Evaluation plan

VERSION
Version 0.7

DATE
09-June-2016

ABSTRACT
The DARWIN project aims to develop state of the art resilience management guidelines and innovative training modules for crisis management. The guidelines, which will evolve to accommodate the changing nature of crises, are developed for those with responsibility of protecting the population or critical infrastructure/services from policy to practice.

This deliverable describes the strategy and plan to evaluate the DARWIN Resilience Management Guidelines (DRMGs) in the context of Task 4.3 (Evaluation Cycles of Guidelines). The proposed methodology for evaluation is grounded on a Realist Approach, based the framework called I-CMO (Intervention-Context-Mechanism-Outcome). It is a formative and iterative approach, which requires the evaluation activities to be grounded in realistic scenarios, involving a purposive sample of stakeholders. The methodology distinguishes the initial evaluation of the generic DRMGs from the evaluation of the more mature version of guidelines that will be based on the organization of pilot exercises.

The evaluation takes into consideration the requirements identified in DARWIN D1.3 (Practitioner and academic requirements for resilience management guidelines) as well as the feedback received in occasion of the first DARWIN Community of Crisis and Practitioners (DCoP) Workshop, reported in D5.2 (DARWIN CoCRP resilience concepts, users and academia interactive workshops).

The deliverable also describes in detail five crisis management scenarios and elaborates on the criteria adopted to select them. Beyond the scope of Task 4.3, the proposed evaluation strategy can be used outside DARWIN by those organizations interested in evaluating the implementation of their own resilience concepts.

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 653289.

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Release history

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*The project uses a multi-stage internal review process, with defined milestones. Milestone names include terms (in bold) as follows:

- **PCOS proposed**: Describes planned content and structure of different sections. Document authors submit for internal review.
- **PCOS revised**: Document authors produce new version in response to internal review comments.
- **PCOS approved**: Internal project reviewers accept the document.

- **Intermediate proposed**: Document is approximately 50% complete – review checkpoint. Document authors submit for internal review.
- **Intermediate revised**: Document authors produce new version in response to internal reviewer comments.
- **Intermediate approved**: Internal project reviewers accept the document.

- **External proposed**: Document is approximately 100% complete – review checkpoint. Document authors submit for internal review.
- **External revised**: Document authors produce new version in response to internal reviewer comments.
- **External approved**: Internal project reviewers accept the document.

- **Released**: Executive Board accepts the document. Coordinator releases the deliverable to the Commission Services.
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The research leading to these results has received funding from Horizon 2020, the European Union’s Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 653289.
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Executive Summary

The deliverable outlines the strategy and plan to evaluate the DARWIN Resilience Management Guidelines (DRMGs) in the context of Task 4.3 (Evaluation Cycles of Guidelines).

The proposed methodology for evaluation is grounded on a Realist Approach, based on the framework called I-CMO (Intervention-Context-Mechanism-Outcome). It is a formative and iterative approach, which requires the evaluation activities to be grounded in realistic scenarios, involving a purposive sample of stakeholders. The methodology distinguishes the initial evaluation of the generic DRMGs (to be included in the D4.2) from the evaluation of the more mature version of guidelines, that will be based on the organization of pilot exercises (to be included in the following D4.4).

The evaluation takes into consideration the requirements identified in D1.3 (Practitioner and academic requirements for resilience management guidelines), as well as the feedback received in occasion of the first DARWIN Community of Crisis and Practitioners (DCoP) Workshop, reported in D5.2 (DARWIN CoCRP resilience concepts, users and academia interactive workshops). In the initial evaluation of generic guidelines, the D1.3 requirements are addressed differently depending on whether they are considered functional, or non-functional requirements. The non-functional requirements are used to validate the DRMGs in a stakeholder workshop with the end-users internal to DARWIN. The functional requirements are directly included into the I-CMO framework evaluation cycle, which involve the same end users and combine a set of semi-structured interviews with another stakeholder workshop, organized as a focus group.

