trial dimension;

2) the mission objective, namely the CM-related goal (e.g. extinguish the fire) – CM dimension; and

[1] DRIVER+ knowledge base is explained in Chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**

3) the solution(s) whose effects will be assessed – solution dimension.

It should be noted that, at this stage, solutions have not been selected yet. Hence, the Trial objective should be mainly defined by taking into account the first two dimensions. The third one will be specified at a later point in the process, but Trial owners should consider this performance measurement area from the outset.

Output

The output of step 1 is captured in the Trial Action Plan (TAP) which defines the following issues:

- the crisis management objective and the crisis management roles, tasks, and processes that are to be improved in the Trial;
- what is to be learned during the Trial regarding the effect(s) of the solutions on crisis management and the factors that affect successful adoption of the solution when shown to be effective;
- the *effects* that solutions should have on achieving the crisis management objective and improving performance of crisis management roles, task, and processes.

Even if the type of solution or the characteristics of the solution(s) are not yet defined, the intended effects on crisis management performance can be considered (e.g. w.r.t. the exchange of crisis-related information).

The output of this step is a formulation of the above-mentioned objectives in the TAP in a manner that it is SMART:

- *specific* for the crisis management processes, tasks and roles that are envisioned in the Trial,
- *measurable* in that indicators of achievement of the objective can be defined
- *assignable* in that it is clear whose performance is improved and whose solution is assessed
- *realistic* in that desired improvement can realistically be achieved, given the setup of the Trial
- *Time-related* in that the duration of the (final) Trial is specified

Actions and required participation

To define the Trial objectives in terms of the CM dimension, the Trial dimension and the solution dimension, the following activities must be considered:

- Identify and structure how practitioners understand relevant crisis management incidents and scenarios, mission objectives to be improved, organizational structures involved (e.g. operational, tactical, strategic teams); the tasks to be performed (e.g. tasking and routing units, evacuation, etc.), crisis management processes (e.g. decision making, information sharing, etc.) or specific workflows.
- Define with practitioners within this context the crisis management mission objective and the crisis management roles, tasks, and processes that should be improved in the Trial.
- Define the overall goal of the trial.
- Define the overall duration of the Trial, and of specific parts of the Trial (e.g., if higher level officials are required at a certain stage in the Trial, the duration of this stage should be aligned with their time-constraints).
- Define globally for which kinds of incidents and scenarios crisis management should be improved in the Trial, what teams and team members from which organizations should be involved and what tasks, processes and workflows should be fulfilled.
- Define relevant factors enabling and constraining crisis management performance that should be taken into account in the Trial (political, financial, organizational, technological, etc.).
- Gather opinions from Trial stakeholders about the identified Trial objectives in terms of the crisis management dimension, the Trial dimension and the solution dimension. Evaluate, rank and select the formulation that most Trial stakeholders agree on.

- Assess the feasibility of achieving these objectives in the Trial and assess the impact on defining the other steps of the methodology.
- When feasible, then decide on the objectives and capture this in the TAP.

Example

Preparation phase – Identify the Trial objectives (Step 1)

Peter decides to improve the performance of the crisis management processes that are related to the selected gaps. He has formed a Trial team to help him define the further steps of the preparation phase for the Trial. They discuss the selected gaps and formulate their objectives.

Peter and his Trial team browse DRIVER+ knowledge base to assess whether and how similar problems have been turned into SMART (Specific, Measurable, Assignable, Realistic, Time Related) Trial objectives. By browsing the DRIVER+ knowledge base, they learn that, in the South of France, another crisis manager practitioner called Monika had similar challenges, and that she carried out a Trial-like experience a few years ago. Peter notices that Monika's Trial objectives are helpful to identify his objectives. Hence, he uses the same formulation by capturing the main mission objectives in one main Trial objective:

The mission objectives are:

- *Managing the source and effects of a fire*
- *Improve communication between onsite and offsite command teams*
- *Develop shared situation awareness about the incident and about the response*
- *Improve decision making (e.g. the tasking and routing of resources)*

The Trial objective is:

- *To assess the effect of a solution on these tasks (managing the source of fire) and processes (develop shared understanding) and to identify factors affecting the adoption of the solution.*

1.1.2.2 Step 2 – Formulate research questions

In this step, for each of the objectives that has been identified in step 1, one or more research questions (RQs) will be formulated. Research questions are formulated to identify the appropriate mix of research methods and data analysis techniques and to capture relevant data during the execution phase. Moreover, RQs are needed to be able to evaluate the solutions in the Trial.

These questions consider the impact of solutions on crisis management in general, and on specific crisis management tasks in particular (such as command and control, communications among first responders in the field, etc.). In addition, some Trial-specific questions can be formulated. All research questions should be defined as SMART as possible.

The DRIVER+ Knowledge base can be used to get examples and to take into account lessons on research questions from the literature and previous Trials.

This step has to be conducted by the Trial owner, the end-user coordinator and the methodological support to Trials. All Trial- stakeholders should understand and approve research questions.

Having defined the objectives, the relevant input/ output and actions for Step 2 in the preparation phase of a Trial are the following:

Input

- Gaps, Trial context and Trial objectives
- Criteria on how to formulate good research questions.

The following list contains criteria to consider when formulating research questions. These criteria should be considered as acceptance criteria, e.g. if a RQ is scenario driven or is already tailored to a specific solution, Trial owners are advised to re-think the formulation so that robust answers can be provided during the evaluation phase.

Criteria and conditions for formulating good RQs:

- Actual questions. RQs should be formulated as questions. As outlined in **Fehler! Verweisquelle konnte nicht gefunden werden.**, based on a systematic literature review, the interrogative form "how" is used most often to understand the impact of solutions on organizations and/or people. Therefore, it is suggested to use this form.

- Gaps. RQs must address a distinct gap. Each research question must address only one gap of DRIVER+ and must not subsume multiple gaps nor exceed the scope of the addressed gap.

- The dimensions. RQs should cover the performance measurement dimensions of Trials. In the context of the research question, the Trial dimension is concerned automatically. The task of the Trial owner is to make explicit its implications. As far the as the crisis management dimension is concerned, it refers to specific CM objectives (e.g. improve shared situation awareness). The solution dimension deals with the role of the solutions: does a solution have the potential to drive innovation in CM? In general, each solution could be measured by solution specific objectives (e.g. user friendliness, run time, etc.), but the Trial owner needs to be aware of the relation between the solution and its contribution to the central dimension, being the CM dimension. This means that the user-friendliness aspect of a solution is not relevant as such. It is only relevant if this aspect is innovative and effective in managing daily operations. In addressing all three dimensions, a question needs to comprise what is to be achieved, given by the overall objective, the aimed impact on crisis management and the opportunity for solutions to provide innovative value.

- Scenario and solutions. RQs must not be scenario-driven. Scenario refers to a fictive storyboard in which the solutions are assessed. In order to define such a scenario, the objective and research question(s) of the Trial need to be defined. It is therefore not possible that the research question is formulated after the scenario design. In other words, the research question is not a reformulation of the scenario in a question format. If, due to practical reasons, a scenario is drafted before the research questions are final, the scenario needs to be revised based on the research question and, if needed, changed accordingly. Accordingly, the research question is solution independent. However, the solution should have a relation to a specific application context and a corresponding problem or gap. Thus, the relevance of the research questions is ensured.

