driver+

Driving Innovation in Crisis Management for European Resilience

D922.21- TRIAL GUIDANCE METHODOLOGY AND GUIDANCE TOOL SPECIFICATIONS (VERSION 1)

SP92 - TEST-BED

MARCH 2018 (M47)

This project has received funding from the European Union's 7th Framework Programme for Research, Technological Development and Demonstration under Grant Agreement (GA) N° #607798

Project information

Project Acronym:	DRIVER+
Project Full Title:	Driving Innovation in Crisis Management for European Resilience
Grant Agreement:	607798
Project Duration:	72 months (May 2014 - April 2020)
Project Technical Coordinator:	TNO
Contact:	coordination@projectdriver.eu

Deliverable information

Deliverable Status:	Final
Deliverable Title:	D922.21- Trial guidance methodology and guidance tool specifications (version 1)
Deliverable Nature:	Report (R)
Dissemination Level:	Public (PU)
Due Date:	March 2018 (M47)
Submission Date:	19/12/2018
Subproject (SP):	SP92 - Test-bed
Work Package (WP):	WP922 - Guidance Methodology and Trial Guidance Tool
Deliverable Leader:	JRC
Reviewers:	David Lund, PSCE Marcel van Berlo, TNO Marcin Smolarkiewicz, SGSP
File Name:	DRIVER+_D922.21_Trial guidance methodology and guidance tool specifications (version 1).docx

Revision Table

Issue	Date	Comment	Author
V0.00	22/01/2018	Initial ToC	Chiara Fonio, JRC
V0.01	28/01/2018	Revised ToC	Dirk Stolk; Kees van Dongen, TNO
V0.02	09/02/2018	Contribution to section 2.1	Konstanze Lechner, DLR
V0.03	15/02/2018	Section 5	Dirk Stolk; Kees van Dongen; Lisette de Koning TNO
V0.04	16/02/2018	Contribution to sections 3.3, section 3	Stine Bergersen; Bruno Oliveira Martins, PRIO
V0.05	18/02/2018	Section 3	Adam Widera, WWU
V0.06	16/02/2018	Contribution to section 3	Funda Atun, JRC
V0.07	16/02/2018	Trial Action Plan	Emil Wrzosek, SRC PAS
V0.08	20/02/2018	Contributions and comments provided to section 4	Chiara Fonio, JRC; Adam Widera WWU
V0.09	21/02/2018	Introduction	Chiara Fonio, JRC
V0.10	21/02/2018	Contribution to section 3.1	Funda Atun, JRC
V0.11	27/02/2018 09/03/2018	Contribution to section 2	Konstanze Lechner, DLR
V0.12	09/03/2018	Contribution to section 5	Kees van Dongen, TNO
V0.13	11/03/2018	Contribution to section 3	Nicola Rupp, WWU; Adam Widera, WWU
V0.14	16/03/2018	Section 7	Job Verkaik, HKV; Cor-Jan Vermeulen, HKV; Gerald Lichtenegger, AIT
V0.15	27/03/2018	Review	Funda Atun, JRC; Chiara Fonio JRC
V0.16	27/03/2018	Section 6	Stine Bergersen, PRIO
V0.17	03/04/2018	Overall review of the document	Chiara Fonio, JRC
V0.18	04/04/2018	Review	Nicola Rupp, WWU
V0.19	15/04/2018	Revision of the Trial Action Plan	Emil Wrzosek, SRC PAS
V0.20	25/04/2018	Review of Annexes	Alexander Scharnweber, DLR
V0.21	26/04/2018	Overall review	Stine Bergersen, PRIO; Bruno Oliveira Martins, PRIO
V0.22	26/04/2018	Overall review, inclusion LLF	Dirk Stolk, TNO
V0.23	27/04/2018	Review and contribution to section 3, 4 and 6 and Annex 6	Adam Widera, WWU
V0.24	30/04/2018	Review and improvements to all sections	Chiara Fonio, JRC

Issue	Date	Comment	Author
V0.25	07/05/2018	Review, adjustment of embedded graphics and formatting	Tim Stelkens-Kobsch, DLR
V0.26	08/05/2018	Update of reference section and figures	Adam Widera, WWU
V0.27	09/05/2018	Final check and approval for submission	Tim Stelkens-Kobsch, DLR, Quality Manager
V0.28	10/05/2018	Final check and approval for submission	Peter Petiet, TNO, Project Director
V1.00	10/05/2018	Final check and submission to the EC	Francisco Gala, ATOS
V1.01	24/06/2018	Review by AB member	Reinhard Hutter, CESS GMBH Fonio, JRC
V1.02	21/11/2018	Summaries included in all sections, new structure (C5-C8), Annex 4 included, Figures and Tables numbering updated	Dirk Stolk, TNO
V1.03	30/11/2018	Pending actions completed (completion of summaries in all sections, typos and re-structuring	Dirk Stolk, TNO
V1.04	30/11/2018	Overall review of updated document and adjustments in all sections plus Annexes. New Annexes included.	Chiara Fonio, JRC
V1.05	01/12/2018	Sections 3.3.1 and 3.3.4 included	Adam Widera, WWU Nicola Rupp, WWU
V1.06	01/12/2018	Section 8 revised	Hanneke Vreugdenhil, HKV Drazen Ignijatovic, AIT
V1.07	06/12/2018	All sections improved, overall revision	Chiara Fonio, JRC
V1.08	06/12/2018	New infographics for sections 5-6-7	Nicola Rupp, WWU
V1.09	10/12/2018	Section 3.3.1 updated and revised	Adam Widera, WWU
V1.10	13/12/2018	Full document review	Marcel van Berlo, TNO David Lund, PSCE Joanna Tymińska, SRC PAS
V1.11	14/12/2018	Final checks and further changes (section 8.4)	Chiara Fonio, JRC
V1.12	17/12/2018	Changes to section 10	Cor-Jan Vermeulen, HKV
V1.13	17/12/2018	Changes to section 3	Adam Widera, WWU
V1.14	18/12/2018	Finalisation of document	Chiara Fonio, JRC
V1.15	18/12/2018	Final check and approval for submission	Tim Stelkens-Kobsch, DLR, Quality Manager
V1.16	19/12/2018	Final check and approval for submission	Marijn Rijken, TNO, Project Director
V2.00	19/12/2018	Final check and submission to the EC	Francisco Gala, ATOS

The DRIVER+ project

Current and future challenges, due to increasingly severe consequences of natural disasters and terrorist threats, require the development and uptake of innovative solutions that are addressing the operational needs of practitioners dealing with Crisis Management. DRIVER+ (Driving Innovation in Crisis Management for European Resilience) is a FP7 Crisis Management demonstration project aiming at improving the way capability development and innovation management is tackled. DRIVER+ has three main objectives:

1. Develop a pan-European Test-bed for Crisis Management capability development:
    a. Develop a common guidance methodology and tool, supporting Trials and the gathering of lessons learnt.
    b. Develop an infrastructure to create relevant environments, for enabling the trialling of new solutions and to explore and share Crisis Management capabilities.
    c. Run Trials in order to assess the value of solutions addressing specific needs using guidance and infrastructure.
    d. Ensure the sustainability of the pan-European Test-bed.
2. Develop a well-balanced comprehensive Portfolio of Crisis Management Solutions:
    a. Facilitate the usage of the Portfolio of Solutions.
    b. Ensure the sustainability of the Portfolio of Solutions.
3. Facilitate a shared understanding of Crisis Management across Europe:
    a. Establish a common background.
    b. Cooperate with external partners in joint Trials.
    c. Disseminate project results.

In order to achieve these objectives, five Subprojects (SPs) have been established. **SP91** ***Project Management*** is devoted to consortium level project management, and it is also in charge of the alignment of DRIVER+ with external initiatives on Crisis Management for the benefit of DRIVER+ and its stakeholders. In DRIVER+, all activities related to Societal Impact Assessment are part of **SP91** as well. **SP92** ***Test-bed*** will deliver a guidance methodology and guidance tool supporting the design, conduct and analysis of Trials and will develop a reference implementation of the Test-bed. It will also create the scenario simulation capability to support execution of the Trials. **SP93** ***Solutions*** will deliver the Portfolio of Solutions which is a database driven web site that documents all the available DRIVER+ solutions, as well as solutions from external organisations. Adapting solutions to fit the needs addressed in Trials will be done in **SP93**. **SP94** ***Trials*** will organize four series of Trials as well as the final demo. **SP95** ***Impact, Engagement and Sustainability***, is in charge of communication and dissemination, and also addresses issues related to improving sustainability, market aspects of solutions, and standardization.

The DRIVER+ Trials and the Final Demonstration will benefit from the DRIVER+ Test-bed, providing the technological infrastructure, the necessary supporting methodology and adequate support tools to prepare, conduct and evaluate the Trials. All results from the Trials will be stored and made available in the Portfolio of Solutions, being a central platform to present innovative solutions from consortium partners and third parties, and to share experiences and best practices with respect to their application. In order to enhance the current European cooperation framework within the Crisis Management domain and to facilitate a shared understanding of Crisis Management across Europe, DRIVER+ will carry out a wide range of activities. Most important will be to build and structure a dedicated Community of Practice in Crisis Management, thereby connecting and fostering the exchange of lessons learnt and best practices between Crisis Management practitioners as well as technological solution providers.

Executive summary

This deliverable presents the foundations of the Trial Guidance Methodology (TGM), the steps of the TGM and the functional requirements of a tool (the Trial Guidance Tool, TGT) that support the end-users in applying the TGM.

The TGM is conceived for high-level crisis managers as it supports in investigating innovations in terms of new capabilities leading to improved crisis management operations. It focuses on a step-by-step approach to carry out Trials in a pragmatic yet sound and ethical way.

The foundations of the TGM draw on three main sources, which serve as the supporting knowledge base underlying the DRIVER+ methodological approach:

- Concept Development and Experimentation (CD&E).
- A systematic literature review (SRL) of more than 200 peer-reviewed papers published in the last decade (2007-2017).
- Lessons learnt from the first phase of the project.

These three pillars lay the groundwork for a new approach to Trials, which comprises three main phases:

1. The preparation phase, which consists of the iterative and co-creative DRIVER+ six-step approach (i.e. identify the Trial objective, formulate research questions, formulate data collection plan, formulate evaluation techniques and metrics, formulate the scenario and select solutions).
2. The execution phase, which consists of two dry runs and the actual execution of the Trial. The dry runs are the rehearsal to be carried out before the Trials to check both technical and methodological issues.
3. The evaluation phase, which covers the analysis of the Trial and also includes communication strategies.

D922.21 outlines the tasks and activities to be implemented in each phase, focusing on four main aspects: objectives, input, output and required activities. Several examples are also provided to illustrate these concepts.

Moreover, the functional requirements of the Trial Guidance Tool (TGT) with regards to the preparation phase to Trials are described in this document.

This document describes the first (initial) version of the TGM. The usage of each phase of the TGM in the upcoming Trials will be assessed, and lessons learnt on its application will be covered in an initial version of a handbook (M56), an updated version of the TGM (version-2, in **D922.41**, M58), and finally the TGM will be described in the form of a final handbook regarding systematic designing of Trials (**D922.42**, M66).

Table of Content

List of Figures

List of Tables

List of Acronyms

Acronym	Definition
C4I	Connectivity for Industry
CD&E	Concept development and experimentation
CfA	Call for Application
CM	Crisis Management
CMINE	Crisis Management Innovation Network Europe
COP	Common Operational Picture
CoW	Collaboration Workspace of DRIVER+
CP	Civil Protection
CRUD	Create, Read/Retrieve, Update, Delete/Destroy
DR&CM	Disaster Resilience and Crisis Management
DRM	Disaster Risk Management
EC	European Commission
ELSI	Ethical, Legal, Societal Issues
EU	European Union
GDPR	General Data Protection Regulation
ICT	Information and Communication Technology
KPI	Key Performance Indicator
LL	Lessons learnt
LLF	Lessons Learned Framework
NDA	Non-Disclosure Agreement
NGO	Non-Governmental Organisation
PoS	Portfolio of Solutions
RCRC	Red Cross Red Crescent
RQ	Research Question
SIA	Societal Impact Assessment
SLR	Systematic Literature Review
SMART	Specific, Measurable, Assignable, Realistic, Time-related
SOP	Standard Operating Procedure
SotA	State of the Art
TAP	Trial Action Plan
TGM	Trial Guidance Methodology

Acronym	Definition
TGT	Trial Guidance Tool
TRL	Technology Readiness Level
UML	Unified Modelling Language
UN	United Nations
UNISDR	United Nations International Strategy for Disaster Reduction
WP	Work Package

1. Introduction

1.1 Innovation in Crisis Management

The number and severity of natural disasters as well as humanitarian and civilian emergencies are increasing worldwide, causing fatalities as well as considerable economic losses. As a result, crisis management is a constantly evolving challenge. European crisis management capabilities need to continuously improve in order to face the rising challenges and needs.

This improvement is driven both from the bottom up by the response organisations carrying out the operations, as well as from the top down through the European Union's (EU) Civil Protection Mechanism and the European member states. The top down approach also supports and promotes prevention measures, as well as various (scientific) projects that prepare operations, set up disaster control structures and develop strategies, such as trainings, large-scale exercises, the Exchange of Experts Program and capacity building projects with the candidate countries.

Today more than ever, the EU's main objective in Crisis Management (CM) and Civil Protection (CP) is to provide assistance to those who need it as quickly as possible. The foundations for this are the Lisbon Treaty[1] and the Stockholm Programme[2]. Their objectives include improving the EU's disaster resilience and its capacity to prepare for and respond to acute threats. To meet these objectives, innovative socio-technical solutions promise to have a significant impact on the effectiveness of the whole CM system in the EU.

However, CM organisations often face difficulties to assess the potential impact of a change in their socio-technical setup for several reasons, ranging from the lack of resources to the lack of adequate methodological know-how to assess innovative solutions. Investments in new but inappropriate sociotechnical solutions not only produces significant costs, but also has negative impacts for the operational performance of response organisations. Changes may be brought about, for instance, by different types of solutions, such as new software or new training or workflow processes, each adopted with the aim to improve certain functions or activities. Assessing the potential impact of any kind of change is not a trivial task as it points to both capability development and to the identification of innovation. In the field of crisis management, innovation is often framed in terms of “innovation management” or innovative technical tools.

1.2 Setting up Trials to evaluate solutions

In the DRIVER+ project, the term innovation is closely linked to solutions that address the needs of the practitioners. The Trial-oriented environment developed in Subproject 92 (**SP92 *Test-bed***), is conceived and designed *to allow systematic assessing of solutions in realistic but non-operational contexts (namely, in Trials) to help practitioners in assessing solutions that can drive innovation (changes) before adopting them*. In a nut-shell, the pan-European Test-bed provides an appropriate environment in which the assessment of solutions is carried out using a structured, all-encompassing and mutual-learning approach.

In the context of **SP92**, **WP922** is tasked with providing adequate guidance to practitioners through an iterative and co-creative approach. The detailed methodological approach consists of a pragmatic and sound, step-by-step framework – the Trial Guidance Methodology (TGM) – to prepare, execute and

[1] Consolidated versions of the Treaty on European Union and the Treaty on the functioning of the European Union. June 2010, DOI: 10.2860/58644. https://publications.europa.eu/en/publication-detail/-/publication/3c32722f-0136-4d8f-a03e-bfaf70d16349

[2] The Stockholm Programme – an open and secure Europe serving and protecting citizens. OJ C 115, 4.5.2010, p. 1–38. http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52010XG0504(01)

evaluate a Trial[3]. Starting from gaps that have been identified by end-users (**D922.11**), Trials are *designed* together with relevant stakeholders (**T922.2**, **SP94**) in such a way that the impact of changes/innovations can be properly assessed. The experiences in the Trials will lead to an updated and final version of the Trial Guidance Methodology and its corresponding Trial Guidance Tool (**T922.3** and **SP93**). To ensure the correct understanding and implementation of the methodology as well as the effective use of the Trial Guidance Tool, **WP924** will organise *ad-hoc* training modules.

Despite being primarily focused on the development of the Trial Guidance Methodology, **WP922** also works in close collaboration with **WP923**. The building blocks of the DRIVER+ Test-bed (i.e., methodology, Test-bed reference implementation and support to Trials) are conceived as inherently related. Hence, this document positions itself in a broader context, both within **SP92** and in relation to other Subprojects. The support tools developed in the context of **WP923**, like the Online Observer Support Tool and the After Action Review Tool are in fact key elements to be used during the evaluation phase.[4] While the first will support the data collection from observers during the Trials, the second will facilitate the evaluation of the trialled solutions against pre-defined objectives. The functional specifications of the Trial Guidance Tool as defined in this deliverable are the basis its development in **SP93** (Solutions). Moreover, the initial TGM will be evaluated during the (preparation, execution and evaluation of) Trials and subsequently improved based on the feedback received from Subproject 94 (Trials).

The present deliverable is in fact the first version of both the Trial Guidance Methodology and the specifications of the Trial Guidance Tool. The second and updated version will be submitted in M58 and the final Handbook in M66.

This first version sets out the basis of the TGM. As such, it focuses on the following three main topics:

- The **theoretical foundations of the TGM**, in particular the knowledge base on which it draws;
- The **actual TGM**, namely the steps that Trial owners must follow to carry out Trials in a systematic way;
- The **functional requirements of the Trial Guidance Tool (TGT).**

While **D922.21** provides the first version of the framework of the methodological approach, version 2 will be more focused on the improvements of the actual TGM based on lessons learnt from the Trials, and the final Handbook will have, besides a further update, a didactic scope.

Rather than being a methodological quick-fix that fits all Trials, this deliverable provides the above-mentioned common framework with the ambition of being systematic as well as pragmatic, while also flexible enough to fit Trial-specific requirements and to be improved and revised during the project life cycle.

The main target group of this version are higher level crisis managers as it offers support *in investigating innovations in terms of new capabilities leading to improved crisis management operations*. Such investigations take into account the nature of the operational context (dynamic, uncertain, complex) and the way of working (procedural and hierarchical, as well as experience-based). Hence, methods of investigation are not imposed upon but rather developed together with practitioners so that these dimensions are adequately captured.

Besides high-level crisis managers, solution providers benefit from this approach. By giving practitioners the opportunity to assess a solution, the providers will get direct feedback. This enables them to gradually adapt the solutions to better fit operational conditions and it reinforces acceptance among users of the solutions via their active involvement and it provides evidence to decision-makers that the solutions have added value and are cost-effective.

[3] From a methodological stand-point these phases correspond to specific steps. The rationale behind the TGM design is explained in sections 3 and 4.

[4] Information on the Test-bed is provided in: **D923.11** (17) and **D923.21** (18).

In sum, integrating the perspectives and expertise from practitioners, solution providers, policy-makers and researchers in the design of a Trial is essential for stimulating innovation and true capability development within the Crisis Management domain.

1.3 Reader's guide

The document is organised as follows:

- Section 2 focuses on Trials. It shortly describes the purpose and the scope of a Trial by introducing the key performance measurement dimensions to be considered during Trials. Moreover, it shortly describes the main roles and responsibilities of those involved in Trials, especially the roles referred to in this deliverable.
- Section 3 deals with the foundations of the DRIVER+ Trial Guidance Methodology. Specifically, it focuses on the three main sources of knowledge that guided the development of the TGM design, namely: the concept development and experimentation approach (CD&E), a systematic literature review (SLR) and lessons learnt from past experiments conducted within the first phase of the project.
- Section 4 describes the design of the TGM from a broad perspective.
- Section 5 introduces the actual TGM and provides an overview of the methodology and the three phases of a Trial (preparation, evaluation and execution). In sections 6, 7 and 8 tasks and activities are outlined in more detail for each of the phases of the TGM by emphasising: objectives, input, output and required activities while examples are provided in Annexes.
- Section 9 covers research ethics and Societal Impact Assessment (SIA) by providing both recommendations for Trials and a plan for implementing the SIA methodology into the TGM.
- Section 10 describes the functional requirements of the Trial Guidance Tool to be used by Trial owners to design a Trial. The tool is based on the steps of the TGM.
- Section 11 focuses on the way forward, namely how and when the TGM will be improved and updated.

The Annexes provide information and details on:

1. The DRIVER+ terminology used in this document.
2. An extended description of the Systematic Literature Review.
3. Experiences from previous DRIVER+ experiments (lessons learnt).
4. Examples illustrating the use of the TGM.
5. Background of the Societal Impact Assessment Methodology (SIA).
6. Trial Action Plan (TAP).
7. Unified Modelling Language (UML) version of the Trial Guidance Tool (TGT)
8. List of functional requirements of the Trial Guidance Tool.

2. Purpose and scope of a Trial

This section starts with a description of the purpose of a Trial (section 2.1). Differences between Trials on the one hand and experiments and exercises on the other hand are explained, while the conditions for conducting a well-balanced Trial are explicated. Next the scope of a Trial is dealt with (section 2.2). This is done by explaining the various dimensions of a Trial (Crisis Management, solutions and Trial), and by describing the challenges of the practitioner-oriented approach of Trials. This section ends with an overview of the main roles and responsibilities of those involved in Trials (section 2.3).

2.1 Purpose of a Trial

In the domain of disaster resilience and crisis management, exercises have a primary role in testing the capabilities of organisations. At European level, Civil Protection exercises (full scale and module-field or table-top) are organised every year with the dual aims of both enhancing collaboration in disaster preparedness across borders and improving preparedness among EU civil protection authorities and teams. Exercises are considered to be important opportunities "for testing specific response capacities, as well as the self-sufficiency, interoperability, coordination and procedures of response teams and equipment. Table-top exercises, in turn, focus on in-depth training of key-personnel."[5] In such exercises, the *testing* element is the key and differentiates these activities from, for instance, Concept Development and Experimentation (CD&E) campaigns traditionally used in the defence domain in which cause-and-effect relationships underlying capability development are investigated.

Trials differ from exercises and they do not aim to train or test the capabilities and preparedness of the involved organisations or teams. Instead, *the purpose of conducting Trials in DRIVER+ is to find out if and how some innovative solutions can help resolve the needs of the CM practitioners*.

Additionally, the term "experiment", which was used in the first phase of the project, may be confusing as the conceived "controlled nature" of experimentation activities is seen as a pre-condition for conducting scientifically valid experiments. However, this laboratory-test like setting under strict controlled conditions does not apply to the activities carried out in DRIVER+. While, as outlined in section 3 some significant elements of the CD&E have been retained and adapted to the context of the project, the more neutral term "Trial" is considered more appropriate as DRIVER+ supports the identification of game changers that provide the needed innovation for CM practitioners.

The aims of conducting Trials are in fact not about carrying out scientifically validated experiments. It is about systematically finding and assessing valuable solutions in realistic environments for current and emerging needs in such a way that high-level crisis managers can do this using a structured yet pragmatic approach. The purpose of the TGM is to help assessing solutions. Proper assessment can take place only if the overall design of a Trial follows a structured method.

The different stakeholders in a Trial consist of one or more solution provider(s), one or more practitioner(s) and the Trial owner, who organises the Trial. The TGM is really dedicated to tackling the last mile problem of innovative solutions.

By carrying out a Trial (dry runs as well as the actual Trial run), participants are able to introduce the operative reality at an early stage of solution development, and they get support in shaping the design of new solutions and approaches. The result of this approach is that innovation dynamics are aligned in such a way that a real added value for crisis management can be created in the end.

However, for a Trial to produce valuable results, and in order to create a complete and well-balanced Trial environment, the following key factors need to be taken into account:

1. **Gaps and needs as defined by the practitioners**

[5] https://ec.europa.eu/echo/what/civil-protection/simulation-exercises_en

The starting point for each Trial is the identification by practitioners of a gap or a requirement to improve and support operational processes. A gap and requirement analysis should therefore underlie a Trial. It should be specified in detail in advance which kind of user needs are to be the main focus of a Trial so that a suitable Trial environment can be created for the assessment of potential innovative solutions[6]. In line with the identified gaps and the context in which these occur, the required types of practitioners and their roles can be defined.

2. **Involvement of CM practitioners as users of solutions**
   A comprehensive view of CM also requires a multi-functional approach, involving practitioners in the Trials and covering the full range of functions involved in CM, from emergency services, law enforcement, public health and medical services to public decision-makers and non-governmental organisations. It is essential that these practitioners, who will be using the solutions, are involved in the actual assessment of these solutions. The planning and implementation of the Trials is foreseen to be planned as cooperation between CM practitioners and solution providers.

3. **Involvement of solution providers**
   In order to assess the potential value of a particular solution, the respective provider should be actively involved as well, both during the Trial phase and in the preparation phase. The solution provider can adapt the solution to fit the purpose of the Trial, can indicate how to best measure the performance of a solution and can train the practitioners in using the solution. Within the scope of the project, solution providers are selected via a Call for Applications, followed by a review and selection Process[7].

4. **Test-bed to create a space for trialling**
   The DRIVER+ Test-bed, defined as a distributed technological infrastructure enabling the pooling and sharing of resources across Europe, as well as the gathering of experiences from Trials in different contexts to stimulate each other, is developed.

5. **Innovative solutions, their assessment and evaluation**
   The Trial environment is not primarily about inventing new solutions, but about achieving innovations based on the systematic assessment and adaptation of existing ideas and (emerging) solutions. The added value of these solutions in supporting the CM and their cost effectiveness is described and stored via a content-based management system, the so-called Portfolio of Solutions (PoS). The results can be content-oriented (for instance: Did the solution lead to a better Situational Awareness?) and process-oriented (for instance: Did the combination of solutions lead to a more effective decision-making process?).

2.2 Scope of a Trial

As mentioned in section 1, proper assessment of innovation can only take place if the overall assessment process follows a structured method. In this context, the object of investigation is a key as it refers to the ability to detect and assess the potential impact of a change on the socio-technical set-up of crisis management organisations. This involves a systematic investigation into the multiple effects of the solutions using mixed research methods. The primary focus is not solely the cause of the change (namely, the solutions), but rather the effects and the impact of the change on the so-called **crisis management dimension,** which is the key performance measurement area in DRIVER+ Trials[8] .

As explained in **D23.21** (1), there are three DRIVER+ performance measurement dimensions to be considered during Trials: the Trial dimension, the Solution dimension and – as the core dimension – the CM

[6] More details on the identification of gaps in the context of the project are provided in **D922.11** (14).

[7] More details are provided in **D942.11** (4).

[8] A performance measurement scope introduction of experiments conducted in the initial project phase is provided in **D23.21** (1).

dimension (Figure 2.1). All three performance measurement dimensions[9] are covered by the TGM containing methodological, procedural and logistics-related elements (such as specific data gathering techniques, checklists or relevant templates). The three performance measurement dimensions are explained below:

1. The Trial dimension covers the perspective of the Trial owner (i.e. the organisation hosting a DRIVER+ Trial) and measures all relevant data related to the pre-defined Trial objectives. As an example, in the context of spontaneous volunteer management, a Trial could investigate the question as to how many voluntary participants can be motivated to join a Trial in order to fill sandbags needed to build a dike. For measuring purposes in order to answer such questions Key Performance Indicators (KPI) are used (e.g. *"the quotient participating volunteers/required volunteers"*.
2. The CM dimension is the key performance measurement area. The identification of CM objectives, described as mission objectives, is the foremost place to indicate whether a change of a process, the application of a new technology or a training module has an impact on the CM performance. Besides, the CM objectives need to be understood as the determining element of experiment objectives and the decision support objectives. Due to the different relief situations, stakeholders and time horizons the measurement objects vary in terms of specific roles, tasks, and processes. The question if a particular performance is effective or not can only be evaluated once the involved actors including their responsibilities and practices are defined. In the context of a chemical spill, one exemplary KPI can be derived from the major objectives targeting the evacuation of affected population (e.g. "number of evacuated persons/number of persons to be evacuated").
3. Finally, the Solutions dimension must be measured in order to learn whether a particular solution (e.g. a piece of technology or a new process) has the potential to drive innovation in CM. In the presented example, it could be a solution supporting evacuation tasks through the interaction with citizens; here, one solution function could be to identify the location of evacuees through the application of drones (one related KPI could be "time to locate evacuees with a drone/time to locate evacuees without a drone").

The identification of CM objectives, described as mission objectives, is the foremost place to indicate whether a change of a process, the application of a new technology or a training module has an impact on the CM performance. Besides, the CM objectives need to be understood as the determining element of experiment objectives and the decision support objectives. Due to the different relief situations, stakeholders and time horizons the measurement objects vary in terms of specific roles, tasks, and processes. The question if a particular performance is effective or not can only be evaluated, once the involved actors are defined, including their responsibilities and practices. These definitions have to be used to identify and configure the appropriate KPIs.

Taking the three dimensions and their interrelations into account, a clear and structured approach allows for the identification of relevant KPIs capable of measuring the *real impact of new solutions in CM*. This process is supported with generic rules of performance measurement approaches, procedural guidelines and recommendations.

[9] The dimensions are only introduced here. The importance of the dimensions within the actual TGM is explained in section 5.

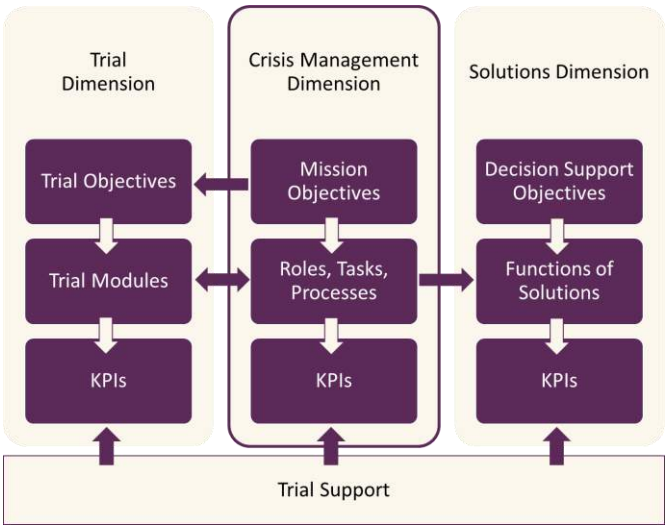

Figure 2.1: Key Performance Measurement Dimensions

Defining KPIs given the objectives in each of the Dimensions, is not an easy process for many practitioners and requires guidance and support. Therefore, during the preparations of the Trials within DRIVER+, dedicated support is being provided by a methodological team[10]. This methodological team does not work in isolation, but rather offers on the guidance to the Trial Committee, starting from the identification of the Trial objectives to the evaluation phase. Furthermore, the guidelines and recommendations of the TGM can be tailor-made to the specific context of a Trial. While some general guidelines are provided (section 5) methods are specifically tailored to the characteristics of a particular crisis management organisation and the (Trial) context in which it operates.

There is no methodological "silver bullet" wrapped up in forms of guidelines that can empower practitioners without taking into account a number of specific conditions: gaps at a regional and local level, specific processes and procedures within different crisis management organisations, tactical and strategical crisis management plans etc. Special socio-cultural conditions demand *ad hoc* methods to ensure that the potential impact of a change is measured within a specific context and is relevant to be considered in that context. Context-dependency implies that methods are transferrable but not entirely "replicable": via the TGM and the TGT, practitioners will have access to a wide variety of recommendations so that they can implement best practices in their respective contexts. Conversely, the approach used in the course of the project, namely the guidance process (the establishment of an iterative Trial development) adopted with the stakeholders, is of course reusable.

Additionally, the methodological team works with IT developers so that the TGT is consistent with the TGM. Structured feedback provided by the Trial stakeholders and the TGT developers is crucial for developing the appropriate environment in which to Trial solutions, namely DRIVER+ Test-bed. As specified, the Test-bed evolves during Trials thanks to feedback mechanisms that revolve around co-creation and mutual learning. This allows for working processes and learning patterns that are circular, instead of linear.

There are a few challenges to consider related to this practitioners-oriented approach:

1. While Trials are not scientifically validated experiments, the ambition of the TGM is to be scientifically sound. This implies a robust method that has to be translated into both the language and the real-life experiences of the users.
2. The ambition of being sound, rigorous and simple – but not simplistic – also implies an iterative development process with all the stakeholders. In this context iterative means that the concept

[10] The methodological team consists of the main partners involved in **WP922**, specifically the organisations involved in the methodological support to Trial owners.

matures and grows until it can be trialled. The iterative nature of this process is yet another important aspect of the CD&E, which is still valid in the context of the methodology used in DRIVER+ Trials. Likewise, the Test-bed itself evolves and matures during Trials. While this approach reduces complexity, it requires a participatory method that may be difficult to sustain after the end of the project. In the course of the project, face-to-face meetings with the stakeholders are organised regularly to discuss and refine concepts (e.g. Trials objectives, research questions, key performance indicators – KPIs - etc.). A sustainable process needs to be put in place so that DRIVER+ Test-bed can retain its "support to end-users" nature.

3. Exercises are more commonly used than Trials. Practitioners are more prone to testing teams and procedures. The inherently different nature of Trials calls for a different framework; this, in turn, may lead to new standardization needs.

2.3 Roles in Trials

While roles and responsibilities are explained in the Trial Action Plan (TAP), the following explanations provide an overview to ensure a shared understanding of the main roles which are referred to in the deliverable:

- **Trial Owner** who is responsible for the overall management and success of the Trial as well as well for the acceptance of gaps, scenario and solutions selection. He/she coordinates the Trial Committee.
- **End-users coordinator** who makes the first contact with relevant End-users and supports the External Coordination Manager in contacting the End-Users and informing them on the Trial.
- **Scenario coordinator** who coordinates the selection of gaps and research questions in the Trial, prepares the scenario, and is also involved in the actual execution of the Trial.
- **Test-bed Guidance and/or methodology support team** that ensures the correct understanding and implementation of the TGM; specific support is provided for all Trials.
- **Solution coordinator** who controls the use, the integration and the assessment of the solutions, and who supervises the training of selected solutions.

Next section describes the foundations of the DRIVER+ methodology. The design of the TGM as well as the TGM itself will be illustrated in sections 4 and 5.

3. Development of the Trial Guidance Methodology

This section describes the rationale of the TGM. It starts with a description of the "Concept Development and Experimentation" (CD&E) approach that was used in the previous phase of the project (section 3.1). To ensure a smooth transition from past experiments to DRIVER+ Trials, the experiments have been analysed and the findings consolidated as lessons learnt (section 3.2). Section 3.3 focuses on a systematic literature review (SLR) on Trial-like events conducted in the past decade.

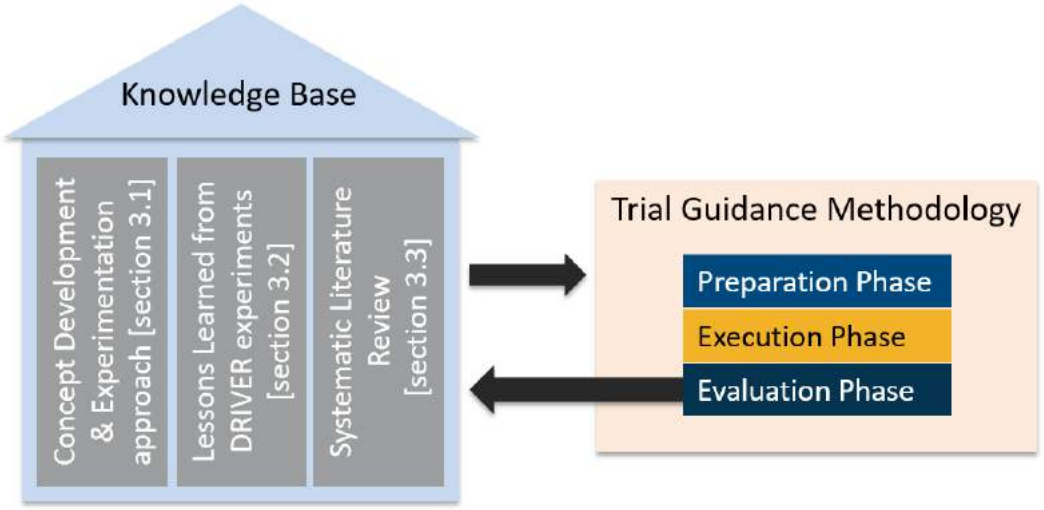

Figure 3.1: Interdependencies between KB and TGM

These three important pillars feed the so-called DRIVER+ "knowledge base", as shown in Figure 3.1. The Knowledge base serves the purpose of providing examples which are worth considering when planning, executing and evaluating Trials. Additional knowledge coming from Trials will enrich the knowledge base. The bi-directional information flow, in which the knowledge gained from conducting the Trials, is fed back into the knowledge base. The set-up and functionality are further explained in sub-section 3.3.5.

3.1 Concept Development and Experimentation (CD&E) in the context of DRIVER+

In the previous phase of the project, the foundations of the methodology were identified in the CD&E approach. As mentioned in section 2.1 , the use of this approach remains valid in DRIVER+ albeit to a lesser extent. In this section, after providing a short description of the approach, an adjustment to the context of DRIVER+ is suggested.

The CD&E approach was pioneered in military defence research[11] and is used for example at NATO[12]. They define CD&E´s purpose as: "A solution-oriented transformational idea that addresses a capability shortfall or gap." (MC 0583). It is seen as an adaption of basic scientific methods to the concept development and validation process in the military and defence domain[13] (2). CD&E defines a way to develop new concepts by experiencing the challenges and by developing and evaluating the new concept in a realistic setting before expensive resources are acquired or before organisational changes are implemented. It is a creative process whereby a concept is developed through brainstorming, evaluation sessions and analyses combined with input from experiments.

[11] A short description of the CD&E is also provided in **D23.21** (1)**.**

[12] http://www.act.nato.int/images/stories/events/2014/cde/cde2014ra_1a.pdf.

[13] According to NATO, CD&E is one of the tools enabling the structured development of creative and innovative ideas into viable solutions for capability development.

According to (3) the focus of the experimentation is twofold:

1. All key concepts should be understood by all involved members and advisory practitioners.
2. The focus should be set on refining the concept in a learning-by-doing approach.

Starting point is an initial concept idea stemming from either a need, a capability gap, or from a new opportunity or new solution. The lines of development are defined and the concept grows while including them all. The concept matures until it can be demonstrated or trialled in a relevant operational setting. During the development, the concept will be partially and, if possible, fully assessed in experiments. The experimentation results provide important input for the further development of the concept, or its rejection if it does not provide added value. This is the iterative nature of CD&E. The final evaluation of the CD&E process results in an evidence-based recommendation on the implementation readiness.

This methodology was previously determined to be applicable for crisis management capability building during the FP7 ACRIMAS project.[14] Proceeding from this finding, in DRIVER, the "experimentation campaign" was developed. In this approach, every experiment was followed by an analysis, which led to a refined concept and ultimately a better experiment design. This showed a direct relation between the concept development and the experimentation. However, the term "experimentation" might be misunderstood as a classical experiment known from the natural sciences focusing on quantitative research methods (like setting up controlled laboratory experiment environments or the evaluation of specific hypotheses).

As described in **D23.21**, DRIVER+ adapts and adjusts the CD&E process to the CM domain in general and the Test-bed in particular. More specifically, the CD&E approach is used as a method that will support the evaluation of new solutions. The related CD&E guidelines (e.g. foundations of integrated analysis or experimental design considerations) are considered as valuable sources for the DRIVER+ knowledge base. Starting with small cases, the solution requirements increase through a higher complexity of the test cases, e.g. by adding more CM organisations, extending the period of relief operations or considering cascading effects.