The deliverable also describes in detail five crisis management scenarios, with the following titles:

- Aircraft crashing in urban area close to Rome Fiumicino Airport shortly after taking off
- Blackout in Rome Area Control Centre
- Disease outbreak during flight due to land at Rome Fiumicino
- Organ transportation in severe weather conditions
- Collision between oil tanker and passenger ferry leaving Gotland islands in severe weather conditions.

The scenarios were elaborated with a central role of the three DARWIN end users, i.e. ENAV, ISS and KMC. The scenarios will be used as reference examples for the contextualization of the initial evaluation and as basis for the pilot exercises that will characterize the following evaluation cycles (Task 4.2 - Implementation of pilot cases). The scenarios are about crisis situations combining both expected and unexpected aspects. The deliverable elaborates on the criteria adopted to select them and explains to what extent it was possible to comply with the same criteria.

It is worth noting that the scenarios mainly focus on the two domains identified as reference in DARWIN, i.e. the Healthcare and the ATM. Nonetheless, the evaluation process will also include a collection of feedback on the applicability and fitness-for-purpose of the DRMGs to domains different from Healthcare and ATM, taking advantage of the DCoP members with professional experience in such domains.

About the project: The DARWIN project aims to develop state of the art resilience guidelines and innovative training modules for crisis management. The guidelines, which will evolve to accommodate the changing nature of crises, are developed for those with the responsibility of protecting population or critical services from policy to practice.

The guidelines address the following resilience capabilities and key areas:

- Capability to anticipate
  - Mapping possible interdependencies
  - Build skills to notice patterns using visualisations
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- Capability to monitor
  - Identify resilience related indicators, addressing potential for cascade
  - Establish indicators that are used and continuously updated
- Capability to respond and adapt (readiness to respond to the expected and the unexpected)
  - Conduct a set of pilot studies
  - Investigate successful strategies for resilient responses
- Capability to learn and evolve
  - Explore how multiple actors and stakeholders operate in rapidly changing environments
  - Enable cross-domain learning on complex events
- Key areas: social media and crisis communication; living and user-centred guidelines; continuous evaluation and serious gaming
1 Introduction

1.1 Purpose of the document

The deliverable illustrates the plan and methodology to evaluate the DARWIN Resilience Management Guidelines (DRMGs) that WP2 will produce. The plan applies to both the “Initial Evaluation of Guidelines” (D4.2) - focussed on the Generic DRMGs and due at the end of August 2016 – and to the pilot exercises that will lead to the evaluation of the DRMGs adapted to both Healthcare and ATM, until the end of March 2018.

Main contents of the deliverable are the approach and methodology proposed for the evaluation of the DRMGs in the different phases of the project and a set of scenarios that have been elaborated to assess the effectiveness of the guidelines in specific crisis management situations.

1.2 Intended readership

The deliverable is primarily addressed to readers working in DARWIN Task 4.2 (Implementation of Pilot Cases) and Task 4.3 (Evaluation cycles of Guidelines).

It may be also of interest for those working in DARWIN WP2 (Development of Resilience Management Guidelines) since it will anticipate the way DRMGs will be evaluated and some of the potential scenarios in which there is an expectations that the DRMGs will actually provide a benefit in terms of improved resilience.

Readers interested in resilience and crisis management can use this document as a source for defining evaluation process while implementing resilience concepts in their organizations.

1.3 Relationship with other deliverables

The Methodology for Guideline Evaluation presented in this document received inputs from:

- “D1.3 – Practitioner and academic requirements for resilience management guidelines”, presenting requirements to be considered for the evaluation of the initial generic DRMGs and for the more mature version of them, including those adapted to Healthcare and ATM.
- “Task 2.1 Development of Resilience Management Guidelines”, since the work being done in this task provided very preliminary indications on the content and format of the DRMGs to be evaluated.
- “D3.1 – Diverse representation and evolution of resilience guidelines support”, presenting the issues that will be addressed during the development of the representation and dissemination of DRMGs.
- “D5.2 DARWIN CoCRP resilience concepts, users and academia interactive workshop”, including initial feedback on the D4.1 scenarios (types of crisis) by the DCoP members, in the context of the first DCoP Workshop.
- “D7.4 – Ethic Approvals”, describing the ethical requirements for the data collection activities that will occur during the DRMG’s evaluation process.