- Measurable. RQs need to be answerable and measurable by the Trial. While formulating the research question, one needs to ensure that the Trial is capable of answering the question. More often than not, yes or no answers respond to generic (not measurable) questions. Independent from the solutions being tested, the assessment of the question has to be considered in the later Trial design. A detailed and specific evaluation plan can be defined later in reference to the related CM objectives and trialled solutions.

- Participatory approach. RQs must be understood and approved by all Trial stakeholders. The research question is not only defined by the Trial owner, but in addition, it is crucial and mission critical for the Trial to ensure that all involved stakeholders understand and approve the relevance of the questions. To facilitate this, the writing style of the formulation must be end-user focused and specifically accepted by those involved.

- Main and sub-research questions. RQs can be organized in a multi-level, hierarchical structure. A leading research question fitting to the Trial objective can be deconstructed into several sub-questions, each addressing a more precise aspect. This multi-level, hierarchical structure can be detailed as far as needed in order to ease the planning and design of the Trial and the evaluation of results.

- Simple, but not easy to answer. Simplicity refers to the overall answerability of the question in line with the criterion revolving around participatory approach. RQs should provide new insights and findings in terms of the three dimensions mentioned above.

Output

The output of this step is a set of research questions for the Trial documented in the TAP. The answer to the research questions helps to determine the effect that a solution has on crisis management roles, tasks, and processes.

Actions and required participation

Research questions must specifically address the crisis management task (e.g. managing the source and effects of a fire), processes (e.g. speed and accuracy of communication), the content (e.g. threat evolution and response to it), the actors (e.g. onsite and offsite command teams) and finally also the solutions that are researched (e.g. solution 1 and 2).

At the start of the preparation phase, when the crisis management gaps and the objectives of the Trial are described in generic terms, the formulation of the research question could be unfocused, such as:

- How can communication problems between crisis management teams be solved when managing the source and effects of a fire?

To make this research questions more focused on the operational problems of the Trial owner, the following questions about the crisis management gap needs to be answered: 1) What kinds of teams have communication problems? 2) What kinds of communication problems do they have? 3) What is causing these problems? 4) In which conditions do these problems occur? 5) Which problems are to be solved in the Trial?

When the crisis management gap and the objective of the Trial are more focused and specific, the research question may be reformulated as:

- How can problems with communication between onsite operational command teams and offsite tactical command teams regarding threat evolution, and the response to it, be solved?

To make this research question focused on specific solutions for this problem, the research question may be reformulated as follows:

- *What solutions* could solve problems with communication between onsite operational command teams and offsite tactical command teams when managing the source and the effects of a fire?

When, for instance, two potential solutions are expected to solve this problem, the research questions may be reformulated in:

- How does *solution 1* affect problems with communication between onsite operational command teams and offsite tactical command teams regarding threat evolution and the response to it?
- How does *solution 2* affect problems with communication between onsite operational command teams and offsite tactical command teams regarding managing the source and the effects of a fire?

To be able to gather data that indicates whether or not communication problems are solved in the Trial as a result of the solution, one has to be specific about which communication problems needs to solved. The research question may be reformulated along these lines:

- How does solution 1 affect problems with the *speed and accuracy* of communication between onsite operational command teams and offsite tactical command teams about threat evolution and the response to it, when managing the source and effects of a fire?

If compared to the first general formulation, the latter includes a solution along with aspects that can be measured in terms of time and correctness of information. Additionally, it includes roles and processes. Therefore, it is considered specific enough to be answered in a Trial.

The formulation of proper questions is not a trivial, one-shot activity. Trial owners can work on this with the appointed methodological support so that, during each formulation round, questions are checked against the objectives.

Example

Preparation phase – Formulate research question

Before selecting the solutions, Peter comes up with three research question:

How does a solution affect the speed and accuracy of communication between onsite and offsite command teams about threat evolution and response to it when managing the source and effect of a fire?

How does a solution facilitate a shared situation awareness between onsite and offsite command teams about threat evolution during an incident and response to it?

How does a solution have an impact on decision making about the tasking of routing of resources when managing the source and effects of a fire*?*

1.1.2.3 Step 3 – Formulate data collection plan

In this step, for each of the research questions that has been formulated in step 2, a plan to collect relevant data is determined. Key performance indicators must be taken into account in step 3. Hence, what data is needed and how it will be "weighted" are crucial here.

Key performance indicators (KPIs) represent "a set of measures focusing on those aspects of organizational performance that are the most critical for the current and future success of the organization" (Parmenter, 2010). The identification of KPIs is crucial as it provides a way to quantify the outcomes of a Trial and assess the performance of the trialled solutions.

A data collection plan has to be developed that describes in which way all kinds of required data will be collected (measured), by whom or by which means, during the Trial. This should be done in a clear and consistent way to avoid ambiguity and to collect data of good quality. This plan should enable answering the research questions.

The DRIVER+ Knowledge base can be used to get examples of research methods, and to take into account experiences on data collection of previous Trials.

This step should be initiated by the Trial owner, the end-user coordinator and the methodological support representative; in later stages of this step, all members of the Trial committee should be involved to ensure that the envisioned way of collecting data is realistic and achievable. Support from someone with experience in data collection is useful.

Having defined the objectives, the relevant input/ output and actions for Step 3 in the preparation phase of a Trial are the following:

Input

- Research questions
- Knowledge base
- Criteria to define KPIs (D23.21)
- Recommendations and common problems for quantitative and qualitative methods for data collection (D23.21)

Output

The output of this step is a data collection plan that is captured in the TAP.

The data collection plan describes:

- Under what conditions performance measures and data is collected
- *what* data is collected and the source and location of this data
- *who* will collect what data,
- *when* the data will be collected,
- *where* the data will be collected, *what* performance measures are used and what the operational significance of these measures is,
- *how* data is collected to determine scores on measures,
- *how* much data will be collected (i.e. sample size),
- *how biases* in collecting data are minimized
- *how ethical aspects* [2]concerning data collection are taken into account

Actions and Required participation

- First determine in what conditions data is collected. The design of the Trial determines the conditions: e.g. data collection should be carried out in a condition in which the solution is not used and in a condition in which the solution is used to carry out a comparative analysis. Without some sort of comparison, it is not possible to determine whether a change in crisis management performance occurred as a result of a solution. For example, depending on the research question,

[2] Ethical aspects are described in Chapter **Fehler! Verweisquelle konnte nicht gefunden werden.** .

data can be collected about performance on crisis management a) in a condition solution 1 and a condition with solution 2; b) with solution 1 in time segment 1 and time segment 2; c) with solution 2 in scenario A and scenario B; d) with participant group 1 or 2.