Furthermore, the CD&E explicitly suggests several qualitative data collection techniques in order to identify the impact of a particular concept on a given problem or need, e.g. the execution and analysis of interviews during observations. This in turn allows DRIVER+ to explore and discover "real" effects in CM as perceived and experienced by those who are actually doing the work in the field. At first glance, such a mixed approach of quantitative and qualitative research appears contentious given that it builds upon contrary philosophical assumptions and epistemologies. However, in the context of a demonstration project like DRIVER+, it is the required method of choice in order to meet the practitioners' needs with respect to learning, experiencing and understanding the performance of new CM solutions within the context of a Trial.

In turn, the CD&E approach needed to be adjusted from DRIVER experiments to DRIVER+ Trials. Trials focus on closing one or more gaps, which are identified by practitioners. All gaps are embedded in a realistic scenario. Moreover, as explained in section 1, the investigations carried out in Trials do not take place in laboratory-like settings. Instead, Trials take into account the complexity and dynamic nature of the world in which practitioners operate.

In a Call for Application (CfA) for solutions, the practitioners look for solution providers who purport to fill the identified gap(s) (see **D942.11** (4)). Promising solutions are then trialled in as realistic as possible scenarios in order to identify game changers that provide the needed innovation for CM practitioners.

The Trial-concept fits indeed very well with the NATO definition (see above) of the CD&E´s purpose:

1. Finding capability shortfalls and gaps is the very basis and starting point of each Trial.
2. Each Trial aims at finding transformational ideas – game-changing innovations for crisis management

[14] **D23.21** Executive summary (1).

3. The solution-oriented approach is reflected in the whole procedure of the Trial set-up, especially the call for application.

A major concept of the CD&E methodology is to enable a maturity increase early in the process. This is ensured through the two steps "interpret evidence" and "draw conclusions" as these are not only limited to the solutions but also concern also the whole Trialling process as well as the Test-bed. As there are four Trials and a final demonstration in DRIVER+, the TGM as an iterative CD&E approach ensures that the overall Trialling-concept itself matures already in its early steps. Furthermore, the level of maturity increases more and more until the concept can be trialled in a relevant operational setting – which is the overall goal of our sustainability efforts. Hence, the CD&E is not entirely dismissed but rather adjusted to the context and the purposes of the Trials.

The next section describes the second pillar or main source which nourishes the DRIVER+ knowledge base, namely the knowledge gained from the systematic literature review.

3.2 Lessons learnt

Another important source of knowledge is the lessons learnt from the experiments conducted in the first phase of the project. This body of knowledge has been analysed in two ways:

1. By inferring generic lessons learnt already captured in **D610.1** (5) and applicable to DRIVER+ Trials.
2. By using a codebook to collect more specific lessons learnt on the experiments drawing on the respective deliverables.

The template for the codebook draws on past experiment descriptions (and consequently reflects the former methodological approach of the first phase of the project) and includes the items shown in the table below:

Table 3.1: Template to collect lessons learnt

Experiment No XX	Full title of the experiment and relevant documents (e.g. DXX, Experiment Report, Templates etc.)
Experiment objectives	E.g. investigate the benefits of …etc.; measure community resilience … etc.; test a specific tool …. etc.
Research questions	E.g. how did the solution contribute to solve …
Experiment planning and deviations	E.g. Timeline and causes of delays.
Methods	E.g. quantitative (e.g. survey), qualitative (e.g. focus group), mixed methods research.
Key Performance Indicators (KPIs)	A set of measures focusing on those aspects of organisational performance that is most critical for the current and future success of the organisation. (6)
Data collection plan	E.g. questionnaires distributed during/after the experiment etc.
Data analysis	E.g. qualitative analysis of textual data though specific tools etc.
Ethical procedures	E.g. informed consent.
Results	E.g. answers to the research questions.
Methodological LL (lessons learnt)	E.g. non-representative sample etc.

To ensure consistency between the SLR and the analyses of the lessons learnt this template was re-used for the SLR as described in Section 3.3. The overall aim is to identify experiences that can be helpful for Trial owners (e.g. examples of research questions and/or data collection analysis and techniques).

Similar to the SLR, the idea is to support the project in two ways:

1. Turning the lessons learnt into a knowledge-base by generating lessons learnt codebooks.
2. Using the first item to further support Trial planning through quick and condensed access to examples.

In doing so, both Trial-like *examples* derived from the SLR as well as *experiences* from past experiments can be made available in the Trial Guidance Tool (the relational database mentioned in 3.3.5) to support Trial design at different stages.

This section mainly elaborates on general lessons learnt that have guided the new TGM design. Detailed information collected through templates (experiences in carrying out experiments) will be included in the Trial Guidance Tool. An example of a completed template, as well as identified challenges identified in **D610.1** (5), is provided in Annex 3.

These lessons learnt are of different nature: e.g. the organisation of regular meetings and the robustness of the evaluation plans. These recommendations were taken into account to design the new methodological approach to DRIVER+ Trials and will be expanded upon in section 5.5.

Additionally, *the identified challenges have shed light on the need to develop a new TGM and guided the new TGM design*. The design described in section 4 illustrates how the difficulties of the previous phase of the project have been carefully considered to ensure a more detailed and tailored, step-by-step approach to end-users.0 illustrates how the difficulties of the previous phase of the project have been carefully considered to ensure a more detailed and tailored, step-by-step approach to end-users.

The methodological approach used in the previous phase of the project has also been revised on the basis of both the outcomes of the SLR and the feedback provided by the experiment owners (**D610.1** (5)). Therefore, the first set of challenges and recommendations described in **D610.1** (5) have shaped the design of the methodology and the approach to Trials, more specifically but not solely the working processes mentioned in section 1 (e.g. involvement of the end-users). The involvement of the end-users in the methodological work is in fact a key to ensure that the methods support the Trial owners by focusing on the specific objectives of their Trials.1 (e.g. involvement of the end-users). The involvement of the end-users in the methodological work is in fact a key to ensure that the methods support the Trial owners by focusing on the specific objectives of their Trials.

However, to turn the lessons learnt into a knowledge-base, additional information and input were needed. In other words, the necessity to go beyond generic recommendations in order to provide meaningful experiences (“dos and don’ts”) was considered a key element of the support to Trials.

The starting point of the work presented in the following section is the definition of lessons learnt provided in **D530.1**: “A lesson learnt is a knowledge or understanding gained by experience. An experience may be positive or negative, a mishap or failure. Successes are also considered sources of lessons learnt. A lesson must be significant in that it has a real or assumed impact on operations; valid in that it is factually and technically correct; and applicable in that it identifies a specific design, process or decisions that reduces or eliminates the potential for failures and mishaps or reinforces a positive result” (7).

The word experience is the key in this context as it refers to the process of getting knowledge (as well as learning) from one or more than one event. Acquiring knowledge involves learning both from positive and negative experiences. Additionally, it involves the opportunity of relying on the experiences gained from others to use best practices or to avoid common mistakes.

3.2.1 Data collection and presentation of the knowledge

During the data collection, the main challenge was harmonizing different types of collected data from past experiments to generate knowledge that can be helpful for Trial owners. The data comes in different formats for two main reasons. First, as various tools are used, the data varies in typology, quantity and

quality. Second, the data depends - especially the lessons learnt data - on approach, previous experience and previous knowledge of the data provider. Experiment reports and deliverables focused on the experiments carried out in the previous phase of the project were analysed.

Based on the information collected through the templates relevant knowledge has been structured in a way meriting DRIVER+. In doing so, the theoretical knowledge is organised and presented in a practical way, taking into account the potential actions required during the preparation, execution and evaluation phases of a Trial. The collected inputs reveal several challenges according to the phases of the Trials. Considering first the same function areas and parameters, some insight is presented in Table 3.2.

Table 3.2: Actions and methodological steps for Trials

Factor	Parameter	Preparation	Execution	Evaluation
Facilitate a common understanding	The chosen Gap / Solution	• Frequent teleconferences. • Gap assessment workshop. • Conducting rehearsals. • Preparation of the definition of terminology that will be used in Trials. • Match gaps, risks and legal settings with the context of involved practitioners.	• Choose some main gaps and solutions, and focusing on them only. • Use dashboard.	• More discussion & feedback sessions to avoid passive, inadequate participation and informal results. • Ensure that Trial owners and end-users have the same understanding as to what should be evaluated.
	Language	• Ensure that Trial participants speak English. • Provide simplified materials to deal with multi-lingual taxonomies. • Use a simplified and terminology free language in all the materials.	• Ensure that simultaneous translation can be provided. • Print and distribute to participants an explanation of the terminology and taxonomy used.	• Being sure that participants are comfortable with the language to provide evaluation.
	Address the end-user's need	• Choose the specific purpose, decision making, collaborative learning, mediation, model improvement etc.	• Depart from new skills, insights and design the Trial for truly user driven innovation.	• Check together with the end-users whether the results of the Trial are aligned with their needs.
Methodology	Research question	• Follow the criteria on how to formulate a research question. • Assess its validity. • Check former research questions. • Link research questions with gaps/objectives.	• Allow interaction with appropriate participants. • Facilitate a common understanding for answering the research question.	• Check whether all the questions have been referred by the participants. • Allow the participants to ask further questions that can enlarge the affected area of the research question. • Compare the results among Trials.
	Data collection	• Prepare a customized checklist. • Facilitate a common understanding of which data to collect, how to collect it and by whom the data will be collected. • Distinguish well the data streams that can be automated and those that cannot. • Check with the research ethics about how to collect data, what to prepare before data	• Observer support tool.	• After action review tool. • Check with the research ethics to understand how to store the data and for how long.

Factor	Parameter	Preparation	Execution	Evaluation
		collection to meet the ethical requirement.		
	Data analysis	• Find the appropriate tools. • Link the data analysis tools/techniques with RQ and data collection plan. • Prepare templates to structure an evaluation approach to be filled by participants and Trial owners.	• Communication and visualisation during Trials should be linked and support the data analysis.	• Modelling the data after analysis to communicate it with the participants and end-users. • Facilitate how to share the data after analysis with the participants. • Consult with the ethics board. • Complete the templates together with participants.
	Experiment planning / deviation	• Define objectives. • Prepare the setting. • Define how to identify and select the participants. • Define roles and share it with the responsible people of timing and team building (if different).	• If necessary, any deviation can be done without affecting the other methodological steps, including data analysis and data collection.	• Trial owners will assess the performance of the planning processes. • Trial owners will provide feedback to the project partners. • Interpretation of how it was affected by the solution.
	Key Performance indicators	• Define KPIs and prepare a list. • Connect KPIs with RQs, gaps and solutions.	• Facilitate a common understanding on different KPIs that indicate the effects of solutions • How to measure and interpret the different KPIs.	• Scoring of KPIs by practitioners and end users. • Group discussion on what and how to improve the scores. • Trial owners to explain the evaluation process.
Means	Timing	• Prepare the timeline for the scenario. • Prepare a set of actions for defined periods.	• Provide support to keep the timing.	• Allocate time for evaluation and discussion.
	Final resources & Physical setting	• Minimise the potential acoustic disturbance in advance through some physical implementations.	• Separate groups physically.	
	Team building	• Define the team according to the concept of the Trial.	• Dividing participants into small groups to let them establish teams.	• Providing evaluation forms to teams to evaluate/assess the new solutions.

Factor	Parameter	Preparation	Execution	Evaluation
Participants	Level of participation	• Define and agree on the role and level of responsibility of participants. • Define how to instruct and train the participants to work with new solutions.	• Involvement in solution providing is different than the drills conducted in a controlled environment.	• Providing participants access to solutions to validate them further on.
	Getting a representative sample	• Selection of a heterogeneous group of volunteers with a variety of age, gender, education, experience level.	• Good coordination. • Timely and appropriate involvement of all participants.	• Share information with the participants and keep them in the loop.

Capturing lessons learnt is also crucial in the context of DRIVER+ Trials. The way in which the DRIVER+ Lessons Learned Framework described in **D530.1** will be implemented in the context of the Trials will be explained in the future versions of the methodology (**D922.41** and **D922.42**).

3.3 Systematic Literature Review (SLR)

The CD&E approach (section 3.1) was chosen as a base for the initial phase of the DRIVER+ project and as such remains a valid part of the TGM design process. However, the need for a systematic assessment of alternative approaches towards Trial-like events was articulated not only by the reviewers but also by the leaders and participants of the experiments conducted in the initial phase of DRIVER+. The most problematic issue of the CD&E approach can be found in (a) the application domain as well as (b) the identified needs towards research methodologies:

(a) In crisis management we don't have a command-based decision chain with clear and aligned responsibilities, but complex, independent, uncertain and dynamic characteristics. Thus, it is at least necessary to have a look at related research approaches for this particular setup.

(b) Besides, the practitioner needs show that both qualitative and quantitative evaluation methods are required, so the appropriate approach cannot rely on laboratory like settings but needs eclecticistic elements in order to "research and analyse" all elements, which the practitioners are interested in. This however does not mean that scientific standards can be ignored. Depending on the researched object appropriate research methods need to be applied.

In order to address the before mentioned needs, it was decided to do a systematic literature review (SLR) focused on Trial-like events conducted in the past decade. The SLR approach is a mean to reduce the bias of study selection, data extraction and presentation; to ensure a high quality, and because it is reproducible due to the systematic and well documented procedure. From different available SLR procedures the approach presented by (8) was followed. The main advantage of this approach is the fact, that it promotes teamwork in selecting and analysing the literature and hence a high quality of the SLR can be expected. As there are no crisis management specific guides, (8) was chosen, because the tasks and procedures of both are much alike. This was combined with the lessons learnt template (Table 3.1) which is used as extraction forms for primary studies called codebook. Hence, the idea of consistency between the lessons learnt from experiments conducted in the initial DRIVER+ phase and the SLR is supported.

3.3.1 Methodology

Thomé et al. (8) analysed existing literature review techniques and developed a step-by-step guideline for a SLR process. It consists of 8 steps as shown in Figure 3.2. In the first step: "Planning and formulating" the problem, a review team needs to be set up, the scope needs to be clarified and set in context. Additionally, a protocol is set up that describes how the next steps are to be executed. This protocol is the main differentiation between conventional literature reviews and SLRs. Before the actual execution, the search and selection, data gathering and quality evaluation, analysis and interpretation procedure are defined. For search, the databases, keywords and time span are defined. Selection process is done in two iterations by at least two members of the review team. First, the abstract, title and keywords are reviewed, and predefined selection criteria are applied. A criterion stands for a decision to include or exclude a study, so one "applies" the criteria, meaning the reviewer includes or excludes a study by choosing an appropriate criterion for the study. Secondly, the full text is reviewed, and in-/excluded based on the chosen criterion that fits the research paper best. Data must be extracted in data extraction forms (codebooks) defined within the protocol. Subsequently the procedures on how the studies quality can be assured have to be defined. Then, the extracted data needs to be analysed, synthesized and interpreted to answer the research question. How this is done is also explained in the protocol.

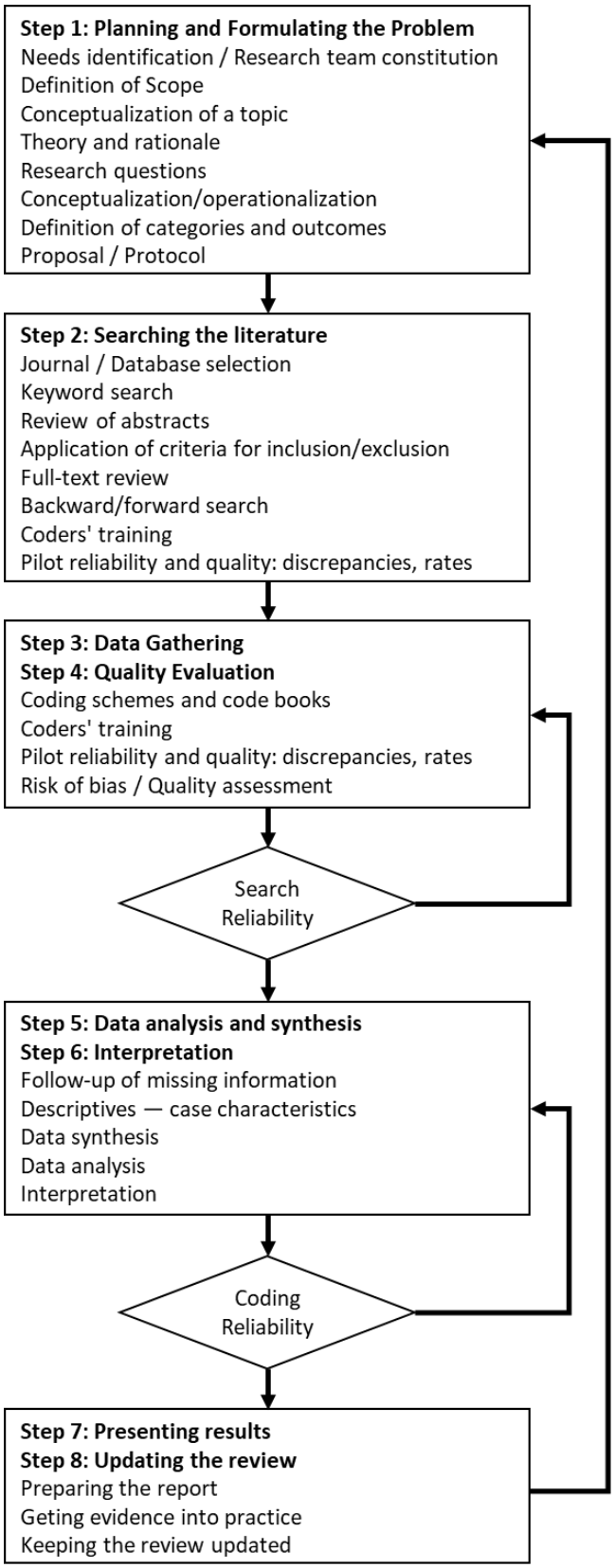

Figure 3.2: SLR procedure (compare (8))

Step 1 – planning and formulating the problem

The aim of the SLR is two-fold: First, as the CD&E was deemed not comprehensive enough for the purposes of DRIVER+, an overview of existing approaches for conducting Trial-like events in the past decade in the

Crisis Management domain was considered a necessary starting point. And second to provide a solid and robust knowledge base for Trials.

More pragmatically, the idea of the SLR is to support DRIVER+ in two ways:

- Analysing the state of the art (SotA) concerning the use of methods etc. over the course of the past decade (*What kind of methods were used? What kind of research questions was asked?*).
- Turning the state of the art into a knowledge-base that can be used for further Trial planning.

The long-term vision is to have this knowledge base provided through the Trial Guidance Tool to everyone who wants to set up a Trial (see Section 3.3.5.).

The **application context** was aimed to be the core activities of DRIVER+ consortium: Crisis Management practitioners, researchers as well as solution providers. The **review team** consisted of members from four different organizations: The German Aerospace Center (DLR), the European Commission's Joint Research Center (JRC), the Netherlands Organization for Applied Scientific Research (TNO), and the University of Muenster (WWU).

The SLR's **objective** was to *"analyse the state of the art (SotA) concerning the use of methods etc. over the course of the past decade (What kind of methods were used? What kind of research questions was asked?)"*.

From that *follows* the **research question** "*How to design and evaluate a space for trialling socio-technical innovations for crisis management in a realistic and multi-stakeholder setting?"*

In order to contextualize the research question, the PICOC (Population, Intervention, Control, Outcome, and Application Context) characteristics introduced by Kitchenham (9) and mentioned by Thomé (8) were chosen.

Table 3.3: PICOC Criteria

Characteristic	Description
Population	CM practitioners, CM researchers, policy makers.
Intervention	Exploration of Trial-like approaches, which evaluate socio-technical solutions in the crisis management domain.
Control	Concept Development and Experimentation (CD&E) approach; lessons learnt of the first phase of the demonstration project "Driving Innovation in Crisis Management for European Resilience" (DRIVER+); contribution of the multidisciplinary DRIVER+ consortium.
Outcome	1. Answer if there are other "holistic" approaches like CD&E. 2. What are specific elements of existing approaches which even cover only a small set on how to trial and evaluate solutions. 3. Knowledge base.
Application context	Crisis management practitioners, researchers and solution providers.

The Keywords were derived from objective, research question and context. They were categorized by field of interest as shown in Table 3.4.

Table 3.4: SLR Keywords

Field of interest	Keywords for search query
Application context	crisis management, emergency management, disaster relief, humanitarian operation, disaster management, disaster response
Functional description	simulation, serious game, exercise, game, test, Trial, experiment, training
Research object	innovation, software, algorithm, decision support, tool, solution, process, organization, partnership

Step 2 – searching the literature

In order to guarantee a high quality, it was decided to search only for peer-reviewed journal papers. To enable the use a software solution it was important that the data could be exported as a .ris file. This led to the following **source list**:

"EBSCO", "Google Scholar" and "ScienceDirect" (The idea of using JSTOR had to be dropped, as this one was not able to handle the long search query that came up).

By combining the keywords defined before the following search string was created:

("crisis management" OR "emergency management" OR "disaster relief" OR "humanitarian operation" OR "disaster management" OR "disaster response") **AND** ("simulation" OR "serious game" OR "exercise" OR "game" OR "test" OR "Trial" OR "experiment" OR "training") **AND** ("innovation" OR "software" OR "algorithm" OR "decision support" OR "tool" OR "solution" OR "process" OR "organisation" OR "partnership").

The search results were included for the initial screening if they were peer reviewed, in English and published between 2007 and 2017. This resulted in 2,934 results. First, 320 duplicate papers were deleted. Subsequently an initial filter was applied. Keywords, title or abstract had to include at least one of the following words:

"assessment" OR "evaluation" OR "generalizability" OR "method" OR "methodology", "procedure" OR "qualitative" OR "reliability" OR "validity"

These filter terms form the very core of the project as it aims at assessing and evaluating innovation by using a defined methodology that is a qualitative, reliable and valid process that leads to generalizable (but case-driven) results. This step reduced the number of possibly relevant papers to 948. After abstract and full text screening as well as manually deleting undetected duplicates, a total of 239 studies were included for the next steps. Studies were included if the authors conducted some sort of experiment (simulation, case study, table top exercise, ...), included communication or coordination between different organizations in a crisis management context, covered an interdisciplinary approach for emergency preparedness, had a training component, concerned crisis management decision making, or included the test of a socio-technical solution. Studies were excluded if it did not contain any of the previously mentioned subjects. Additional 21 studies had to be excluded, either because the full text could not be retrieved, or deemed irrelevant, when reading the entire content of the paper. Figure 3.3 shows the steps as a flow diagram based on the PRISMA[15] standard.

[15] http://www.prisma-statement.org/

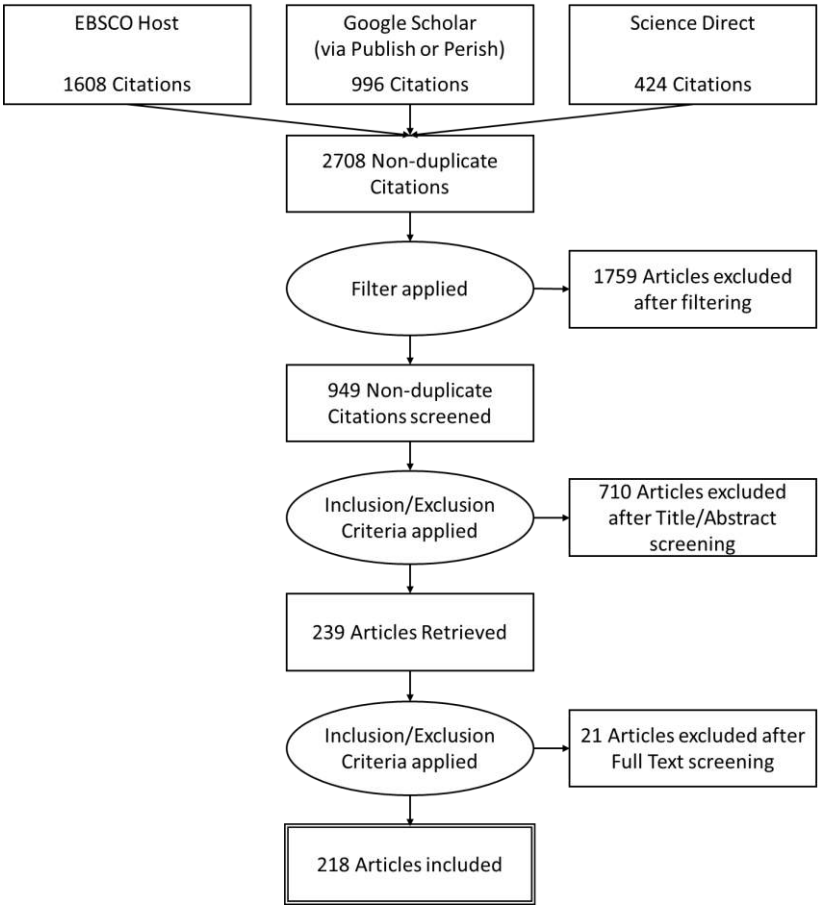

Figure 3.3: PRISMA Flow Diagram (see (10))

Step 3 – data gathering

The data gathering was done by creating a codebook for each included paper that was introduced for the lessons learnt from experiments conducted in the initial project phase to ensure reproducibility and comparability. As depicted in Annex 3, Table A6 contains 10 categories: Experiment, Exercise or Trial Objectives: a short description what the objective is or what the study consists of. Research Questions: the paper's objectives (or aim) as a question or statement. Experiment Planning: how the Trial, exercise or experiment was planned and what was considered in order to conduct it. Research Methods: the method the authors applied for their research. Metrics and KPIs: the metrics used in order to determine the success of the experiment and how they were measured. Data Collection Plan: concerning from whom or what the data was collected (e.g. if the paper included a survey, how many people did they include, was it a questionnaire or recorded debriefing sessions?). Data Analysis Method: The Method used to analyse the collected data. Ethical Procedures: was there any protocol for obtaining permission of data usage, or its records? Results: the main results of the study. Methodological LL (lessons learnt): this field explains any methodological learning derived from the experience of conducting the research. It also shows how the methods can be improved or what the next steps would be. There was also additional space for comments as suggested in multiple SLR Guidelines (11) (12).

Each paper was completely read and analysed and short summaries for each of these categories were saved in a codebook. The 218 relevant papers were split between the four involved organizations, so that for each paper two codebooks would be created by two different team members. The results were then synthesized to one single codebook for each paper which will be used as the foundation for the knowledge base. The process is depicted in Figure 3.4.

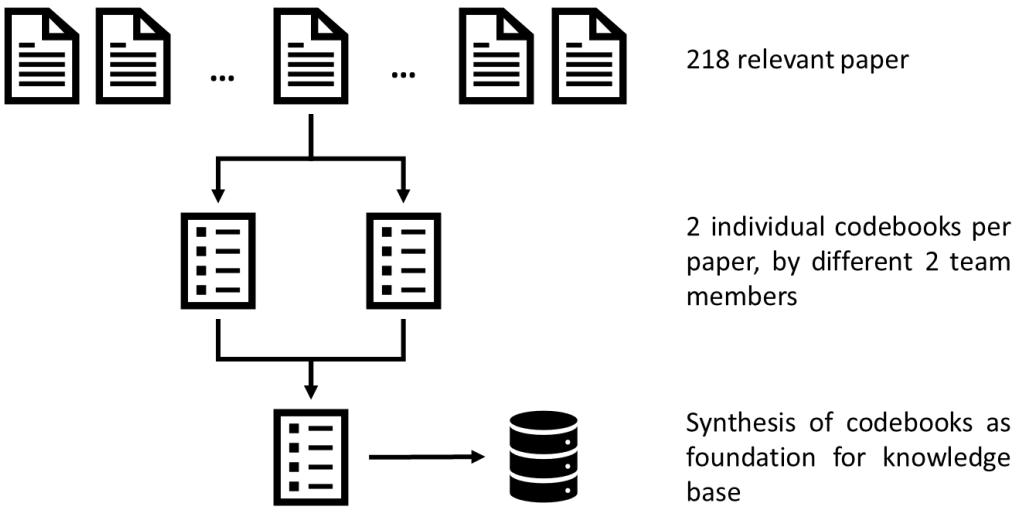

Figure 3.4: Data gathering procedure

Step 4 – quality evaluation

One of the SLRs aims was to support the design of the TGM as well as to serve as a data base of best practices on Trial-like event methodologies. The latter objective requires a careful quality assurance of the usability of each potential best practice for TGM applicants. Therefore, only peer reviewed studies were included, thus, the high publication standards served as quality assurance. Additionally, data gathering was done in two rounds, where first two SLR team members created decentralized and independently a codebook, which was then synthesized in a second round. In consequence, the peer extraction of DRIVER+ relevant information on the best practices supported a certain inter-subjectivity of the created codebooks. This is not only relevant in order to double check the codebooks in a proper way, but also to support the reviewers in terms of the different scientific disciplines of the papers and the reviewers. This also reduced the risk of missing as much information as possible. Hence, the task to "follow up on missing information" as stated by Thomé et al. (2016) was not necessary.

Step 5 – data analysis and synthesis

A first data analysis was done by using basic descriptive statistics, so that analysing the state of the art concerning the use of methods, research questions, experiment planning, KPI usage, data collection and data analysis could be aggregated in order to interpret the current SotA. This is further described in in the sub-section 3.3.3, that presents the findings.

Step 6 – interpretation

Interpreting data was discussed within the review team. It was decided to use graphics and charts to depict the findings. This will enable others to also interpret the data as quickly as possible and furthermore puts the data into the context of the formulated objective for the whole SLR (see Annex 2).

Step 7 – presenting results

The results are presented in the following section. It was decided to use a visual approach by using graphics and giving a small explanation text. In order to enable the use of the results for the target audience of DRIVER+, the knowledge base was created (see sub-section 3.3.5). As it is part of the Trial Guidance Tool it is online and free for everyone to use while preparing a Trial or informing oneself about Trials in general.

Step 8 – updating the review

This step is planned to be an on-going process. Every time a journal-paper is identified by the consortium (during the project phase) and/or by the parties involved during the setup and execution of a Trial (during and after the project phase) a codebook should be filled in by the authors and then be fed into the knowledgebase. Furthermore, all consortium members are encouraged to fill the knowledge base with more codebooks of relevant peer-reviewed journal articles they encounter. This will be taken up by the Trial Guidance Tool that allows users to suggest new entries into the knowledge base. Here quality will be ensured, as all new entries will be peer reviewed.

3.3.2 Tool support

In the chosen SLR approach by Thomé et al. (2016) a separation in three phases: preparation (step 1 in Figure 3.2), execution (step 2 to 4) and summarization (step 5 to 8). This separation is also embedded in the software StArt[16] which was developed by the Laboratory of Research on Software Engineering (LaPES) of the Computing Department of the Federal University of São Carlos (DC/UFSCar). It helps with managing systematic reviews (a screenshot of the tool is provided in Figure 3.5). It was decided to use this tool, as it is not only available as a freeware but also has extensive online tutorials. Both mentioned circumstances allowed every member of the SLR team[17] to use the tool easily.

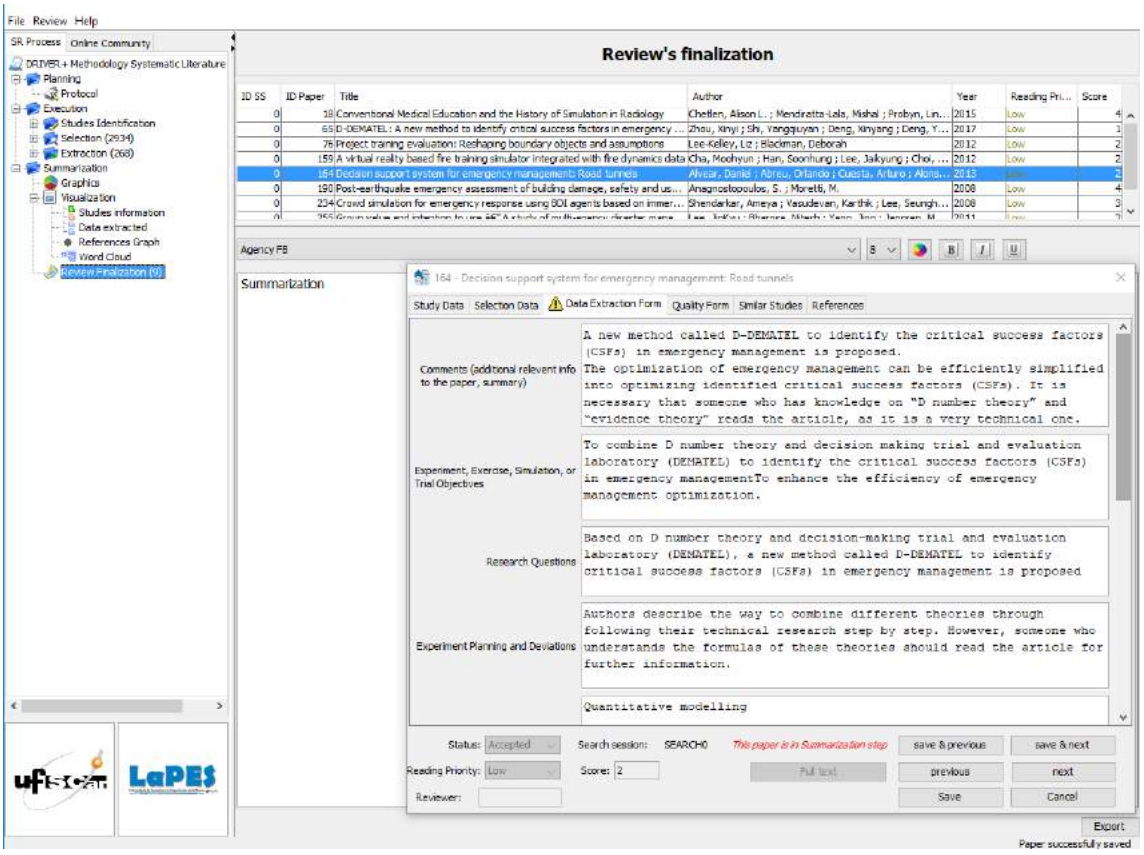

Figure 3.5: Screenshot of the SLR in StArt

For data extraction Microsoft word was used. Here the template for the codebooks was created and spread amongst the team members, who used it to create one codebook per paper assigned to him/her. According to the objective of exploring Trial-like events (see 3.3.1 for more details) the task was to extract the main

[16] StArt is the acronym for "State of the Art through Systematic Review".

[17] As stated in the DoW the team consists of the DRIVER+ partners: DLR, JRC, TNO and WWU.

information from the selected papers (e.g. which RQ was followed or which evaluation approach was chosen). Hence, no subjective text mining needed to be executed but a structured and comparable summary of the most relevant Meta information of the selected papers was targeted. As one paper was always assigned to two reviewers, in the end the reviews could be easily combined.

Because the number of relevant papers is significantly higher than average (13), manual synthesis was not feasible, thus the software MAXQDA Analytics Pro 2018 (release 18.0.3) was used. Furthermore, all entries from the combined codebooks were inserted in Microsoft excel where some basic analysis could be performed (e.g. the number of empty fields etc.).

3.3.3 Findings from the SLR

In the following section the results from step 5-7 will be presented.

3.3.3.1 Research questions

The first characteristic about a research question is that the expression is worded in an interrogative form. While this might not be true on a general level (one can elicit information without a question mark), the interrogative form is important in the context of DRIVER+ Trials as it facilitates the first phase of the Trial design by directly linking gaps both to questions and to Trial objectives[18]. Defining research questions is also important in the evaluation phase, during which answers are provided. Surprisingly, only one out of ten of the peer-reviewed papers contained a statement in the form of an interrogative question or questions. Figure 3.6 depicts the distribution of these questions and their type of formulation.

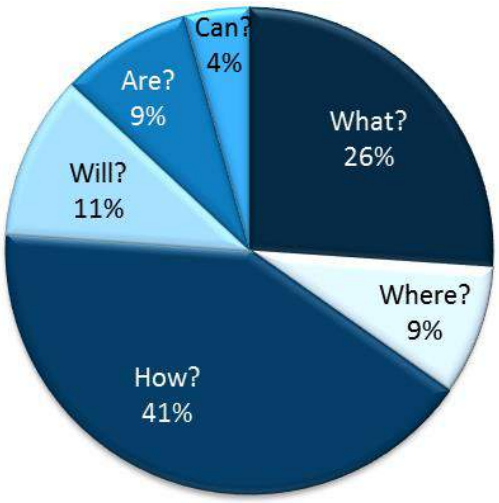

Figure 3.6: Split of interrogative pronouns in research questions

With more than 40%, the “How?”-questions are by far the most frequently used of the interrogative pronouns. “How”-questions focus mainly on understanding the effects/influence that methods or technical solutions have on organisations or groups of people. This means that they aim to examine and assess the change brought about by a solution within a specific set-up (e.g. “How to examine nontechnical skills in simulations”). As one of the core elements of the DRIVER+ Test-bed is to assess the impact of solutions (or the impact of a specific aspect of one or more solutions) it might seem sensible to consider the formulation of “How” questions for the Trials.

[18] More detailed explanations are provided in section 6

The second most commonly used interrogative pronoun is “What”. The analysis shows that these types of questions are used with the objective of providing a definition or quantification of a specific subject or measure respectively. Examples of these definitions can be processes, success/crucial factors and procedures. Moreover “What” questions also help to set a direction as to the steps/tasks to be followed for a specific procedure.

This pronoun can also be used to widen a theme or to narrow down a specific subject. In the first case, an example of such a question is “What produces change in the Standard Operating Procedures (SOP) of our medical team when solution X is used?” For the second case, the variant “To what extent…?” may be added.

As mentioned above, not every research question needs an interrogative pronoun. 13% of the questions were phrased using Can/Is/Are- constructions. When using these, it is important to make sure that the questions refer to a specific, measurable subject. If this is not considered, there is a risk that the formulated questions lead to very subjective or broad answers (e.g. “Is this a good solution?”). On the contrary, a question like “Is this solution usable on our fire truck?” will result in a measurable Trial setup.

The rest of the field for research questions was filled in with the aim or objective the papers meant to address. Recurring topics were the construction of frameworks or methodologies for the design and development of decision-support systems, simulation testbeds or even training programs identifying the critical skills for them. Another topic studied within this domain were training programs for which simulations are often used in order to evaluate the effectiveness of a program or to establish the training itself.

3.3.3.2 Experiment planning and deviations

By conducting the SLR the aim was to get an overview of experiment planning and deviations used often in the past decade. While the results revealed that this criterion is closely connected to the specific topic of each paper, it is possible to identify six broad terms (see Figure 3.7) that are highly connected to the experiment planning, and which are in line with the research method followed by the paper.

Additionally, it was also found that, in order to plan an experiment, there seems to be two possible alternatives to tackle this: 1) develop the experiment theoretically or 2) design and execute a practical experience. 32% of the reviewed research followed a theoretical approach through the use of case studies or self-analysis/synthesis. The majority of cases, however, make use of the experiential approach through questionnaires, exercises or workshops.