The Methodology for Guideline Evaluation and the Scenarios presented in this document provide inputs to the following deliverables and tasks:

- “D4.2 – Initial Evaluation of Guidelines”, for the description of the approach and methodology for evaluation, including the use of the I-CMO framework and of the D1.3 Requirements for the evaluation of the initial generic DRMGs.
- “D4.3 – Pilot’s Implementation and Evaluation”, for the Scenarios to be used in the Pilot Exercises.
- “D4.4 – Final Guidelines Evaluation Report”, for the way to organize the evaluation based on pilot exercises according to the I-CMO framework.
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- “Task 2.1 Development of Resilience Management Guidelines”, for indications on the strategy and criteria that will be used to evaluate the DRMGs.
- “D3.3 – Simulation tools and serious games for specific purpose”, for indications on the possible scenarios (types of crisis) to be modelled and represented with simulation tools and serious games.
- “D5.2 DARWIN CoCRP resilience concepts, users and academia interactive workshop”, for information on the scenarios (types of crisis) presented during the first DCoP workshop, in order to receive feedback by the DCoP members.
- “Task 6.1 Dissemination”, for information on the methodology and scenarios (types of crisis) that will be used for evaluating the DRMGs to be included in different dissemination activities.

The diagram below illustrate these relationships. Black solid arrow represent direct input-output links. While the arrow with a texture background represent mostly a simple exchange of information between the WP4 teams and teams working at other deliverables or in other tasks.

**Figure 1-1: Relationship between D4.1 and other DARWIN tasks and deliverables**

### 1.4 Acronyms and abbreviations

**Table 1: List of abbreviations**

<table>
<thead>
<tr>
<th>Term</th>
<th>Explanation</th>
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<tbody>
<tr>
<td>I-CMO</td>
<td>Intervention – Context Mechanism Outcome</td>
</tr>
<tr>
<td>DRMG</td>
<td>DARWIN Resilience Management Guideline</td>
</tr>
<tr>
<td>ACC</td>
<td>Area Control Centre</td>
</tr>
<tr>
<td>AdR</td>
<td>Aeroporti di Roma (Company managing Rome Airports)</td>
</tr>
<tr>
<td>ANSP</td>
<td>Air Navigation Service Provider</td>
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<th>Approach</th>
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<td>ATC</td>
<td>Air Traffic Control</td>
</tr>
<tr>
<td>ATCo</td>
<td>Air Traffic Controller</td>
</tr>
<tr>
<td>ATS</td>
<td>Air Traffic Services</td>
</tr>
<tr>
<td>CAVOK</td>
<td>Ceiling and Visibility OK</td>
</tr>
<tr>
<td>CNT</td>
<td>Centro Nazionale Trapianti (National Italian Transplant Centre)</td>
</tr>
<tr>
<td>CRT</td>
<td>Centro Regionale Trapianti (Regional Transplant Centres)</td>
</tr>
<tr>
<td>DG SANTE</td>
<td>Directorate General Health and Consumers</td>
</tr>
<tr>
<td>ECHO</td>
<td>European Commission's Humanitarian aid and Civil Protection department</td>
</tr>
<tr>
<td>ENAC</td>
<td>Ente Nazionale Aviazione Civile (Italian Civil Aviation Authority)</td>
</tr>
<tr>
<td>ENAC DA</td>
<td>ENAC Direzione Aeroporto (ENAC Airport General Directorate)</td>
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<tr>
<td>ESR</td>
<td>Ethics Screening Report</td>
</tr>
<tr>
<td>FIR</td>
<td>Flight Information Region</td>
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<tr>
<td>FOD</td>
<td>Foreign Object Debris</td>
</tr>
<tr>
<td>GT</td>
<td>Gross Tonnage</td>
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<tr>
<td>HEMS</td>
<td>Helicopter Emergency Medical Service</td>
</tr>
<tr>
<td>IPI</td>
<td>International Permanent Instructions</td>
</tr>
<tr>
<td>JRCC</td>
<td>Joint Rescue Co-Ordination Centre</td>
</tr>
<tr>
<td>LIRF</td>
<td>Rome Fiumicino Airport (ICAO designation)</td>
</tr>
<tr>
<td>MOATS</td>
<td>Manual Of Air Traffic Services</td>
</tr>
<tr>
<td>NITp</td>
<td>Northern Italy Transplant Programme</td>
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<td>PAX</td>
<td>Passengers</td>
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<td>RWY</td>
<td>Runway</td>
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<tr>
<td>SAR</td>
<td>Search and Rescue</td>
</tr>
<tr>
<td>SOLAS</td>
<td>Safety of life at sea</td>
</tr>
<tr>
<td>TWR</td>
<td>(Air Traffic Control) Tower</td>
</tr>
<tr>
<td>UNCLAS</td>
<td>United Nations convention on the law of the sea</td>
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<tr>
<td>UPS</td>
<td>Uninterruptable Power Supply</td>
</tr>
<tr>
<td>USMAF</td>
<td>Ufficio di Sanità Marittima, Aerea e di Frontiera (Maritime, Air and Border Health Office – Ministry of Health)</td>
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2 Methodology for guidelines evaluation