- Determine *what* data is to be collected. For example, what data is useful to determine performance of crisis management processes, tasks and roles (e.g. effectiveness, response time, errors, efficiency, safety, costs, etc.)? Do you need objective facts, subjective interpretations of participants or both to be non-biased and informative?
- Determine *who* will collect the data. Who is responsible for collecting relevant data during the execution phase? Observers (internal and/or external) or participants collecting this data must be able, competent and motivated to take measure seriously.
- Determine *when* the data will be collected. What is the time schedule of the Trial and when is what data collected by whom?
- Determine *where* data will be collected, and in what research setting. Is it a field Trial, where the natural environment is used to manipulate some factors? Is it a table-top? Determining which environment is best to collect data depends on the research questions.
- Determine *what* performance measures are used and what the operational significance of these measures are for assessing crisis management objectives, tasks, processes and roles (e.g. information sharing, situation assessment, decision making, tasking, coordination, mission effectiveness, etc.). What measures are required for answering the research question? The measures and metrics must be useful for assessing the expected effects of the solution on crisis management performance.
- The abstract terms in the research question have to be rephrased in concrete terms that can be validly measured. This refers to the extent to which measures and metrics actually measure what we want to measure (time, quality, safety, efficiency, effectiveness, cost). Valid measures and metrics can be achieved by using clear definitions of the abstract terms one wants to measure, by using measures and metrics from peer-reviewed literature, or by using multiple measures of the same abstract term.
- Determine *how* data is collected to determine scores on measures. A difference can be made between self-reporting methods and observational method. With self-report methods, people are asked to rate their own behavior (e.g. a questionnaire, interviews, focus groups). With observational methods, researchers observe the participants themselves. In addition, a distinction can be made between objective performance measurements (like logging duration, errors) or subjective measurements (like questionnaires, interviews, observations, focus group sessions, expert opinions). It must be clear whether data is subjective or objective, quantitative or qualitative. Discuss what type of data you need and what the advantages and disadvantages are.
- Determine *how* much data will be collected (i.e. sample size). How many participants use the solution? How many of them are observed or interviewed? Is this sample representative of the population about which one wants to draw a conclusion? For example, if the participants are only male with a certain professional background and between the age of 40 and 50, the results cannot be generalized.
- *Biases in collecting data* influences the interpretation of data and must be minimized. Possible biases include e.g. how the participants are recruited, but observers can also be biased. For example, when observers know what solution is evaluated and what effect this will have on the behavior of participants, he/she will be more likely to observe this behavior.

Examples

Preparation phase: Formulate data collection plan

After having formulated the research questions, Peter thinks about a plan to collect the data that he needs in order to assess the effect of the solution on his identified crisis management gap.

Peter wants to measure characteristics of communication, shared situation understanding and decision making. Peter also wants a subjective appreciation of the solution by participants in the Trial.

He thinks about different techniques to collect data, such as observations, questionnaires, using simulator data, and group discussion. For questionnaires he considers using or adjusting existing and scientifically validated questionnaires for his Trial.

Measurement: Using observers and the conditions of data collection

Beforehand, the Trial committee has defined what the observers are going to observe and how. This was based on the performance measures that were defined.

The observation questions are incorporated in the Online Observer Support Tool. The tool provides Trial-specific pre-made forms (templates) to create observations.

Peter decides to assess communication in two sessions.

He wants participants to experience performance with and without the solution, and he wants to assess the effect of the solution on crisis management performance. Therefore, he will organize:

- one session where participants use the new solution (a Common Operational Picture Tool),

- one session where people work with their own tools and working procedures. The differences between these sessions indicate the positive or negative effects of using the solution.

When participants already know the scenario in advance of the second session, an improvement may not be the result of using the solution, but rather the result of already knowing what will be communicated and what is to be decided. Thus, the scenario will be slightly changed for the second session.

Measurements:

Peter will use the same measurement for both sessions to be able to compare them. He uses self-report measures (e.g. questionnaire, focus group session) and observational methods (using observers) to gain information from different perspectives.

To assess communication in the two sessions, Peter has defined what characteristics of communication he wants to assess in the Trial. He considered duration (is it faster?), the topics shared (it is relevant and complete?), as well as the number misunderstandings and errors (is it accurate?).

Peter searches the DRIVER + Knowledge base to find existing observation protocols that could be used or adjusted for his Trial.

Other possible designs to evaluate solutions:

A disadvantage with this design is that Peter only gets the opinion of two teams in just two similar scenarios. This might not be sufficiently representative and reliable for drawing conclusions about the operational benefits of, for instance, a Common Operational Picture tool (COP tool).

Furthermore, the comparison between the two sessions is not really valid.

Different designs all have advantages and disadvantages. It is important to discuss different options. In these cases, the following options are also possible:

- *Perform more sessions with different teams and change the order of sessions (either starting with or without the solution).*
- *Only perform sessions with participants using the solution. Let participants compare their experience with previous experiences. This way it is also possible to compare with previous situation.*

1.1.2.4 Step 4 – Formulate evaluation approaches and metrics

In this step, it is formulated how the data that will be collected during the Trial will be analyzed. It is described which techniques will be used and how analysis results will be reported (i.e. answers on research questions and conclusions about whether Trial objectives have been met). The evaluation approach depends on the data collection. For instance, qualitative data gathered during focus groups should be evaluated through specific techniques.

The DRIVER+ Knowledge base can be used to get examples of data analysis techniques, and to take into account experiences on data analysis of previous Trials.

This step should be executed by the Trial owner, the methodological support representative and the end-user coordinator.

Having defined the objectives, the relevant input/ output and actions for Step 4 in the preparation phase of a Trial are the following:

Input

- Data-collection plan.

Output

- Description of how data will be analyzed when data is collected.

Actions and Required participation

- There are different ways of analyzing data depending on your research question. Determine under which conditions crisis management performance is to be assessed. Does the research question require a comparison between a condition with and without a solution, between multiple solutions or changes in performance over time?
- Start with general descriptive statistics (frequency, means, etc.) to get an overall view of the data.
- The reliability of the score on measures and metrics is increased with a large sample size of data points and participants. Reliability is the extent to which the same scores on measures and metrics are obtained at different moments and by different participants. When there are too few data points, it is not possible to conduct statistical data analysis. Then it is better to describe the results, for example the experiences of the participants.

- Determine whether the data is analyzed in terms of inferential statistics (e.g. regression)
- Think of how to visualize the different results.
- For qualitative data (collected from interviews, case studies, focus groups) it is important to think about how the results will be processed. For example, how to analyze these data through e.g. hermeneutic or semiotic concepts, or to give an in-depth narrative description of thoughts and feelings of participants, or a combination.
- For each data analysis approach, the limitations need to be carefully taken into account when looking at the conclusions. There is no silver bullet to answer research questions, but the Trial results need to be framed in the current state of the art of the applied paradigm. For example, when looking at the results of an optimization model, the results must be reflected with the assumptions and side restrictions of the actual model and the real world. When looking at the analysis of an expert interview, the sample size and specific background of the interviewee has to be mentioned when presenting the results.