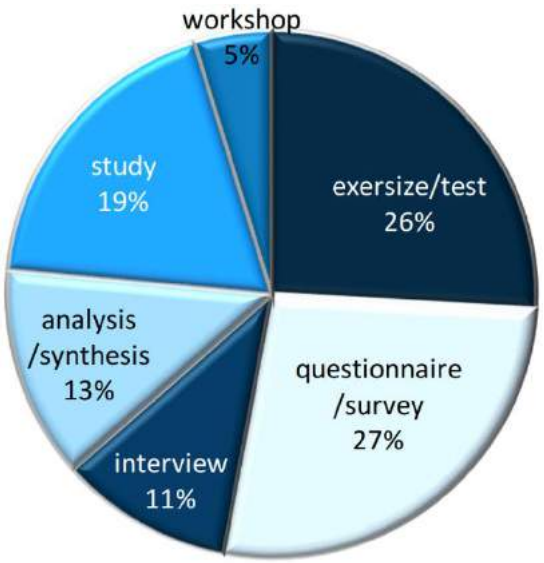

Figure 3.7: Overview of Experimental planning

The “Experimental planning” attribute of the codebook is focused mainly on providing guidance for planning the experiments prior to their execution. This is why recurring topics in the analysis were “scenario planning”, “roles assignment” or “protocol construction”. These refer to important aspects of the proper scoping of the experiment, the roles participants play in each of the scenarios and number of runs, the content which will be evaluated and how it will be presented to the participants.

Another interesting example that can be derived from this criterion is the explanation for a suitable simulation space for which special attention to the physical space should be paid (for instance, furnishing, availability of appropriate observational equipment like audio and video recorders, space for providing instructions and teaching, etc.).

3.3.3.3 Research methods

Research methods for the domain of crisis management have proven to be quite distinct from study to study. As shown in Figure 3.8, it is challenging to identify a specific trend towards which research is heading. In the sample of studies analysed, simulation was found to be the preferred methodology, with 3 out of 10 papers using simulations either to imitate existing scenarios from past disaster/crisis situations or to simulate new potential disaster scenarios based on predictive models and historic data.

Two other important methods used throughout the literature are interviews and surveys, accounting for a combined total of 29% of the methods used. Through the use of surveys and (semi-structured) interviews, these studies gathered data on the requirements to consider when designing a simulation environment or when deciding on the relevant skills to evaluate as a product of a simulated learning/training experience.

It is worth noticing that a mix of quantitative and qualitative data gathering techniques is the preferred approach for evaluating or validating the outcomes of a Trial. Examples include the creation of a virtual reality learning environment through simulation, supported by software and the use of surveys and focus groups. In addition, the use of participatory approaches such as focus groups or debriefing sessions has helped to collect significant insights from the participants or stakeholders involved in an experiment.

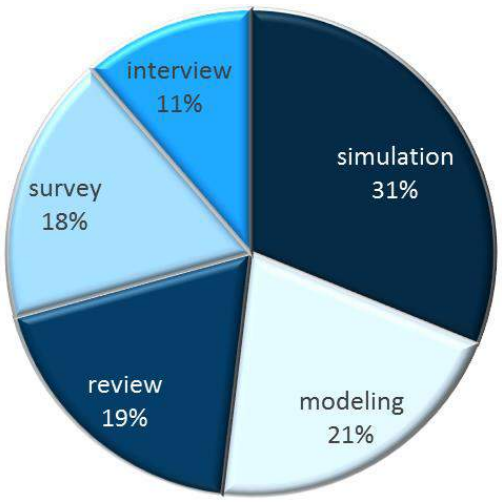

Figure 3.8: Research methods

3.3.3.4 Experiment, exercise, simulation, or Trial objective

Different types of exercises, simulations and Trials have been conducted in the domain of crisis management over the last decade. In this section, a brief explanation of the main objectives is presented (cf. Figure 3.9).

Figure 3.9: Objectives of experiments, exercises, simulations and Trials

As the word is already part of this criterion, it seems natural that "simulating something" was often the aim of a Trial-like event. This method was translated into reality through different forms (e.g. virtual-reality systems or computer-enhanced mannequins). Another interesting approach is the execution of table-top exercises. This is a participatory method with discussion-based sessions. In this case, a table-top could be used for validation purposes of plans and policies, while also identifying potential gaps or weaknesses in the execution of an experiment.

Through the simulation of different scenarios and crisis situations (e.g. forest fires, earthquakes, or even infectious disease outbreaks), experiments have allowed to identify best practices regarding how to detect relevant skills or develop better evacuation/response plans.

Another important objective identified in the literature refers to the development of a method or a product. This might be of particular relevance for DRIVER+ as it aims to, *inter alia*, Trial innovative solutions that, in some cases might require further development.

A recurring aim for conducting experiments has been "training". In this sense, training can be understood as:

1. The development of new skills for agents or personnel who deal with disaster management situations and crisis.
2. The development of improved training programs for crisis management.

As depicted with the objective to "plan", a special emphasis was put on the identification of different decision-making processes when a crisis occurs. With this it is expected to understand what the different roles of solution providers and people in the field are, or which decisions are critical for executing a successful operation. Finally, some attention is paid to teamwork practices and the identification of successful behaviours in activities, tasks, communication, etc.

3.3.3.5 Metrics and Key Performance Indicators

Metrics and Key Performance Indicators (KPIs) are important for analysing a Trial. Only if the objects of investigations are defined together with appropriate measures, the performance can be assessed. Still 32% of the codebooks did not include any information about metrics and KPIs.

Some of the typical key words that are used for KPIs were found in the literature, such as time, cost and quality. Though time is the most often mentioned metric (29 times) it cannot be considered as a common metric or KPI. As the objective of 15% of the Trial-like events was to "train", it seems fitting that 14 papers measure the performance of people or systems. The typical keywords for measuring performance in this field (for example accuracy, efficiency, applicability, reliability or satisfaction) are mentioned in only 2 to 7 codebooks. These findings corroborate the observations made in **D23.21** regarding the difficulties to establish generic performance measurement approaches in CM. A dedicated literature review on this

(**D23.21**) concluded that common sets of metrics can be used, but that they always need to be reflected and adjusted to specific (Trial) contexts. (Figure 3.10)

No pattern was found in the SLR. In each case, specific metrics directly linked to the topic of the peer reviewed article were identified. Moreover, the use of a real metric, such as a number, could be found in only 12 papers.

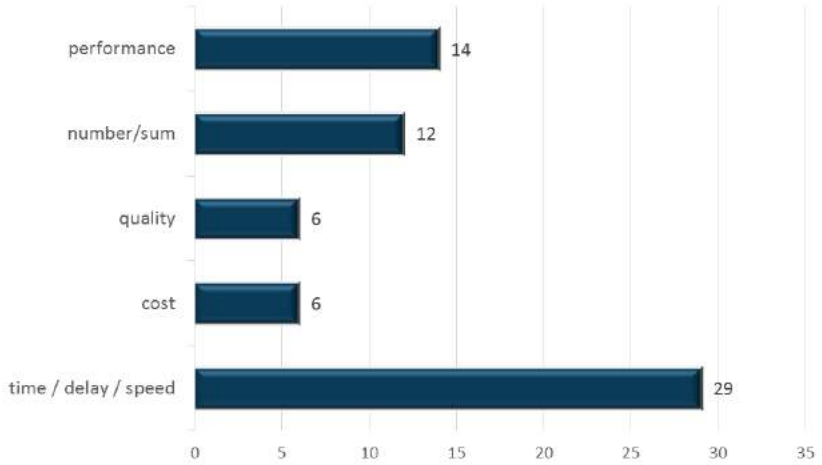

Figure 3.10: Metric and key performance indicators

3.3.3.6 Data collection & analysis

In order to collect data, relevant information needs to be measured. The data, either of quantitative or qualitative nature, must address the research questions identified in the preparation phase. While quantitative data can be statistically analysed, qualitative data needs to be analysed by appropriate methods like hermeneutics or semiotics. Most likely, questionnaires or surveys are used to collect quantitative data, while focus groups, interviews or case-studies are used to collect qualitative data.

The SLR confirmed the need to apply a mixed research approach in Trial-like investigations in the context of crisis management. The identified data collection methods are listed in Figure 3.11 according to the distinction between quantitative (lower part) and qualitative (upper part). As shown, quantitative approaches are used more often than qualitative ones.

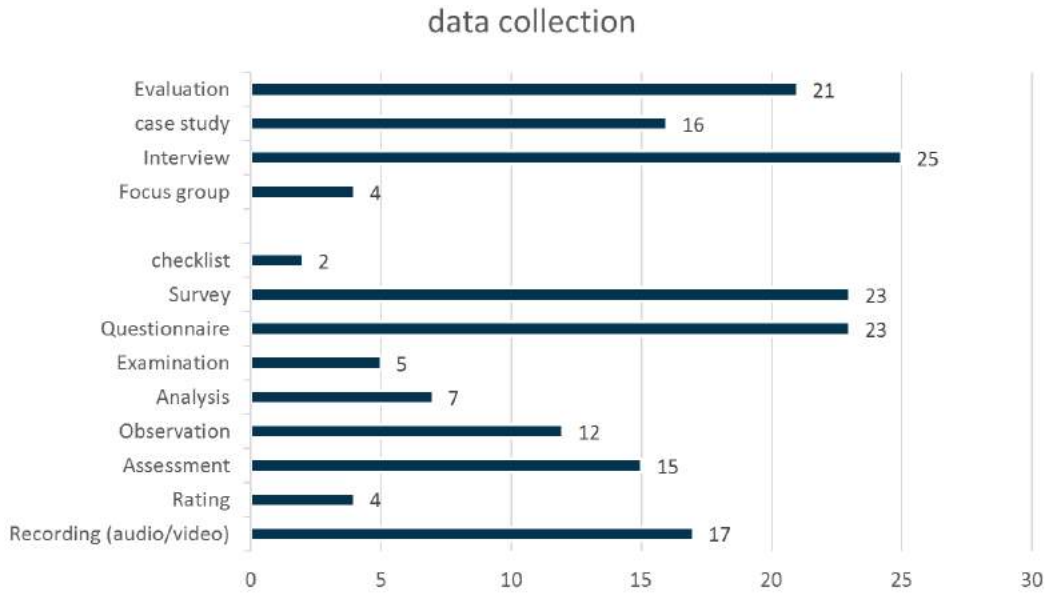

Figure 3.11: Data Collection

Interviews, evaluations, surveys and questionnaires are preferred. While training is essential to conduct e.g. focus groups in a proper way, untrained personnel can conduct certain types of surveys, especially those which revolve around "training" or development capabilities". These might be the reasons for why, in Trial-like events with practical aims, quantitative data collection techniques are preferred to others.

As depicted in Figure 3.12, there are different techniques that can be applied to analyse data. However, by text mining, the three striking patterns were "simulation", "evaluation", "comparison" and "statistical analysis". Attempts to identify more specific data analysis methods revealed fewer than 10 mentions per technique identified, the majority of which merely provide additional details about the kind of mathematical analysis.

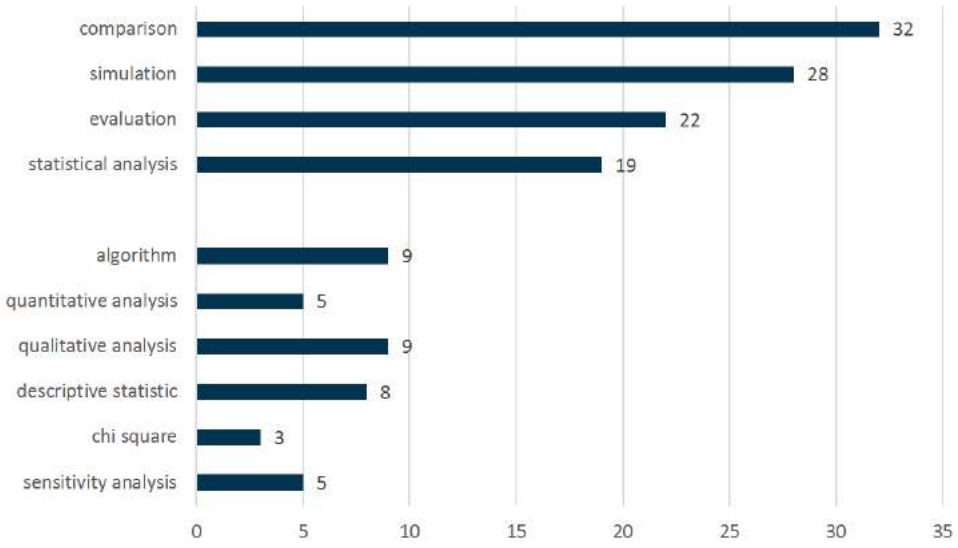

Figure 3.12: Data analysis methods

3.3.3.7 Ethical procedures

Only 21.1% of the analysed peer reviewed paper included information on ethical procedures. The most common way of addressing ethical issues is through approvals. As depicted in Figure 3.13, in 30 papers some kind of approval is used. The degree of specificity varies, with some papers merely asserting that approval was obtained, while others indicate the source of such approvals. While there is papers that just state, that they got approved, others mention exactly by whom: 15 papers tell of an ethics committee, 11 mention a review board and one was approved by a Total Quality Council. Few papers mention the exact protocol that was followed.

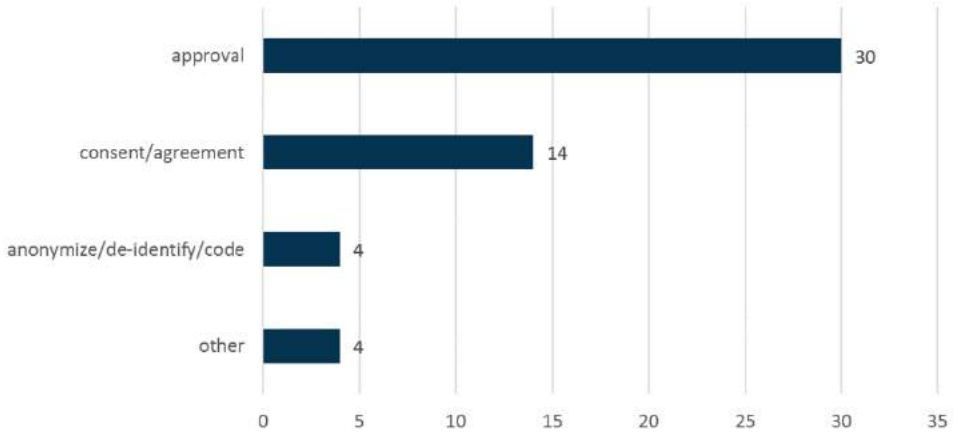

Figure 3.13: Ethical approach

The second most common approach was to obtain the (informed) consent of the participants. It has to be mentioned that seven papers mentioned using both: the approval and the consent.

Further thoughts about ethical issues revolved around topics like: confidentiality obligations, information requirement, voluntary participation, disclosure and anonymization. One paper states that it uses an "ethics-by-design approach" [ID 1524]. Some very practical, yet highly relevant, research ethics considerations were mentioned, such as "hard copies in a cabinet in a locked office" [ID 1885] or "files are stored in a locked file cabinet located in a locked room" [ID 2378]. Though these examples clearly relate to a form of data protection consideration, they also reveal that ethical issues appear to remain unclear to many researchers in the field on which the SLR focused.

3.3.4 Conclusion

The initial filter was crucial to reduce the number of possibly relevant papers quickly and start manual screening. Here mainly sources from google scholar were omitted, because they often did not have an abstract and/or due to the poor citation export possibilities provided by the site. Additionally, the filter also excluded too theoretical papers and/or papers that did not assess Trial-like experiments.

During the manual initial screening the reasons to exclude as study was most often that a different type of crisis was assessed (economic crisis, mental health crisis, etc.). Other excluded papers also often did not test solutions in a CM setting or tested a non-socio-technical solution (mainly Medical or Psychological interventions). Also, too specific and too theoretical, mathematical or computational models were a mayor part of excluded studies.

The identification and analysis of 218 relevant peer-reviewed journal papers directly contributed to two major objectives. The identified heterogeneous disciplines, research methods and Trial-like events confirmed the underlying DRIVER+ decision to consider a mixed research approach for the TGM. Furthermore, the SLR enabled the creation of high-quality best practices in the TGM knowledge base that now supports every Trial member in applying the Trial Guidance Methodology. This knowledge base is available via the Trial Guidance Tool. Further explanations on this can be found in the following (see 3.3.5). Another finding is that the past decade did in fact struggle with considering ethical aspects. Within the TGM design these are taken up, as described in section 9.

By using the twofold approach of turning the SLR into a knowledge base via the Trial Guidance Tool (in addition to undertaking a systematic review of the literature as such), the impact of the SLR is maximized. As a search function is coded within the Trial Guidance Tool everyone interested in conducting a Trial can benefit from the high quality codebooks and get inspired.

3.3.5 Turning the SotA into a knowledge base

By looking at the state of the art concerning the use of methods throughout the scientific crisis management community over the past decade, it was important to not just analyse it, but to make it available for DRIVER+.

During the SLR, 218 peer reviewed papers were turned into one codebook each by using a predefined template. These codebooks do not always appear to share commonalities as the topics of the papers tend to vary. However, by using the codebook, the content of each paper has been structured in a uniform way, making it is possible to compare codebooks despite their diverging topics. In a relational database this is done by using a table as in depicted in Table 3.5.

Table 3.5: Relational database

attribute

ID	objective	Research question	Experiment planning & deviations	Research methods	Metrics & key performance indicators	Data collection plan	Data analysis	...

tuple

A characteristic for relational databases is the existence of attributes and tuples. A **tuple** is a data set of a single item – in our case a codebook. An **attribute** is a specific element of such a tuple – in our case the overall topics of each codebook. A **relation** is now a set of tuples that have the same attributes, as all codebooks have. By using a relational database it becomes possible to create a new set of data (selected attributes and tuples) that shows only the information one is interested in. In order to make this usable it is important not just to fill the fields in the table with the content written in the codebooks, but to go a step further and abstract this content by giving it a specific code. This is best demonstrated using an example:

For codebook 65 the content for "research method" is: *"Authors describe the way to combine different theories through following their technical research step by step. However, someone who understands the formulas of these theories should read the article for further information."* This can be further abstracted for example by tagging this with the appropriate keyword for the research method that could be "experimental", "opinion based" or "observational". Following this procedure, every attribute can then be refined until the query mentioned in the beginning: "research questions" in relation to "serious games" is possible.

To make the most of the SLR and the knowledge-base, the idea is to go one step further. Figure 3.14 presents a search in two steps:

Step 1: Horizontal search - search for every codebook that has information on serious games in the metrics & KPI in the same way as explained before for the research method. Results will be in the same attribute – in this example now the metrics & KPI attribute (highlighted with yellow boxes). These results could be depicted, for example, in a list giving the ID and the info about metrics.

Step2: Vertical search – look again at the whole codebook for one ID, the whole tuple. The idea is to enable the possibility to discover more relevant information as depicted here for a specific ID, and maybe even motivate the user to go deeper and read the whole paper and its underlying research.

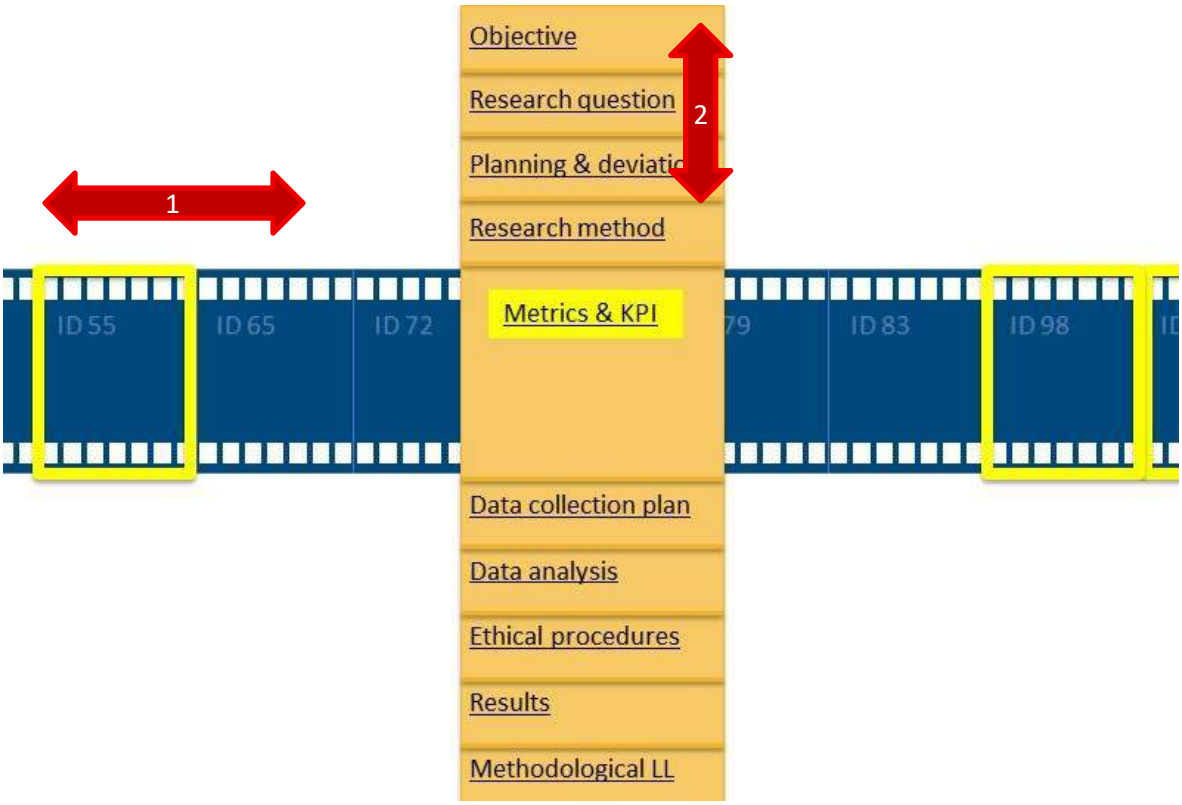

Figure 3.14: Re-use of SLR results for the search engine in the Trial Guidance Tool

There could, however, be a third step in which all information from one attribute will be depicted for all relevant tuples (yellow boxes). In this way, it would be possible to identify further similarities – or differences – for Trials in one specific area, such as serious games.

3.4 Lessons learnt

Another important source of knowledge is the lessons learnt from the experiments conducted in the first phase of the project. This body of knowledge has been analysed in two ways:

1. By inferring generic lessons learnt already captured in **D610.1** and applicable to DRIVER+ Trials.
2. By using the same template or codebook of the SLR to collect more specific lessons learnt on the experiments drawing on the respective deliverables.

The overall aim is to identify experiences that can be helpful for Trial owners (e.g. examples of research questions and/or data collection analysis and techniques).

Similar to the SLR, the idea is to support the project in two ways:

1. Turning the lessons learnt into a knowledge-base by generating lessons learnt codebooks.
2. Using the first item to further support Trial planning through quick and condensed access to examples.

In doing so, both Trial-like *examples* derived from the SLR as well as *experiences* from past experiments can be made available in the Trial Guidance Tool (the relational database mentioned in 3.3.5) to support Trial design at different stages.

This section mainly elaborates on general lessons learnt that have guided the new TGM design. Detailed information collected through templates (experiences in carrying out experiments) will be included in the Trial Guidance Tool. An example of a completed template, as well as identified challenges identified in **D610.1**, is provided in Annex 3.

These lessons learnt are of different nature: e.g. the organisation of regular meetings and the robustness of the evaluation plans. These recommendations were taken into account to design the new methodological approach to DRIVER+ Trials and will be expanded upon in the following sections.

Additionally, *the identified challenges have shed light on the need to develop a new TGM and guided the new TGM design*. The design described in section 4 illustrates how the difficulties of the previous phase of the project have been carefully considered to ensure a more detailed and tailored, step-by-step approach to end-users.0 illustrates how the difficulties of the previous phase of the project have been carefully considered to ensure a more detailed and tailored, step-by-step approach to end-users.

The methodological approach used in the previous phase of the project has also been revised on the basis of both the outcomes of the SLR and the feedback provided by the experiment owners (**D601.1**). Therefore, the first set of challenges and recommendations described in **D610.1** have shaped the design of the methodology and the approach to Trials, more specifically but not solely the working processes mentioned in section 1 (e.g. involvement of the end-users). The involvement of the end-users in the methodological work is in fact a key to ensure that the methods support the Trial owners by focusing on the specific objectives of their Trials.1 (e.g. involvement of the end-users). The involvement of the end-users in the methodological work is in fact a key to ensure that the methods support the Trial owners by focusing on the specific objectives of their Trials.

However, to turn the lessons learnt into a knowledge-base, additional information and input were needed. In other words, the necessity to go beyond generic recommendations in order to provide meaningful experiences ("dos and don'ts") was considered a key element of the support to Trials.

The starting point of the work presented in the following section is the definition of lessons learnt provided in **D530.1**: "A lesson learnt is a knowledge or understanding gained by experience. An experience may be positive or negative, a mishap or failure. Successes are also considered sources of lessons learnt. A lesson must be significant in that it has a real or assumed impact on operations; valid in that it is factually and technically correct; and applicable in that it identifies a specific design, process or decisions that reduces or eliminates the potential for failures and mishaps or reinforces a positive result" (14).

The word experience is the key in this context as it refers to the process of getting knowledge (as well as learning) from one or more than one event. Acquiring knowledge involves learning both from positive and negative experiences. Additionally, it involves the opportunity of relying on the experiences gained from others to use best practices or to avoid common mistakes.

4. Design of the TGM

This section briefly describes why the DRIVER+ Trial Guidance Methodology has been developed and replaces the original CD&E approach of the initial project phase (section 4.1), followed by the general design principles of the TGM and the three separate Trial phases (section 4.2).

4.1 From CD&E to Trials

As described in the Description of Work, the Concept Development and Experimentation approach served as a starting point for the DRIVER+ Test-bed. Based on the experiences described in the previous section, limitations concerning the applicability of the CD&E methodology were identified. As explained before in this deliverable, CD&E was originally developed for the military domain. Due to the uncertain, complex and dynamic nature of crisis management operations the laboratory-like setup of CD&E led to unsatisfying results.

In fact, the experiment "users" – namely the involved parties ranging from the platform providers to the solution providers – perceived the approach as challenging rather than useful regarding the design, execution and analysis of experiments (**D610.1**). Besides, external consultations have shown that the main objective, which is to identify potential crisis management innovations in a secure but realistic scenario, was hardly reached in most experiments. Some scenarios did not reflect current practitioner realities and needs as the data collection and analysis was mainly technology-driven and, consequently, the results neglected to capture the actual impact of experimented solutions on the actual CM performance.

Therefore, it was decided to abandon a "positivistic" approach and instead to develop a well-structured and practitioner-oriented mixed research methodology. Thus allowing a step by step guidance to systematically develop a space in which to trial and analyse potential crisis management innovations for European resilience. To this purpose the DRIVER+ TGM has been developed.

4.2 General design principles of the TGM

The DRIVER+ TGM discriminates between three main phases, which are briefly explicated in this section: preparation, execution and evaluation.

Preparation phase

The first phase, the preparation phase, encompasses the **iterative and co-creative DRIVER+ six-step approach**. The process starts with the identification of the specific **Trial context** and relevant **CM gaps**. The Trial context is mainly determined by the interested Trial owner (platform provider), and it is supported by the related Trial committee including a Trial Coordinator, End User Coordinator, a Test-bed Guidance support, a Test-bed infrastructure support, a Solution Coordinator. To put it simply, the Trial context is where the so-called Trial dimension described in section 2 comes into play. It refers to socio-cultural and legal characteristics of the context in which the Trial will be carried out (e.g. roles, responsibilities, legal constraints etc.).

The validated **DRIVER+ CM gaps**[19] are reflected in the context of the Trial owner setup in order to identify and prioritize relevant gaps for the involved actors in their operational context (professional and geographic).

Both inputs are major prerequisites for carrying out the first step dealing with the identification of **specific Trial objectives**. By utilizing the **DRIVER+ knowledge base** (cf. section 3), the Trial committee gets support

[19] In the context of DRIVER+, gaps are validated through a specific process explained in **D922.11**.

to define appropriate **research questions** through accessing examples from experiments conducted in the initial project phase and well-documented experiences from the broader CM community. This information, the lessons learnt and the State of the Art results, is stored in a relational database accessible through the Trial Guidance Tool (presented in section 10).

As described in section 3 full text or key word search regarding the Trial objective points the user to potentially relevant research questions that can be used in order to define a new Trial specific question. An appropriate guideline ensures the considerations of several criteria of a good research question (see section 5). Once the second step is fulfilled, the same support is enabled for the third and fourth step, the **formulation of a data collection plan and related evaluation approaches and metrics**. Combining the results of the first four steps, the broader Trial **scenario**, which might have been envisioned during the formulation of the Trial objective, can be further detailed, and the first elements of a Trial story board can be designed here. In relation to the identified gaps, the **preselection of potentially useful solutions** can be done in the sixth step. To this purpose, the DRIVER+ taxonomy of CM functions can be utilized by accessing the Portfolio of Solutions (PoS). Besides, a specific call for applications can be launched in order to express the interest for support in certain areas.

It has to be noted that all steps are interrelated so that a decision in step four, e.g. the capability to execute specific interviews with citizens, might lead to an adjustment of the overall Trial objective. It might also happen that the absence of a desired CM solution, which was identified as a major need, affects the overall Trial.

Going through each of the aforementioned steps will lead to a specific Trial design that is relevant for the involved practitioners and which promises to gather new, transferable and robust conclusions with respect to the formulated questions of the CM community. In the end, each Trial design consists of a clear objective, questions, set of data collection methods, specific analysis techniques, a story board and a set of solutions to be trialled. All results are documented in the so-called Trial Action Plan (see Annex 6).

The purpose of the Trial Action Plan is to provide a detailed plan of the Trial organisation and to facilitate the monitoring of the Trial preparation activities. The TAP not only covers methodological-related aspects, but rather serves as a comprehensive document which revolves around Trial planning (from the division of responsibilities to organisation and logistics). Therefore, while the scope of the TAP goes beyond methodology, it is a key supporting document for Trial owners and includes the outputs of TGM design[20]. It should be considered as a "living" document as it is meant to be updated by relevant stakeholders involved in Trials until the end of Dry Run 2 (referred as "maturation phase" in the TAP).

It should be noted that each Trial event phase, as described in the TAP, corresponds to a phase in the TGM, as depicted in the Figure 4.1 below. The 6-step preparation phase corresponds to the initial phase until the dry runs in the second phase (the execution phase) where the actual execution (dry runs and Trial run) is taken place. The recapitulation phase corresponds to the evaluation phase in the TGM.

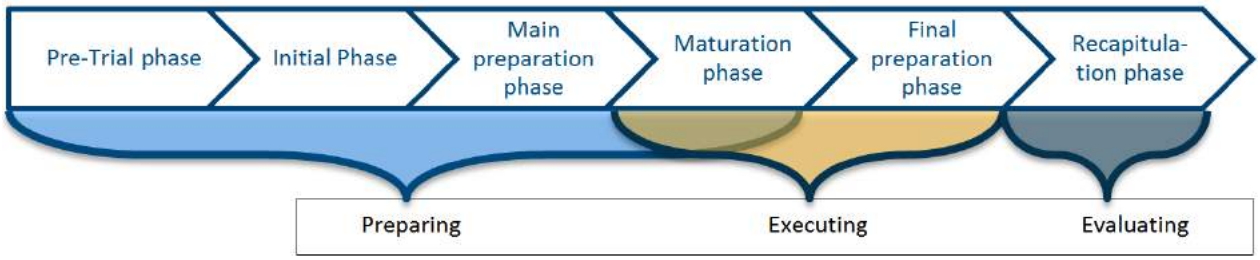

Figure 4.1: Trial phases

[20] There is a strong connection between the TGM and the TAP, which is epitomized, as mentioned above, in the outputs of the Trial design. The main difference between the TGM and the TAP is that while the first aims to describe the methodology step-by-step as well as to offer insights into the rationale behind it, the TAP shows, *inter alia*, the results of the methodological steps (e.g. the Trial objective). The TAP collects in one document all key Trial-related information including the methodology. The template structure suggests the non-descriptive nature of the document.

The phases, which reflect the stages of Trial preparation, also include gateway events aimed at organising dry runs and validating the progress:

1. Phase A – Pre-Trial and Initial phase, completed with Workshop "0" (gateway event).
2. Phase B – Main preparation phase, completed with Dry Run 1.
3. Phase C – Maturation phase, completed with Dry Run 2.
4. Phase D – Final preparation phase, completed with the Trial itself.
5. Phase E – Recapitulation phase, completed with the publication of the Results.

Execution phase

The main outcome of the preparation phase is the design of the Trial, which will be applied in the second phase. In this phase, the Trial committee ensures the feasibility of realizing all decisions taken in the first phase. Three main elements of each Trial are: the specific adaption of the Test-bed in accordance with the Trial design, the concretization and simulation of the identified scenario within the DRIVER+ Test-bed as well as the ability to run the evaluation approach covering the three DRIVER+ performance measurement dimensions (Crisis Management, Trial and Solutions).

After ensuring the adequate functioning of the Test-bed, the simulated scenario and the selection and adjustment of the most promising solutions, the planning elements of the TAP are finalized. The last step of the execution phase is the actual Trial run: the defined scenario is simulated, the potential innovative solutions are applied and the relevant data is collected. In addition to the data collected during the Trial, additional feedback from evaluators and/or observers is gathered shortly after the Trial.

Evaluation phase

The first step of the evaluation phase is dedicated to the analysis of the Trial. This task starts with a thorough check of the collected data. The data collection method and evaluation approach formulated in the preparation phase determine the type, quality and quantity of data to be collected in order to derive relevant and significant conclusions on the trialled solutions. These requirements will be used to verify the actual data collected during the Trial. Based on the findings, appropriate data analysis techniques will be executed so that each performance measurement dimension is analysed in detail. The analysis is completed by a synthesis of the findings where interrelations of the three dimensions are investigated. As a result, the observed impacts of the trialled solutions are concluded.

Each step and artefact are documented thoroughly, and the documentation is used twofold:

1. 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.
2. As an internal learning step, the results are transmitted into the DRIVER+ knowledge base (especially into the lessons learnt database in the first place) and the PoS. These documents shall be used not only for internal use, but also to be disseminated with the broader crisis management practitioner and scientific community.

Figure 4.2 provides the design overview of the TGM showing the main phases and the specific tasks of the proposed methodology, including several methodological inputs and outputs. Based on this design the TGM, as described in section 5, has been developed.

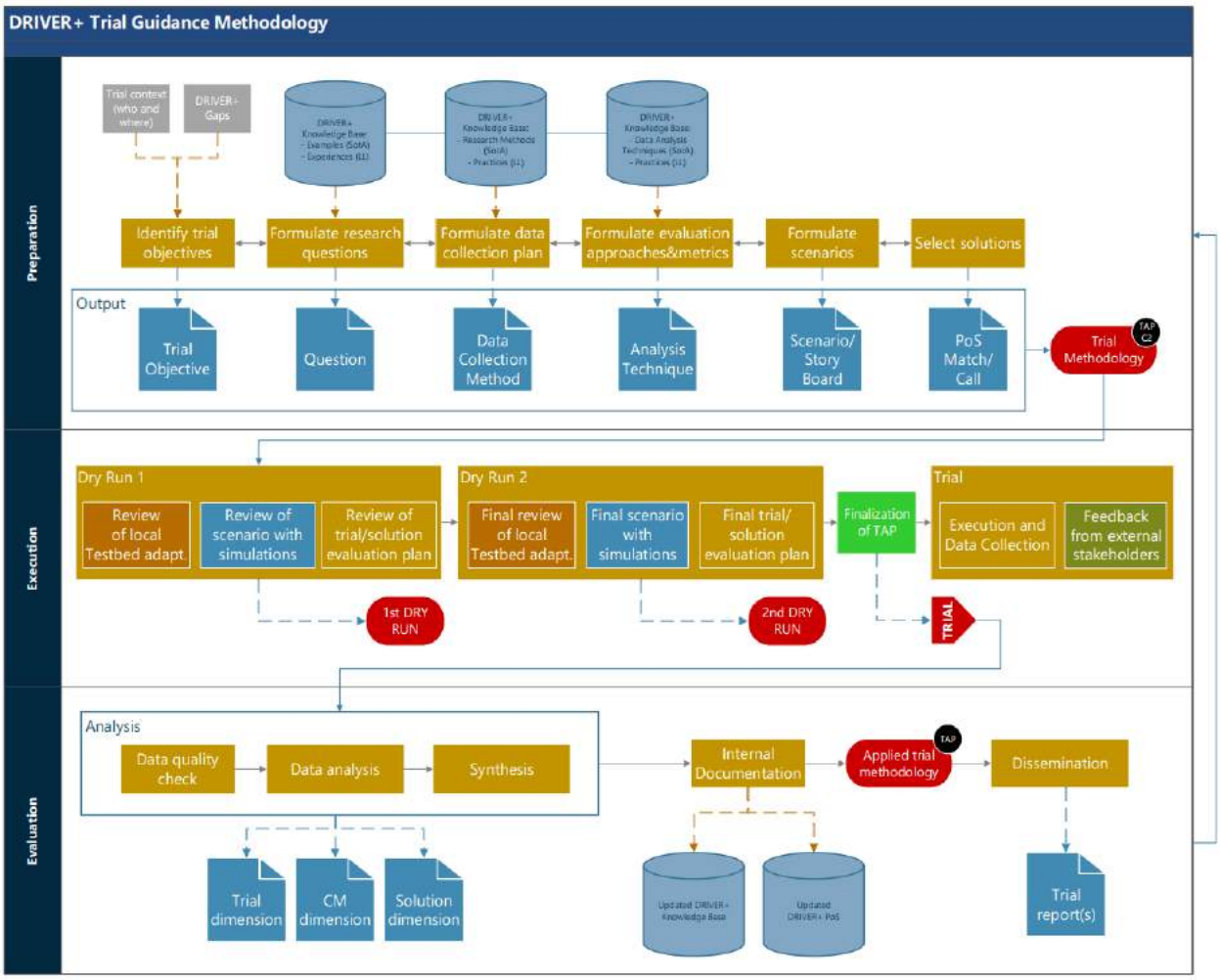

Figure 4.2: TGM design

5. DRIVER+ Trial Guidance Methodology – Overview

As introduction to the actual TGM, this section provides an overview of the steps that Trial owners must take to carry out a Trial in a systematic yet pragmatic way. While the "backbone", namely the design of the TGM, is provided in section 4, in this section a summary of relevant tasks and activities is outlined for each of the different phases of carrying out a Trial: preparation (5.3), execution (5.4) and evaluation (5.5). For detailed descriptions on these tasks and activities one is referred to sections 6 (preparation), 7 (execution) and 8 (evaluation). In addition, Annex 4 provides examples that illustrate the use of the TGM.

5.1 Status of the TGM

It should be noted that, as specified in the Introduction (section 1) this deliverable 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, in this version of the methodology mainly the preparation phase has been elaborated in detail, while the evaluation and execution phases are described at a more general level.

Experiences from the Trials (which were 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. These experiences will be used in the updated version of the TGM.

The long-term vision is that Trial owners are supported in following and implementing the TGM via the application of the online Trial Guidance Tool that will help them with performing several steps necessary for carrying out a successful Trial. The functional requirements of the Trial Guidance Tool are further described in section 9.

5.2 Overall set-up of the TGM

Figure 5.1 depicts the different phases which the Trial Guidance Methodology is structured along. These are explained in next sub-sections of this section 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" (15). As further outlined in this and the next three sections, *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.