2.1 Strategy and approach to evaluation

Building on the literature survey conducted concerning evaluation criteria and evaluation methodologies (see [2] and [3]), the evaluation activities in DARWIN are designed to provide feedback to the technical project activities, and to aggregate and provide evidence about the fitness for purpose of the DARWIN Resilience Management Guidelines (DRMGs). This will be achieved by incrementally building an empirically grounded theory of how the DRMGs might work in practice. In addition to this, the evaluation activities will provide feedback in relation to the maturity of the resilience concepts included in the DRMGs.

Guidelines are deceptively simple tools for organising and managing work activities with the purpose to understand and enhance resilient operations. One might argue that guidelines cannot be evaluated meaningfully without consideration of the context and the purpose of use. Therefore, evaluation within DARWIN is based on a number of quality and process requirements set out in Deliverable D1.3 [3], and originally based also on criteria identified in D1.2 [2]. The table below shows how these requirements will be addressed:

<table>
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<th>How the evaluation plan addresses it</th>
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<td>DR-119</td>
<td>The evaluation of the DRMG should aim to maximize the participation of actual (not simulated) professionals representing stakeholders realistically</td>
<td>The evaluation of guidelines will involve representatives of end users both internal and external to DARWIN. Professionals representing stakeholders will be directly involved in dedicated pilot exercises. See the field “Subject Matter Experts to involve in the Pilot Testing” in the template for scenario development illustrated in 4.1.3.</td>
</tr>
<tr>
<td>DR-120</td>
<td>The evaluation of the DRMG should use stakeholders’ experience with past and present exercises/projects</td>
<td>The experience of DARWIN end-users has been considered during the elaboration of the scenarios, with a special focus on the first two sections of each scenario template: “Description and Characteristics of the Scenario” and “Baseline Information relevant for the Scenario” (see 4.1.3). The stakeholders’ knowledge of the dynamics and actors involved during the management of a crisis has been useful to detail and give realism to the scenarios. A summarized version of the same scenarios was also presented for feedback to practitioners external to the consortium, in the context of the 1st DCoP Workshop. The experience of DARWIN end users will also be used to evaluate the fitness for purpose of the guidelines by way of interviews and focus groups, in the initial evaluation of the generic guidelines (see...</td>
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### D4.1 – Evaluation Plan