Example

Preparation phase: Formulate evaluation approaches and metrics

After deciding which data can and will be collected, Peter formulates specific evaluation approaches in order to analyze the Trial in a proper manner. Here, Peter needs to fulfill two main tasks:

1. *Depending on the data collection plan, appropriate analysis techniques need to be applied. Since Peter is interested in both the quantitative and qualitative impact of a COP tool, he needs to combine two different analysis techniques.*
    a. *For the quantitative part he concentrates on the main objective of the (simulated) response operation through comparing the duration of a certain task in a scenario without the solution (baseline) and with the trialed innovation. Here, the time needed for creating situation awareness in order to react, e.g. making specific decisions such as defining an evacuation plan, becomes a key performance indicator. As a second key performance indicator Peter decides to analyze the actual outcome of the (faster or slower) decisions. The actual operation outcomes, which may be partly simulated, are directly compared with each other, e.g. the ratio between evacuated citizens and citizens in need.*
    b. *For the qualitative part, Peter wants to consider the professional feedback of the crisis managers involved into the operation. Here, Peter decides to carry out semi-structured interviews addressing the perceived appropriateness of the new solution into the current way the practitioners work. Next to numeric estimations (e.g. using the Likert scale) in order to identify patterns of the group, Peter formulates open-ended questions in order to gather the individual perceptions and make sure he is not missing important subjects. Depending on the outcomes gathered directly after the Trial, Peter analyzes topics of interest and develops follow-up interviews in order to catch-up observations he didn't anticipate in the initial questionnaires.*
2. *At the same time, Peter is aware that the observations are all of different nature and have to be put into a context. For this purpose, he assigns all relevant and available data according to the DRIVER+ performance measurement dimensions. He anticipates for example which and how many representatives are needed to Trial what, how and in which condition (e.g. the side restrictions of a time-pressing situation or disruptive telecommunication should be considered appropriately). For the crisis management dimension he structures the main objectives of the Trial scenario according to the involved roles, tasks and processes so that specific operational effectiveness measures are clearly described (e.g. evacuation time). For the solution dimension he relates the crisis management tasks to the dedicated solution function so that a direct contribution can be deduced, but Peter also takes into account solution specific evaluation approaches in order to later make sense of why a certain impact has been observed (e.g. applying evaluation standards regarding human-computer interactions).*

1.1.2.5 Step 5 – Formulate scenarios

In this step, one or more realistic scenarios are developed. Scenarios must be realistic in terms of the context of the end-users and the environment in which they operate. While it is unlikely that scenarios are developed only at step 5 (ideas on potential scenarios may come into play earlier e.g. after gaps have been identified in the Trial context), in this phase they are refined, revised and tailored to the objective of the Trial. For example, if the gap is related to cross border communication between first responders in case of large-scale forest fires, the scenario script (and simulations) should contain the characteristics of such a situation. In addition, the scenario should enable the Trial owner to measure the performance of various solutions during the Trial by defining so-called key-events. (Note: for research purposes, a scenario can be split up into several stages or scenes.)

The DRIVER Test-bed should be used to consider and make use of its support features in scenario development and scenario simulation.

This step should be executed by the Trial owner in collaboration with the end-user coordinator and the methodological support representative.

Having defined the objectives, the relevant input/ output and actions for Step 5 in the preparation phase of a Trial are the following:

Input

The results of steps 1, 2 and 3 are essential input to the scenario development. In fact, the scenario should serve to facilitate that Trial objectives can be met, that the research questions can be answered, and that the requested data can be collected in alignment with the selected research approach. In addition, the scenario should fit the type of Trial (field experiment, table-top, hybrid, etc.).

Output

This step results in one or more scenarios that can be used during the Trial (if needed, a scenario can be split up into one or more stages/scenes). A scenario consists of the following elements:

- the environment (arena, context) in which the scenario takes place;
- the various players described by their roles (contributing to crisis management tasks), primary objectives and resources, means (including means that are subject of the Trial); and
- the storyboard: set of key events (e.g., the initial incident and its impact) within each stage.

Actions and Required participation

- Develop a fictive environment or select a real environment in which the context of the gaps and solutions can be simulated in a realistic way (e.g., if the topic of interest concerns a gap in forest fire-fighting in a cross-border situation, the Trial environment should contain a forest that stretches out to at least two countries/regions).
- Determine the crisis management organizations/functions that are related to the gaps and their solutions, and describe how these organizations/functions are interrelated (organization structure and interdependencies).
- Select which of the crisis management functions should be played during the Trial and by whom: by professionals, by supporting role-players or by simulators. For each of these 'role-players', the primary objectives during the Trial and the relevant means that are at their disposal (relevant for comparison of candidate/ alternative solutions) should be described.
- Develop the storyline (or script) of the scenario by:
- (1) defining key events related to the gap(s) that trigger one or more role-players while fulfilling their tasks;
- (2) elaborating these key events in the context of the developed environment;

- (3) adding other events to ensure a realistic situation (e.g. by additional messages and/or events to create time-pressure or information-overflow)
- Define instructions for role-players.

Example[3]

Preparation phase: Formulate scenario

Peter thinks about what elements the scenario should address to be able to measure the effect of the solution on the performance measures. It is important that events trigger the execution of the crisis management processes, roles and tasks one wants to improve. To avoid the so-called " learning effect" , he decides that the events in the scenario will be different, but similar in the sessions with and without the solution, respectively. In doing so, he will be able to carry out a comparative analysis and draw conclusions about the impact of the solution.

But before he can develop the scenario he has to think about:

- Teams and participants: what teams and team roles are responsible for crisis management performance and who are the actual users of the solution? The gap is about distributed teams that work on different locations, involving communication between onsite and offsite teams about the evolution of a threat like a smoke plume. Peter therefore decides that he wants to include onsite and offsite teams in the Trial.

- Crisis management task that has to be performed. In this case the onsite team has to assess a large incident, manage the source and effects of a large fire and make a request for additional resources; the offsite team has to assign the right units and route these units to the right location at the right time.

Characteristics of the scenario that he wants to include:

- *Information dependencies between the two teams about the incident and the location of the incident*
- *Resource dependencies between the teams. The events in the scenario require the onsite team to share information with the offsite team, because they need additional resources to, for example, assess smoke toxicity.*

Peter thinks about the main storyline of the scenario.

1.1.2.6 Step 6 – Select solutions

In this step, one or more solutions will be selected from the DRIVER+ Portfolio of Solutions (PoS). By entering key words that characterize the selected gap(s) and research questions, available solutions will pop up. When no or only a few solutions are available in the PoS, a search for potential solutions outside the PoS can be done, or a call for solutions can be initiated. Providers of identified and/or interested solutions can be invited to participate in the Trial.

This step should be executed by the Trial owner in collaboration with the solution coordinator and in consultation with the end-user coordinator.

Having defined the objectives, the relevant input/ output and actions for Step 6 the preparation phase of a Trial are the following:

[3] The learning effect mentioned in this example refers to the ability of performing an activity when people are exposed to this activity. Practice and familiarity with a specific task have an impact on performance. Improvement on performance may only be due to repetition.

Input

The specification of the gap(s) in the Trial context (result of task 1) and the DRIVER+ Portfolio of Solutions (PoS), from which potential solutions can be selected, are important sources of input for this step. In case more solutions are available (e.g. when a specific call for solutions has been done), these will serve as additional inputs to this step.

Output

This step will result in a set of appropriate and available solutions that will potentially solve the investigated gap(s) and that can be used in the Trial.