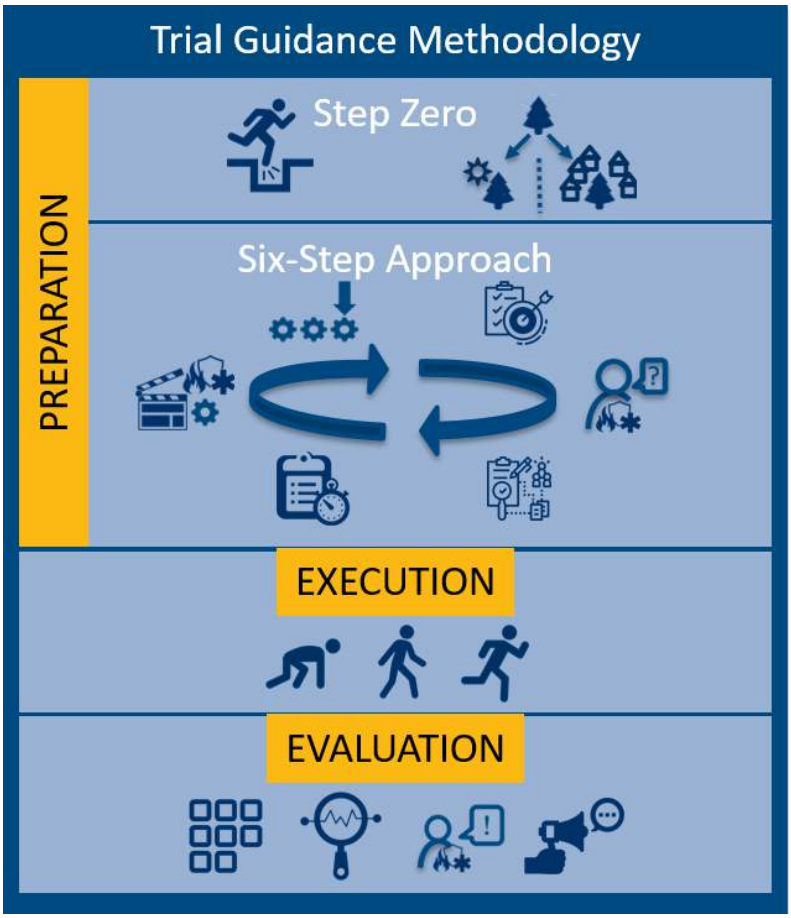

Figure 5.1: Overview of the Trial phases

5.3 Key elements of the preparation phase

Preparation – Task 1 ("Step zero")

The preparation of each Trial starts with characterizing the (capability) gaps in crisis management for which potential solutions should be investigated by conducting the Trial. These gaps can be of different nature (technical and/or non-technical) and reflect one or more problems in crisis management performance. To specify gaps, within DRIVER+ a specific process is used that is explained in **D921.11**.

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 organisation(s) or the facilities or the organisations hosting the Trial.

Once the gaps have been specified in more detail in the context of the Trial, the actual design of the Trial can start.

Preparation – Task 2 – Design of a Trial

The design of the Trial is created by following an iterative six-step approach. Each of these steps is made several times to refine elements in alignment with the contents of other steps. The six steps are:

1. Identify the Trial objectives

The most important gaps that have been identified in task 1 should be reformulated as prioritized objectives of the Trial. In addition, it should 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.).

2. Formulate research questions

For each of the Trial objectives one or more research questions (RQs) have to be formulated. This should be done in way that enables to identify the appropriate mix of research methods and data analysis techniques and to capture relevant data during the execution phase. 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.

3. Formulate the data collection plan

For each RQ a plan should be developed to collect relevant data enabling to answer such a question. To this purpose Key performance indicators (KPIs) are needed to be defined. In fact, KPIs represent "a set of measures focusing on those aspects of organisational performance that are the most critical for the current and future success of the organisation". 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. The data collection plan should describe in which way all kinds of required data has to be collected (measured), by whom and/or by which means during the Trial.

4. Formulate evaluation approaches and metrics

It should be determined how the collected data will be analysed. This concerns descriptions on which techniques will be used to analyse all kinds of qualitative and/or quantitative data, and in which way results (e.g. answers on research questions and conclusions about whether Trial objectives have been met) will be reported.

5. Formulate scenarios

To conduct the Trial one or more realistic scenarios have to be developed. Scenarios must be realistic in terms of the context of the end-users and the environment in which they operate. 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. It should be noted that that initial ideas on scenarios already might occur at an earlier stage (e.g. after gaps have been identified in the Trial context); anyhow, in this step they need to be refined, revised and tailored to the objective(s) of the Trial.

6. Select solutions

In this step, one or more solutions need to be selected. This can be done in several ways. One option is to select potential solutions from the DRIVER+ Portfolio of Solutions (PoS). By entering key words that characterize the selected gap(s) available solutions will pop up. Another or additional option is a search for potential solutions outside the PoS. To this purpose also a call for solutions can be initiated. Subsequently, providers of identified and/or interested promising solutions can be invited to participate in the Trial.

Preparation – Task 3 – Finalization

After having completed the Trial design in task 2, all Trial supporting materials such as instructions and questionnaires should be developed and/or finalised. The main output of task 3 consists of:

- An overview of selected solutions that will participate in the Trial.
- The scenario and its key events that trigger relevant crisis management functions as well as an overview of required participants with their specific tasks and roles.

- Availability of the scenario, including configuration of the simulators in the DRIVER+ Test-bed environment.
- The approaches to collect, check, analyse and visualize data during and after the Trial.
- A template for reporting the Trial, including the protocol to answer research questions and drawing conclusions.
- A list of invited and informed Trial participants.
- A draft agenda and a set of instructions for the various participants about the Trial.
- Available logistics such as buildings, rooms, workplaces, systems and other tools.

5.4 Key elements of the 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. 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 analysability 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.

Execution – Dry Run 1

In Dry Run 1 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.

Execution – Dry Run 2

Dry Run 2 is a full test: a general test in preparation for the "real" Trial: The Trial run(s). The 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.

Execution – Trial run(s)

After successful completion of the Dry Run 1 and 2 the actual Trial can take place by conducting one or more Trial runs. During this part of the Trial the following activities need to be carried out:

- Briefing, instructing and training Trial participants, role-players, observers to carry out their tasks (e.g. Trial participants should be trained in using the trialled solutions) before the actual scenario.
- Executing the scenario (stages) and collecting data.
- Conducting a "hot-wash" and a final wrap-up session.

5.5 Key elements of the evaluation phase

After having executed the Trial its results can be assessed and reported. Main evaluation activities concern: checking the collected data, analysing the data, analysing the data, drawing conclusions, visualising the results, reporting the Trial results and disseminating these.

Evaluation – Data collection check

First the data that have been collected during the Trial via various sources need to be checked for completeness and quality. In case of missing, vague or erroneous data additional information should be collected as much as achievable. This will result in a verified and structured set of collected data.

Evaluation – Data analysis

The verified set of collected data will be analysed according to the evaluation approaches as determined during the preparation phase (task 2) in which e.g. KPIs for several dimensions have been defined.

Evaluation – Answering research questions

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

Evaluation – Dissemination of results

As a final step of the evaluation phase, all the results and knowledge gained will be disseminated to ensure these 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). The results can be included in the Portfolio of Solutions as well as discussed on the CMINE (Crisis Management Innovation Network Europe).

6. TGM – 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 organisation(s) or the facilities or the organisations hosting the Trial.

Once the 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 (cf. Figure 6.1):

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 (Design of a Trial), the Trial design is developed and the supporting Trial materials can be developed (task 3 – Finalization).

Figure 6.1: Iterative 6 step approach

6.1 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 (**D530.2**).

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 a 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.
- The problems to be investigated 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.
- 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.

6.2 Trial design "six step approach"

Once the context and the gaps have been identified, the preparation phase for the Trial officially starts (Task 2). Each of the six steps is 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.

6.2.1 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[21] can be used to gather examples and experiences of objectives from previous Trials and/or from literature.

[21] The DRIVER+ knowledge base is explained in section 3.

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

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 explained in section 2 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 fulfil 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
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 learnt 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. with regard to 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* insofar that the 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, organisational 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 organisations 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, organisational, 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.

6.2.2 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.

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 3.3.3.1, based on a systematic literature review, the interrogative form “how” is used most often to understand the impact of solutions on organisations 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.
- **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 and added 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 organised 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), and 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, are 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 be 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.

6.2.3 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 organisational performance that are the most critical for the current and future success of the organisation" (6)**. 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*[22] 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, 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?

[22] Ethical aspects are described in Section 9.

- 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 needs to be measured (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 behaviour (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.
- A bias 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 behaviour of participants, he/she will be more likely to observe this behaviour.

6.2.4 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 analysed. 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.

Input

- Data-collection plan.

Output

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

Actions and Required participation

- There are different ways of analysing 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 analysed 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 analyse these data, 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.

6.2.5 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.

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).
- 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 organisations/functions that are related to the gaps and their solutions, and describe how these organisations/functions are interrelated (organisation 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:
  - Defining key events related to the gap(s) that trigger one or more role-players while fulfilling their tasks.
  - Elaborating these key events in the context of the developed environment.
  - 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.

6.2.6 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.

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 learnt 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 organisations 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.

6.3 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 (Task 3). 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 fulfil 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[23].
- 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.

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

- 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 trialling are connected to the Test-bed common information space and made available in the right locations for Dry Run 1.
- The approach to check, analyse 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.

7. TGM – 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. The TGM provides guidance for the execution phase (Figure 7.1), dry run 1 (7.1), and dry run 2 (7.2) and the actual Trial (7.3).

These subsequent steps are described in next sub-sections. 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 analysability 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.

Figure 7.1: Execution phase

7.1 Dry Run 1

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.

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 and 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.

7.2 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 Run 2 in the execution phase of a Trial are the following:

Input

- Outputs of Dry Run 1.
- Adjustments after 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.

7.3 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 two dry runs.

Output

- Collected data.

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) from:
  - 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.

8. TGM – Evaluation phase

In the evaluation phase (Figure 8.1) 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 and visualise the results.
- Draft conclusions, recommendations and lessons learnt 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 is 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 are:

- 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 **D530.1** (7)) / other type(s) of dissemination in the field of disaster resilience and crisis management.
  - With respect to the conducted Trial in a document that can be used by future DRIVER+ Trials.

Figure 8.1- Evaluation phase

8.1 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 verify 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

- Rough data collected from the Trial.

Output

- Achieve a verified and structured set of data.

8.2 Data analysis

In this step, the verified set of collected data will be analysed 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 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 (cf. section 6.2.4).

Output

Gather 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 analyse 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.

8.3 Answering research questions – concluding / synthesis

In this step, based on the analysed 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 analysed data and by a line of reasoning that justifies why the link between the analysed 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.
- Analysed 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:

- Organise 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.

8.4 Dissemination of 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** stakeholders, following each Trial, the results of solution assessment will be stored and made accessible in the Portfolio of Solutions (PoS). Additionally, the experiences and practices resulting from the conduct of the Trial will feed both the DRIVER+ Lessons Learned Framework (which will be included in an updated version of the TGM) and the knowledge base so as to extend the collection of information to the current activities of the project. In doing so, a "virtuous circle" of knowledge sharing is being ensured. While, on the one hand, the experience and best practices coming from Trials will facilitate conducting Trial-related activities (e.g. experiences in Trial 1 will help stakeholders involved in Trial 2), this body of knowledge will also help the TGM developers to improve the methodology. A wide variety of consortium partners can benefit from it: from Trial owners and hosts to solution providers.

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. Also external stakeholders may have access to the Portfolio of Solutions. Furthermore, the public deliverables as mentioned above will be shared with the CM community via the public website and relayed on the social media channels of the project. The internal "virtuous circle" mentioned above goes hand-in-hand with external feedback: having fruitful discussions on the CMNE on experiences in applying the TGM will help to improve the methodological approach.

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.

9. Towards an ethical Trial Guidance Methodology

As shown in section 3, a small amount of peer reviewed papers included information on ethical procedures. This important missing aspect triggered the need for including research ethics in the TGM based also on the more general consideration that, in order to establish a shared understanding of CM in Europe, societal values must not be overlooked. Furthermore, the overall objective of DRIVER+ Trials is to investigate to which extent potential solutions solve gaps and/or meet needs that have been identified by practitioners in the domain of CM in Europe. It is important for the success of DRIVER+ that this investigation is conducted in a way that is societally acceptable, that research ethics rules and regulations are followed, and that potential negative impacts are mitigated and minimized, or eradicated if possible. This is mainly taken care of via two streams of work[24]: one on research ethics (i.e. data protection and privacy), and one on societal impact assessments. This section presents the integration of work from both of these streams into the TGM.

While section 9.1 deals with the need for research ethics in the context of the project and provides recommendations for Trials, important considerations with regards to the Societal Impact Assessment (SIA), are shortly described in section 9.2. In Annex 5, more information on the background of the SIA methodology is provided.

9.1 Research ethics

9.1.1 Need for research ethics

For the first stream, from a research ethical perspective, the DRIVER+ project involves the collection, processing and storage of data derived from individuals, both from members of the DRIVER+ consortium and individuals that are not formally part of the project[25]. The single most important issue for the research activity within the project currently relates to privacy and data protection, and how to safeguard the former via implementing the latter. In this section, a list of concrete recommendations for this is given. At the very core of research ethics are rules and guidelines for the participation of human subjects in research activities, which refer to the standard European Commission research ethics[26]. A plan for how to tackle the larger issue of ethics in the sense of societal impact is suggested and integrated into the TGM. By making the already developed DRIVER+ Societal Impact Assessment (SIA) framework a part of the TGM, the idea is that both approaches will be mutually strengthened in terms of sustainability throughout and beyond the scope of DRIVER+. In addition, by including the societal impact dimension in the TGM, it is ensured that the Trials incorporate an assessment method focused on potential impacts in terms of secondary in/securities (such as unease and calmness, misuse and protection) core societal and ethical principles (i.e. participation,

[24] Both of these are located in **WP913**, and their implementation in **SP92**, and in particular the TGM, is described in this section. The conceptual development, as well as the resulting deliverables relating to both streams can be found in **WP913**, and the following descriptions are to be regarded as highlights most relevant for the Trials.

[25] In short, research ethics principles and rules (i.e. with regards to data protection and privacy issues) are upheld and implemented via a set of already established administrational procedures. For project activities, including the DRIVER+ Trials, templates for both data protection approval and informed consent have been made available on the CoW (DRIVER+ Share Point). A more extensive informed consent form has also been prepared specifically for the Trials. This form, which doubles as an information letter, is aimed at external participants who are not necessarily solution providers but are involved in some way in the Trials. This could, for example, be volunteers or practitioners involved in the evaluation.

[26] The main concern of research ethics in DRIVER+ is not only to conform to given legal (i.e. data protection legislation) and moral codes, but also to enhance the legitimacy and scientific quality of the project[26]. Research ethics fundamentally refers to the need to govern the impact (both positive and negative) that research can have on the society, and the operationalization of this includes finding good ways to incorporate and integrate rules, regulations and best practises into the very fabric of the research activities on a fundamental level.

diversity), sustainability, political and administrative principles (i.e. accountability, transparency), legitimacy, and legal values (i.e. in/justice).

Still within the first stream of research ethics, the Trials are a key component in DRIVER+, and it is crucial for the success of the project that the Trials are prepared, executed and evaluated in a well-thought-of way. The concept of "informed consent" is at the core of an approach that respects the right to privacy. Informed consent implies that the individual whose data is collected is informed about the purpose of the research, and consents to the use of their data for these purposes. As the execution phase of the Trial results in collected data about CM and the effects of solutions, the need for, and importance of, using informed consent sheets whenever individuals are involved in the research activity is crucial. This is relevant both for individuals participating as solutions providers, but also for non-affiliated external participants such as volunteers. A template for an exhaustive information sheet and informed consent sheet to be used for the DRIVER+ Trials has been prepared by PRIO. The template should be tailored by the Trial owner in the preparation phase of the Trial, and the information sheet and informed consent sheet should be distributed to all external participants two weeks before they are involved in the research activity. In case only a very basic form is required (for example because information has already been given in a Non- disclosure agreement (NDA) or in the Confirmation of Commitment), a simpler version of an informed consent form is also available.

For the first Trial (May 2018), a less extensive version of this form was deemed most relevant (because of the nature of the Trial activities including externals and because the required information was covered in the two other signed documents), and this will be distributed to all external participants (following the distribution also of the Confirmation of Commitment and the NDA) in order to secure their privacy and data protection rights. However, the forms will be revisited after each Trial, to ensure that they meet the needs of the Trial owners; hence they will also play a role in the evaluation phase of the Trials.

For the second stream, the method chosen is a comprehensive SIA framework (**D840.11** (16)), designed for DRIVER+. Resulting from a systematic and dedicated work throughout the first two years of the project, the SIA framework is a method for making assessments of the broad positive and negative impacts that CM solutions can have on society. The aim of the framework is to be a practical and usable tool for conducting societal impact assessments to solution providers, practitioner organisations, end-users and researchers working in CM[27]. In the coming months and years this will be integrated into the TGM. While the current version of the SIA framework was developed on the basis of the solutions that were part of the project at the time of development, the next version will be broader, and support responsible and ethical research in CM in general. The IsITethical? Exchange[28] (hereinafter called ELSI-guidelines), which supports responsible ICT research and innovation and digital ethics in disaster risk management, follows a similar structure as the societal impact assessments already made using the DRIVER+ SIA framework. Firstly, the list of impact criteria validated and used in the DRIVER+ framework contains many overlaps with the list of what the ELSI-guidelines describes as "key terms"/ "concepts", and which forms the basis for their guidelines. Furthermore, the ELSI-guidelines sort different problematic issues (such as "cultural/linguistic differences") under larger headlines (such as "organisational interoperability"), and give guidance about the issues using guiding questions, contextual information, real-life examples and references to further reading. This is to a large extent the same structure as the DRIVER+ SIA framework.

[27] In parallel to the SIA framework, a set of societal impact assessments were also delivered as **D840.21** (13) and the assessments were elaborated using the framework. Furthermore, a series of training events are currently (M47) being planned, and throughout 2018 training sessions with consortium partners will be conducted to train them in using the SIA framework.

[28] The *isITethical? Exchange* is an initiative led by a group of scholars from Lancaster University in collaboration with the Public Safety Communications Europe Network. It brings together guidelines from EU projects such as SecInCore http://www.secincore.eu/, EPISECC https://www.episecc.eu/; SECTOR https://www.sector-project.eu/; Redirnet https://www.cetic.be/REDIRNET-2068; COncORDE http://www.concorde-project.eu/; Bridge http://www.bridgeproject.eu/en .The guidelines can be accessed at: http://www.isitethical.eu/elsi-guidance/.

For the upcoming revision of the framework however, which will mean an expansion of the scope, the ELSI-guidelines will be leveraged with the DRIVER+ framework to ensure a broad scope that also echoes experiences from other EU projects in the Disaster- and Risk Management (DRM) field. The current DRIVER+ SIA framework takes into account the various key societal issues that have been identified by different research disciplines, such as the fields of risk assessment, data protection, critical infrastructure protection, resilience, community and civic engagement, decision-making frameworks, communication, and critical security studies in general. The fundamental idea is that the actors and agents in CM research and implementation must consider the potential societal impacts of their activities, to increase the potential for successful implementation and societal acceptability. Such impacts are difficult to assess via quantification or existing cost-benefit methods. Therefore, the SIA framework offers a methodology that aims to increase the understanding and the management of, and response to, potential societal impacts of CM research and CM measures.

9.1.2 Concrete data protection and privacy recommendations for the Trials

The General Data Protection Regulation (GDPR[29]) is part of the EU data protection reform package, along with the data protection directive for police and criminal justice authorities. It allows European Union (EU) citizens to better control their personal data. It also modernises and unifies rules allowing businesses to reduce red tape and to benefit from greater consumer trust. For the DRIVER+ Trials, the changes that come with this new regulation will refer to *citizens'* rights. While the new rules for *businesses* are also highly relevant for DRIVER+, the implementation and enforcement of these lie with the individual company/ business/ organisation taking part in the project[30]. This means that the ethical component in the TGM will not be aimed at assisting businesses in adapting to the GDPR, but it will first and foremost take into account the rights of the citizens who are potentially participating in the Trial activities. In sum, the GDPR has been developed to strengthen existing rights, to provide for some new rights and to give citizens more control over their personal data. The GDPR can be split into a handful of privacy principles, which will structure the recommendations below[31]. In order to protect the privacy of participants in the Trials, but also for every other activity in DRIVER+, personal data needs to be processed in accordance with data protection rights.

While all these recommendations mainly refer to the preparation phase of a Trial, some are also relevant for the execution and the evaluation phase. In the list of recommendations below, the different recommendations are tied to which phase they are relevant for. The following recommendations- to reflect also the new rights described in the GDPR- should be observed[32]:

1. Lawfulness, fairness and transparency:
    a. Preparation: Tell the data subject what kind of data will be collected and processed, and make sure that the data actually collected matches this description.
    b. Preparation: Make the conduct of observation or recording of people very clear. Give anyone potentially affected by it the possibility to refuse from being observed or recorded.
    c. Evaluation: Facilitate de-briefing for research activity participants when relevant (such as for external participants in Trials with a large field component with extensive scenarios).

[29] Regulation (EU) 2016/679 — protection of natural persons with regard to the processing of personal data and the free movement of such data. Available at: http://eur-lex.europa.eu/legal-content/EN/LSU/?uri=uriserv:OJ.L_.2016.119.01.0001.01.ENG.

[30] A summary of the key rules for businesses can be found here: http://eur-lex.europa.eu/legal-content/EN/LSU/?uri=uriserv:OJ.L_.2016.119.01.0001.01.ENG.

[31] A similar list describing the six key principles of GDPR has also been made by MThree Consulting. This list can be found here: https://www.mthreeconsulting.com/blog/2017/04/the-6-privacy-principles-of-gdpr.

[32] Several deliverables in **WP913** will deal with the GDPR and the overall task of research ethics, but this list provides an overview of current general key recommendations relevant for the DRIVER+ Trials. Specific considerations for each Trial, as they evolve, will be discussed between PRIO and the Trial owner/ Trial committee.

   d. Preparation: Always inform all participants and potential bystanders thoroughly and well ahead of the conducted research.
   e. Preparation: Consult local data protection authorities to make sure that rules and regulations ensuring data protection rights are followed. Registration with national authorities must be made where required.

2. Purpose limitations: The GDPR states that personal data can only be obtained for "specified, explicit and legitimate purposes" [article 5, clause 1(b)]:
   a. Preparation: Make sure that participants in any research activity provide informed consent.
   b. Preparation/execution/evaluation: Ensure that data is not being used for any other purpose than what was agreed in advance.
   c. Evaluation: Do not re-use data without written agreement of the owner.
3. Data minimisation: The GDPR states that data collected on a subject should be "adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed" [article 5, clause 1(c)]:
   a. Preparation/ execution: Practice data minimization, i.e. avoid collecting unnecessary data.
4. Accuracy: The GDPR states that data must be "accurate and where necessary kept up to date" [article 5, clause 1(d)]:
   a. Execution/ evaluation: Refrain from processing data that is not up-to-date.
   b. Execution/ evaluation: Be aware that under the GDPR any person located in the European Union (anyone residing in the EU, not just EU citizens) can request their personal information be removed from a corporate database, or know the reason why it cannot.
5. Storage limitations/ Integrity and confidentiality: The GDPR states that personal data should be "kept in a form which permits identification of data subjects for no longer than necessary" [article 5, clause 1(e)]. The GDPR also states that those processing data should do that "in a manner [ensuring] appropriate security of the personal data including protection against unlawful processing or accidental loss, destruction or damage" [article 5, clause 1(f)]:
   a. Preparation/ execution/ evaluation: Collected data which is no longer required should be deleted. In case of a data breach, this will lessen the amount of affected individuals.
   b. Preparation/ execution/ evaluation: Ensure that personal data collected is stored in a secure way, for example by using the ISO/IEC 27000 family of standards.[33]
   c. Preparation/ execution/ evaluation: Anonymize and encrypt personal data as a general rule.
   d. Preparation/ execution/ evaluation: Use technology for data recording only if necessary. Provide justification.

9.2 Societal Impact Assessment and relevant considerations for DRIVER+ Trials

In this section, a plan for implementing the SIA methodology in the TGM is described. The SIA criteria are currently used to assess 16 CM functions (resulting in **D840.21** (17)). While these functions relate to different features of a wide array of CM solutions (one specific solution can for example have data collection as one of its functions), the idea for further development is that the object of assessment can be made specific to the Trials.

For example, the integration of the framework into the TGM could imply that the solutions that take part in a certain Trial are first defined according to their functions (based e.g. on the updated taxonomy of

[33] https://www.iso.org/isoiec-27001-information-security.html

functions), and that these identified functions are assessed against the criteria using the SIA framework. In its final version, the TGM (and the Test-bed) would then have an integrated method for taking societal impacts into account. As part of the preparation phase of a Trial, a structured method for doing SIA will be built into the TGM that future Trial initiators can use. The specific integration of this into the TGM will be explored over the next months and years, but the final result will allow the relevant user to carry out societal impact assessments of the solutions he or she is considering for a Trial. Instructive guidelines will be available, as well as a set of example assessments for inspiration. The integration of the SIA methodology in the TGM will place the societal impact assessments in the preparation phase of a Trial. Then, for each time the TGM is applied to a Trial, the SIA methodology will also be used to assess the solutions for each specific Trial and the results of this is foreseen stored in the PoS. This means that knowledge on societal impact tied to each solution in the PoS will build up over time, providing future Trial owners with a knowledge base when selecting solutions for a Trial.

Concretely, when considering a solution for a Trial, the various functions that the relevant solutions perform can be assessed by applying the criteria. This can include a scenario-thinking exercise (describing likely future scenarios of societal impact), research on concrete examples of impacts that happened in the past, background literature (e.g. on underlying logics and assumptions), or the assessment can draw on personal experience from the field. The assessment should be concise and critical, and at the same time draw attention to the effects that the planned CM function may have on society, but also be followed by recommendations for concretely how to avoid (unintended) negative impact and foster positive impact. It should also present a comprehensive view of the key issues that are relevant for describing the societal impacts of a function. The aim of this assessment is not only to avoid negative impacts, but indeed to create an added value.

Using the criteria, making a societal impact assessment would therefore typically include the following steps:

1. A short description of the CM function/assessment object, what it refers to, mainly with regard to its relevance and use within DRIVER+, but also to CM in general. This introduction also includes an illustration, which is practically an entryway into the assessment. It could be a situation or a development that describes how the implementation of a CM function has already impacted or could impact society. It should be simple and illustrative, showing that the assessment has relevance and the function has concrete effects. Already here, critical thinking about the respective function could be incited.
2. The actual assessment is the core of the procedure, which is basically a systematic analytic exercise structured by the different criteria. It assesses the function vis-à-vis each given criterion, following the questions described above:
    a. What is the impact of *function y* on *criterion x*? (E.g. what is the impact of the function “data collection” on the criterion “suspicion-trust”?).
    b. How is that impact positive/negative?
    c. Is there access to examples from personal experience or academic and policy literature to back such an assessment up?
    d. What are concrete recommendations for solution providers and implementers to avoid negative and to foster positive societal impacts?
3. Each assessment ends with a concrete recommendation in order to provide the user with actionable advice. It includes concrete tips and guidance on how to choose solutions in a way that negative impacts are avoided, and opportunities seized. A set of example assessments will be delivered to go with the final version of the framework so that premade assessments can be used for reference, inspiration or guidance for Trial owners in how to conduct an assessment themselves.

10. Functional requirements of the Trial Guidance Tool

In previous sections, the design of the Trial Guidance Methodology (section 4) as well as the steps that Trial owners must follow to carry out a Trial following the TGM (sections 5-8), have been described. Furthermore, section 9 describes the ethical aspects of the TGM. In this section, the technical and functional requirements needed for implementing the TGM through the so-called Trial Guidance Tool will be explained. This section naturally builds on all previous sections and describes how the content of these will come to life.

The rationale of the Trial Guidance Tool is shortly presented in section 10.1, while the functional requirements for implementing the TGM via the TGT are described in the remaining sections. The main focus is on the preparation phase, for the reasons outlined in section 5. Additionally, it is foreseen that the TGT will ultimately be used mainly in the preparation phase to assist Trial Owners with the Trial design, and to help them in implementing the TGM. However, during the execution and the evaluation phase, other Test-bed tools will be used (e.g. the Observer Support Tool). Information with regard to the Trial execution and evaluation is provided in Annex 8.

10.1 TGT rationale and overall process

In order to support Trial owners and high-level crisis managers in the implementation of the Trial Guidance Methodology through the Trial phases, a web-based software tool is being developed. Given the fact that the TGM by its nature is complex, effective and successful implementation requires systematic guidance provided by the tool. In other words, guidance is needed to enable the users of the TGM to follow the steps and validate the outcomes. In doing so, not only is the methodology handled correctly through on-line support, but it is also made accessible to future users. In order to assure that practitioner's needs together with Trial objectives are met, the tool focuses on following the 6 steps defined by the methodology in a standardised way, allowing validation of each step's outcome and assuring that they are followed as intended.

The TGT aims to simplify identification of operational (real-life) crisis management problems by offering a list of predefined gaps stored in the tool's database. Examples drawn from lessons learnt from previous Trials help practitioners to define an appropriate mix of research methods and data analysis techniques to form a relevant research question. Offering examples of "do's" and "don'ts" gained from experience in the past, the TGT helps formulating structured and pragmatic data collection plans for evaluating Trial results in realistic situations, described by Trial scenarios. Trial Guidance Tool's search and matching function based on CM functions taxonomy is designed to help identify potential solutions for previously identified gaps to be benchmarked in a Trial. Being derived directly from the ever-improving TGM, the tool itself is subject to change and matures during the course of the project, therefore ultimately resulting in a complete, experience-based, Trial guidance software solution for future generations of crisis managers. Its existence assures that the complexity of the TGM is handled in a correct manner and made accessible to the end users.

In order to visualise the Trial Guidance Tool, a Unified Modelling Language (UML) was used. UML is a common tool in software engineering with the aim to provide a standardized way to depict the ideas for the design of software in an UML diagram. The UML translates and structures the initially identified requirements in an appropriate overall design. The UML of the TGT supported the alignment between the TGM designers and the TGT developers. While the whole UML is presented and described in annex 6, the following sections briefly list the desired TGT requirements including potential mock-ups of the later artefact.

The functional requirements for implementing the TGM via the TGT will be explained throughout this section following the three main TGM phases. The main focus will be on the preparation phase. Additionally, it is foreseen that the TGT will ultimately be used mainly in the preparation phase to assist Trial Owners with the Trial design, and to help them in implementing the TGM. However, during the

execution and the evaluation phase, other Test-bed tools will be used (e.g. the Observer Support Tool). Information with regard to the Trial execution and evaluation is provided in Annex 8.

As for the overall TGT, functional requirements will be revised based on structural feedback from SP94 (Trials). This first version of the requirements introduces a description and uses called mock-up screens: these mock-up screens are intended solely to illustrate the described functionality[34] and do not pre-empt the look-and-feel of the later developed TGT. In describing the functional requirements of the TGT, the steps are presented in the same order as the one presented in section 5.

This approach is inspired by the web-form used in the Netherlands that people use to apply for a tax-return[35]. This application enables users to go through the process relatively easy (back and forth), although the full process can also be complex.

10.2 General requirements

For the development of the TGT, an incremental approach has been followed (agile development). The functional requirements are therefore based on a more or less theoretical view of conducting Trials explained in the following sections.

Since the TGT will mature over the course of the Trials to be conducted in DRIVER+, the TGT must be a configurable tool. Changes to the tool will be proposed by the experts in the Trial guidance methodology. Examples of these configuration changes can be e.g. amendments in the workflow, modification in support texts and examples.

In the following pages, a web-based TGT for Trial owners to design a Trial is described. The tool itself will be developed in the DRIVER+ project **SP93** (**WP933**). The ultimate goal, however, is the use of the TGT by future Trial owners, e.g. high-level crisis managers in need of a new solution.

Structured along the three phases of a Trial, in addition to general Trial management, the following sections describe the specifications arising from the TGM structured along three main blocks of functional requirements:

- Preparation phase:
  - Identify the Trial objectives.
  - Formulate research questions.
  - Formulate the data collection plan.
  - Formulate evaluation approach and metrics.
  - Formulate scenario.
  - Select solutions
- Execution phase.
- Evaluation phase.

Furthermore, a vision on a possible realisation in the form of a software tool is given by using the technique of mock-up screens. In the mock up screens, a shorten version of the terms listed above is used:

- Preparation phase:
  - Trial objectives.
  - Research questions.
  - Data collection plan.
  - Evaluation approach.
  - Scenario.
  - Solution selection

[34] This approach is inspired by the web-form used in the Netherlands that people use to apply for a tax-return for instance https://cdn.lynxbroker.com/wp-content/uploads/2017/03/belastingaangifte-1.png

Following the explanation of each main block (further segmentation may be executed on certain blocks) the related requirements for the TGT are presented in a table (see Annex 8). These requirements are used as criteria in the acceptance test for the current version of the TGT.

In Annex 8 (requirements 1 to 7) the requirements for the TGT are listed that are of a general nature and thus cannot be linked to a certain phase of the process. These requirements draw on some general key elements of the TGM explained in previous sections e.g. experiences and examples of the DRIVER+ knowledge base that should be made available to Trial owners.

10.3 Requirements: Trial management (Trial details)

This section will describe requirements linked specifically to Trial management (Trial details)[36].

The tool opens with the landing page: a screen where the user (e.g. a Trial owner) logs in and authenticates (cf. Figure 10.1). The landing page also offers information on the DRIVER+ project and contact information for the TGT site administrator. Login rights with/without permission to add content should be granted by the TGT site administrator.

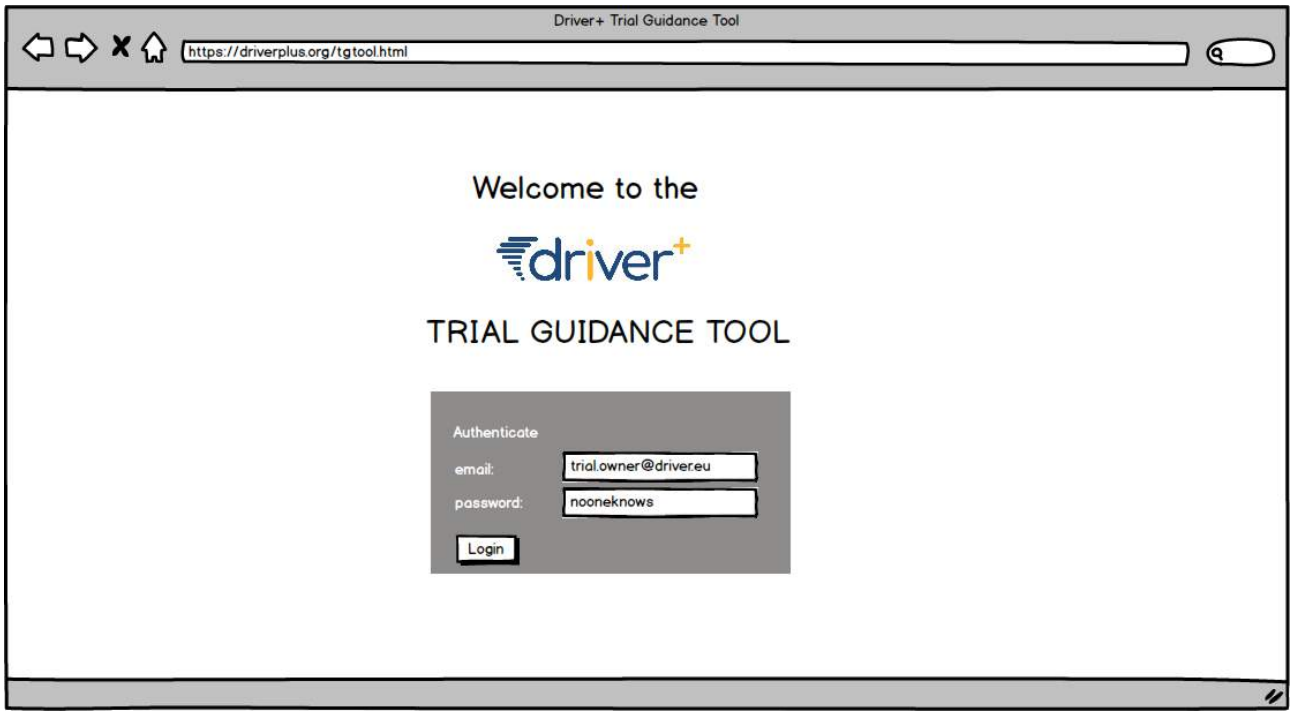

Figure 10.1: Visualisation of TGT specification – authentication

After a successful login, the user starts to select a Trial or create a new Trial.

[36] The "Trial management" is not included in the description of the TGM as it applies only to the tool and to authentication of users.

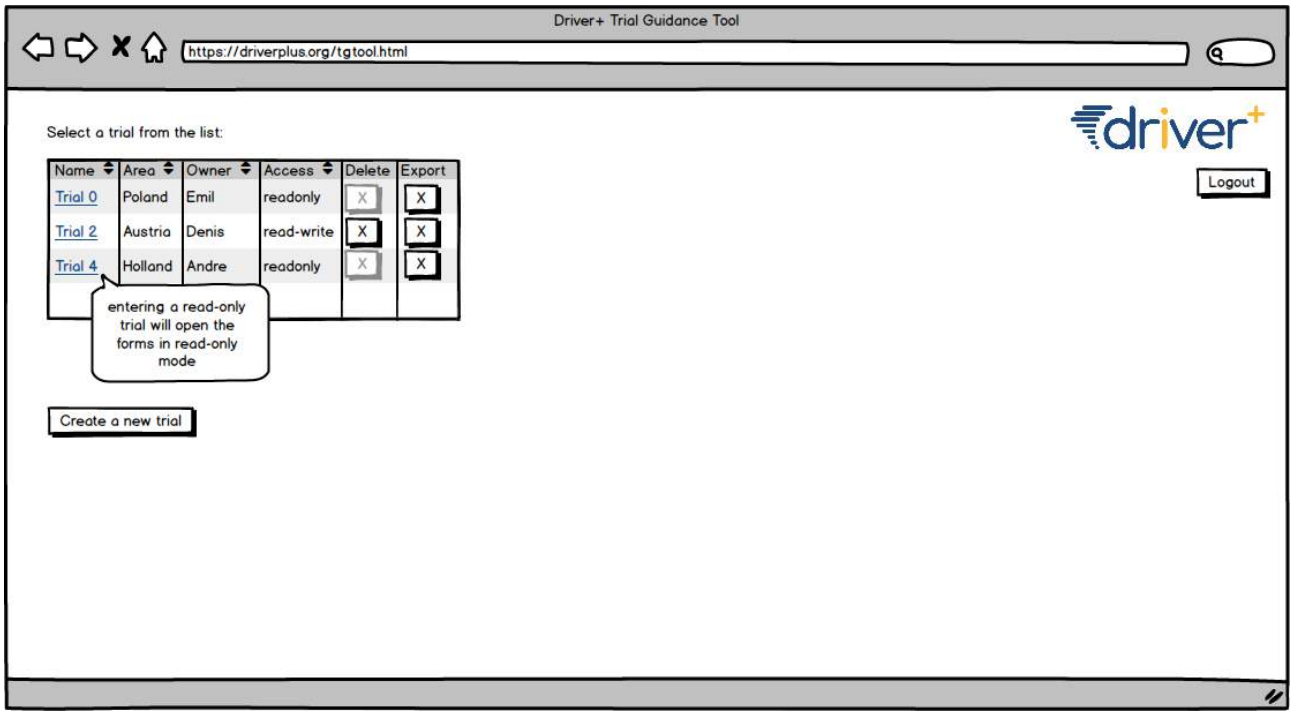

Figure 10.2: Visualisation of TGT specification – Trial selection

After Trial selection the user can give or change some details and a short description of the Trial. The first step is to enter information on the Trial design. This comprises general information on the Trial (like a Trial name, the date and its location) and the **Trial context**[37] – a brief description of the Trial. This information is entered by the Trial owner.