<table>
<thead>
<tr>
<th>DR-121</th>
<th>ERQ-03</th>
<th>The evaluation of the DRMG should use scenarios, chosen to stress the resilience ability of the user organizations and to investigate aspects such as the interactions of these organizations with the public and between, to stress risks identified and possible cascading effects, and to link to established risk management.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR-122</td>
<td>ERQ-04</td>
<td>The evaluation of the DRMG should ascertain a consistent interpretation of the DRMG.</td>
</tr>
<tr>
<td>DR-123</td>
<td>ERP-01</td>
<td>The DRMG should be evaluated.</td>
</tr>
<tr>
<td>DR-124</td>
<td>ERP-02</td>
<td>The evaluation of the DRMG should be performed at different stages, providing feedback to the project team at key points of the project lifecycle.</td>
</tr>
</tbody>
</table>

The present deliverable establishes the strategy and plan to evaluate the DRMGs; it is therefore the first response to this requirement that will be then followed by D4.2, D4.3 and D4.4.

The evaluation will start at the outset of DRMG production in WP2 and will continue throughout the project lifetime. The initial theory of how the DRMGs might work in practice will be initially evaluated in D4.2 and then refined through feedback from the pilot exercises and consultation of DCoP members.

The five scenarios illustrated in Chapter 4 represent realistic crisis situations identified with the involvement of the DARWIN end users (ENAV, ISS, KMC). They have been designed to highlight both the link with established risk management and the possible cascading effect. They will be used both during the initial evaluation of guidelines (D4.2) as reference examples and as basis for the preparation of the pilot exercises (D4.3) to feed the final evaluation (D4.4).

In order to meet the overall aim of the evaluation, and to satisfy the evaluation requirements, a realist evaluation approach will be adopted as the overarching framework. The methodological background is described in the next section.

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The research leading to these results has received funding from Horizon 2020, the European Union’s Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 653289.
2.2 Realist evaluation approach

Realist evaluation grew out of the increasing frustration with traditional experimental evaluation when applied to complex socio-technical interventions and policy programmes [4]. Complex socio-technical interventions and policy programmes involve a number of different people who interact in a non-linear fashion to produce outcomes that are highly context dependent. While experimental approaches to evaluation sometimes succeeded in describing whether or not an intervention or a policy “worked”, subsequent attempts at replicating the interventions and policy programmes in additional settings, or at larger scale, frequently proved to be difficult, and were often unsuccessful.

The reasons for this struggle with experimental evaluation are that (a) it is very difficult to provide a controlled environment for complex socio-technical interventions or policy programmes, and (b) experimental evaluation is descriptive rather than explanatory. Put simply, complex socio-technical interventions and policies tend to work for some people or organisations, but not for others, and in some contexts, but not in others – and experimental evaluation is not well suited to explain what works, for whom and in what circumstances, and why. Experimental evaluation only tells us (at best) that either the intervention worked in a particular case or not.

2.2.1 Explanatory configurations: I-CMO

Realist evaluation aims to move beyond empirical description towards providing a causal explanation – i.e. towards building a theory1 of how complex socio-technical interventions and policies work in particular contexts. More specifically, realist evaluation sets out to describe which aspects of the intervention (I) work for whom and under which ba circumstances (which context - C), and how (i.e. through which mechanisms - M) to produce certain outcomes (O). The combination of intervention, context, mechanism and outcomes is referred to as I-CMO configurations. This is illustrated in Figure 2-1.

![Figure 2-1: The I-CMO configuration.](image)

---

1 Theory in this context can be interpreted as “causal explanation of how the intervention brings about change”. In the context of DARWIN, the interventions are the DRMGs. The realist evaluation aims to provide, therefore, a theory of DRMGs in use, not a theory of resilience concepts as such.
2.2.2 Evaluation cycle

The evaluation cycle is represented in Figure 2-2.