Actions and Required participation

- Enter the Portfolio of Solutions (PoS) website and enter key words expressing the crisis management gaps and the roles, tasks, and processes that need to be improved (e.g. communication, information sharing, situational awareness, common operational picture, firefighting, etc.).
- Review which innovative solutions are available for the crisis management problems that have been defined for this Trial.
- Formulate selection criteria with the Trial committee and select solutions that are worth considering for a Trial.
- Read the descriptions and determine/ consider a number of factors: whether solutions are already on the market or still in a developmental / prototype stage, product/service description, reviews, interoperability with the DRIVER+ test-bed, typical use cases, provider, price, freeware, local resellers, version, picture, movie, current customers/users, past experiences and lessons-learned as described by practitioners.
- In case no relevant solution is available in the PoS, the Trial committee should consider an open call within the DRIVER+ community, in order to identify relevant solutions that are not currently in the DRIVER+ PoS. The procedure can follow the same procedure for carrying out a call for applications, as was applied during the project duration. Here, the review criteria were formulated by the practitioner organizations within the DRIVER+ consortium. The double-blind review process might not be obligatory, but could help to ensure un-biased review results. Best practices to manage the call for applications can be derived from D942.11 and D942.21.
- Select solutions for the Trial.

Example[4]

Societal Impact Aspects

A key consideration when selecting solutions for a Trial is to assess whether the solution has any known unintended side-effects or societal impacts that Peter should be aware of. When selecting the solution from the PoS, Peter became aware that no such assessment currently existed for the specific solution since the COP-tool that he wanted to use is new, and thus he decided to make an assessment himself. Based on the selected solutions for the selected scenario, he carries out an assessment using the DRIVER+ Societal Impact Assessment Framework (SIA), which allows him to assess how the use of the COP-solution can potentially have a negative or positive impact on the broader society.

The SIA framework is not tool specific, but is developed for assessing the most common functions that CM tools have. This means that Peter could potentially use the same method for assessing all kinds of solutions that he might be considering. The assessment starts with identifying what kind of functions the solution has (e.g. does it collect or process data, or does it facilitate communication?), and then systematically linking the functions to a predefined set of societal impact criteria. In the PoS, Peter can also look up assessments and concluding recommendations that other users of the PoS have made of other solutions or tools. Thus, if solutions with similar functions as the COP tool have been assessed before, Peter can use these as inspiration.

Preparation phase – Selection of solution

Erik, who is also part of the Trial team, told Peter about the solutions available in the online DRIVER + Portfolio of Solutions. Peter decides to search, evaluate and select a solution that is expected to improve the crisis management performance he wants.

Using key words that describe the crisis management tasks, processes and roles he wants to improve, Peter finds all kinds of solutions including experiences of others and lessons learned.

Together with his Trial team he formulates selection criteria and selects solutions that are worth considering:

- *Training for communication and decision making.*
- *Multiple software tools providing a Common Operational Picture (COP).*
- *Ways to monitor units, to monitor sensor data and predictive models.*

They finally decide to select a Common Operational Picture (COP) solution for Trialing that meets their criteria. Peter reads that the COP is an online software tool providing a shared map that multiple command teams can view and use to share information about incident, units or routes.

[4] Societal Impact Aspects are outlined in Chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**

Preparation phase – Iteration of research questions

Now that the Trial team has selected a solution, it is possible to further specify the research questions, the measurements and Trial design.

The objective of this specific Trial is to assess the effect of the selected COP tool on communication and shared situation awareness between command teams using the COP tool, and its impact on making effective decisions in a simulated but realistic scenario. Research questions are now reformulated as follows:

- *How does the COP tool affect communication between onsite and offsite command teams?*
- *How does the COP tool facilitate shared situation awareness about incident and response to it?*
- *How does the COP tool affect decision making about the routing of resources?*

Other adjustments (iterations) based on the chosen solution and design

Because the COP tool is new, participants should be trained in using the COP tool and should receive instructions about their task.

Because Peter and his team decided to have two sessions with the same teams, they decided not to use the same scenario twice. To avoid a learning effect, Peter decides that the events in scenario will be similar, but not the same between the sessions with and without the solution, respectively. This is because he wants to use the comparison of measures between the sessions to draw conclusions about the effect of the solution.

Participants will not be instructed about the scenario, because in that case they can respond as they would normally do and have no previous knowledge that might influence their performance.

Specific questions about the COP tool are added to the different measurements (observation protocol, the questionnaire and focus groups). Examples of guiding questions for the focus groups:

What advantages/disadvantages did you experience in using the COP?

Can you provide specific examples?

1.1.3 Development of Trial materials

Introduction

At the end of the preparation phase, the Trial design is ready. Materials for the Trial and two Dry Runs need to be developed. The developed materials, such as instructions or questionnaires, will then be piloted in Dry Run 1, used for rehearsal in Dry Run 2 and used in the Trial.

Input

The inputs to fulfill this step are the decisions that were taken during the six-step approach, as described in the previous pages. Based on this, the design of these materials can be developed and configured.

Output

The output of task 3 step 1 is captured in and consists of the following materials:

- The scenario, source and effects of incidents, locations of relevant objects and people are detailed, developed and made available for Dry Run 1. The key events in the scenario that trigger crisis

management processes, tasks and roles (including workflows between teams or team roles such that communication) required in each Trial session are made available in the Test-bed Trial scenario Manager and Time service. The simulators in the Common Simulation Space of the DRIVER+ Test-bed are configured[5].

- The Trial participants are identified, contacted, invited and informed for the Dry Run 1, Dry Run 2 and Trial sessions. The Trial participants are: the Trial owner, conductor, participating practitioners, solution providers and observers.
- Instructions to participants about the Trial and the crisis management objective, their tasks, processes and roles are developed and the solutions are ready for testing in Dry Run 1
- Buildings, rooms, workplaces, systems and instruments are available, configured and ready to be used by all invited participants for Dry Run 1
- The agenda and the instructions for all data collectors are clear about *who* collects *what* data, *how* and *when* and *where* and *why* and relevance of the conditions. It is clear how the observer and after action tools of the DRIVER+ Test-bed are used.
- The selected solutions for trialing are connected to the Test-bed common information space and made available in the right locations for Dry Run 1.
- The approach to check, analyze and visualize collected data is ready for use after Dry Run 1 and understood by those who carry out the analysis
- The template for reporting the Trial is configured and the protocol to answer research questions and drawing conclusions is ready for Dry Run 1.