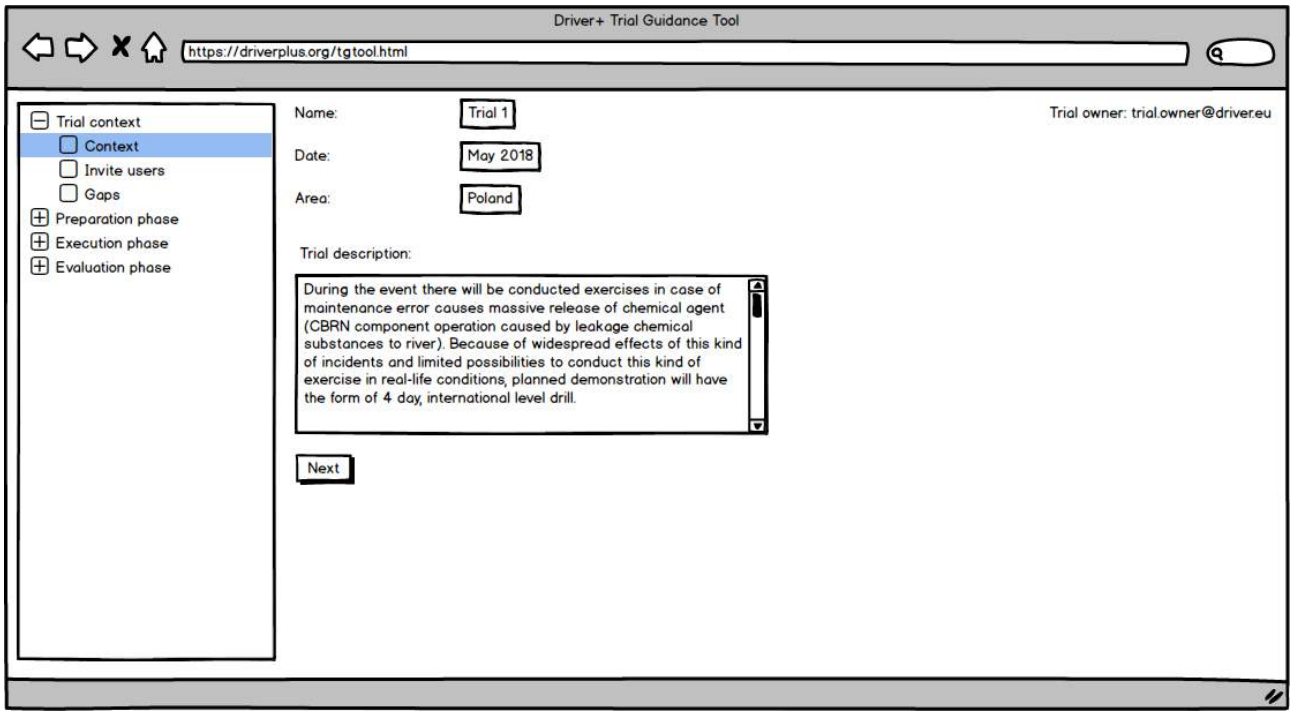

Figure 10.3: Visualisation of TGT specification – Trial context

[37] In description of the TGM, the specification of gaps is carried out in the Trial context (Step 0). In the TGT, the context is specified before the gaps because it is directly linked to possibility of inviting other users. However, alignment with the TGM is ensured, as depicted in Figure 10.3. Both the gaps and the Trial context are depicted as pre-requisite of the preparation phase.

The Trial owner can also invite other users (e.g. the members of the Trial committee) and grant her/him rights to view and/or edit the content. In the next screen a table is displayed showing Trials to which the user has viewing and/or editing rights (cf. Figure 10.4). All Trials can be exported (some xml/json format). In case the user is the Trial owner, (s)he is allowed to amend the description of Trial. The user can open viewable Trials in read-only mode. The user can open an editable Trial in edit mode. If allowed, the user can be allowed to create a new Trial.

The table below specifies the different users of the TGT. The current version of the TGT does not yet support the different roles in a Trial (as described in the TGM). The current first users are therefore requested to edit only those sections which they are supposed to edit.

Table 10.1: of TGT users

User	Is allowed to do this:
The Trial owner	• Can create a new Trial. • Can edit his/her own Trials. • Can invite others by email to become member of a group. • Can authorise Trial member (read/write). Can remove a member from group.
Trial member	Can view/modify a Trial depending on the authorization granted by the Trial owner
Tool configurator	Can change the structure of the Trial Guidance Tool. This means, doing CRUD (create, read, update and delete) actions on the steps in the workflows, the texts, and other content.

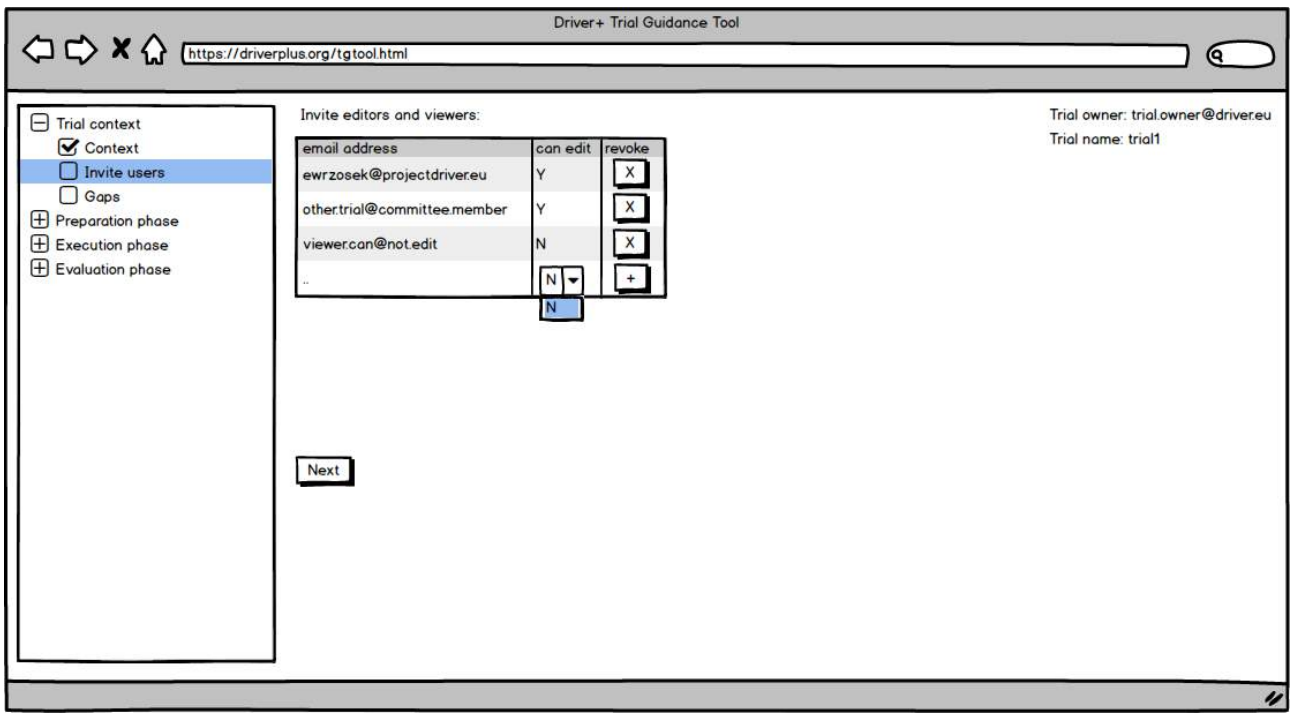

Figure 10.4: Visualisation of TGT specification – Trial management

The requirements defined for Trial management are listed in Annex 8, requirements 8 to 10.

10.4 Requirements: Trial preparation

Having described the general requirements as well as requirements specific to Trial management, this section will describe requirements linked specifically to the Trial preparation phase.

Figure 10.4 already showed a mock-up of one of the screens in the TGT with a “tree structure” comprising all of the topics that could be part of the TGT. The topic comprises sub-topics. The list of topics, and their logical order, is fixed and based on the steps of the TGM. Depending on the choices made by the user, additional sub-topics may appear in the list. Topics that may not be relevant to every Trial may be de-activated by a check box, meaning that no questions will be presented for the topic. The user can go back and forth through the topics (no one-way traffic) and make changes. The user can save and close the application and re-enter at a later time.

Every topic ends with a validation of the fields entered (e.g. a. “Next” or “Save” button). This button triggers a control mechanism that gives the user feedback on the fields that have been filled. If the test fails, the user is asked to make adjustments. If the test succeeds, the topic is marked “completed”. If the test fails, the users can postpone the adjustment to another time: The Trial Guidance Tool marks the item as not finished. The complete guidance process is only accepted when all topics are approved.

In case the user starts a new Trial, a window is opened displaying information on the Trial Guidance Methodology (cf. Figure 10.5). A link to the full methodology document is presented alongside a figure depicting the six-step approach (as described in sections 5 and 6).

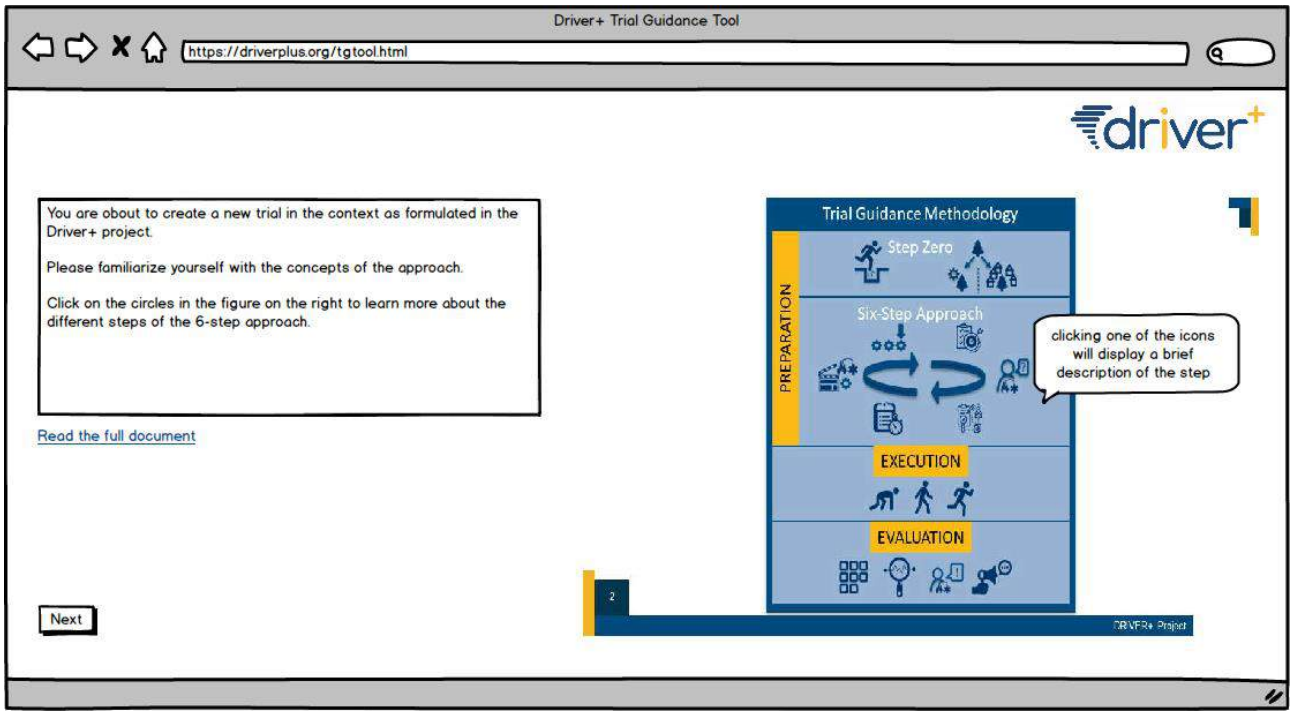

Figure 10.5: Visualisation of TGT specification – concepts of the Trial Guidance Methodology

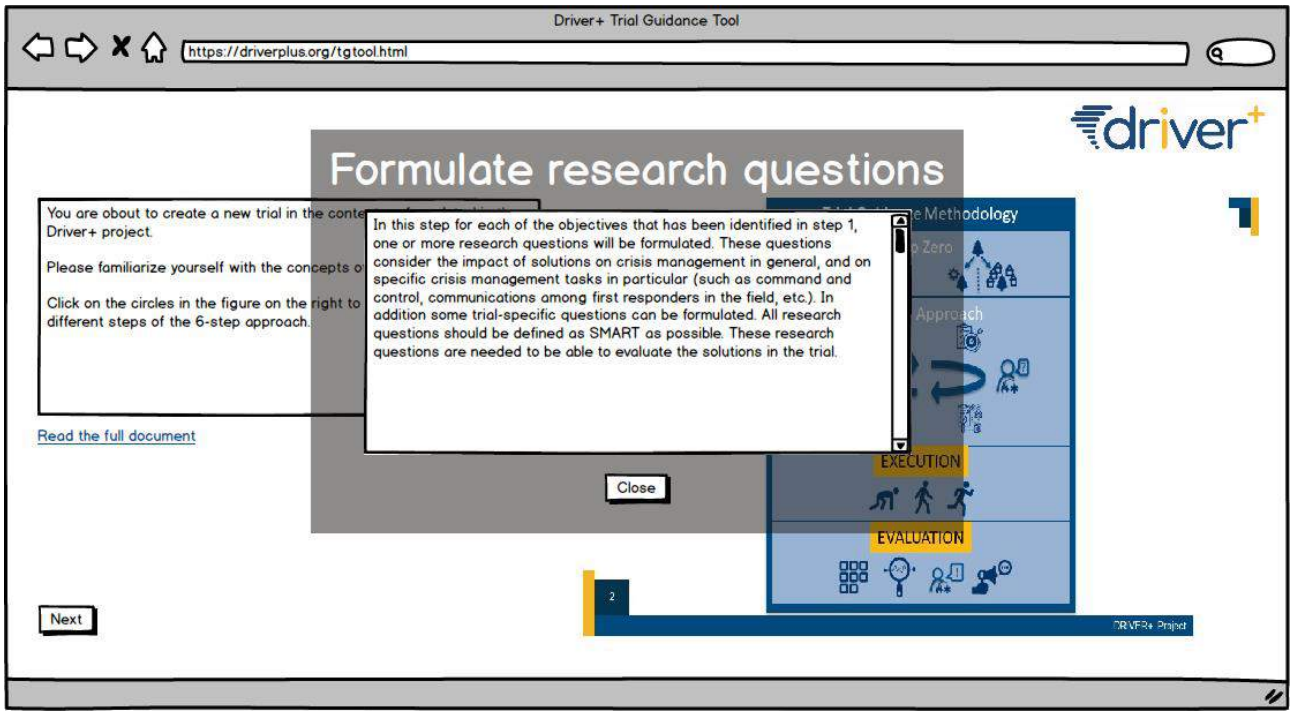

Figure 10.6: Visualisation of TGT specification – pop-up with brief description of one step

Clicking on one of the icons in the figure displayed in the window will display a brief description of the selected step (cf. Figure 10.6). This window introduces the structure of the TGT. Note that the six-step approach can be used iteratively, which means that users can return to a previous step and revise it, if needed. However, in some steps, references need to be made to content specified in an earlier step.

The user can click on "next" and then select one or more gaps from the list of validated DRIVER+ gaps (**D922.11** (18)) to the Trial (cf. Figure 10.7 and Figure 10.8).

10.5 Preparation – Task 1 ("Step zero")

The preparation of a Trial starts with characterizing the (capability) gaps in crisis management for which potential solutions should be investigated by conducting the Trial (see note 37)

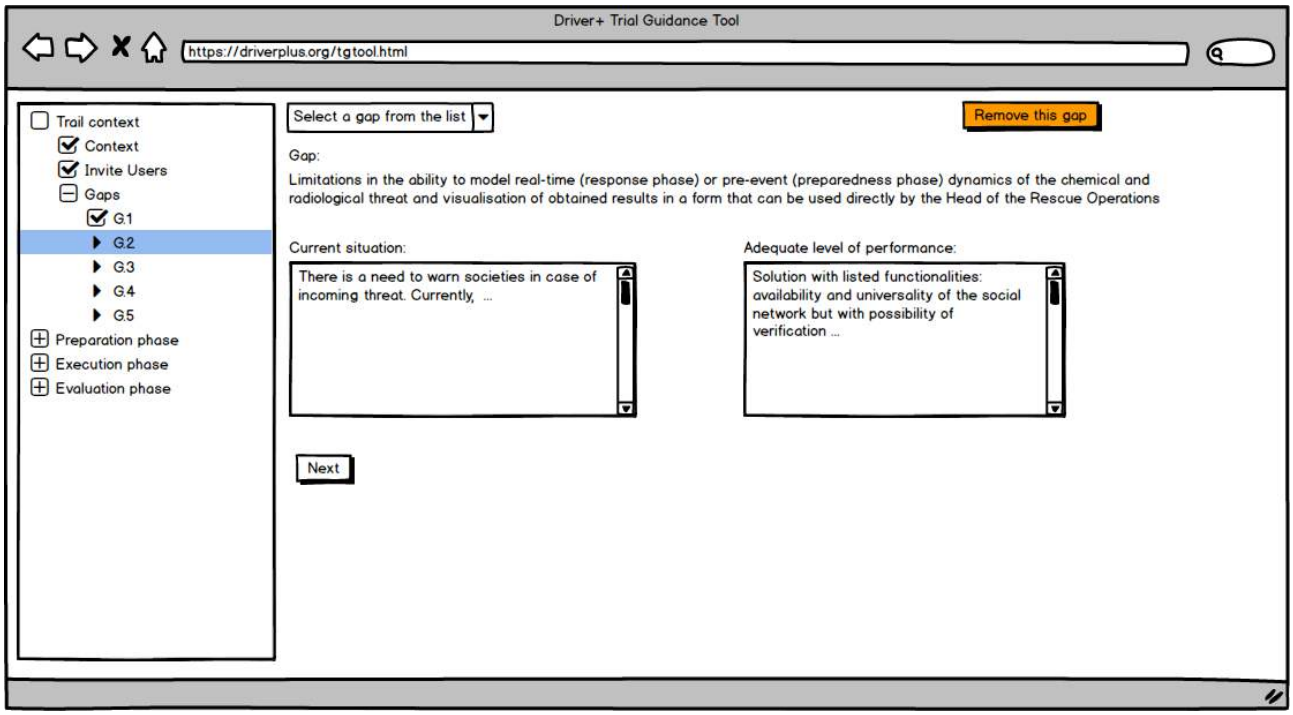

Figure 10.7: Visualisation of TGT specification – selection of gaps

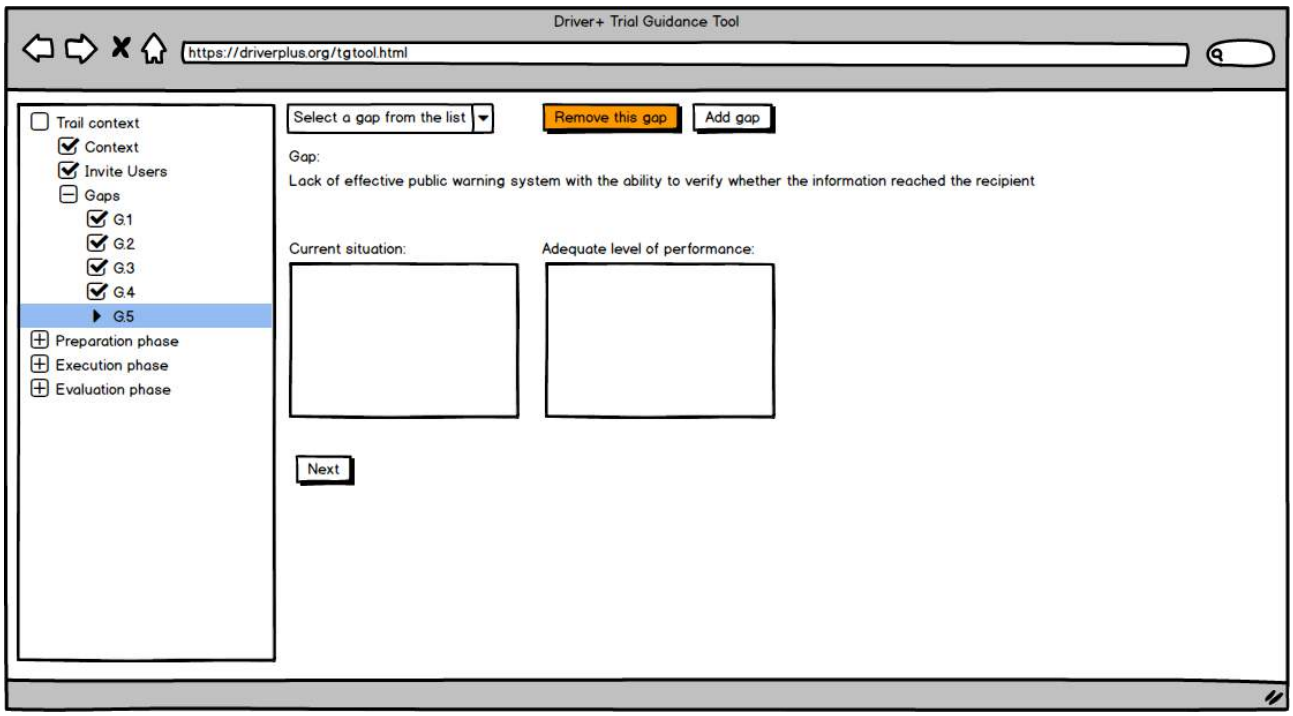

Figure 10.8: Visualisation of TGT specification – selection of gaps

The requirements defined for defining gaps in the Trial preparation are listed in Annex 8, requirements 11 to 16.

10.6 Preparation – Task 2 – Design of a Trial

In designing a Trial the iterative six-step approach is followed. Each of these steps is made several times to refine elements in alignment with the contents of other steps. These steps are:

These six steps are elaborated in paragraphs 10.6.1 to 10.6.6.

10.6.1 Requirements: Step 1 - Identify the Trial objectives

As part of the Trial preparation, it is crucial to identify the objective(s) for the Trial. The Trial Guidance Tool displays the gaps identified and prompts the user to formulate one or more Trial objectives corresponding to each gap (cf. Figure 10.9). Trial objectives comprise the three dimensions explained in section 2. Each objective is categorized either as a "crisis management dimension", a "solution dimension" or a "Trial dimension".

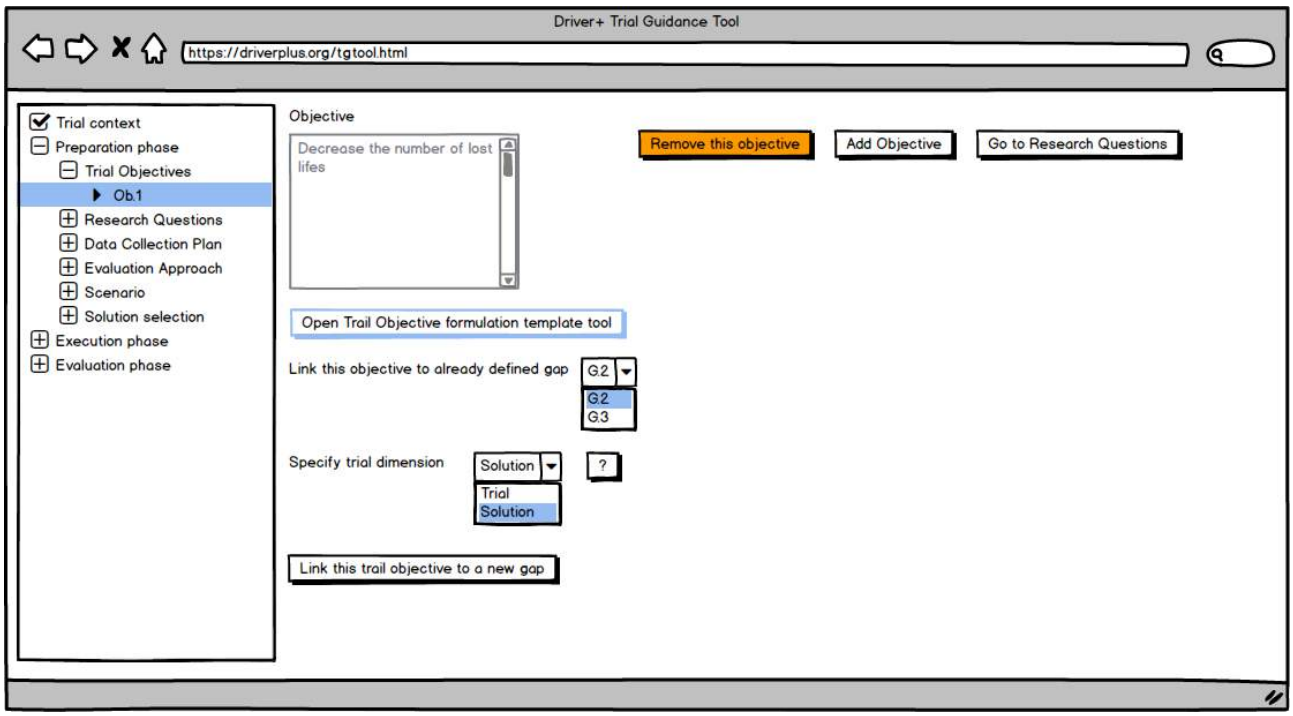

Figure 10.9: Visualisation of TGT specification – Identify the Trial objectives

The TGT provides a definition as well as templates and examples of Trials objective(s). Such a template involves a generic formulation of typical objectives.

The requirements for Trial preparation with regards to Trial objectives are listed in Annex 8, requirements 17 to 22.

10.6.2 Requirements: Step 2 - Formulate research questions

Having defined the objectives for the Trial, good research questions need to be defined. The Trial Guidance Tool displays the Trial objectives entered and prompts the user to formulate one or more research questions for the Trial (cf. Figure 10.10). A research question is the specification of the objectives.

For each objective there is one research question[38] and vice versa.

[38] It should be noted that, while in this mock-up, research questions are formulated as "free text", discussions are on-going between the methodological team and the GT developers whether this would be the better the option. For instance, another valid option to consider would be to present RQs using a "user-story" structure so that, instead of having a free-text box, must fill in: "who", "what" and "why" field to facilitate the formulation of research questions.

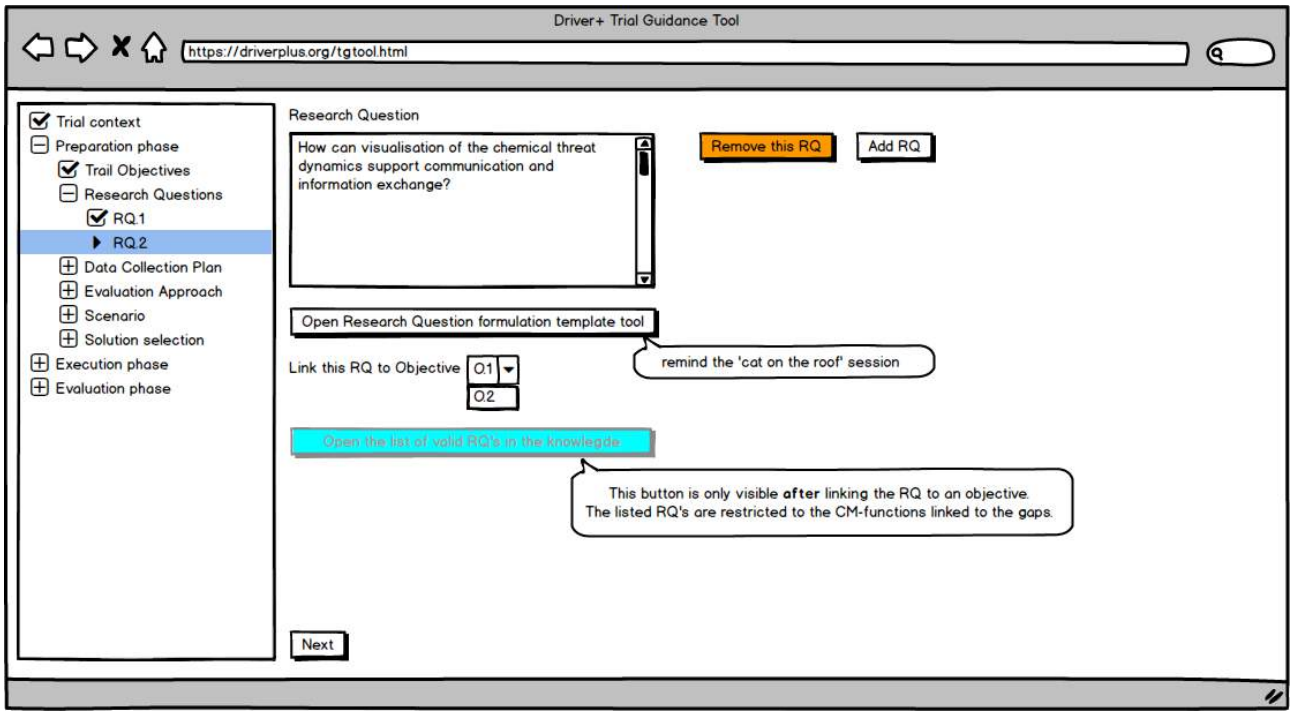

Figure 10.10: Visualisation of TGT specification – Formulate research questions

The requirements defined for Trial preparation with regards to defining research questions are listed in Annex 8, requirements 23 to 25.

10.6.3 Requirements: Step 3 – Formulate the data collection plan

The data collection method is an important part of preparing for a Trial, and it relates e.g. both to the defined research questions and the objectives of the Trial. At this point in the process, the TGT offers a list of possible methods for data collection aimed on a valuable evaluating the Trial. Each method is described and supported with references, tricks & tips and examples. Examples of methods[39] are:

- Observations.
- Questionnaires.
- Simulator data.
- Interviews.
- Group discussions.

For each objective, the user first enters KPIs which represent success (or failure) in the Trial regarding the specified question.

The tool TGT provides the template for the information on the data collection to be used; the content is an input derived from the Trial Guidance Methodology.

The requirements defined for Trial preparation with regards to the data collection plan are listed in Annex 8, requirements 26 to 31.

[39] The list with methods is not final, additional methods may be entered. Either the user of the TGT enters (in free text) the method, or the GT application manager amends the method to the application file.

10.6.4 Requirements: Step 4 – Formulate evaluation approach and metrics

Depending on the specification of the research questions, indicators and metrics to evaluate the results should be defined. Concretely, so-called SMART[40] indicators (metrics) pertaining to the research questions should be identified (Figure 10.11). Per research question, one or more indicators/metrics are needed. The metrics comprise three dimensions in the Trial (the Trial itself, the crisis management and the solution in the Trial).

The user is prompted to relate metrics to the objectives from a (not limited) list.

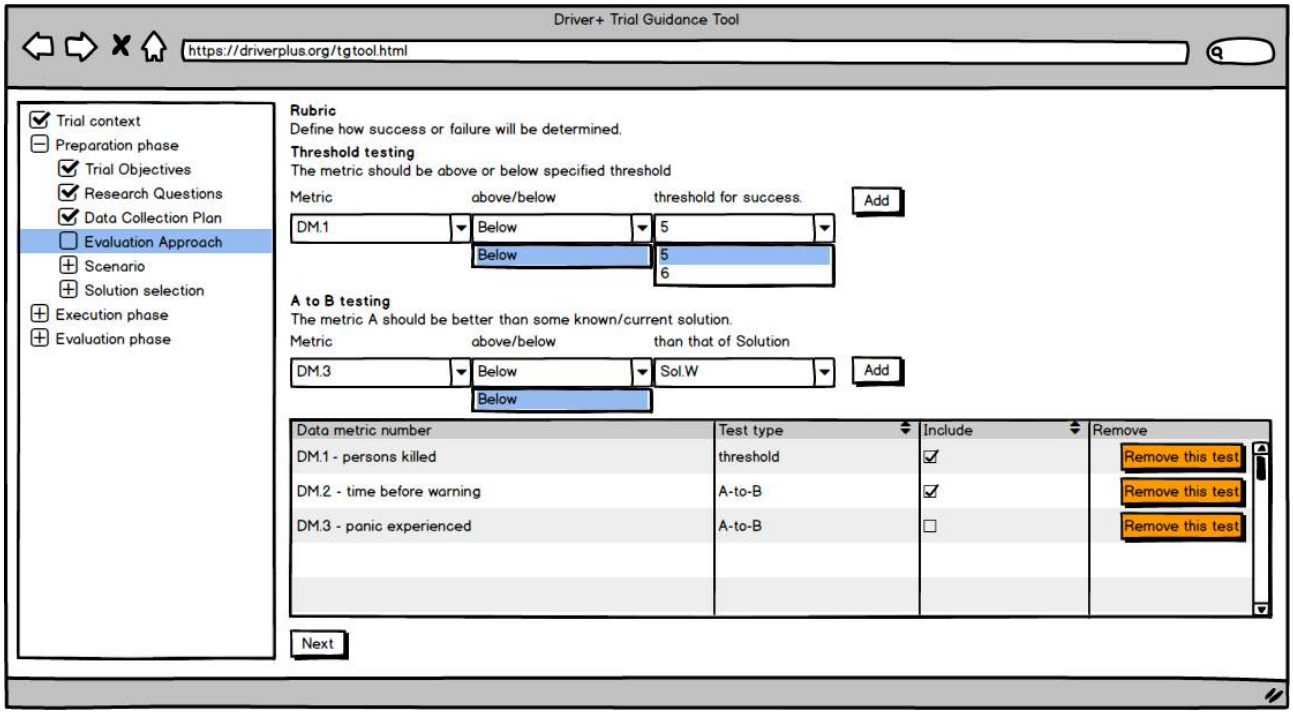

Figure 10.11: Visualisation of TGT specification – Formulate evaluation approach and metrics

The requirements for Trial preparation with regards to evaluation approaches and metrics are listed in Annex 8, requirements 32 to 35.

10.6.5 Requirements: Step 5 – Formulate scenario

In order to set up the Trial, the user needs to choose a scenario which will form the basis for the Trial, and which allows the user to get the best results with regards to the defined research questions, objectives, etc. In order to do this in the TGT, the user can enter the scenario by typing the text or by uploading a text file (and edit this text if needed) as shown in Figure 10.12.

[40] SMART: Specific, Measurable, Assignable, Realistic, Time-related

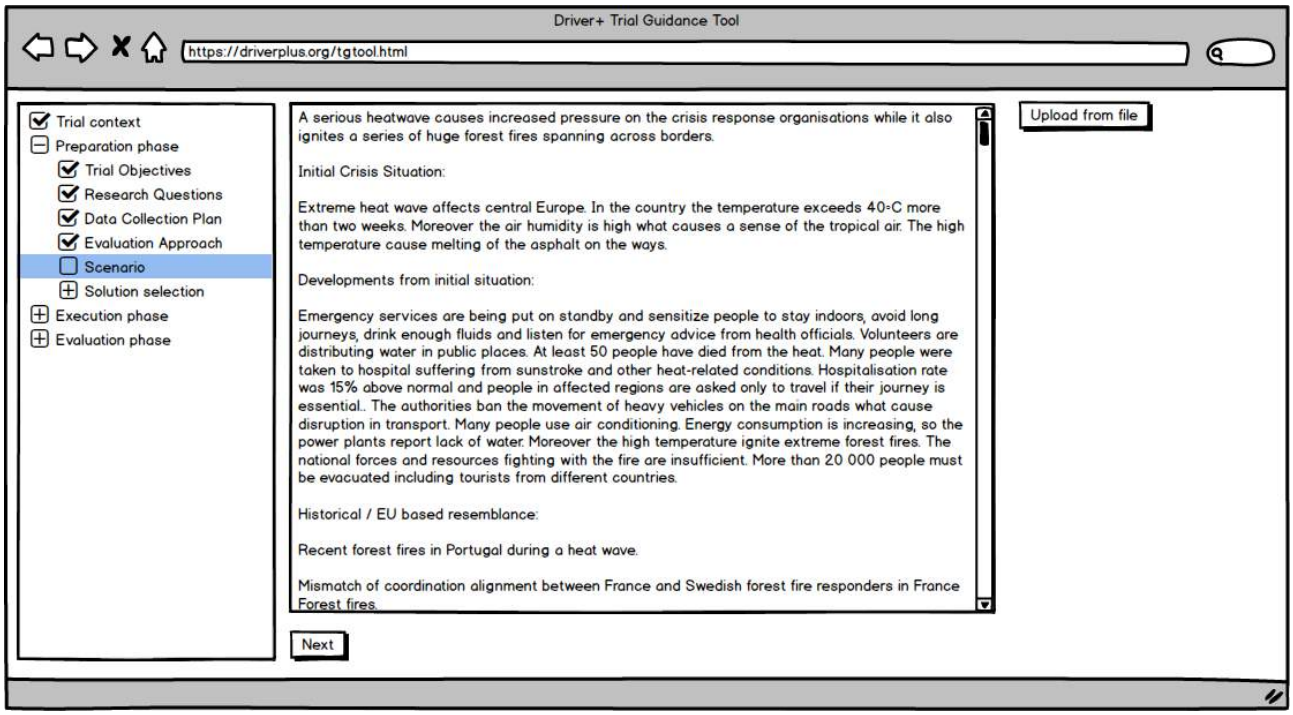

Figure 10.12: Visualisation of TGT specification – Formulate scenario

Requirements defined for Trial preparation with regards to defining the relevant Trial scenario and listed in Annex 8, requirement 36 and 37.

10.6.6 Requirements: Step 6 - Select solutions

The last stage in the Trial preparation loop is to select one or more solutions to be tested during the Trial. There are three options for selecting a solution:

- Proposed solution based on a mapping from gaps and objectives in the PoS (cf. Figure 10.13).
- Selection from the PoS, using a filter based on the crisis management taxonomy of CM functions (cf. Figure 10.14).
- Call for solutions (cf. Figure 10.15).

While the call for solutions is to be used within the project itself, the first two options point towards the use of the tool after the end of project. The first option implies that a solution is proposed from the PoS based on the defined objectives for the Trial as well as an existing gap analysis.

If the second option is preferred, the Trial Guidance Tool suggests suitable solutions from the PoS, filtering out relevant solutions based on a comprehensive taxonomy of CM functions. Figure 10.13 illustrates the first option. Here, the user may choose to select none, one or more from the presented list.