![Figure 2-2: The Realist Evaluation cycle based on I-CMO configurations](image)

Realist evaluation starts with the formulation of an initial theory at an abstract level of how the intervention might bring about change and desired outcomes, i.e. an initial set of – at this stage – still abstract I-CMO configurations.

In the next step, the theory is used to identify relevant real-world scenarios, and to generate hypotheses about what might work, for whom, and under what circumstances in those scenarios. The choice of cases or scenarios for evaluation is purposefully chosen in order to test and to refine the emerging theory.

Then, empirical data is collected to provide actual evidence for the I-CMO configurations. The empirical data can be both qualitative and quantitative. Depending on the specific situation, data collection methods typically include observations of real-life scenarios, interviews with relevant stakeholders, simulations, and the collection of quantitative process indicators and outcome data. Data collection methods need to be specified when the specific type of DRMGs to be evaluated will be defined, together with the specific scenarios that will be adopted for their evaluation.

The analysis of the evaluation scenarios allows formulation of what actually happened, i.e. what actually worked, for whom, and under what circumstances. Reflection on the analysis outputs can then feed back into the refinement of (a) the intervention, and (b) the explanation of how the intervention brings about change, i.e. the theory. Subsequent evaluation cycles can then continuously refine both the intervention and the corresponding theory of change.

---

2 The emerging theory refers to the DRMGs in use, i.e. how the DRMGs bring about change in the context of the scenarios.
2.2.3 Evaluation in DARWIN

The adoption of a realist evaluation in DARWIN implies that the evaluation activities aim to contribute to evaluation of the progress of resilience concepts as well as better understanding of how the DRMGs can be applied in practice, in which circumstances, and for what purposes. Over the project lifetime, the evaluation activities can provide feedback to the guideline development activities. The final DRMGs can then be accompanied by a comprehensive description of all the relevant I-CMO configurations, which explain how different aspects of the guidelines (i.e. different Is) work in practice. In this way, strengths and limitations of the guidelines are described, and causal mechanisms are explained. It is hoped that this approach might contribute to greater generalisability to other potential contexts, and to the successful adoption of the guidelines in practice following the project end date.

Evaluation in DARWIN is centred on different real-world scenarios. An evaluation template will be used to guide data collection and data presentation. The evaluation template will be based on the concept of I-CMO configurations and will use the structure shown in Table 3.

<table>
<thead>
<tr>
<th>Table 3: Evaluation Template</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scenario</strong></td>
</tr>
<tr>
<td><strong>Intervention</strong></td>
</tr>
<tr>
<td><strong>Mechanisms</strong></td>
</tr>
<tr>
<td><strong>Outcomes</strong></td>
</tr>
<tr>
<td><strong>Context</strong></td>
</tr>
<tr>
<td><strong>Data Collection Plan</strong></td>
</tr>
</tbody>
</table>

3 For example, the DRMGs might contain guidance on supporting collaboration between organisations. For a given scenario, this might be interpreted as improved communication between specific organisations when dealing with a particular crisis situation (success criterion). Improved communication might be measured through, for example, the time to initiative communication between different organisations, the number of communication activities between stakeholders from different organisations, and the overall time for resolution of the crisis (outcomes).
D4.1 – Evaluation Plan

There will be more evaluation cycles over the duration of Task 4.3 (“Evaluation cycles of guidelines”). The initial evaluation of the generic DRMGs will constitute of one evaluation cycle, to be documented in D4.2. Subsequently, there will be additional evaluation cycles to be documented in D4.4, based on the scenarios outlined in Section 4. It is anticipated the arrangement of at least one evaluation cycle per scenario, but depending on the number, type and complexity of DRMGs, further evaluation cycles might be required. Apart for the initial evaluation cycle, for the subsequent cycles there might be a need to distinguish them in two different types. The first type will provide feedback to guideline developers in D2.2 and D2.3 (“Resilience management guidelines adapted to health care” and “Resilience Management Guidelines adapted to ATM”). The second type will mainly aim at providing feedback on how to revise the D2.1 generic DRMGs, in order to make them generalizable to the improvement of resilience for all critical infrastructures at a European level, as part of D2.4 (“Revised Generic Resilience Management Guidelines”). Due to the limited information available at this stage – particularly with regard to the DRMGs to be evaluated – it is not yet possible to determine the exact number of evaluation cycles and their scheduling. However, a description of the main time constraints identifiable in the DARWIN DoA and of the criteria to follow for scheduling the evaluation cycles is available in section 5. Such criteria will be used for a more precise planning in the context of Task 4.3.