1.2 Execution phase

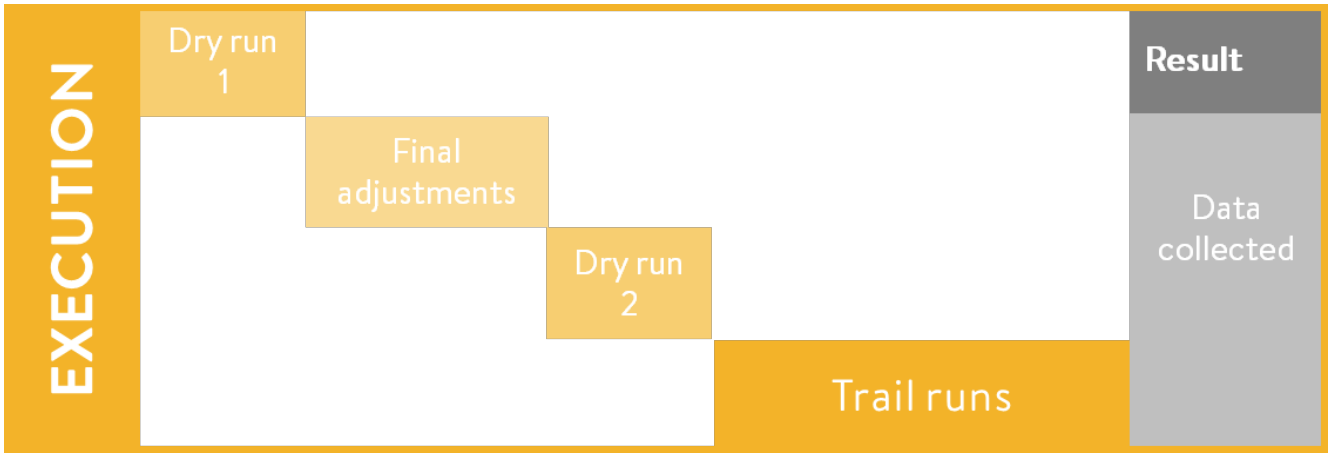

Figure 1.3: Execution phase

Once the Trial design, including the technical Test-bed arrangements, has been developed, its applicability can be tested in dry-runs to ensure everything is properly working when the 'real' Trial is run, thus enabling to collect the required data in a proper way. For the execution phase, the methodology provides guidance for dry-runs (steps 1 and 2) and running the Trial (step 3).

These subsequent steps are described in next sub-paragraphs. The execution phase results in sets of collected data. Acceptable data for the evaluation phase is acquired in an iterative manner by testing data quality assurance in a data collection plan and analyzability of data before and after the dry-runs. This means that elements of the data collection plan are adjusted as more information about data quality is acquired.

1.2.1 Dry-run 1

[5] The above-mentioned tool are developed within DRIVER+ Test-bed. Detailed information is provided in D923.21.

In this step, the Trial design and all technical Test-bed arrangements are tested at the location(s) where the actual Trial will take place. This concerns both technical and non-technical issues. The aim is to test whether or not the results of all the six steps have been implemented correctly and are clear for the involved stakeholders and/or users.

With respect to technical issues, it should be checked whether solutions can operate in a proper way, both stand-alone and – if necessary – in interaction with the Test-bed environment. Initially, all aspects can be tested separately. At the end of dry-run 1 a complete test-Trial will be executed. For this dry-run, it is not necessary that all roles (instructors, practitioners, observers, etc.) are played by different professionals, but it is key that all kinds of expertise is on hand to test the proper functioning of the Trial from both technical and non-technical points of view.

Dry-run 1 will result in a list of required adjustments, including an indication of who is/are responsible to carry out each adjustment and – if necessary - who should be involved.

The Trial-owner and the complete Trial committee should participate in this activity.

Having defined the objectives, the relevant input/ output and actions for the Dry Run 1 in the execution phase of a Trial are the following:

Input

- Results from preparation phase, TAP.

Output:

Insight into what needs to be adjusted in the Trial (check of all steps of the preparation phase and the TAP).

Actions and Required participation

- Testing the completeness and applicability of the data collection plan.
- Make sure that the procedure and methods for data collection are clear and known by data collectors. For example, by piloting the collection of data from simulators, observations, surveys, interviews, focus group sessions in one or more Dry Runs or pilots.
- Testing the completeness and usefulness of the collected data
- Testing the relevance of scenario events to trigger the crisis management processes, tasks and roles of participants.
- Testing the availability of participants that are responsible for, and competent in executing the crisis management processes and using the solutions in the Trial.

Example

Execution phase: Dry Run 1

Peter wants to test the design of the Trial with a Dry Run.

He uses students to perform this Dry Run. In this way, he receives feedback about the design of the Trial and the scenario, without taking too much time from the practitioners. Also, by using students, the participants are not informed (biased) before the actual Trial.

After the Dry Run, Peter has collected a lot of feedback about the Trial design. He found out that the instruction was not sufficient to be able to use the COP tool effectively. He decides to train the participants who will use the COP tool during the Trials more thoroughly before the actual run. For this, he uses a totally different scenario, one from a previous exercise.

He also checked the questionnaire with a domain expert who is not participating in the Trial. The feedback he received was very useful. Some questions were not clear, and he reformulated these questions.

The observation questions they used were too difficult for the observers. They realized that some of the questions were not concrete enough to observe behavior of the participants.

The focus group session went well and was very useful. It provided insight into the use of the tool and its added value.

Peter sees during the Dry Run that the events in the scenario required the onsite team to share information with the offsite team because they need additional resources to assess e.g. smoke toxicity. Peter confirms that events in the scenario actually do trigger the execution of the right crisis management processes. However, the participants (students) give feedback about the scenario and say that the two scenarios are too similar. This influences the performance of the second session. The second session was too easy because of this. He asks his colleague to adjust the scenario.

Execution phase: Dry Run 1, data collection plan

After the Dry Run 1, Peter analyses the data. This way he gets an idea as to whether the collected data is sufficient to answer his research questions.

He has two observers whom he instructed beforehand with elements to observe. He checks whether this results in data that is suitable to answer the research questions. Peter notes that the observation questions are not adequately incorporated in the observer tool. To assess communication in the two sessions, Peter not only wants to observe the duration of communication (a change in duration could indicate increased efficiency), but also the topics that are shared (is there a change in relevant topics shared?) and the number of misunderstandings and errors that occur (is there a change in accuracy?).

Peter also pilots performance measurement in the simulated world. He checks whether a difference in drive-up performance can be assessed based on the log in the simulated world. Peter sees that it can be assessed whether units arrive at the right or wrong drive up route, whether the units do or do not encounter dangerous smoke or obstacles like water hoses.

Peter decides to further specify how all data is collected and stored. The check of the data and a Dry Run of the analysis and visualisation of the results, show that he will get the data he needs to answer his research questions. Peter notes however that the number of practitioners for the Trial is not very large. This limits the use of inferential statistics. He decides to only use descriptive statistics. He decides to qualify any answers to the research questions since the sample size will be too small to be sufficiently certain.

1.2.2 Dry-run 2

Dry-run 2 is a full test: a general test in preparation for the 'real' Trial. In this step the Trial design and all technical Test-bed arrangements are tested at the location(s) where the actual Trial will take place. This concerns both technical and non-technical issues. The aim is to test whether (a) adjustments that have been appointed at the end of dry-run 1 have been implemented in a proper way, and (b) that the constellation as a whole functions properly. It is recommended that in dry-run 2 all roles (instructors, practitioners, observers, etc.) are played by at least one professional or someone who has enough expertise/know-how to play a certain role.

Note: After dry-run 2, only minor adjustments can be made. If there are too many major shortcomings after dry-run 2, the 'real' Trial should be postponed (to enable additional adjustments) or parts of the Trial should be skipped.

The Trial-owner and the complete Trial committee should participate in this activity.