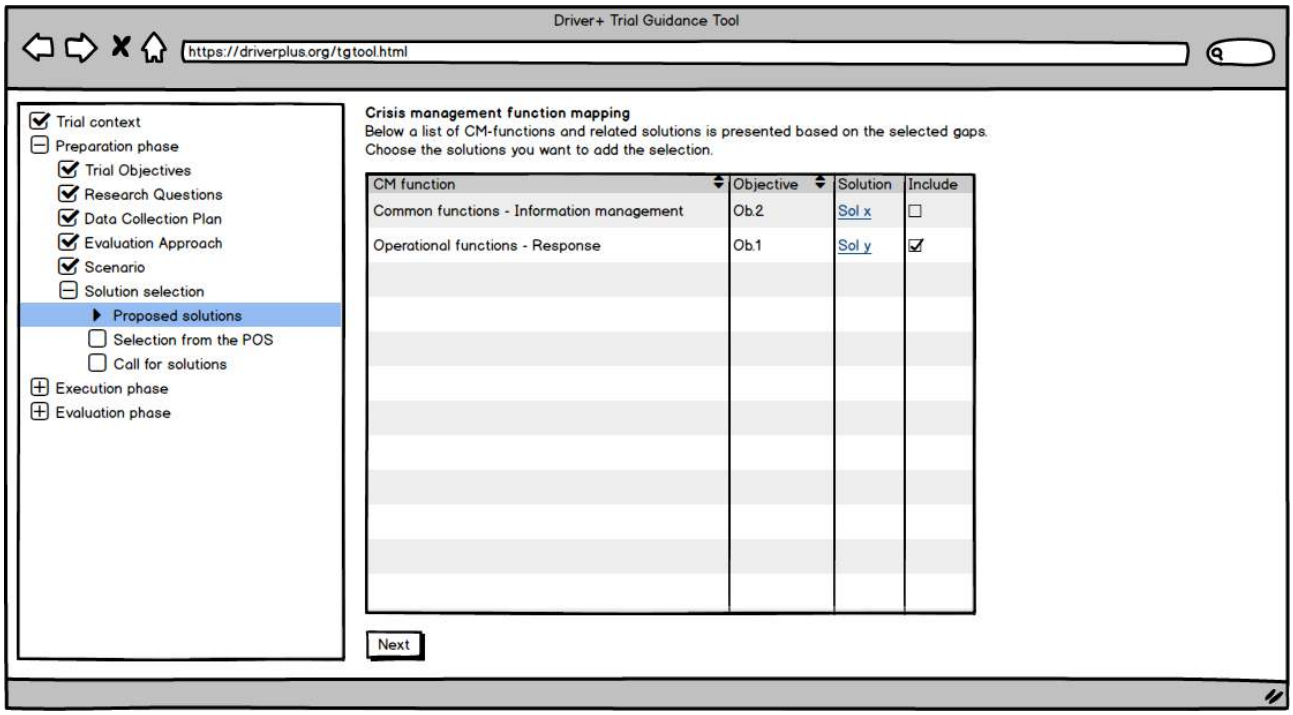

Figure 10.13: Visualisation of TGT specification – proposed solution based on a mapping from gaps and objectives in the PoS

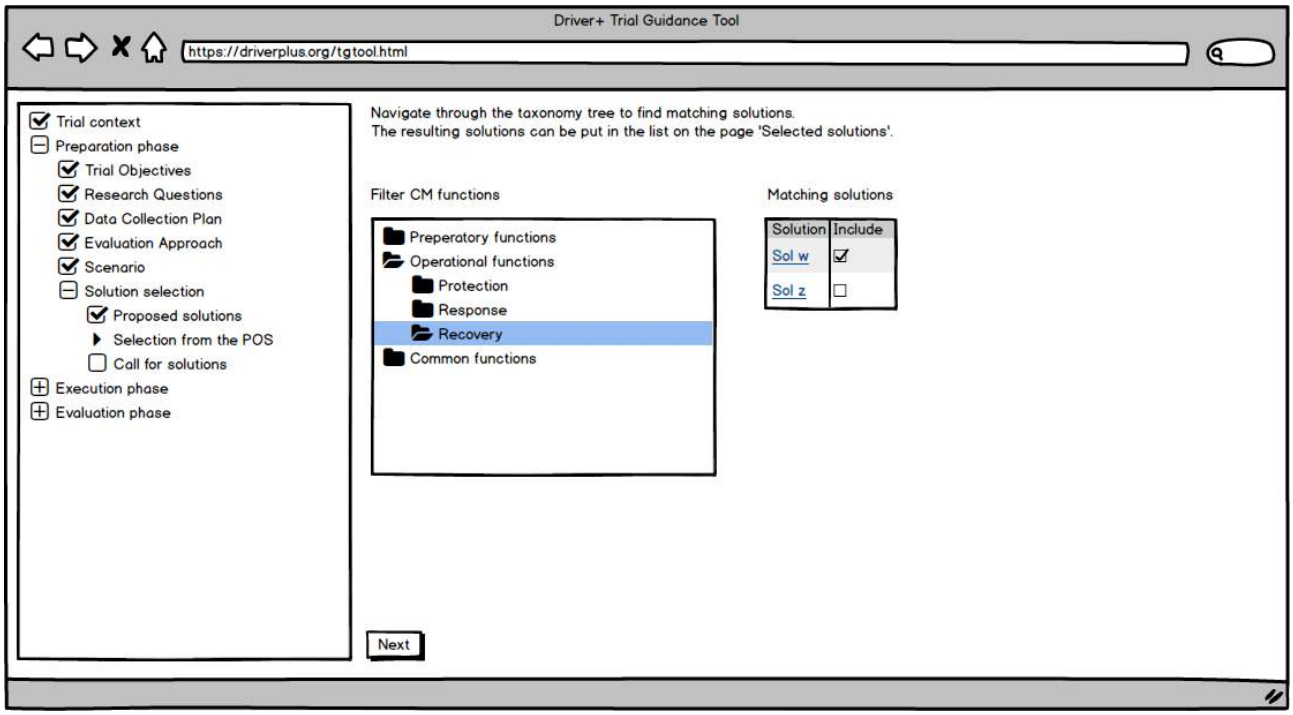

Figure 10.14: Visualisation of TGT specification – selection of solutions based from PoS

In case none of these two options are successful or relevant, the third option may be chosen. This means that the user can chose to issue a call for solutions. The user can open the “call for solution form”, which is available in the TGT. In this form, the user can enter the necessary information to issue the call. The call for solutions is the same procedure used for the DRIVER+ Trials, where solutions are selected based on the agreed-on procedure with reviewers. The Trial Guidance Tool does not facilitate the process but offers examples of which steps to take in the procedure, based on the DRIVER+ approach (e.g. scenario descriptions, timeline, reviewer network, selection criteria, etc.).

To carry out a call for solutions includes several aspects:

1. Call for solutions option:
   - Screen with info on “call for applications” (ID, URL, date).
   - Add with option “Load scenario” (from scenario) with edit functionality.
   - Export (to Word document).
2. Call for solutions schedule.
3. Review committee.
4. Review process.
5. Consolidation of review results.
6. Assessment and preselection of solutions.
7. Ethical concerns.

A visualization of the call for solutions form is presented in Figure 10.15.

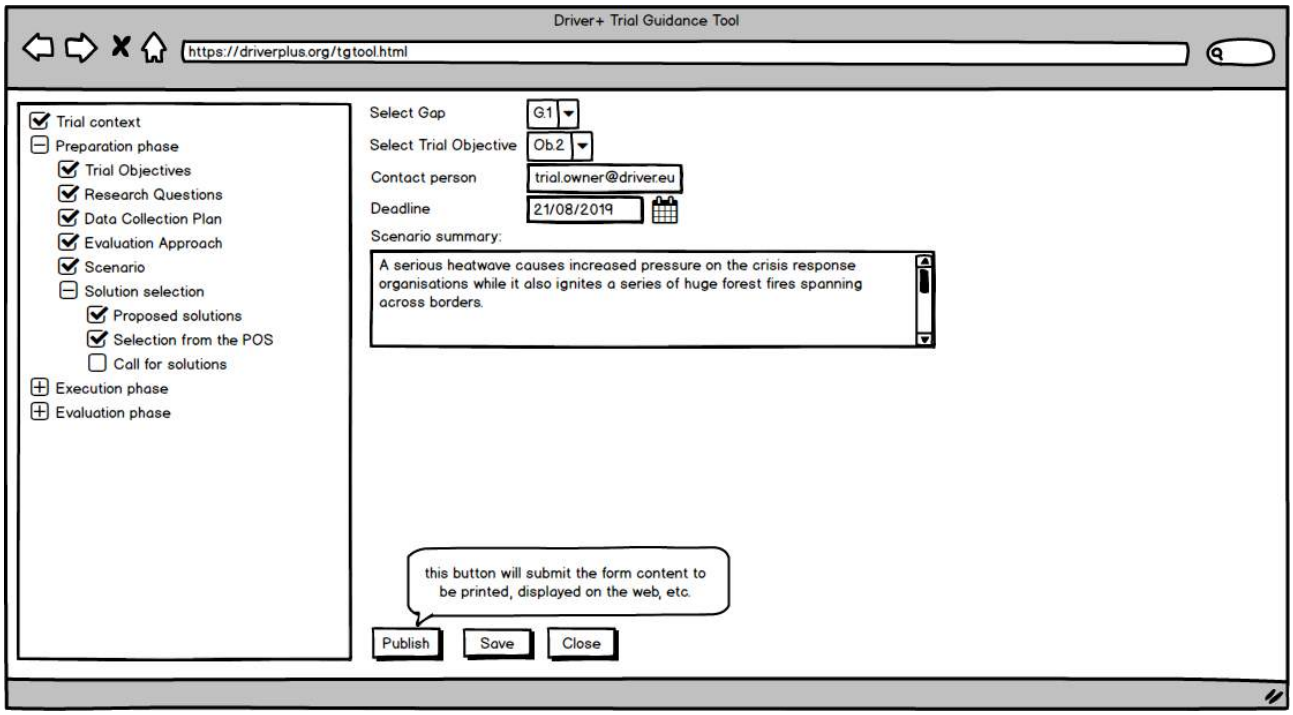

Figure 10.15: Visualisation of TGT specification – call for solution form

Regardless which of these three options the user decides to use in order to identify relevant solutions for a Trial, the result of the process is a list of proposed solutions from which to select the solutions to include in the Trial (Figure 10.16). The user can also look up Trials that have been performed before that addressed the same gaps and/or objectives. The user can consider the “do's” and “don'ts” for this experience, but also take into account the results from these Trials.

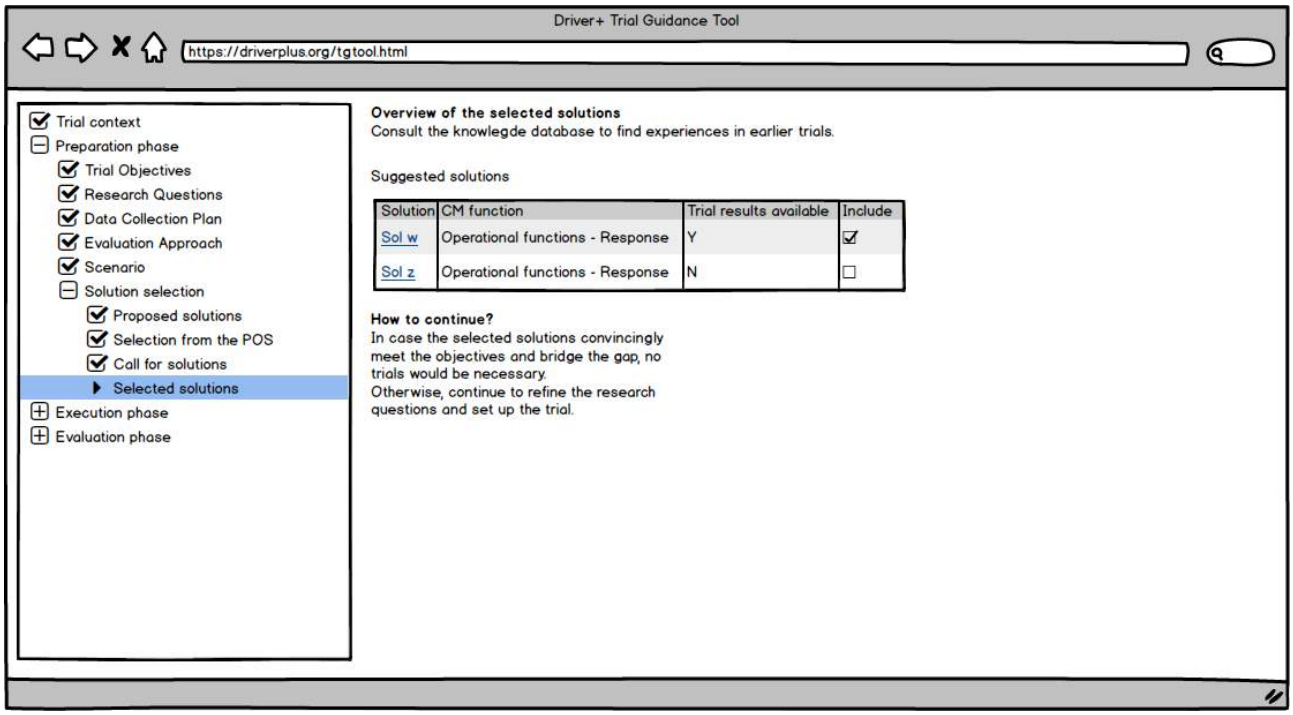

Figure 10.16: Visualisation of TGT specification – selection of solutions from knowledge base

The requirements for Trial preparation with regards to selecting solutions for a Trial are listed in Annex 8, requirements 38 to 42.

11. Way forward

In this deliverable the foundations of the DRIVER+ Trial Guidance Methodology and the functional requirements of the Trial Guidance Tool are described. It sets out the basis of the TGM and provides the first version of the methodological framework through the description of the steps that Trial owners must follow to carry out a Trial in a systematic yet pragmatic way. This deliverable revolves more around the preparatory phase of Trials. A detailed description of the preparation phase is in fact crucial to ensure a robust Trial design.

This deliverable was written during the preparation phase of Trial 1 that took place in Poland in M49 (May 2018). The initial TGM, as well as the functionalities of the TGT will be evaluated during Trials and improved based on feedback coming from SP94 (Trials). The evaluation will be carried out in the context of tasks **T943.5**, **T944.5**, **T945.5** and **T946.5**. Relevant data to evaluate the methodology will be collected during the execution and evaluation phase of Trials 1-4 and also during the preparation phase of Trials 3 and 4.

Updated versions of the TGM (**D922.41**: M58, and **D922.42**: M66) will be based on the structural feedback coming from **SP94**. Draft versions of the deliverables will also be made available, along with necessary clarifications, training and on the job support, to relevant stakeholders involved in Trials prior to submission. This structural feedback will help in improving the TGM itself, in particular in refining the guidelines of the preparation phase and, above all, in providing adequate and detailed support to assess the solutions in a proper way (evaluation phase).

Not only will the evaluation of the first version of the TGM be based on feedback from SP94, but "internal" (**WP922** and **WP924**) lessons learnt will be carefully taken into account to provide an updated version of the methodology before Trials 2, 3 and 4. Lessons learnt from **WP922** are the results of the participatory method used with relevant stakeholders involved in Trials. Since methods are not imposed upon but developed with them, the circular working processes and learning patterns mentioned in section 2 will ensure that **D922.41** captures the needs and improvements emerging from internal discussions. Pragmatically, this will take place during and after Trial 1 as well as in the preparation and execution phase of Trial 2.

One of the main objectives of the **SP92** meeting which will be held in M50, three weeks after the execution of Trial one, is to reflect upon, *inter alia*, the methodological support *received from* **SP92** and *needed from* an **SP94** perspective. The key outcomes of the meeting will pave the ground to improve the TGM and the requirements of the TGT so that a draft version of **D922.41** will be made available before Trial 2 (M54).

The meetings that took place in the preparation and the execution phase of Trial 1, shed light on specific needs of the Trial owners and on the kind of support which is expected. The idea of the Test-bed as a "service" has become apparent due to the amount of informal guidance required, especially in the pre-Trial phase. While within the scope of DRIVER+ this is of course necessary and possible, after the end of the project the "service" (working processes and methods) should be made sustainable (see also **WP954**).

Important lessons learnt from the first six-months of the project from a methodological stand-point are:

- Similarities and differences between exercises and Trials need to be discussed with Trial committees at an early stage. The majority of the end-users are mainly familiar with exercises that involve, for instance, testing the preparedness of the organisations or teams, rather than assessing (new) solutions that can drive innovation.
- A pragmatic approach is important to understand and implement the TGM. While, on the one hand, it is important to provide recommendations and criteria on e.g. how to formulate good research questions, on the other, "hands-on" sessions are necessary. These sessions can take the form of face-to-face meetings (e.g. the **SP92**-**SP94** meeting which took place in M41 in which research questions and sub-research questions for Trial 1 were discussed) or of "mini-Trials", like the demonstration that took place at Workshop "0" in M42. The TGM needs to be more *demonstrated* than *explained* to ensure a common understanding of the steps. Despite, due to time constraints, it was not possible to provide a comprehensive explanation of all the steps of the TGM

during the mini-Trial, working with tangible examples has proven to be effective and it was a source of inspiration for drafting sections 5 to 8.

- Identifying roles, tasks and processes of the CM dimension is crucial. This involves an in-depth understanding of how CM practitioners would respond to a specific operation as described in a generic scenario without any change or innovation, namely without the solutions that will be assessed during Trials. The description or the visualisation of a detailed scheme of processes is the baseline to understand the context and identify relevant KPIs. Only the practitioners familiar with a given socio-cultural and legal context can provide such information.
- The development of the TGM involves a "virtuous circle" between different teams: the methodological team and TGT developers, for instance, consist of people with different background and different expectations on the same output (e.g. the Trial Guidance Tool). Frequent meetings are necessary to align those expectations and visions.

These lessons learnt are part of the mutual-learning approach of SP92 and will shape future versions of the methodology.

Furthermore, to ensure the correct understanding of the methodology and the effective use of the Trial Guidance Tool, **WP924** will develop and organise two training modules. The aim is to facilitate the correct implementation of the methods during Trials. The feedback from the participants is crucial to identify the complex and challenging aspects of the TGM. The TGM will be revised also based on these feedbacks so that concepts can be better understood.

The way forward, thus, involves both a short-term and long-term vision. Within the project life cycle, the TGM will evolve and mature *with* the Trials to ensure that a proper assessment of the solutions can take place. In particular, the step-by-step approach will serve the needs of the Trial owners and will be refined and adapted after each Trial. Having set out the basis of the TGM in this deliverable, future version will give more emphasis on the actual implementation of the TGM. In the long-run, it is necessary to think in terms of potential "services" to help setting out Trials in different locations. This points towards the sustainability of the Test-bed (in relation to the Portfolio of Solutions), currently being discussed with **SP95**.

References

The full list of references of the SLR is provided in Annex 2

1. **DRIVER+ project.** *D23.21 - Performance and Effectiveness Metrics in Crisis Management Experiments.* 2017.

2. *Concept Development and Experimentation Policy and Process: How Analysis Provides Rigour.* **Nijs, Han de.** 2010. RTO-MP-SAS-081.

3. **Alberts, D.S. and Hayes, R.** *Code of Best Practice for Experimentation.* Washington, D.C. : Command and Control Research Program Publications, 2002.

4. **DRIVER+.** *D942.11 - Report on Review and Selection Process.* 2018.

5. **DRIVER+ project.** *D610.1 - Joint Experiments 1 & 2 Scenarios and functionalities (Milestone 2 Report: Joint Experiment Design).* 2017.

6. **Parmenter, D.** *Key Performance Indicators (KPI): Developing, Implementing, and Using Winning KPIs.* 6(7). Hoboken : Wiley & Sons, 2010.

7. **DRIVER+ project.** *D530.1 - Lessons Learned Framework Concept.* 2017.

8. **Thomé, A.M.T., Scavarda, L.F. and Scavarda, A.J.** Conducting systematic literature review in operations management. *Production Planning & Control.* 27, 2016, Vol. 5, 27(5), pp. 408-420.

9. **Kitchenham, B.** Procedures for performing systematic reviews. 2004, 33, pp. 1-26.

10. *Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement.* **Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group.** 2009, PLoS medicine.

11. **Kitchenham, B.** *Guidelines for performing Systematic Literature Reviews in Software Engineering.* 2007.

12. *A Guide to Conducting a Standalone Systematic Literature Review.* **Okoli, C.** 37(43), 2015, Communications of the Association for Information Systems.

13. *Systematic literature reviews in software engineering–a systematic literature review.* **Kitchenham, Barbara, et al., et al.** 51 (1), 2009, Information and software technology, S. 7-15.

14. **Secchi, P., Ciaschi, R. and Spence, D.** *A Concept for an ESA Lessons Learned System.* Noorwijk : The Netherlands: ESTEC, 1999.

15. **Sennett, R.** *The Craftsmen.* New Haven : Yale University Press, 2009.

16. **DRIVER+ project.** *D840.11 - Societal Impact Assessment Framework.* 2017.

17. —. *D840.21 - A guide on assessing unintended societal impact of different CM functions – Version 1.* 2017.

18. —. *D922.11 - List of Crisis Management gaps.* 2018.

19. **DRIVER+ report.** *D93.1 - Report on opportunities for positive societal impact of CM and DRIVER activities.* 2015.

20. *Systematic reviews in the social sciences.* **Petticrew, M., & Roberts, H.** [ed.] Malden and Mass. s.l. : Blackwell, 2006.

21. **DRIVER+ project.** *D923.11 - Functional Specification of the Test-bed.* 2018.

22. —. *D923.21 - First Release of the Test-bed Reference Implementation.* 2018.

23. *Rationale for systematic reviews.* **Mulrow, Cynthia D.** 309(6954), 1994, BMJ (Clinical research ed.), pp. 597-599.

24. *The Medical Review Article: State of the Science.* **Mulrow, Cynthia D.** 106(3), 1987, Annals of Internal Medicine, p. 485.

Annexes

Overview of Annexes:

1. The DRIVER+ terminology used in this document.
2. An extended description of the Systematic Literature Review.
3. Experiences from previous DRIVER+ experiments (lessons learnt).
4. Examples illustrating the use of the TGM.
5. Background of the Societal Impact Assessment Methodology (SIA).
6. Trial Action Plan (TAP).
7. Unified Modelling Language (UML) version of the Trial Guidance Tool.
8. List of functional requirements of the Trial Guidance Tool.

Annex 1 – DRIVER+ Terminology

In order to have a common understanding within the DRIVER+ project and beyond and to ensure the use of a common language in all project deliverables and communications, a terminology is developed by making reference to main sources, such as ISO standards and UNISDR. This terminology is presented online as part of the Portfolio of Solutions and it will be continuously reviewed and updated[41]. The terminology is applied throughout the documents produced by DRIVER+. Each deliverable includes an annex as provided hereunder, which holds an extract from the comprehensive terminology containing the relevant DRIVER+ terms for this respective document.

Table A1: DRIVER+ Terminology

Terminology	Definition	Source
End-users	Individual person who ultimately benefits from the outcomes of the system. Note 1 to entry: The End-user can be a regular operator of the software product or a casual user such as a member of the public. DRIVER+ Note 1: In the context of DRIVER+ End-user encompasses practitioners, solution providers and other stakeholders.	ISO/IEC 25010:2011(en) Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — System and software quality models Link: https://www.iso.org/obp/ui/#iso:std:iso-iec:25010:ed-1:v1:en.
Gap	Gaps between the existing capabilities of responders and what was actually needed for effective and timely response.	Project Responder 5.
Innovation	Implementation of a new or significantly improved product (good or service), or process, new marketing method, or new organizational method in business practices, workplace organization or external relations. ISO 37500:2014(en) Guidance on outsourcing, section 3.6: new or changed object (3.6.1) realizing or redistributing value.	ISO 9000:2015(en) Quality management systems — Fundamentals and vocabulary, 3.6.15.
Lessons Learnt	Lessons learning: process of distributing the problem information to the whole project and organization as well as other related projects and organizations, warning if similar failure modes or mechanism issues exist and taking preventive actions.	ISO 18238:2015(en) Space systems — Closed loop problem solving management, 3.3.

[41] The Portfolio of Solutions and the terminology of the DRIVER+ project are accessible on the DRIVER+ public website (https://www.driver-project.eu/). Further information can be received by contacting coordination@projectdriver.eu.

Terminology	Definition	Source
Portfolio of Solutions	A database driven web site that documents the available Crisis Management solutions. The PoS includes information on the experiences with a solution (i.e. results and outcomes of Trials), the needs it addresses, the type of practitioner organisations that have used it, the regulatory conditions that apply, societal impact consideration, a glossary, and the design of the Trials.	Initial DRIVER+ definition.
Scenario	Pre-planned storyline that drives an exercise, as well as the stimuli used to achieve exercise project performance objectives. DRIVER note 1: In the context of DRIVER+ scenarios are defined for Trials not for exercises.	ISO22300:2018(en).
Test-bed	The software tools, middleware and methodology to systematically conduct trials and evaluate solutions within an appropriate environment. An “appropriate environment” is a testing environment (life and/or virtual) where the trialling of solutions is carried out using a structured, all-encompassing and mutual learning approach. The Test-bed can enable existing facilities to connect and exchange data, providing a pan-European arena of virtually connected facilities and crisis labs where users, providers, researchers, policy makers and citizens jointly and iteratively can progress on new approaches or solutions to emerging needs.	Initial DRIVER+ definition.
Trial	An event for systematically assessing solutions for current and emerging needs in such a way that practitioners can do this following a pragmatic and systematic approach.	Initial DRIVER+ definition.
Trial Guidance Methodology	A structured approach from designing a Trial to evaluating the outcomes and identifying lessons learnt.	Initial DRIVER+ definition.
Trial Guidance Tool	A software tool that guides Trial design, execution and evaluation in a step-by-step way (according to the Trial Guidance Methodology) including as much of the necessary information as possible in form of data or references to the Portfolio of Solutions.	Initial DRIVER+ definition.

Annex 2 – Systematic Literature Review: extended description

For DRIVER+ the **study identification** was using the following approach: it was decided to use EBSCO, Google Scholar, and ScienceDirect for identifying relevant papers. For EBSCO this meant searching in different libraries. As depicted in Table A2, there were slightly modified search queries for each website. This was due to the fact that each website has its own way of functioning. For scholar.google.de this unfortunately meant, that the keywords used in red (see below in Table A2) might have not been included in the search but it is not possible to say this for sure. For ScienceDirect it was necessary to decide on a range of publication dates. As the latest research results should be looked at, only papers after 2006 were included.

Table A2: Websites and search queries

Website	Query
http://web.b.ebscohost.com/ehost/search/advanced	("crisis management" OR "emergency management" OR "disaster relief" OR "humanitarian operation" OR "disaster management" OR "disaster response") **AND** ("simulation" OR "serious game" OR "exercise" OR "game" OR "test" OR "Trial" OR "experiment" OR "training") **AND** ("innovation" OR "software" OR "algorithm" OR "decision support" OR "tool" OR "solution" OR "process" OR "organisation" OR "partnership")
https://scholar.google.de **https://harzing.com/resources/publish-or-perish**	("crisis management" OR "emergency management" OR "disaster relief" OR "humanitarian operation" OR "disaster management" OR "disaster response") **AND** ("simulation" OR "serious game" OR "exercise" OR "game" OR "test" OR "Trial" OR "experiment" OR "training") **AND** ("innovation" OR "software" OR "algorithm" OR "decision support" OR "tool" OR "solution" OR "process" OR "organisation" OR "partnership")
http://www.sciencedirect.com/science (mode: expert search)	pub-date > 2006 and tak(("crisis management" OR "emergency management" OR "disaster relief" OR "humanitarian operation" OR "disaster management" OR "disaster response") **AND** ("simulation" OR "serious game" OR "exercise" OR "game" OR "test" OR "Trial" OR "experiment" OR "training") **AND** ("innovation" OR "software" OR "algorithm" OR "decision support" OR "tool" OR "solution" OR "process" OR "organisation" OR "partnership"))

As explained in section 3, this search gave all in all 20,420 results for the time span 2007-2017. At first glance it showed, that all results were "somehow" related to the topic. However, this relation was pretty weak for a big number of them. Therefore, the first adjustment was to apply the search only on title, abstract and keywords. The first resulted in 2,934 results.

These numbers are based on some further limitations which were necessary according to the search engine. For EBSCO the setup included "English language" and "Scientific papers (Peer-Reviewed) Journals". For Google Scholar no further information was requested to start a search. For ScienceDirect it was chosen "all sciences", "Title abstract Key (tak)", "Books and journals" as well as "peer-reviewed by default". The distribution of results on the different citations is shown in Figure A1.

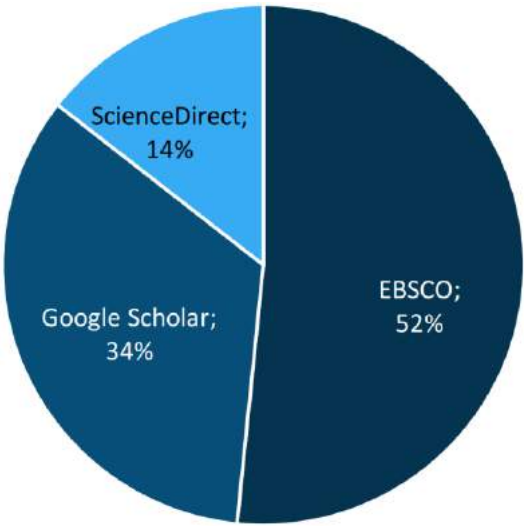

Figure A1: Distribution of first research results

After running the search, little information was listed and generated: Title, author and publication year of every identified paper. These were imported into the StArt-software and listed with the following information: paper ID, title, author, year, status/selection, status/extraction, reading priority and score:

- The ID is simply a consecutive number given to each paper.
- The status/selection can be either "accepted", "rejected" or "duplicated". While duplicated is chosen if a paper has already shown up before the status/selection of "accepted" and "rejected" is chosen by the one conducting the SLR. How this selection was done is described in the following section.
- The parts status/extraction and reading priority were not used for this SLR.

Special cases

In 13 cases the first or second reviewer rated a paper as "not relevant" while the other reviewer rated it as "relevant". For these special cases, a third review was done to decide on the matter. Only three out of these 13 papers were finally rated "relevant" and included in the following analysis.

All in all 218 peer reviewed articles were analysed by filling in a codebook for each paper. It was decided to look at the whole past decade in order to find relevant, but not outdated information. As shown in Figure A2 average almost 23 relevant papers were published each year. This deviates between a min. 12 and a max. 29. Though this is a difference of 17 papers it is hard to say that a trend could be derived from the distribution, which seems to confirm the idea to look at all years of the past decade.

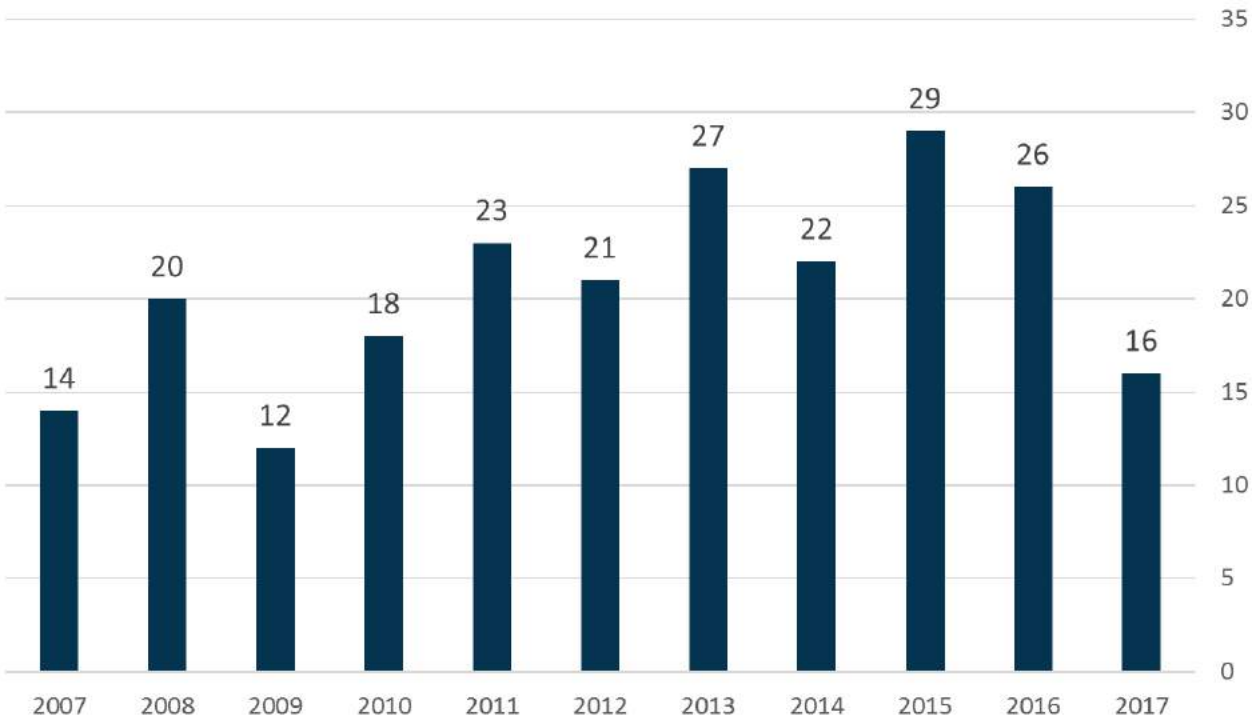

Figure A2: Quantity of papers per year

Keywords provided a rough idea of the main area the papers focused on. By plotting all keywords that had been mentioned 3 times and more often in a word cloud (cf. Figure A3) it can clearly be seen that "management" and "emergency" were the most important words within the scope of the SLR. The next most frequent are the words "simulation", "systems" and "disaster".

This confirms that the SLR has really given the expected results in the areas of crisis management, but also shows that the health area (health, nursing, medical) is represented quite often. Furthermore, "management" and "emergency" were the most important words within the scope of the SLR. The next most frequent are the words "simulation", "systems" and "disaster".