It is worth noting that the results of each evaluation cycle will feed the dataset named “DS.WP4.DBL.Pilots.Healthcare and Air Traffic Management”, consisting of qualitative and anonymized data deriving from the feedback provided during the evaluation activities by the representatives of end-users and DCoP members. These data will not allow the identification of individuals in the data material neither directly through names or personal ID numbers, nor indirectly through background variables, list of names, connection keys, encryption formula or codes (for further info see section 3.2 in “D7.3 - Initial Data Management Plan” [6]).

As a complement to the evaluation cycles based on I-CMO configurations, the DARWIN evaluation team will also consult the DCoP members to derive feedback on the applicability and fitness-for-purpose of the DRMGs to critical infrastructures different from those identifiable in the two main DARWIN domains, i.e. the health care and ATM. Although this part of the evaluation will be less in-depth compared to the one performed in the specific health care and ATM pilot exercises, there is an expectation that this will support Task 2.1 in the process of generalizing the DRMGs as European Resilience Management, applicable to a wide variety of domains. The concrete modalities for achieving this feedback will be established in cooperation with Task 5.2 (“End user & academia CoCRP4 innovation activities”). These may range from a dedicated session in one of the official DCoP workshops to collect feedback from selected representatives of different critical infrastructure domains, to the administration of a questionnaire to DCoP members working in domains different from health care and ATM. No matter which specific method will be chosen, it will be possible to initiate this consultation only after a sufficiently consolidated version of D2.2 and D2.3 will be made available (see section 5 for more specific indications on the time constraints).

2.3 Maturity Assessment

Maturity of operational concepts and technologies can be described through Technology Readiness Levels (TRL). Within Horizon 2020 eight TRLs have been proposed, and these have been adapted for use in DARWIN as shown in Table 4. Transition from one TRL to the next should be triggered by validation activities in order to ensure that there is sufficient confidence in the validity of the operational concept or technology prior to progressing to the next life cycle phase.

DARWIN aims to produce outputs at different levels of maturity, ranging from resilience concepts documented in examples (TRL 2) to pilot demonstrations of resilience concepts in realistic scenarios (TRL 6). The assessment of the TRL and recommendations for transitions between levels for each output will be

4 Starting from April 2016, the DARWIN Consortium has decided to rename the CoCRP (Community of Crisis and Resilience Pratictioners) into DCoP (DARWIN Community of Practitioners).
achieved through validation exercises appropriate for the corresponding level of maturity, to be combined with the evaluation activities outlined in 2.2. For outputs at TRL 2 and TRL 3, validation will be achieved through stakeholder consensus. Depending on the evaluation phases, representatives from the DARWIN end users and/or DCoP members will be invited to discuss the maturity of the outputs, and to provide feedback on the transition to the next TRL. For outputs at higher levels of maturity (TRL 4 – TRL 6), validation exercises will be based on the pilot exercises for the scenarios described in Section 4.