Applying all adjusted elements in a rehearsal with the goal that all the actors involved in running the Trial (e.g. solution providers, test-bed operators, scenario managers, observers, interviewers, etc.) are aware of their roles and responsibilities.

Having defined the objectives, the relevant input/ output and actions for Dry Run2 in the execution phase of a Trial are the following:

Input

- Outputs of Dry Run 1

Output

Insights into the overall Trial design.

Actions and Required participation

- Assess whether adjustments decided after Dry Run 1 have been implemented properly.
- Assess whether the team is ready to carry out the actual Trial.

Example

> ***Execution phase: Dry Run 2***
>
> *The feedback on Dry Run 1 is adjusted and the Trial team is ready to perform Dry Run 2.*
>
> *Dry Run 2 serves as a final check for Peter to confirm that all of the materials are ready, the technique works and that everybody knows what to do. They perform the Dry Run as if it is the actual Trial.*
>
> *Dry Run 2 went well, and the team is now ready for the Trial.*

1.2.3 Trial runs

In this step the Trial is executed. During the Trial, all kinds of data, as described in the data collection plan, will be collected.

Having defined the objectives, the relevant input/ output and actions for actual run/execution of the trial are the following:

Input

- All decisions taken during the preparation phase.
- Outputs from the Dry Run 1 and 2.

Results

- Data collection.

Actions and Required participation

Conduct the Trial based on insights and plans from Dry Run 1 and 2 during the preparation phase.

- Preparations
  - Technical and non -technical
- Briefing
  - Instruct role-players and observers to know their roles and be prepared to use the tools that are at their disposal
- Instruct Trial participants
  - Obtain informed consent (if relevant)
  - Train participants in using the solutions
- Conduct the Trial as described in the preparation phase (in one or more stages)
- Executed scenario (stages) and collected observation data (via observation tool and other methods)
- Hot-wash (e.g. short questionnaire or a group session with participating practitioners, and one with observers)
- Collected feedback right after each scenario (stage) –
  - Practitioners
  - Observers
- Final wrap-up

- Initial conclusions from the Trial by all participants with respect to:
  - Crisis Management improvement by using the solutions
  - Performance improvement of specific crisis management tasks by using the solutions
  - Relevance of the conducted Trial
  - Experiences with the Trial supporting tools that have been used

Example

Execution phase: Trial runs

In this step Peter has to carefully check if the result of all the preparatory steps are up and running. Unexpected changes (e.g. participation of key practitioners) need to be documented, analyzed and considered for the rest of the Trial. Even ad-hoc adjustments of the data collection and evaluation plans are valid options. Generally speaking, although this phase might appear not to be influenced of a certain event, in the "Trial reality" Peter needs to expect the unexpected.

1.3 Evaluation phase

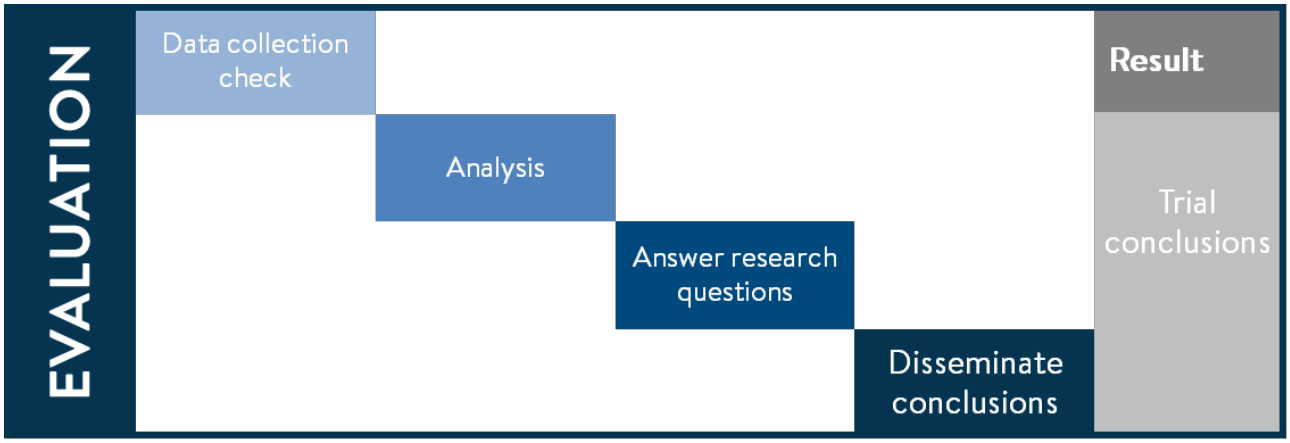

Figure 1.4: Evaluation phase

In the evaluation phase, the results of the Trial are assessed and reported. For the evaluation phase, the TGM will provide support in the following tasks:

- Checking the collected data (e.g. the set of data collected from various sources during the execution)
- Answering research questions (answering the questions as defined in the preparation phase, drawing conclusions and providing recommendations with regards to the three key performance measurements dimensions and the Test-bed tools. E.g. was the observer tool helpful to capture relevant observation? Was the number of participants sufficient to execute the Trial? Was the overall set-up of the Trial comprehensive enough to answer to RQs?)
- Analyse the data a visualise the results
- Draft conclusions, recommendations and lessons learned in alignment with the KPIs defined during the preparation phase. The aim here is to answer questions such as: Can the results be generalized? What are the impact of the solution on the CM dimension, e.g. on the routine operations carried out by first responders? etc.
- Disseminate conclusions

Relevant topics to be covered in this phase:

- Analysis of results
  - With respect to the tested solutions (data analysis, conclusions, practical implications)
  - With respect to conducting the Trial
- Reporting results
  - With respect to the tested solution in the DRIVER+ Lessons learned framework (see D530.2) / other type(s) of dissemination in the field of DR&CM,
  - With respect to the conducted Trial in a document that can be used by future DRIVER+ Trials

1.3.1 Data collection check

In this step, the data that have been collected during the Trial via various sources will be checked for completeness and quality (vagueness or errors). In case of missing, vague or erroneous data additional information might be collected. This step results in a verified and structured set of collected data.

This step has to be conducted by the Trial owner and the methodology support coordinator

The goal of this step is to check, structure and verity the data that has been collected during the Trial, as well as to collect missing data.

Having defined the objectives, the relevant input/ output and actions for the data collection check in the preparation phase of a Trial are the following:

Input

Input: rough data from the Trial.

Results

A verified and structured set of data.

Example

Evaluation phase: data collection check

The data is checked for outliers, or for any other remarkable findings.

1.3.2 Data analysis

In this step, the verified set of collected data will be analyzed according to the evaluation approaches as determined during the preparation phase (task 2, step 4), in which KPIs for several dimensions have been defined.

This step has to be conducted by the Trial owner with support from the Test-bed guidance

The goal of this step in the methodology is to combine, structure and present data that indicates – in accordance with the KPIs that have been formulated during the preparation phase – the degree to which crisis management performance was improved during the Trial, the effects of the solutions on this performance, how participants worked with the solution, and the role and significance of factors other than the solution.