Figure A3: Word-cloud based on keywords of relevant papers

List of EBSCO databases

Academic Search Premier
American Antiquarian Society (AAS) Historical Periodicals Collection: Series 3
American Antiquarian Society (AAS) Historical Periodicals Collection: Series 1
American Antiquarian Society (AAS) Historical Periodicals Collection: Series 2
American Antiquarian Society (AAS) Historical Periodicals Collection: Series 4
American Antiquarian Society (AAS) Historical Periodicals Collection: Series 5
American Bibliography of Slavic and East European Studies
ATLA Religion Database with ATLASerials
Business Source Premier
Communication & Mass Media Complete
eBook Collection (EBSCOhost)
EconLit with Full Text
GeoRef
GeoRef In Process
GreenFILE
Humanities International Index
Index Islamicus
Library, Information Science & Technology Abstracts
MEDLINE
MLA Directory of Periodicals
MLA International Bibliography
New Testament Abstracts
Peace Research Abstracts
Philosopher's Index
PsycARTICLES
PsycINFO
PSYNDEX: Literature and Audiovisual Media with PSYNDEX Tests
Regional Business News
RILM Abstracts of Music Literature (1967 to Present only)
SPORTDiscus with Full Text
The Nation Archive (DFG)
The New Republic Archive (DFG)
PsycBOOKS
Arab World Research Source
CINAHL

The list of papers used for the SLR is provided in Table A3 below:

Table A3: List of papers used for SLR

ID	Title	Author	Year
18	Conventional Medical Education and the History of Simulation in Radiology	Chetlen, Alison L. ; Mendiratta-Lala, Mishal ; Probyn, Linda ; Auffermann, William F. ; DeBenedectis, Carolynn M. ; Marko, Jamie ; Pua, Bradley B. ; Sato, Takashi Shawn ; Little, Brent P. ; Dell, Carol M. ; Sarkany, David ; Gettle, Lori Mankowski	2015
55	Simulation forward processes of surgical care	Pucher, Philip H. ; Darzi, Ara ; Aggarwal, Rajesh	2013
65	D-DEMATEL: A new method to identify critical success factors in emergency management	Zhou, Xinyi ; Shi, Yangqiuyan ; Deng, Xinyang ; Deng, Yong	2017
72	A risk assessment tool for improving safety standards and emergency management in Italian onshore wind farms	Astiaso Garcia, Davide ; Bruschi, Daniele	2016
76	Project training evaluation: Reshaping boundary objects and assumptions	Lee-Kelley, Liz ; Blackman, Deborah	2012
79	Evaluation of Medical Management During a Mass Casualty Incident Exercise: An Objective Assessment Tool to Enhance Direct Observation	Ingrassia, Pier Luigi ; Prato, Federico ; Geddo, Alessandro ; Colombo, Davide ; Tengattini, Marco ; Calligaro, Sara ; La Mura, Fabrizio ; Michael Franc, Jeffrey ; Della Corte, Francesco	2010
83	Development, initial reliability and validity testing of an observational tool for assessing technical skills of operating room nurses	Sevdalis, Nick ; Undre, Shabnam ; Henry, Janet ; Sydney, Elaine ; Koutantji, Mary ; Darzi, Ara ; Vincent, Charles A.	2009
98	A service oriented architecture for decision support systems in environmental crisis management	Vescoukis, Vassilios ; Doulamis, Nikolaos ; Karagiorgou, Sofia	2012
123	Striving to be resilient: What concepts, approaches and practices should be incorporated in resilience management guidelines?	Adini, Bruria ; Cohen, Odeya ; Eide, Aslak Wegner ; Nilsson, Susanna ; Aharonson-Daniel, Limor ; Herrera, Ivonne A	2017
131	Expanding the use of simulation in open vascular surgical training	Pandey, Vikas A. ; Wolfe, John H.N.	2012
150	Emergency transportation network design problem: Identification and evaluation of disaster response routes	Nikoo, Nariman ; Babaei, Mohsen ; Mohaymany, Afshin Shariat	2017
159	A virtual reality based fire training simulator integrated with fire dynamics data	Cha, Moohyun ; Han, Soonhung ; Lee, Jaikyung ; Choi, Byungil	2012
160	Prepositioning of supplies in preparation for a hurricane under potential destruction of prepositioned supplies	Galindo, Gina ; Batta, Rajan	2013
164	Decision support system for emergency management: Road tunnels	Alvear, Daniel ; Abreu, Orlando ; Cuesta, Arturo ; Alonso, Virginia	2013
173	A continuous approximation approach for assessment routing in disaster relief	Huang, Michael ; Smilowitz, Karen R. ; Balcik, Burcu	2013

ID	Title	Author	Year
190	Post-earthquake emergency assessment of building damage, safety and usability Part 2: Organisation	Anagnostopoulos, S. ; Moretti, M.	2008
227	Design of fault simulator	Gabbar, Hossam A. ; Sayed, Hanaa E. ; Osunleke, Ajiboye S. ; Masanobu, Hara	2009
234	Crowd simulation for emergency response using BDI agents based on immersive virtual reality	Shendarkar, Ameya ; Vasudevan, Karthik ; Lee, Seungho ; Son, Young-Jun	2008
236	A nature-inspired decentralized trust model to reduce information unreliability in complex disaster relief operations	Kostoulas, Dionysios ; Aldunate, Roberto ; Pena Mora, Feniosky ; Lakhera, Sanyogita	2008
255	Group value and intention to use – A study of multi-agency disaster management information systems for public safety	Lee, JinKyu ; Bharosa, Nitesh ; Yang, Jing ; Janssen, Marijn ; Rao, H.R.	2011
256	Towards a Lightweight Approach for On-site Interaction Evaluation of Safety-critical Mobile Systems	Holl, Konstantin ; Nass, Claudia ; Villela, Karina ; Vieira, Vaninha	2016
263	Flood Emergency Management Using Hydrodynamic Modelling	Liu, Yongzhi ; Zhang, Wenting ; Cui, Xinmin	2012
273	A general computational recognition primed decision model with multi-agent rescue simulation benchmark	Nowroozi, Alireza ; Shiri, Mohammad E. ; Aslanian, Angeh ; Lucas, Caro	2012
275	Modeling and simulation method of the emergency response systems based on OODA	Huang, Yanyan	2015
284	Developing shared situational awareness for emergency management	Seppänen, Hannes ; Mäkelä, Jaana ; Luokkala, Pekka ; Virrantaus, Kirsi	2013
292	A real-time stochastic evacuation model for road tunnels	Capote, Jorge A. ; Alvear, Daniel ; Abreu, Orlando ; Cuesta, Arturo ; Alonso, Virginia	2013
323	Design of formative evacuation plans using agent-based simulation	Zarboutis, Nikos ; Marmaras, Nicolas	2007
339	Research on Efficiency of Collaborative Allocation System of Emergency Material Based on Synergetic Theory	Dou, LianTGTan ; Sun, Ying ; She, Lian	2012
350	eStorys: A visual storyboard system supporting back-channel communication for emergencies	Malizia, A. ; Bellucci, A. ; Diaz, P. ; Aedo, I. ; Levialdi, S.	2011
371	Detection of undesirable communication patterns in multi-agent systems	Gutiérrez, Celia ; García-Magariño, Iván ; Fuentes-Fernández, Rubén	2011
393	Scenario-based design: A method for connecting information system design with public health operations and emergency management	Reeder, Blaine ; Turner, Anne M.	2011
414	An expert system for an emergency response management in Networked Safe Service Systems	Liu, X. ; Li, W. ; Tu, Y.L. ; Zhang, W.J.	2011
416	A container multimodal transportation scheduling approach based on immune affinity	Hu, Zhi-Hua	2011

ID	Title	Author	Year
	model for emergency relief		
500	Simulation for team training and assessment: case studies of online training with virtual worlds	Heinrichs, WLR ; Youngblood, P ; Harter, PM ; Dev P	2008
556	Obstetric simulation as a risk control strategy: course design and evaluation	Gardner, R ; Walzer, TB ; Simon, R ; Raemer, DB	2008
808	Managing the inconceivable: participatory assessments of impacts and responses to extreme climate change	Toth, FL ; Hizsnyik, E ;	2008
820	Reconstruction and Exploration of Large-scale Distributed Operations – Multimedia tools for Evaluation of Emergency Management Response	Pilemalm, S ; Andersson, D ; Hallberg, N	2008
847	An assessment of activity-based modeling and simulation for applications in operational studies, disaster preparedness, and homeland security	Henson, K ; Goulias, K ; Letters, Golledge, R	2009
936	Defining Team Performance for Simulation-based Training: Methodology, Metrics, and Opportunities for Emergency Medicine	Shapiro, MJ ; Gardner, R ; Jay, GD ; Lindquist, DG ; Salisbury, ML ; Salas, E	2008
980	Development and evaluation of ontology for intelligent decision support in medical emergency management for mass gatherings	Haghighi, PD ; Burstein, F ; Zaslavsky, A ; Arbon, P	2013
1019	Expert system CRIPS: support of situation assessment and decision making	Dellwing, H ; Schmitz, W	2007
1041	A general methodology for data-based rule building and its application to natural disaster management	Rodríguez, JT ; Vitoriano, B ; Montero, J	2012
1165	Utilizing simulation technology for competency skills assessment and a comparison of traditional methods of training to simulation-based training	Tuttle, RP ; Cohen, MH ; Augustine, AJ ; Novotny, DF ; Delgado, E ; Dongilli, TA ; Lutz, JW ; DeVita, MA	2007
1195	The workpad user interface and methodology: Developing smart and effective mobile applications for emergency operators	Humayoun, SR ; Catarci, T ; deLeoni, Massimiliano ; Marella, A ; Mecella, Massimo ; Bortenschlager, M ; Steinmann, R	2009
1420	Community Assessment for Public Health Emergency Response (CASPER): An Innovative Emergency Management Tool in the United States.	Schnall, Amy ; Nakata, Nicole ; Talbert, Todd ; Bayleyegn, Tesfaye ; Martinez, DeAndrea ; Wolkin, Amy	2017
1421	Short simulation exercises to improve emergency department nurses' self-efficacy for initial disaster management: Controlled before and after study.	Jonson, Carl-Oscar ; Pettersson, Jenny ; Rybing, Jonas ; Nilsson, Helene ; Prytz, Erik	2017
1424	Public Health System Research in Public Health Emergency Preparedness in the United States (2009—2015): Actionable knowledge base.	Savoia, Elena ; Lin, Leesa ; Bernard, Dottie ; Klein, Noah ; James, Lyndon P. ; Guicciardi, Stefano	2017

ID	Title	Author	Year
1427	Interactive plant simulation modeling for developing an operator training system in a natural gas pressure-regulating station.	Yongseok Lee ; Changjun Ko ; Hodong Lee ; Kyeongwoo Jeon ; Seolin Shin ; Chonghun Han	2017
1431	Traffic evacuation simulation based on multi-level driving decision model.	Yuan, Shengcheng ; Chun, Soon Ae ; Spinelli, Bruno ; Liu, Yi ; Zhang, Hui ; Adam, Nabil R.	2017
1437	Identifying and explicating knowledge on method transfer: a sectoral system of innovation approach.	Hvannberg, Ebba	2015
1439	A 3-year Health Care Coalition Experience in Advancing Hospital Evacuation Preparedness.	Lowe, John J. ; Hansen, Keith F. ; Sanger, Kristine K. ; Obaid, Jannah M.	2016
1449	A dynamic model for disaster response considering prioritized demand points.	Rivera-Royero, Daniel ; Galindo, Gina ; Yie-Pinedo, Ruben	2016
1457	Influencing Factors on Social Media Adoption in County-level Emergency Management Departments.	Schuwerk, Tara J. ; Davis, Allison	2013
1465	Testing a methodology to improve organisational learning about crisis communication by public organisations.	Palttala, Paulina ; Vos, Marita	2011
1478	Multi-purpose 3-D Real Estate: Understanding the Role of 3-D Technology for Enhancing Resilience	Christensen, Pernille H. ; McIlhatton, David ; Blair, Neale ; Grunninger Bonney, Courtney	2016
1484	A Simulation Tool for Examining the Effect of Communications on Disaster Response in the Oil and Gas Industry.	Singh, Arvind ; Adams, Richelle ; Dookie, Isa ; Kissoon, Shiva	2016
1489	Data Model Development for Fire Related Extreme Events – An Activity Theory and Semiotics Approach	Chen, Rui ; Sharman, Raj ; Rao, H. Raghav ; Upadhyaya, Shambhu J.	2013
1513	Using Twitter in crisis management for organisations bearing different country-of-origin perceptions.	Xu, Jie ; Wu, Yiye	2015
1514	High Fidelity Simulation to Evaluate Emergency Management in Urgent Care Centers.	Tabor, Megan ; Vaughn, Brooke L.	2017
1520	Challenges in coordination: differences in perception of civil and military organisations by comparing international scientific literature and field experiences.	Pramanik, Roshni	2015
1521	The creation of a training model to support decision-making of emergency management practitioners: A design research study.	McCarthy, Nora ; Neville, Karen ; Pope, Andrew ; Gallagher, Anthony ; Nussbaumer, Alexander ; Steiner, Christina M.	2016
1524	Towards the development of a decision support system for multi-agency decision-making during cross-border emergencies.	Neville, Karen ; O'Riordan, Sheila ; Pope, Andrew ; Rauner, Marion ; Rochford, Maria ; Madden, Martina ; Sweeney, James ; Nussbaumer, Alexander ; McCarthy, Nora ; OÃ¢â‚¬Ëœ Brien, Cian	2016

ID	Title	Author	Year
1535	Impact of an Education Intervention on Missouri K-12 School Disaster and Biological Event Preparedness.	Rebmann, Terri ; Elliott, Michael B. ; Artman, Deborah ; VanNatta, Matthew ; Wakefield, Mary	2016
1543	Team regulation in a simulated medical emergency: An in-depth analysis of cognitive, metacognitive, and affective processes.	Duffy, Melissa C. ; Azevedo, Roger ; Sun, Ning-Zi ; Griscom, Sophia E. ; Stead, Victoria ; Crelinsten, Linda ; Wiseman, Jeffrey ; Maniatis, Thomas ; Lachapelle, Kevin	2015
1548	Increasing emergency medicine residents' confidence in disaster management: use of an emergency department simulator and an expedited curriculum.	Franc, Jeffrey Michael ; Nichols, Darren ; Dong, Sandy L	2012
1557	Educating the Next Generation to Respond to a Bioterrorism Event.	Sobel, Annette L. ; Fisher, Beth M.	2012
1560	Context-Specific, Scenario-Based Risk Scales.	Yu, Michael ; Lejarraga, Tomás ; Gonzalez, Cleotilde	2012
1573	25 Years of MCDA in nuclear emergency management.	Papamichail, K. Nadia ; French, Simon	2013
1580	Relationships Between Mental Health Distress and Work-Related Factors Among Prefectural Public Servants Two Months After the Great East Japan Earthquake.	Fukasawa, Maiko ; Suzuki, Yuriko ; Obara, Akiko ; Kim, Yoshiharu	2015
1581	Investing in Disaster Management Capabilities versus Pre-positioning Inventory: A New Approach to Disaster Preparedness	Kunz, Nathan ; Reiner, Gerald ; Gold, Stefan	2014
1582	Proposing “the burns suite” as a novel simulation tool for advancing the delivery of burns education.	Sadideen, Hazim ; Wilson, David ; Moiemen, Naiem ; Kneebone, Roger	2014
1583	Using Real-Time Decision Tools to Improve Distributed Decision-Making Capabilities in High-Magnitude Crisis Situations.	Moskowitz, Herbert ; Drnevich, Paul ; Ersoy, Okan ; Altinkemer, Kemal ; Chaturvedi, Alok	2011
1587	Disaster Preparedness in Philippine Nurses.	Labrague, Leodoro J. ; Yboa, Begonia C. ; McEnroe-Petitte, Denise M. ; Lobrino, Ledwin R. ; Brennan, Mary Geronima B.	2016
1592	Examining the Role of Social Media in Effective Crisis Management: The Effects of Crisis Origin, Information Form, and Source on Publics’ Crisis Responses.	Jin, Yan ; Liu, Brooke Fisher ; Austin, Lucinda L.	2014
1593	Mechanisms of Control in Emergent Interorganisational Networks.	Marcum, Christopher Steven ; Bevc, Christine A. ; Butts, Carter T.	2012
1594	Does message placement influence risk perception and affect?	Lachlan, Kenneth ; Spence, Patric R.	2014
1603	Improving Communication in Crisis Management by Evaluating the Relevance of Messages.	Netten, Niels ; van Someren, Maarten	2011

ID	Title	Author	Year
1604	Applying Analytical Hierarchy Process to Supplier Selection and Evaluation in the Hospitality Industry: A Multiobjective Approach	Chung, Kaie-Chin	2015
1606	The use of emergency operations centres in local government emergency management.	Sinclair, Helen ; Doyle, Emma E.H. ; Johnston, David M. ; Paton, Douglas	2013
1607	Assessing and improving cross-border chemical incident preparedness and response across Europe.	Stewart-Evans, James ; Hall, Lisbeth ; Czerczak, Slawomir ; Manley, Kevin ; Dobney, Alec ; Hoffer, Sally ; Palaszewska-Tkacz, Anna ; Jankowska, Agnieszka	2014
1616	Training and learning for crisis management using a virtual simulation/gaming environment.	Walker, Warren E. ; Giddings, Jordan ; Armstrong, Stuart	2011
1622	Team Coordination in Escalating Situations: An Empirical Study Using Mid-Fidelity Simulation	Bergstöm, Johan ; Dahlström, Nicklas ; Henriqson, Eder ; Dekker, Sidney	2010
1630	Crisis Management Dilemmas: Differences in Attitudes towards Reactive Crisis Communication Strategies among Future Business Professionals in Croatia	Tipuric, Darko ; Skoko, Bozo ; Jugo, Damir ; Mesin, Marina	2013
1631	Engineering Trust in Complex Automated Systems.	Lyons, Joseph B. ; Koltai, Kolina S. ; Ho, Nhut T. ; Johnson, Walter B. ; Smith, David E. ; Shively, R. Jay	2016
1632	Psychological Effects of Disaster Relief Activities on Japan Ground Self-Defense Force Personnel Following the 2011 Great East Japan Earthquake.	Dobashi, Kosuke ; Nagamine, Masanori ; Shigemura, Jun ; Tsunoda, Tomoya ; Shimizu, Kunio ; Yoshino, Aihide ; Nomura, Soichiro	2014
1644	Jordanian nurses' perceptions of their preparedness for disaster management.	Al Khalaileh, Murad A. ; Bond, Elaine ; Alasad, Jafar A.	2012
1648	A priority driven ABC approach to the emergency management of high energy pelvic trauma improves decision making in simulated patient scenarios.	Daurka, Jasvinder S. ; Rankin, Iain ; Jaggard, M.K.J. ; Lewis, Angus	2015
1652	Validity evidence of non-technical skills assessment instruments in simulated anaesthesia crisis management.	Jirativanont, T. ; Raksamani, K. ; Aroonpruksakul, N. ; Apidechakul, P. ; Suraseranivongse, S.	2017
1658	The effect of a simulation-based training intervention on the performance of established critical care unit teams.	Frengley RW ; Weller JM ; Torrie J ; Dzendrowskyj P ; Yee B ; Paul AM ; Shulruf B ; Henderson KM	2011
1659	Interprofessional non-technical skills for surgeons in disaster response: A qualitative study of the Australian perspective.	Willems, Anneliese ; Waxman, Buce ; Bacon, Andrew K. ; Smith, Julian ; Peller, Jennifer ; Kitto, Simon	2013
1675	Atmospheric dispersion and impact modeling systems: How are they perceived as support tools for nuclear crises management?	Benamrane, Yasmine ; Boustras, Georgios	2015
1677	REACT: A paraprofessional training program for	Marks, Madeline R. ; Bowers, Clint ; DePesa, Natasha S. ; Trachik, Benjamin ; Deavers, Frances	2017

ID	Title	Author	Year
	first responders-A pilot study.	E. ; James, Nicholas T.	
1681	Crisis Leadership in an Acute Clinical Setting: Christchurch hospital, New Zealand ICU Experience Following the February 2011 Earthquake.	Zhuravsky, Lev	2015
1682	Building health care system capacity to respond to disasters: successes and challenges of disaster preparedness health care coalitions.	Walsh, Lauren ; Craddock, Hillary ; Gulley, Kelly ; Strauss-Riggs, Kandra ; Schor, Kenneth W	2015
1687	Development and evaluation of an offshore oil and gas Emergency Response Focus Board	Taber, Michael J. ; McCabe, John ; Klein, Raymond M. ; Pelot, Ronald P.	2013
1688	The Emerging Role of Higher Education in Educating and Assessing Future Leaders for Disaster Relief.	Buschlen, Eric ; Goffnett, Sean	2013
1697	Assessment of the reliability of the Johns Hopkins/Agency for Healthcare Research and Quality hospital disaster drill evaluation tool.	Kaji AH ; Lewis RJ	2008
1699	The Rapid Disaster Evaluation System (RaDES): A Plan to Improve Global Disaster Response by Privatizing the Assessment Component.	Iserson, Kenneth V.	2017
1701	The Role of Law in Public Health Preparedness: Opportunities and Challenges.	Jacobson, Peter D. ; Wasserman, Jeffrey ; Botoseneanu, Anda ; Silverstein, Amy ; Wu, Helen W.	2012
1704	The effectiveness of a disaster training programme for healthcare workers in Greece.	Bistaraki, A. ; WaddinTGTon, K. ; Galanis, P.	2011
1705	Knowledge, Experiences and Training Needs of Health Professionals about Disaster Preparedness and Response in Southwest Ethiopia: a cross sectional study.	Berhanu, Negalign ; Abrha, Hailay ; Ejigu, Yohannes ; Woldemichael, Kifle	2016
1714	Culpable leaders, trust, emotional exhaustion, and identification during a crisis.	Kovoor-Misra, Sarah ; Gopalakrishnan, Shanthi	2016
1717	Learning crisis resource management: Practicing versus an observational role in simulation training – a randomized controlled Trial.	Lai, Anita ; Haligua, Alexis ; Dylan Bould, M. ; Everett, Tobias ; Gale, Mark ; Pigford, Ashlee-Ann ; Boet, Sylvain	2016
1718	A Socio-Physical Approach to Systemic Risk Reduction in Emergency Response and Preparedness.	Ross, William ; Gorod, Alex ; Ulieru, Mihaela	2015
1722	How Simple Hypothetical-Choice Experiments Can Be Utilized to Learn Humans' Navigational Escape Decisions in Emergencies.	Haghani, Milad ; Sarvi, Majid ; Shahhoseini, Zahra ; Boltes, Maik	2016
1723	Disaster spread simulation and rescue time optimization in a resource network.	Hu, Zhi-Hua ; Sheng, Zhao-Han	2015
1727	A survey of the practice of nurses' skills in Wenchuan earthquake disaster sites:	Yin, Huahua ; He, Haiyan ; Arbon, Paul ; Zhu, Jingci	2011

ID	Title	Author	Year
	implications for disaster training.		
1728	Health worker and policy-maker perspectives on use of intramuscular artesunate for pre-referral and definitive treatment of severe malaria at health posts in Ethiopia.	Kefyalew, Takele ; Kebede, Zelalem ; Getachew, Dawit ; Mukanga, David ; Awano, Tessema ; Tekalegne, Agonafer ; Batisso, Esey ; Edossa, Wasihun ; Mekonnen, Emebet ; Tibenderana, James ; Baba, Ebenezer Sheshi ; Shumba, Constance ; Nankabirwa, Joaniter I. ; Hamade, Prudence	2016
1764	Full-scale regional exercises: Closing the gaps in disaster preparedness.	Klima DA ; Seiler SH ; Peterson JB ; Christmas AB ; Green JM ; Fleming G ; Thomason MH ; Sing RF	2012
1785	Computer-based collaborative training for transportation security and emergency response	Velasquez, Juan D. ; Yoon, Sang Won ; Nof, Shimon Y.	2010
1803	A Review of Critical Infrastructure Interdependency Simulation and Modelling for the Caribbean.	Dookie, Isa Jeziah ; Singh, Arvind ; Pooransingh, Akash ; Rocke, Sean	2016
1815	Emergency nurses and disaster response: An exploration of South Australian emergency nurses' knowledge and perceptions of their roles in disaster response.	Hammad, Karen S. ; Arbon, Paul ; Gebbie, Kristine M.	2011
1818	Multievent Crisis Management Using Noncooperative Multistep Games.	Gupta, Upavan ; Ranganathan, Nagarajan	2007
1825	Physical and mental health status of soldiers responding to the 2008 Wenchuan earthquake.	Wei Qiang Zhang ; Chaojie Liu ; Tian Sheng Sun ; Jing Zhao ; Ju Qiang Han ; Yong Hong Yang ; Shu Jun Li ; Ya Qun Ma	2011
1826	Burn Disaster Response Planning in New York City: Updated Recommendations for Best Practices.	Leahy, Nicole E ; Yurt, Roger W ; Lazar, Eliot J ; Villacara, Alfred A ; Rabbitts, Angela C ; Berger, Laurence ; Chan, Carri ; Chertoff, Laurence ; Conlon, Kathe M ; Cooper, Arthur ; Green, Linda V ; Greenstein, Bruce ; Lu, Yina ; Miller, Susan ; Mineo, Frank P ; Pruitt, Darrin ; Ribaudo, Daniel S ; Ruhren, Chris ; Silber, Steven ; Soloff, Lewis	2012
1827	The impact of an online interprofessional course in disaster management competency and attitude towards interprofessional learning.	Atack L ; Parker K ; Rocchi M ; Maher J ; Dryden T	2009
1859	Teaching Critical Management Skills to Senior Nursing Students: Videotaped or Interactive Hands-On Instruction?	Baxter, Pamela ; Akhtar-Danesh, Noori ; Landeen, Janet ; Norman, Geoff	2012
1864	Development, initial reliability and validity testing of an observational tool for assessing technical skills of operating room nurses.	Sevdalis N ; Undre S ; Henry J ; Sydney E ; Koutantji M ; Darzi A ; Vincent CA	2009
1874	Barriers to implementing infection prevention and control guidelines during crises: Experiences of health care professionals.	Timen A ; Hulscher ME ; Rust L ; van Steenbergen JE ; Akkermans RP ; Grol RP ; van der Meer JW	2010

ID	Title	Author	Year
1880	Leaders as emotional managers: Emotion management in response organisations during a hostage taking in a Swedish prison.	Alvinius, Aida ; Boström, Malin Elfgren ; Larsson, Gerry	2015
1882	Using pictograms for communication.	Clawson TH ; Leafman J ; Nehrenz GM Sr ; Kimmer S	2012
1885	The Disaster Preparedness Evaluation Tool: psychometric testing of the Classical Arabic version.	Al Khalaileh MA ; Bond AE ; Beckstrand RL ; Al-Talafha A	2010
1888	Impact of crisis resource management simulation-based training for interprofessional and interdisciplinary teams: A systematic review.	Fung, Lillia ; Boet, Sylvain ; Bould, M. Dylan ; Qosa, Haytham ; Perrier, Laure ; Tricco, Andrea ; Tavares, Walter ; Reeves, Scott	2015
1893	Manifest leadership styles in a Caribbean cross-sector network.	Cooper, Tracy	2016
1913	The Borsele files: the challenge of acquiring usable data under chaotic circumstances.	Gouman, Rianne ; Kempen, Masja ; Van der Heijden, Eddy ; Wijngaards, Niek ; De Vree, Philip ; Capello, Toon	2008
1894	A controlled before-and-after evaluation of a mobile crisis partnership between mental health and police services in Nova Scotia.	Kisely, Stephen ; Campbell, Leslie Anne ; Peddle, Sarah ; Hare, Susan ; Pyche, Mary ; Spicer, Don ; Moore, Bill	2010
1927	Using Monte Carlo simulation to refine emergency logistics response models: a case study.	Ruth Banomyong, Apichat Sopadang	2010
1930	Interprofessional team dynamics and information flow management in emergency departments.	Gilardi, Silvia ; Guglielmetti, Chiara ; Pravettoni, Gabriella	2014
1936	Assessing the reliability and the expected performance of a network under disaster risk.	Günneç, D, Dilek ; Salman, F.	2011
1949	A reassessment and review of the Bam earthquake five years onward: what was done wrong?	Motamedia MHK ; Saghafinia M ; Bafarani AH ; Panahi F	2009
1950	Parameter-Based Data Aggregation for Statistical Information Extraction in Wireless Sensor Networks.	Jiang, Hongbo ; Jin, Shudong ; Wang, Chonggang	2010
1953	Toward the regulation of ubiquitous mobile government: a case study on location-based emergency services in Australia.	Aloudat, Anas ; Michael, Katina	2011
1964	A decision support system for debris-flow hazard mitigation in towns based on numerical simulation: a case study at Dongchuan, Yunnan Province.	Fangqiang Wei ; Kaiheng Hu ; Peng Cui ; Qun Guan	2008
1966	Creating order from chaos: part I: triage, initial care, and tactical considerations in mass casualty and disaster response.	Baker MS	2007
1980	An emergency logistics response system for natural disasters.	Tovia, F.	2007

ID	Title	Author	Year
1998	Developing shared situational awareness for emergency management.	Seppänen, Hannes ; Mäkelä, Jaana ; Luokkala, Pekka ; Virrantaus, Kirsi	2013
1999	Dynamic decision support for managing regional resources: Mapping risk in Allegheny County, Pennsylvania.	Chalfant, Brian A. ; Comfort, Louise K.	2016
2000	Emergency crowd evacuation modeling and simulation framework with cellular discrete event systems.	Jafer, Shafagh ; Lawler, Ryan	2016
2015	Supporting collaborative sense-making in emergency management through geo-visualization.	Wu, Anna ; Convertino, Gregorio ; Ganoe, Craig ; Carroll, John M. ; Zhang, Xiaolong (Luke)	2013
2022	An optimization approach for ambulance location and the districting of the response segments on highways	Iannoni, Ana Paula ; Morabito, Reinaldo ; Saydam, Cem	2009
2026	Two complementary mobile technologies for disaster warning.	Samarajiva, Rohan ; Waidyanatha, Nuwan	2009
2030	"G.A.T.E": Gap Analysis for TTX evaluation.	Cacciotti, Ilaria ; Di Giovanni, Daniele ; Pergolini, Alessandro ; Malizia, Andrea ; Carestia, Mariachiara ; Palombi, Leonardo ; Bellecci, Carlo ; Gaudio, Pasquale	2016
2037	Big Board: Teleconferencing over maps for shared situational awareness.	Heard, Jefferson ; Thakur, Sidharth ; Losego, Jessica ; Galluppi, Ken	2014
2054	State Mandate Influences on FEMA-Approved Hazard-Mitigation Plans Under the Disaster Management Act of 2000.	Olonilua, Oluponmile	2016
2061	A Procedural Construction Method for Interactive Map Symbols Used for Disasters and Emergency Response.	Guoqiang Peng ; Songshan Yue ; Yuting Li ; Zhiyao Song ; Yongning Wen	2017
2099	Multi-objective evacuation routing optimization for toxic cloud releases.	Gai, Wen-mei ; Deng, Yun-feng ; Jiang, Zhong-an ; Li, Jing ; Du, Yan	2017
2126	Supporting community emergency management planning through a geocollaboration software architecture.	Schafer, Wendy A. ; Ganoe, Craig H. ; Carroll, John M.	2007
2138	Giving meaning to tweets in emergency situations: a semantic approach for filtering and visualizing social data.	Onorati, Teresa ; Díaz, Paloma	2016
2175	Acil durum servislerinin yer seçimi: Analitik Hiyerarşi Yöntemi ve CBS entegrasyonu	Erden, Turan ; Coşkun, Mehmet Zeki	2010
2177	Decentralized Coordination in RoboCup Rescue.	Ramchurn, Sarvapali D. ; Farinelli, Alessandro ; Macarthur, Kathryn S. ; Jennings, Nicholas R.	2010
2194	A dynamic decision support system based on geographical information and mobile social networks: A model for tsunami risk mitigation in Padang, Indonesia.	Ai, Fuli ; Comfort, Louise K. ; Dong, Yongqiang ; Znati, Taieb	2016

ID	Title	Author	Year
2199	Interoperable architecture for joint real/virtual training in emergency management using the MPEG-V standard.	Ardila, Laura ; Pérez-Llopis, Israel ; Esteve, Manuel ; Palau, Carlos E.	2015
2207	Early warning and mass evacuation in coastal cities.	Hissel, François ; Morel, Gilles ; Pescaroli, Gianluca ; Graaff, Herman ; Felts, Didier ; Pietrantoni, Luca	2014
2213	Resource-Poor Settings: Response, Recovery, and Research: Care of the Critically Ill and Injured During Pandemics and Disasters: CHEST Consensus Statement.	Geiling, James ; Burkle Jr, Frederick M ; West, T Eoin ; Uyeki, Timothy M ; Amundson, Dennis ; Dominguez-Cherit, Guillermo ; Gomersall, Charles D ; Lim, Matthew L ; Luyckx, Valerie ; Sarani, Babak ; Christian, Michael D ; Devereaux, Asha V ; Dichter, Jeffrey R ; Kissoon, Niranjan	2014
2216	Do or die--Strategic decision-making following a shock event.	Bonn, Ingrid ; Rundle-Thiele, Sharyn	2007
2220	Application of Traffic Simulation Modeling for Improved Emergency Preparedness Planning.	Sisiopiku, Virginia P.	2007
2233	Training decision-makers in flood response with system dynamics.	Berariu, Romana ; Fikar, Christian ; Gronalt, Manfred ; Hirsch, Patrick	2016
2235	Forming a global monitoring mechanism and a spatiotemporal performance model for geospatial services.	Xia, Jizhe ; Yang, Chaowei ; Liu, Kai ; Li, Zhenlong ; Sun, Min ; Yu, Manzhu	2015
2241	Agent-oriented modeling and development of a system for crisis management.	García-Magariño, Iván ; Gutiérrez Celia	2013
2243	Comparing four operational SAR-based water and flood detection approaches.	Martinis, Sandro ; Kuenzer, Claudia ; Wendleder, Anna ; Huth, Juliane ; Twele, André ; Roth, Achim ; Dech, Stefan	2015
2261	Optimal Path Selection under Emergency Based on the Fuzzy Comprehensive Evaluation Method.	Yunhua Zhu ; Xiao Cai	2015
2262	Cross-domain integrating and reasoning spaces for offsite nuclear emergency response.	Xie, Tian ; Li, Cong-dong ; Wei, Yao-yao ; Jiang, Jian-jun ; Xie, Rui	2016
2267	Geotagging Twitter Messages in Crisis Management.	Ghahremanlou, Lida ; Sherchan, Wanita ; Thom, James a.	2015
2270	Modeling and representation for earthquake emergency response knowledge: perspective for working with geo-ontology.	Xu, Jinghai ; Nyerges, Timothy L. ; Nie, Gaozhong	2014
2272	Emergency Management Decision Making during Severe Weather.	Baumgart, Leigh A. ; Bass, Ellen J. ; Philips, Brenda ; Kloesel, Kevin	2008
2276	Preparing for Emergency Situations.	Asproth, Viveca ; Amcoff Nyström, Christina	2010
2277	Towards a Holistic Framework for the Evaluation of Emergency Plans in Indoor Environments.	Serrano, Emilio ; Poveda, Geovanny ; Garijo, Mercedes	2014
2284	Context-based automatic reconstruction and texturing of 3D urban terrain for quick-response tasks.	Bulatov, Dimitri ; Häufel, Gisela ; Meidow, Jochen ; Pohl, Melanie ; Solbrig, Peter ; Wernerus, Peter	2014

ID	Title	Author	Year
2311	Simulating individual, group, and crowd behaviors in building egress.	Chu, Mei Ling ; Parigi, Paolo ; Law, Kincho H. ; Latombe, Jean-Claude	2015
2325	Supporting synthesis in geovisualization.	Robinson, Anthony C.	2011
2332	Simulating effects of signage, groups, and crowds on emergent evacuation patterns.	Chu, Mei ; Parigi, Paolo ; Latombe, Jean-Claude ; Law, Kincho	2015
2336	Towards A Framework for Simulation-Based Evaluation of Personal Decision Support Systems for Flood Evacuation.	Knyazkov, Konstantin ; Balakhontceva, Marina ; Ivanov, Sergey	2014
2356	Time-history simulation of civil architecture earthquake disaster relief-based on the three-dimensional dynamic finite element method.	Liu Bing ; Qi Yaoguang ; Du Jiyun	2014
2357	The Role of Simulation and Modeling in Disaster Management.	Steward, Duane ; Wan, Thomas	2007
2359	Study of efficiency of USAR operations with assistive technologies.	Hamp, Quirin ; Gorgis, Omar ; Labenda, Patrick ; Neumann, Marc ; Predki, Thomas ; Heckes, Leif ; Kleiner, Alexander ; Reindl, Leonhard M.	2013
2376	Modeling the emergency evacuation of the high rise building based on the control volume model.	Wu, Guan-Yuan ; Huang, Hao-Chang	2015
2378	Building Capacity for Community Disaster Preparedness: A Call for Collaboration Between Public Environmental Health and Emergency Preparedness and Response Programs. (Cover story)	Gamboa-Maldonado, Thelma ; Marshak, Helen Hopp ; Sinclair, Ryan ; Montgomery, Susanne ; Dyjack, David T.	2012
2398	Regional Approach to Competency-Based Patient Care Provider Disaster Training: The Center for Health Professional Training and Emergency Response.	Scott, Lancer A. ; Smith, Clay ; Jones, E. Morgan ; Manaker, L. Wade ; Seymore, Andrew C. ; Fulkerson, Jacob	2013
2401	9. Assessments: Structure, concepts, and methods.	Nordic Societies of Public Health	2014
2406	Modeling IoT-Based Solutions Using Human-Centric Wireless Sensor Networks.	Monares, Álvaro ; Ochoa, Sergio F. ; Santos, Rodrigo ; Orozco, Javier ; Meseguer, Roc	2014
2413	Development and Implementation of an Adapted Evacuation Planning Methodology in the Framework of Emergency Management and Disaster Response: A Case Study Using TransCAD.	Andrews, Steven ; Wang, Haizhong ; Ni, Daiheng ; Gao, Song ; Collura, John	2010
2419	Self-reported preparedness of New Zealand acute care providers to mass emergencies before the Canterbury Earthquakes: A national survey.	Al-Shaqsi, Sultan ; Gauld, Robin ; McBride, David ; Al-Kashmiri, Ammar ; Al-Harthy, Abdullah	2015
2505	Flood susceptibility analysis and its verification using a novel ensemble support vector machine and frequency ratio method.	Tehrany, Mahyat ; Pradhan, Biswajeet ; Jebur, Mustafa	2015
2507	Early Warning System for Disasters within Health Organisations: A Mandatory System for Developing Countries.	Zaboli, Rouhollah ; Seyedin, Seyed Hesam ; Malmoon, Zainab	2013

ID	Title	Author	Year
2528	Preparation and scheduling system of emergency supplies in disasters.	Jia, Liu ; Kefan, Xie	2015
2541	Near optimal allocation strategy for making a staged evacuation plan with multiple exits.	Xie, Jun ; Li, Qiang ; Wan, Qing ; Li, Xiang	2014
2547	14. Implementation, execution, and completion of projects.	Nordic Societies of Public Health	2014
2552	Methodological aspects of the implementation of the new ICRP recommendations.	Raskob, W. ; Landman, C.	2013
2553	Modeling and simulation of stranded passengers' transferring decision-making on the basis of herd behaviors.	Shen, Yang ; Liu, Sifeng ; Fang, Zhigeng ; Hu, Mingli	2012
2575	A Public Health Academic-Practice Partnership to Develop Capacity for Exercise Evaluation and Improvement Planning.	Wright, Kate S. ; Thomas, Michael W. ; Durham, Jr., Dennis P. ; Jackson, Lillie M. ; Porth, Leslie L. ; Buxton, Mark	2010
2580	Distributed Building Evacuation Simulator for Smart Emergency Management.	Dimakis, Nikolaos ; Filippoupolitis, Avgoustinos ; Gelenbe, Erol	2010
2583	Web-Design Evaluation of the Crisis Map of the Czech Republic Using Eye-Tracking.	Brychtova, Alzbeta ; Paszto, Vit ; Marek, Lukas ; Panek, Jiri	2013
2595	A new hybrid evolutionary based RBF networks method for forecasting time series: A case study of forecasting emergency supply demand time series.	Mohammadi, Reza ; Fatemi Ghomi, S.M.T. ; Zeinali, Farzad	2014
2604	Intersection Group Dynamic Subdivision and Coordination at Intraregional Boundaries in Sudden Disaster.	Lin, Ciyun ; Gong, Bowen ; Yang, Zhaosheng ; Qu, Xin	2015
2608	Lessons from Hurricane Sandy: a Community Response in Brooklyn, New York.	Schmeltz, Michael ; GonzÃƒÂ¡lez, Sonia ; Fuentes, Liza ; Kwan, Amy ; Ortega-Williams, Anna ; Cowan, Lisa	2013
2611	Assessing Public Health Capabilities During Emergency Preparedness Tabletop Exercises: Reliability and Validity of a Measurement Tool.	Savoia, Elena ; Testa, Marcia A. ; Biddinger, Paul D. ; Cadigan, Rebecca O. ; Koh, Howard ; Campbell, Paul ; Stoto, Michael A.	2009
2624	Leadership in complex, stressful rescue operations: A quantitative test of a qualitatively developed model.	Sjoberg, Misa ; Wallenius, Claes ; Larsson, Gerry	2011
2628	Operationalizing "resilience" for disaster risk reduction in mountainous Nepal.	Sudmeier, Karen I. ; Jaboyedoff, Michel ; Jaquet, Stephanie	2013
2634	FireGrid: An e-infrastructure for next-generation emergency response support	Han, Liangxiu ; Potter, Stephen ; Beckett, George ; Pringle, Gavin ; Welch, Stephen ; Koo, Sung-Han ; Wickler, Gerhard ; Usmani, Asif ; Torero, José L. ; Tate, Austin	2010
2636	A model for a multi-agency response management system (MARMS) for South Africa.	Pat Reid ; Dewald van Niekerk	2008

ID	Title	Author	Year
2653	Decentralized Dynamic Task Allocation Using Overlapping Potential Games.	Chapman, Archie C. ; Micillo, Rosa Anna ; Kota, Ramachandra ; Jennings, Nicholas R.	2010
2657	Multiobjective Model for Emergency Resources Allocation.	Zhaosheng Yang ; Huxing Zhou ; Xueying Gao ; Songnan Liu	2013
2662	Simulation-assisted burn disaster planning.	Nilsson, Heléne ; Jonson, Carl-Oscar ; Vikström, Tore ; BenTGTsson, Eva ; Thorfinn, Johan ; Huss, Fredrik ; Kildal, Morten ; Sjöberg, Folke	2013
2674	Nato's New Strategic Concept: A Critical View.	Cervera, Rafael Calduch	2011
2675	Developing Disaster Preparedness Competence: An Experiential Learning Exercise for Multiprofessional Education.	Silenas, Rasa ; Akins, Ralitsa ; Parrish, Alan R. ; Edwards, Janine C.	2008
2687	Rallying the Troops: A Four-Step Guide to Preparing a Residency Program for Short-Term Weather Emergencies.	Chow, Grant V. ; Hayashi, Jennifer ; Hirsch, Glenn A. ; Christmas, Colleen	2011
2691	Situation awareness and virtual globes: Applications for disaster management	Tomaszewski, Brian	2011
2719	Task force deployment for big events	Drechsel, J. ; Kimms, A.	2008
2738	Space-enabled information environment for crisis management. Scenario-based analysis and evaluation in an operational environment	Ryzenko, Jakub ; Smolarkiewicz, Marcin	2010
2746	Evaluating the effectiveness of an emergency preparedness training programme for public health staff in China.	Chongjian Wang ; Sheng Wei ; Hao Xiang ; Yihua Xu ; Shenghong Han ; Baaliy Mkangara, Ommari ; Shaofa Nie	2008
2782	Earthquake relief: Iranian nurses' responses in Bam, 2003, and lessons learnt.	Nasrabadi, A. N. ; Naji, H. ; Mirzabeigi, G. ; Dadbakhs, M.	2007
2813	Failure Prevention in Design Through Effective Catalogue Utilization of Historical Failure Events.	Grantham Lough, K. ; Stone, R. ; Tumer, I.	2008
2815	A contingency model of decision-making involving risk of accidental loss	Rosness, Ragnar	2009
2823	Teaching the NIATx Model of Process Improvement as an Evidence-Based Process.	Evans, Alyson C. ; Rieckmann, Traci ; Fitzgerald, Maureen M. ; Gustafson, David H.	2007
2836	Resolving crises through automated bilateral negotiations	Kraus, Sarit ; Hoz-Weiss, Penina ; Wilkenfeld, Jonathan ; Andersen, David R. ; Pate, Amy	2008
2858	Disaster Readiness: A Community - University Partnership.	Adams, Lavonne M. ; Canclini, Sharon B.	2008
2554	Sustainable Measures in Rebuilding After Disasterpaper.	Veronescu, Otilia ; Szitar, Mirela	2012
2592	Advances in Drama Theory for Managing Global Hazards and Disasters. Part I: Theoretical Foundation.	Levy, Jason K. ; Hipel, Keith W. ; Howard, N.	2009

Annex 3 – Lessons learnt from experiments conducted in the initial DRIVER+ phase

This annex provides insight into the challenges identified in **D610.1** (5) mentioned in section 3. Besides, it serves as an example of a template developed to collect experiences or lessons identified and/or learnt from past experiments.