Having defined the objectives and the goal, the relevant input/ output and actions for data analysis in the evaluation phase a Trial are the following:

Input

- Verified data from the Trial (resulting from the data collection check in the previous step)
- The result of the preparation phase: Step 4 *Formulate evaluation approaches and metrics* (1.1.2.4)

Output

Analysed data, including preliminary conclusions (from technical perspective of the Test-bed and methodological standpoint).

Actions and Required participation

Activities:

- Explore classified data in terms of similarities, differences and patterns.

- Structure data in terms of conditions with and without a solution or different solutions, and in terms of different aspects of crisis management performance, the metrics used to specify crisis management performance, etc.
- Cluster, summarize and visualize summarized data such that arguments for answers to the research questions can be supported with data from the Trial.

To analyze data from objective performance measures, expert assessments, surveys, observations, interviews, focus group sessions, etc. the Trial owner can work with the following Trial stakeholders:

- Quantitative data analyst
- Qualitative data analyst
- Methodological advisors

Example

Evaluation phase: analysis

The results of the observers, questionnaires and focus groups are collected.

For the results of the questionnaires, means are calculated and compared between the two groups. Peter asks a Trial committee team member who has experience with conducting these analysis (t-tests). The group is too small to perform this test and to see significant differences; however a trend can be identified.

Communication time measured with the observation tool is shorter and clearer for the participants using the COP tool.

The results of the focus group and observers provide more insight into the use of the tool and how they support their tasks. An interesting finding is that communication without the tool is very explicit and takes a lot of time. However, with the tool, the communication is sometimes too implicit. Participants expect that filling in the information into the COP is sufficient, without explicitly contacting each other. This is confirmed by the results of the focus groups and by the results of the observers.

1.3.3 Answering research questions – Concluding / Synthesis

In this step, based on the analyzed data, the research questions will be answered and conclusions will be drawn regarding the extent to which the objectives of the Trial have been met.

This step is to be conducted by the Trial owner and all members of the Trial committee.

The concluding step involves formulating the answers to the research questions and supporting these answers with empirical evidence gathered during the Trial. It entails formulating the degree to which the crisis management performance objective, the solution objective and Trial objective have been achieved. The answer specifies the degree to which crisis management performance is improved during the Trial. It specifies the effect of the solution on this outcome. It may also specify how participants used the solution. The answer to the research question is supported by arguments that are grounded in the analyzed data and by a line of reasoning that justifies why the link between the analyzed data and the answer is valid.

The goal of this step in the methodology is to formulate an answer to the research question and to capture the answer in the Trial report. The goal is to provide insight into the degree to which the crisis management performance objective, the solution objective and Trial objective have been achieved.

Having defined the objectives, the relevant input/ output and actions for answering research questions are the following:

Input
To formulate these answers, the following should be used as an input:

- The crisis management performance objectives
- The solution objective
- The Trial objective
- Research question
- Research method
- Evaluation plan
- Analyzed data (resulting from the data analysis in the previous step)

Output
The result of this step is a set of answers to the research questions and a conclusion on the degree to which the objectives of the Trial have been met. In addition, for each dimension (crisis management, solution, and Trial) recommendations might be provided.

Actions and Required participation
Activities:

- Organize a meeting to discuss results with the Trial team. Provide a summary of the main results and present this to the team (without providing interpretations or conclusions). If possible, use graphics to visualize the results.
  Example questions for the discussion:
  - What stands out? What results are remarkable?
  - Did you expect these results? Why or why not?
  - What are possible explanations for these results
  - What is/are the answer(s) to your research question(s)?
  - What advice would you provide about the solution?
  - What can you conclude based on these results?
  - Are the results generalizable to other teams/ contexts? Why or why not?
- Also, discuss the method of the Trial. What were advantages and disadvantages of the Trial design (also described in the preparation phase)?
- What activities are still needed to be able to answer your research questions?

To formulate answers to the research questions and to formulate the degree to which objectives have been achieved, the Trial owner can work with the following Trial stakeholders:

- Decision makers
- Practitioners
- Quantitative and qualitative data analysts
- Methodological advisors

Example

Evaluation phase: Answer research questions

The research questions were:

- *How does the COP tool affect communication between onsite and offsite command teams?*
- *How does the COP tool affect building up shared situation awareness about an incident and the response to it?*
- *How does the COP tool affect decision making on the routing of resources?*

The Trial team learned that the COP tool supported the teams in communicating information. It was faster and fewer errors were made. They also learned of some disadvantages to using the COP tool. A disadvantage is that team members expect that others will see and understand information when it is provided in the COP tool. This is not always the case. They learned that it is crucial to inform people when important information is entered in the COP tool and that in order to achieve a shared understanding, communicated information often requires an explanation in the form of a dialogue between the (two) people involved.

1.3.4 Dissemination of the results

As a final step of the evaluation phase, all the results and knowledge gained will be disseminated to ensure they are made accessible to the project stakeholders and beyond, which should in turn, support the sustainability of the DRIVER+ outputs in the longer-term. The dissemination will thus be two-fold so as to target both the internal stakeholders of the project (consortium members) and the external ones (beyond the consortium).

With regards to **internal** dissemination, the outcomes, final conclusions and recommendations resulting from the conduct of the three aforementioned steps will be documented in D911.91 (M72). It will serve as an important source of knowledge for all project partners, deriving lessons learnt, best practices, conclusions and recommendations for the future.

In addition to the above and following each Trial:

- The results of solutions assessment will be stored and made accessible in the Portfolio of Solutions (PoS).
- The experience gained and practices resulting from the conduct of the Trial will feed both the DRIVER+ Lessons Learned Framework and the knowledge base so as to extend the collection of information to the current activities of the project.

Furthermore, all the lessons learned deriving from the project activities, and therefore, the conduct of the Trial and the Final Demonstration, will be documented in the annual report to be developed under WP953 – Enhancing the shared understanding of Crisis Management.

The objective of this document is to report on lessons learnt and best practices synthesizing twice during the project duration the information collected throughout the project activities. Each edition will provide an analysis and identification of best practices and highlight success stories deriving from the project activities (and thus the methodology) but also beyond, suggesting future research activities. These

documents will be elaborated following a book sprint (a collaborative writing session) methodology, and involving all SP leaders and Trial owners.

With regards to **external** communication, the results, best practices and lessons learnt will be disseminated via different means: the involved partners will participate in scientific publications and participate in third party events of relevance so as to inform the project stakeholders about the main findings and increase the project impact. Furthermore, the annual report and the public deliverable as mentioned above will be shared with the CM community to serve as entry point to the topic. The public deliverable and the initial edition of the annual report will be made accessible via the public website in the form of a flipbook and relayed on the social media channels of the project. The final edition of the annual report will be unveiled on the occasion of the project final conference in Brussels and distributed to the participants in printed versions. In close liaise with SP95 – Impact, Engagement and Sustainability and once the results are made available, the latter will also be promoted through news items on the project website and a dedicated newsletter will be circulated. Based on this, specific infographics will be designed so as to easily promote the outcomes and raise awareness about the added value of the activities towards the EU citizens. Finally, the results will be presented on the occasion of the Innovation for Crisis Management events organised by the project and the final conference.