Table A4: Identified challenges

Preparation and design	Experiment execution	Experimentation approach and methodology
Ensuring appropriate RQ and data collection.	Maintaining and ensuring effective communication.	Designing and executing an end-user driven solution evaluation.
Ensuring timely and appropriate availability of representative volunteer groups.	Defining and agreeing on the role of participants.	Implementing an ad hoc methodology.
Ensuring timely and appropriate involvement of all relevant participants.	Respecting the different levels of experiences of involved participants.	Evaluating experiments.
Ensuring the creation of a realistic and useful scenario.		
Ensuring proper adaption, interoperability and implementation of technical solutions to the scenario.		

Some general lessons learnt were also derived as shown in Table A5 below.

Table A5: General lessons learnt

Preparation and Design	Experiment Execution	Experimentation Approach and Methodology
Stronger involvement of end-users in the early phases of experiment preparation.	Roles, responsibilities and training must be decided and agreed upon in the preparation phases.	The evaluation should be dependent on the overall methodology.
Organisation of regular meetings and agreements (e.g. sharp deadlines) with all relevant stakeholders.	Bilingual computer assistants, as well as local translators are the key to overcome communication constraints.	Apply a robust frame of reference for the activities.
Replay a real disaster to ensure realistic conditions, data, extent and practice.	Extend and reinforce DRIVER+ terminology.	Include feedback rounds with the participants during or after the experiments.
Ensure alignment between the scenario and the solutions.	Keep the scenario simple with a limited number of solutions.	
Agree on the scenario early enough to allow efficient planning.	Have an appropriate physical environment for the experiments.	

Example of a lessons learnt template.

Table A6: Lessons learnt template

Experiments 32	**Toolkit for community based psychosocial support, toolkit for sport & physical activity based psychosocial support, toolkit for preparedness of volunteers**
Experiment objectives	Test and validate existing tools for strengthening individual and volunteer resilience. Provide recommendations for improvement of existing concepts and tools based on the experimental results. Address the level of individuals in disaster management, by focusing on improved individual and volunteer resilience. A total of three toolkits were tested in **WP932**: 1. Community based psychosocial support toolkit – training of trainers. This training is built on the Community-based Psychosocial Training Kit and gives participants insight into aspects of the psychosocial impact of disasters and orientates them to psychosocial support activities and facilitating psychosocial workshops. Through a participatory approach, this training will familiarize participants with the Community-based Psychosocial Training Kit and the following subjects: Crisis Events and Psychosocial Support; Stress and Coping; Loss and Grief; Community-based Psychosocial Support; Psychological First Aid and Supportive Communication; Children; Supporting staff and Volunteers. It further introduces didactic and pedagogical teaching methods, enabling participants to conduct training of trainers. 2. Sports and physical activities as Psychosocial Support intervention in disasters toolkit – training of trainers This training focuses on using sports and physical activities as a tool for psychosocial support. Combining psychosocial support and sport and physical activities can universally benefit diverse groups across cultures and geography. However it is crucial that activities are conducted in a way that respects local cultures and traditions. A holistic, inclusive approach with attention to socio-cultural appropriateness is at the core of this handbook. A European focus with global outreach makes it applicable in many different settings and geographical contexts. 3. Caring for volunteers' toolkit – training of volunteers (not ToT). As psychosocial support has become an integrated activity in many National Societies, we have experienced an increasing number of requests for guidelines and tools on how to help our own volunteers and staff. In other words, how we should put on our own oxygen mask first before helping others, as they say on the airplane. This training provides a thorough introduction to the "Caring for Volunteers, a Psychosocial Support Toolkit," which will help National Societies not only prepare volunteers but also support them during and after disasters, conflicts and other dramatic events. Participants will familiarize themselves with practical tools for preparing for and handling crises, as well as for peer support and communication. In addition, they will gain an understanding of how to

Experiments 32	Toolkit for community based psychosocial support, toolkit for sport & physical activity based psychosocial support, toolkit for preparedness of volunteers
	monitor and evaluate volunteers' efforts.
Research questions	*Overall research question: Is the cascading model[42] an effective method for transferring psychosocial knowledge and skills to volunteers in crisis management organisations?* *Specific research question 1 (EXPE 32.1): Is the cascading model an effective method for transferring knowledge and skills related to community-based psychosocial support through three tiers of volunteers in crisis management organisations?* *Specific research question 2 (EXPE 32.1): Is the cascading model an effective method for transferring knowledge and skills related to sports and psychosocial support through two tiers volunteers in crisis management organisations?*
Experiment planning and deviations	Experiment preparation: September 2014 – March 2015 Run experiment: May 2015-February 2016 Interpret evidence: November 2015- April 2016 Conclusions: April-June 2016
Methods	Mixed approach
Key Performance Indicators (KPIs)	n/a
Data collection plan	The data collection methods used in the two experiments included a combination of qualitative (observations, semi-structured interviews and focus group discussions) and quantitative (questionnaires) methods. Two types of questionnaires were used in the experiments: reactionnaires and pre-post-tests. Reactionnaires are used to measure reaction to trainings through a combination of open-ended and closed questions, and pre-post-test are used to measure learning. *Details available **D320.1**: due to the complexity and variety of methods a full explanation cannot be provided here The same applies to data analysis.*
Data analysis	
Ethical procedures	Informed consent (no ethical approval from the Danish Data Protection Authority Needed).

[42] The cascading model of training consists of a maximum of three tiers or levels of training, in which a master trainer teaches in depth knowledge on a specific topic along with facilitation techniques and methodologies on how to deliver trainings to other participants. Participants at the first tier have experience in the topic of the training and they are be able to, after taking part in the training of trainers, transfer the knowledge to a new group of participants in a basic training. This second group of participants can then directly facilitate the activities or interventions they have been trained in during their basic training, to a new group of community members or volunteers.

Experiments 32	Toolkit for community based psychosocial support, toolkit for sport & physical activity based psychosocial support, toolkit for preparedness of volunteers
Results	The key findings from the two experiments are that the cascading model is an effective model for transferring psychosocial knowledge to volunteers and at the same time, the two training solutions are effective in transferring psychosocial knowledge to volunteers from crisis management organisations. Using Kirkpatrick's model for evaluation of trainings, the analysis has focused on reaction, learning and confidence of trained volunteers on the one hand, and their ability to implement what they have learnt on the other.
Methodological Lessons Learnt	Most challenging aspect: the process of the recruitment of the volunteers and language challenges. The experiments were conducted in two different cultural contexts, which has produced interesting results but also required extensive resources. The trainings built the capacity of volunteers and benefited of the language and cultural of knowledge of volunteers. However, as the experiment templates were developed in English, despite of the use of professional as well as in-house translation from MDA, resources had to be allocated for the translation of documents.

Annex 4 – Examples illustrating the use of the TGM

This annex provides a number of examples of executing the various steps within the TGM. These examples have been clustered in alignment with the three phases of a Trial and in fact illustrate the activities that are described in the main text of this deliverables (Sections 6, 7 and 8).

Examples related to Trial Preparation

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 the 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.

Preparation phase – Formulate research questions

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

- 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 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?

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 organise:

- 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 (are they relevant and complete?), as well as the number of misunderstandings and errors (are data 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 the above-described 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 with their legacy systems. In this way it is also possible to compare with previous situations.

Preparation phase: Formulate evaluation approaches and metrics

After deciding which data can and will be collected, Peter formulates specific evaluation approaches in order to analyse the Trial in a proper manner. Here, Peter needs to fulfil 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 trialled 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 analyse 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 analyses 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).

Preparation phase: Formulate scenario[43]

Peter thinks about which aspects 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: which 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.

[43] 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.

Characteristics of the scenario that he wants to include are:

- 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.

Societal Impact Aspects[44]

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 learnt. 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 COP solution for Trialling 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.

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

[44] Societal Impact Aspects are outlined in Annex 5.

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 and considerations 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?

Examples related to Trial Execution

Execution phase: Dry Run 1

Peter wants to test the design of the Trial in the first 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 Dry Run 1, 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 behaviour 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 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.

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.

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, analysed 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.

Examples related to Trial Evaluation

Evaluation phase: Data collection check

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

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.

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 learnt that the COP tool supported the teams in communicating information. It was faster and fewer errors were made. They also learnt of some disadvantages of 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 learnt 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.

Annex 5 – Background of the SIA methodology

The key idea behind the SIA framework is that CM *functions* (such as data collection) are assessed against a set of impact *criteria* (such as transparency). Table A7 describes the current list of 25 societal impact criteria. In order to facilitate a structured thinking about societal impacts, the different criteria are organised according to impacts of *secondary in/securities*, *core societal and ethical principles*, *sustainability*, *political and administrative principles*, *legitimacy*, *legal values* and particularly relevant *fundamental rights*. In order to facilitate a structured thinking about societal impacts, the different criteria are organised according to impacts of *secondary in/securities*, *core societal and ethical principles*, *sustainability*, *political and administrative principles*, *legitimacy*, *legal values* and particularly relevant *fundamental rights*.

Table A7: The current list of SIA criteria

Secondary in/securities	**Core societal & ethical principles**
Unease – Calmness	Social Cohesion & Solidarity
Suspicion – Trust	Participation
Misuse - Protection	Diversity
New Vulnerabilities - Progress	Open - Control Society
Technology Dependency - Flexible Solutions	Cultural & Gender Sensitivity
Function Creep - Specialized and Controlled Use	
	Legal values
Sustainability	Suitability, Necessity & Proportionality
Sustainability	In/justice & In/equality
Political & administrative principles	**Fundamental Rights**
Accountability	Dignity /Autonomy
Transparency	Non-Discrimination
Integrity	Privacy & Data Protection
Negative - Positive Standardization	Freedoms & Protest
International Cooperation	
Legitimacy	
State-Citizen-Relationship	
Political Reputation	

The criteria listed above were developed through an iterative process with several steps. This process is described in detail in section 3.3 of **D840.11**, but a short version is given below. The criteria in the table above are also largely reflected in what the ELSI- guidance defines as “Key Terms” relevant for iterative ethical impact and privacy impact assessment. The very onset for choosing the criteria was the indications in the DoW of the initial project phase, which asked for assessment criteria to organise a general evaluation of the unease, fear, insecurity or secondary risks that CM activities can produce.

It furthermore asked to use these criteria to assess side-effects to societal values. Based on this, a first list of criteria was developed. Furthermore, the list of assessment criteria could be practically endless. Any

culture, any societal context or group may be organised around different key principles and criteria[45]. As a consequence, it was crucial to strike the right balance between having enough criteria to cover a wide range of impacts, and at the same time not too many criteria, that means a concise number of criteria to make SIA graspable and constructive. It was also a key finding that the selected criteria allowed for meaningful assessments both of the DRIVER+ functions in particular, but also for European CM in general. The policy- relevance of the criteria was confirmed through **D93.1** (19) (submitted in M8), were they were validated through a systematic screening of different UN, EU, and RCRC CM policy documents**.** During and after the second meeting of the DRIVER+ Ethical and Societal Advisory Board in October 2015, the criteria (as well as the complete SIA methodology) were refined and revised into the current set.

[45] One could for example ask: How are the criteria relevant to different European Societies? How do they relate to different concepts of societal security? How do the criteria function in different societal, historical and cultural contexts?

Annex 6 – The Trial Action Plan (TAP)

The first version of Trial Action Plan (TAP) was created during the DRIVER+ project to serve the role of a main Trial planning and preparing document. It covers all areas related to the Trial organisation and will be used to record efforts, circulate decisions and assess progress. Its secondary role, limited for in-project use, is to serve as internal progress reporting deliverable, delivered in the second half of each Trial preparation period. The TAP's fundamental role is to: **facilitate collaborative planning** and to **support combined execution**. It should be considered as a support tool facilitating the Trial management. It is designed to be used as a living document (document being continually edited and updated by multiple authorised authors). It means that the document is in continuous up-date in line with new decisions and actions being realized in the course of preparation work of the Trial Committee and other involved stakeholders. This approach allows collecting all important arrangements, conclusions and effects of work, thus constituting the TAP as repository (also a coordination and information sharing tool) available to all DRIVER+ partners. The document is provided in a form of a self-descriptive template with completion guidelines that also links the user with DRIVER+ methodological documents. Moreover, it supports the application of DRIVER+ methodology. It accommodates or cites all the decisions of Trial Committee concerning the methodological aspects of Trial preparation. This includes: description of gaps selected for the Trial, general and specific research questions the Trial will respond to, the solution selection process and its results, initially identified key performance indicators for selected solutions evaluation, data collection, evaluation approaches and metrics and general scenario formulation.

Trial Action Plan – Completion schedule

Trial Action Plan has its own progress monitoring aid: the TAP completing schedule (presented as a graph below). It precisely explains the logical systematisation of progressing with Trial preparation and execution and suggests the correct order of advancements.

Figure A4: TAP completion schedule

The TAP is composed of 9 sections. A short summary of the sections is provided below:

Section 1 is used as introduction to TAP completion and consists of two subsections: a short explanation of Trial completion process, followed by suggested document review and progress monitoring system.

C2 is meant to be completed in advance. Its aim is to facilitate precise formulation of the Trial objectives during the initial phase of design. It should be very consistent and oriented to identify the Trial primal purpose and listing the goals. Contrary to any other parts of the document, the second section should be frozen before proceeding to next stages of Trial preparation. However, it is recommended to further use its contents to advertise the Trial before prospective contributors and participants.

C3 aggregates the outcomes of methodologically driven Trial set-up. It consists of:

List of selected and validated GAPs.

1. Trial Objectives (specific).
2. Research questions.

3. Data collection plan – method and outline.
4. Analysis Techniques.
5. Initial scenario for Call for Application.
6. Solution selection process - call for application formulation, announcement method and the results: list of selected solutions.

C4 accommodates the Trial planning and project management aspects. It consists of: division of responsibilities, Trial command structure, timeline of preparatory activities, risk assessment and contingency planning.

The practical aspects of a Trial are captured in **C5** and **C6**. The difference between the two is that C6 focuses more on the solutions, including KPIs and models of solution interactions, while C5 describes the local platform, meaning all systems used in Trials that are not considered as solutions (neither legacy nor innovative tools).

C7 is dedicated to the scenario. It begins from baseline information as justification for the theme selection, aimed level of realism and description of the reference baseline (how the scenario alike will currently be managed). Then Trial scenario story is elaborated, with a special emphasis on the story events. The story is then divided into a detailed list of Trial elements – a vast table listing all the injects.

C8 describes the event organisation and logistics. It consists of the detailed agenda, communication plan, and auxiliary activities. It also accommodates two subsections describing the Trial execution revisions: Dry Run 1 & 2: checklists, conclusions and lessons to be learnt, and actions and decisions taken after each of them.

C9 contains all other organisation aspects not specified in former sections: framework conditions, safety plan and arrangements, other trainings (if not mentioned before), Research Ethics and Informed Consent Forms, public relations (esp. dissemination and communication about the Trial towards the external stakeholders and participants), other evaluator activities (if any), solution documentation, authorisation and registrations for Trial and list of other planning documents.

Annex 7 – Unified Modelling Language of the Trial Guidance Tool

In this annex the UML of the TGT is described, followed by the actual diagram. The UML language works with different artefacts. One would be the box, that can be depicted in a reduced form (green box) or a form with all its components, that are then included in a green line.

To depict the diagram three different colours are used: while blue and grey boxes are just elements of the overall (green) box, every purple box is dedicated to one or more human beings.

Overall information

The idea here is that a user first needs a **landing page** that welcomes him/her. If the user wants to create a Trial a **registration and log-in** are necessary, in order to safe elements. Furthermore, some **explanations on the TGM** and the functionality **to create a new Trial** are needed.

For the landing page something welcoming and clear structured as well as understandable is needed. It should contain information on the project DRIVER+, its aims and goals and especially inform about the aim of the Trials and the website itself.

In the following each of these items has been elaborated.

As creating a Trial is directly linked to the TGM, some information and explanation on this is necessary as well. The Trial Guidance Tool shall help people to create a new Trial, so this is a needed functionality. A Trial consists of the Trial committee, where people have certain roles; the associated Trial location that offers the needed hardware (maybe also software) and associated practitioner organisations that could be chosen from a list. As the solutions providers come in later in the process they are not mentioned here at this point, though they are of course a very important part of the Trial.

Preparation phase

The preparation phase consists of the three parts: **Trial context and specification of gaps**, **Trial design – six step approach** and **development of Trial material**.

For the Trial context and specification of gaps the following things are needed: The Trial context is given by the Trial location and the stakeholders (practitioner organisations, maybe politicians as well). So information about past Trials at this location is useful to find out, if the locations offer everything needed.

The key of the whole process is however the CM gap, that should be closed by trialling innovative solutions. Therefor the DRIVER+ CM gaps should be presented here. Of course, the user will have his/her own gap in mind when thinking of creating a Trial, but by seeing that others might have a similar gap, can create synergy. So the other gap-owners could be invited to the Trial and add a lot of value. By this the gap itself can be even more specified.

The heart of the TGM is the six-step approach for Trial design. The six steps are: Identify the Trial objective, formulate research questions, formulate data collection plan, formulate scenarios and select solutions. The Trial Guidance Tool will help with all these steps. However, it is important to link this with DRIVER+ knowledge base, which includes the codebooks from the Systematic Literature Review and from the Lessons Learnt. This knowledge base is linked to the different steps as it helps with knowledge from experiments of the initial project phase as well as Trial like events from the past decade.

Execution phase

All in all the execution phase can be divided in the two parts: **dry runs** and **Trial run(s)**. There are two dry runs with a final adjustment in between. These are dedicated to preparing the Trial Run itself, which will be used for trialling and evaluating innovative solutions in realistic scenarios.

For all dry runs as well as the final adjustment the associated Trial location, the Test-bed as well as the solutions are fixed elements that need to work together. This shall be enabled by the Trial committee, solution provider and the role player. Helpful here is the data collection plan and the realistic scenario/scenes (which shall be linked here).

The main aim of Dry Run 1 is a connectivity check. All solutions that need to connect to the Test-Bed or to other solutions have to be integrated. In this way also the collection of data has to be tested w.r.t. completeness and the data collection plan. The needed amount of training on solutions shall be prepared. Furthermore the scenario needs to be tested w.r.t. their ability to trigger the needed CM processes, tasks and roles. The Dry Run 1 staff is in charge for this. The output should be a list of things that still need adjustment.

This before mentioned list is the input to the final adjustment phase. This is the timeframe between Dry Run 1 and 2. In this period the connectivity, data collection and use of solutions by users shall be enabled, if they have failed before.

All in all the execution phase can be divided in the two parts: **dry runs** and **Trial run(s)**. There are two dry runs with a final adjustment in between. These are dedicated to preparing the Trial Run itself, which will be used for trialling and evaluating innovative solutions in realistic scenarios.

For all dry runs as well as the final adjustment the associated Trial location, the Test-Bed as well as the solutions are fixed elements that need to work together. This shall be enabled by the Trial committee, solution provider and the role player. Helpful here is the data collection plan and the realistic scenario/scenes (which shall be linked here).

This list mentioned before is the input to the final adjustment phase. This is the timeframe between Dry Run 1 and 2. In this period the connectivity, data collection and use of solutions by users shall be enabled, if they have failed before.

As everything is up and running the Dry Run 2 is the final rehearsal of the Trial. So the Dry Run 2 staff and the roles for the scenario, solutions and data collection (observers) have to be present in a way, that all needed positions can be tried before the Trial. The goal is to make sure that the whole constellation is functioning. If any major concerns appear in Dry Run 2, the Trial itself needs to be postponed.

The raw data from the Trial is the input for the data collection check. These are verified concerning errors and vagueness. After that they are structured.

This is feed into the analysis, which will be reported in the Trial reporting template. The form of the template shall give guidance and make the analysis easier. The Trial owner and the evaluation support representative are important for this task.

With the help of the analysed data the answer(s) to the RQ(s) shall be found. Here again the relation to the three dimension is important so this needs to be linked here again.

The final step of the evaluation phase is the (internal and external) dissemination. The internal report will be written and the knowledge base will be updated to enable further Trials. Furthermore the PoS will be updated with the results of the trialled solutions. The external report will give a main conclusion and recommendations and hopefully report, that the CM gap is closed for the Trial owner.

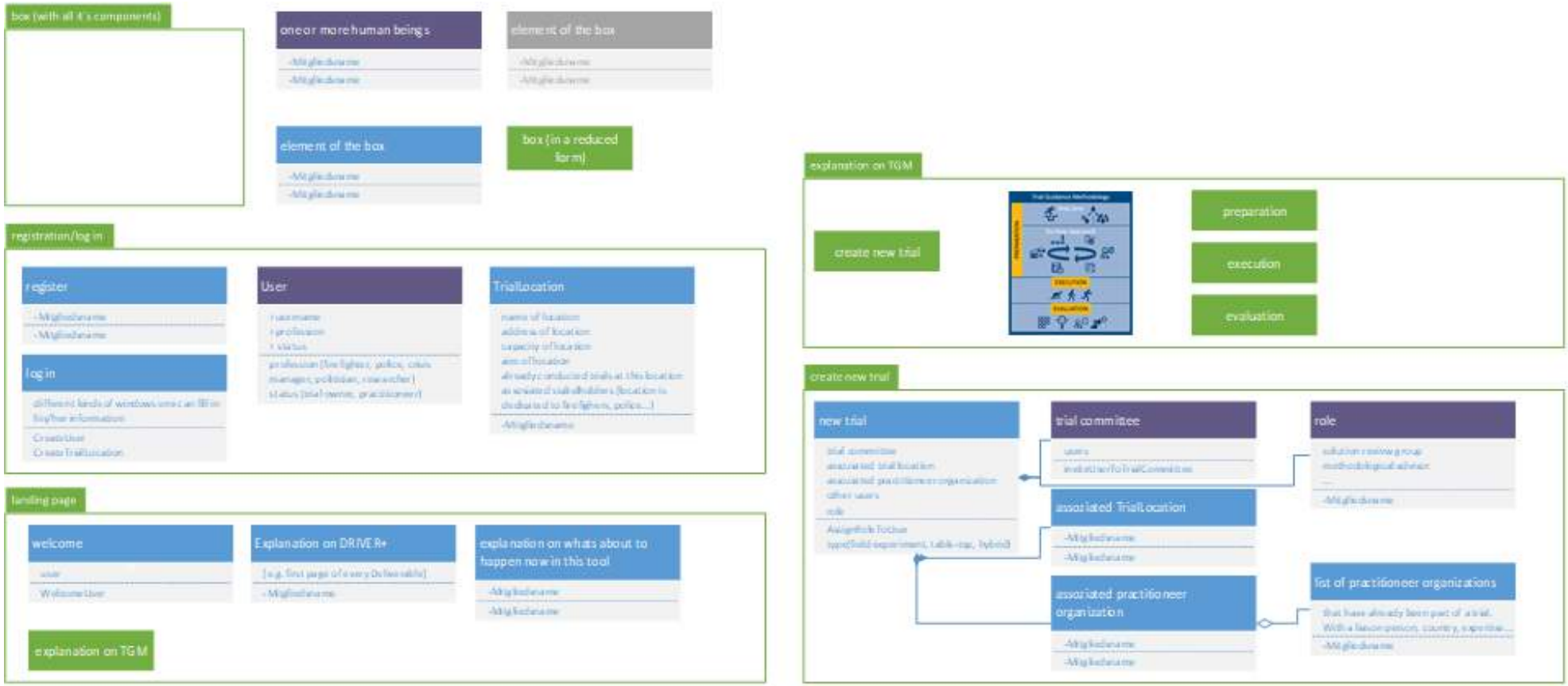

Figure A5: TGT UML overall information

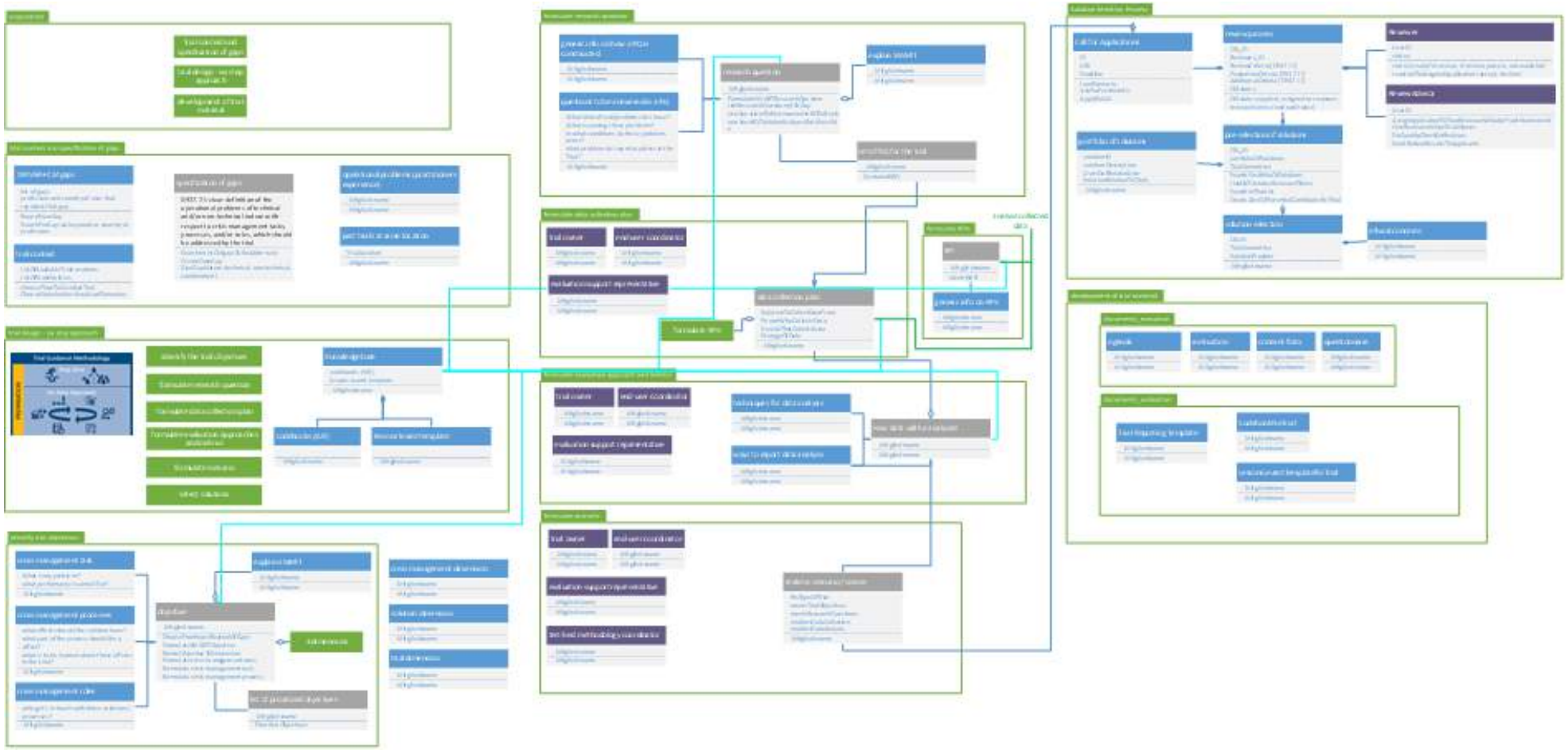

Figure A6: TGT UML preparation phase

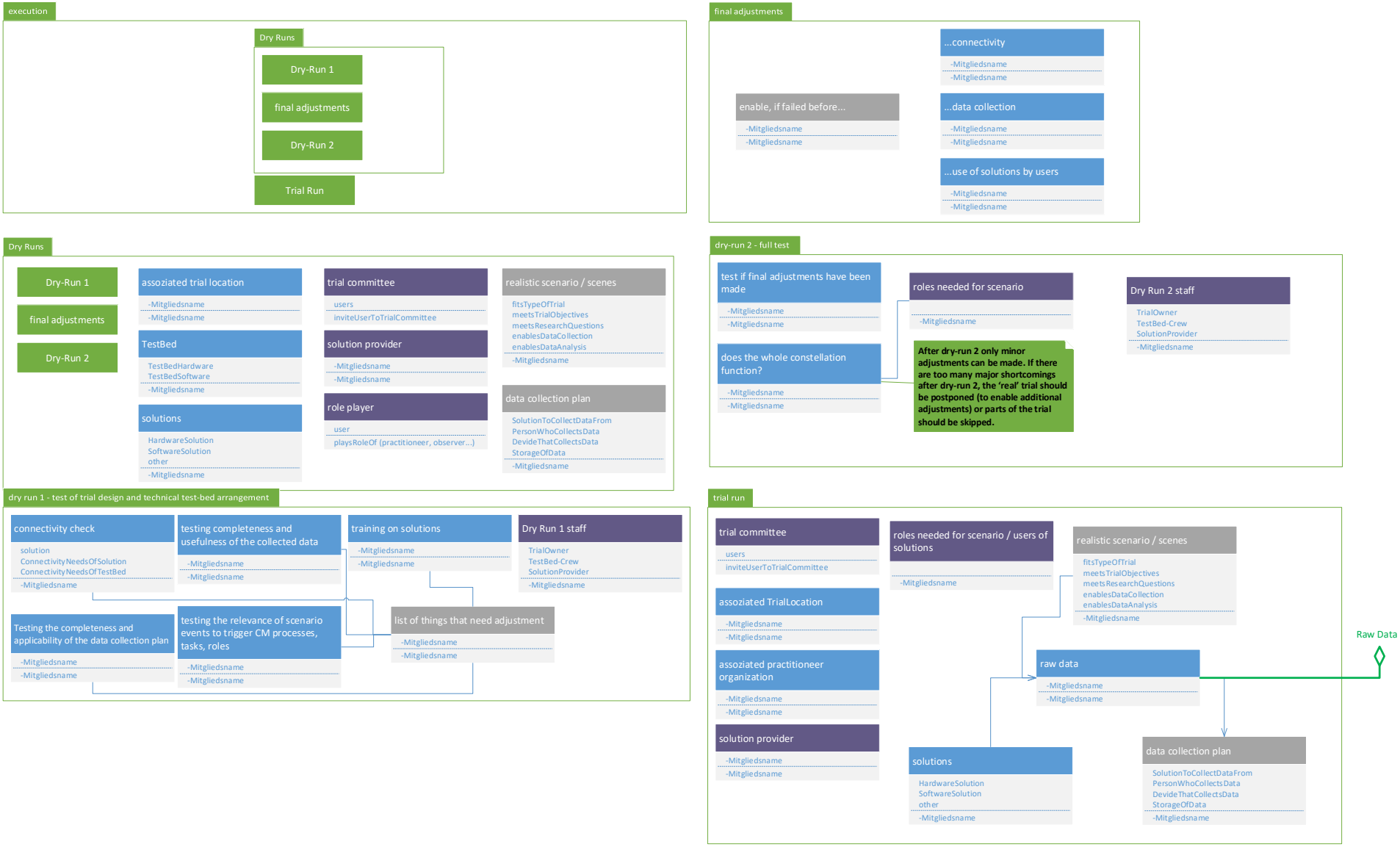

Figure A7: TGT UML execution phase

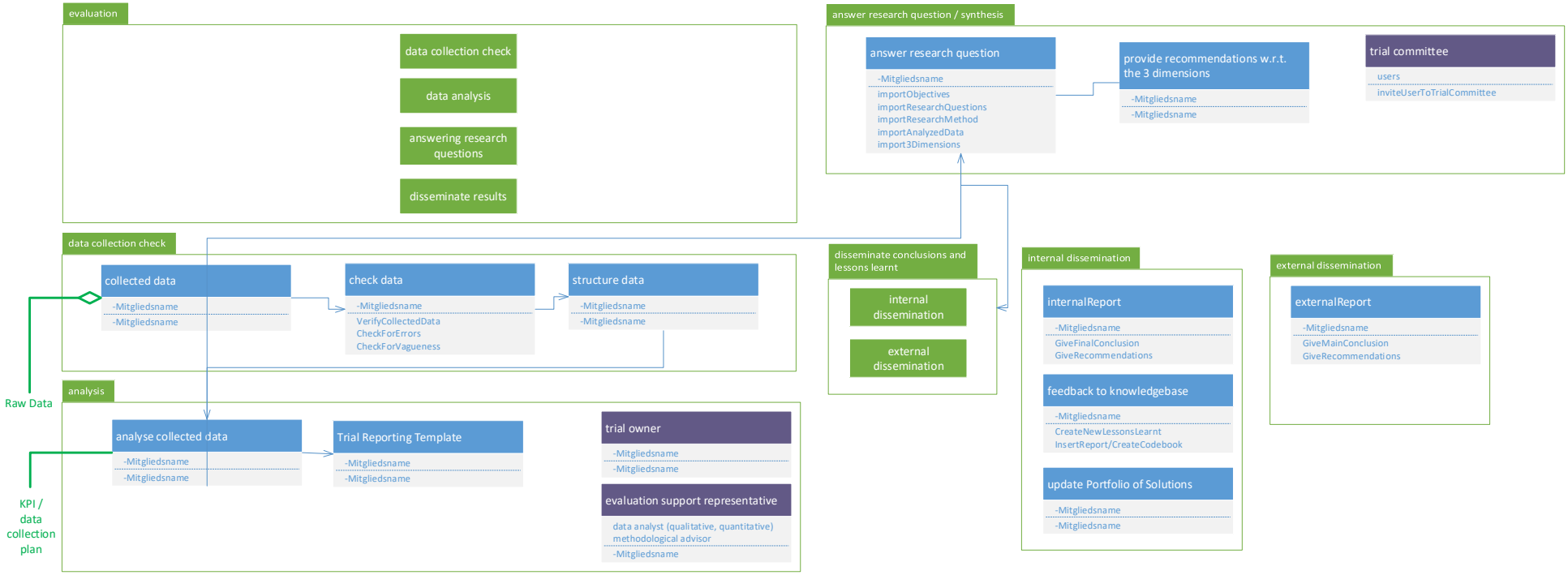

Figure A8: TGT UML evaluation phase

Annex 8 – Trial Guidance Tool requirements

In this annex the requirements for the Trial Guidance Tool are stated. These requirements are a summary of the description of functionalities for the Trial Guidance Tool as described in section 10.

TableA8: Full list of requirements

No.	Requirement	Preparation step
1	The TGT is used by Trial Committees in general and is not restricted to the DRIVER+ project.	general
2	The TGT is web-based.	general
3	The TGT mainly support the preparation phase of the Trials.	general
4	The TGT provides help functionality (explanations, checklists, references). *The starting point is the list of tips & tricks described in section 5 under the headings "Actions and Required participation".*	general
5	The TGT contains a repository of examples. *The starting point for the repository is each example given in section 5. Insights from the DRIVER+ Trials will provide additional examples.*	general
6	The TGT validates the Trial definition. *The validation comprises simple checks at first (i.e. all fields filled in; each gap/objective addressed). Experiences in using the Trial will provide additional checks.*	general
7	The TGT supports different types of users.	general
8	Access to the TGT for authorized users only.	details
9	Authorized users can add or modify Trials in the TGT.	details
10	Trials can be exported (xml/json format).	details
11	The TGT supports the iterative six-step approach.	Task 1, step zero: gaps
12	The output of the TGT may be directly imported into section 2 of the Trial Action Plan (TAP).	Task 1, step zero gaps
13	The TGT extracts information from the Portfolio of Solutions (PoS).	Task 1, step zero gaps
14	The validated DRIVER+ CM gaps are input to the TGT.	Task 1, step zero gaps
15	For each Trial, at least one gap must be selected.	Task 1, step zero gaps
16	Allow different users interaction with the Trial. *Users who are involved in preparation, execution or evaluation of the Trial, such as scientists or a scenario writer.*	Task 1, step zero gaps
17	Trial objectives are linked to at least one CM gap and each CM gap is related	Task 2, step 1

	to a CM function objective.	
18	The TGT provides a template to facilitate the formulation of the Trial objectives in a manner that is SMART (specific, measurable, assignable and realistic).	Task 2, step 1
19	Each objective is categorized as either “crisis management objective”, “solution objective” or “Trial objective”.	Task 2, step 1
20	The TGT provides a list of identified Trial objectives in the Trial. *Users can add/remove/modify Trial objectives in the list.*	Task 2, step 1
21	Examples of Trial objectives used in other Trials are provided, supported by a search filter. *Users can copy such examples into his/her Trial definition and modify the Trial objective.*	Task 2, step 1
22	Include metrics with Trial objectives. *User can select from a list, or enter additional metric.*	Task 2, step 1
23	A research question relates to a Trial objective.	Task 2, step 2
24	The TGT provides a template for the research question dealing with crisis management task, process, content, crisis management roles and the solution required.	Task 2, step 2
25	Examples of research methods are provided from the DRIVER+ knowledge base, including lessons learnt.	Task 2, step 2
26	The TGT offers a list of possible methods for data collection.	Task 2, step 3
27	Every metric is linked to at least one assessment method.	Task 2, step 3
28	Examples of research methods with associated data collection plans are provided from the DRIVER+ knowledge base.	Task 2, step 3
29	Provide a description of different data collection and analysis techniques.	Task 2, step 3
30	Provide a checklist (for the data collection plan).	Task 2, step 3
31	Relate metrics to the online observer tool which is a component of the reference implementation of the Test-bed. *The tool supports an export function with measurements/observations for the online observer tool.*	Task 2, step 3
32	Examples of data analysis techniques and metrics from previous Trials are derived from the DRIVER+ knowledge base	Task 2, step 4
33	Examples of evaluation approaches applied in previous Trials.	Task 2, step 4
34	Provide explanation on evaluation approaches, distinguishing between literature and practice (past Trials).	Task 2, step 4
35	Examples for data techniques to measure/observe metrics in a Trial.	Task 2, step 4
36	Scenario text can be entered by uploading a text file.	Task 2, step 5
37	Scenario text can be edited.	Task 2, step 5

38	Solutions are related to one or more CM functions.	Task 2, step 6
39	The TGT supports the DRIVER+ CM function taxonomy.	Task 2, step 6
40	The TGT supports searching the PoS for possible solutions for the objectives formulated, using filter options. *The users can refine/broaden the search by changing the filter options or keywords.*	Task 2, step 6
41	Selected solutions are presented in the TGT for review, including all information relevant. *For example (if available) the description of the solution, previous Trial results, experiences from end-users, TRL level.*	Task 2, step 6
42	Solutions can be included / excluded into the Trial by the user.	Task 2, step 6