Table 4: Technology Readiness Levels (TRL) in DARWIN

<table>
<thead>
<tr>
<th>TRL</th>
<th>Interpretation in DARWIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRL1</td>
<td>Lowest maturity of concepts and methods. Examples include scientific articles and conference papers.</td>
</tr>
<tr>
<td>TRL2</td>
<td>Concepts formulated with some precision including some case applications. Examples include case study applications.</td>
</tr>
<tr>
<td>TRL3</td>
<td>Analytical studies, regulation and policy aspects analysed. Examples include concepts that take into account DARWIN end users views.</td>
</tr>
<tr>
<td>TRL4</td>
<td>Resilience concept and methods have been validated in simulations or workshops in one or more security sectors.</td>
</tr>
<tr>
<td>TRL5</td>
<td>Resilience concepts are integrated with reasonably realistic supporting elements so that the systems can be tested in a simulated environment.</td>
</tr>
<tr>
<td>TRL6</td>
<td>Representative resilience concepts are tested in a relevant environment. Represents a major step up in a concept demonstration.</td>
</tr>
<tr>
<td>TRL7</td>
<td>Resilience concepts and guidelines near or at planned operational system. Demonstration of an actual system prototype in an emergency preparedness exercise operational environment.</td>
</tr>
<tr>
<td>TRL8</td>
<td>Resilience concepts and associated guidelines are qualified by regulations.</td>
</tr>
</tbody>
</table>
3 Initial evaluation of generic DRMGs

3.1 Strategy for the initial evaluation

WP2 will initially deliver generic DRMGs that will then be refined and tailored for adoption in specific contexts. As part of the first cycle of Task 4.3 (“Evaluation cycle of Guidelines”), the initial generic guidelines will be validated for the purpose of quality assurance by gathering feedback from end users about the extent to which the requirements set out in D1.3 have been addressed (Section 3.3). The initial evaluation of the generic guidelines will also utilise the realist I-CMO framework in order to start building an explanatory theory\(^5\) of how the DRMG supports users in practice (Section 3.4). This initial theory will then be tested and refined in concrete scenarios in the context of Task 4.2 (Implementation of Pilot Cases) and in the following cycles of Task 4.3 (Evaluation Cycles of Guidelines).

3.2 Consideration of Requirements from D1.3

The requirements specified in D1.3 provide a useful basis for validating that the DRMG meets key quality criteria, and for building a theory of how the DRMG will support organisations in practice.

The set of requirements contains a number of functional and non-functional requirements. Functional requirements specify certain behaviours or functions that a product or system should exhibit. Non-functional requirements are quality attributes that set out how a system or product should be (rather than what it should do). In D1.3 the functional requirements are those that relate to the concept. Non-functional requirements have been specified in terms of form, quality, target, process and context.

The set of non-functional requirements serves as input to a validation exercise with stakeholders in order to build confidence that the DRMG has been designed well and in accordance with the previously identified user needs. The set of functional requirements provides input to the iterative realist evaluation, where the aim is to establish if and how the functions supported by the DRMG work in practice for whom, and under what circumstances.

3.3 Validation with non-functional requirements

In preparation to this step, an initial screening of D1.3 non-functional requirements will be made, in order to exclude those that are clearly not applicable to the specific phase of the project or set of guidelines. For example a requirement such as GRQ-08 “The DRMG should contain a training and maintenance package (TMP) that facilitates the introduction of the DRMG” (see section 3.1.5 in [3] or DR-15 in D1.3 Requirement Matrix) may be considered premature for being applied to a project phase in which the DRMGs are still in an initial design process.

After the initial screening, the validation of the initial DRMGs will utilise a stakeholder workshop. A stakeholder workshop is a focus-group based activity [5]. The group setting that is a characteristic feature of focus groups is useful for stimulating discussion among participants, where they can present their unique point of view, be made aware of possibly differing points of view of their colleagues, and comment on their respective experiences.

The aim of the focus group is to elicit the views of end users about the quality of the guideline, and to identify any feedback to the technical project activities. To note that while a focus group frequently forms part of consensus development approaches, such as Nominal Group Technique [7] and Delphi process [8], in this context the use of a full consensus development process does not appear justified. The aim here is not to establish consensus, but rather to provide feedback to the guideline developers about the quality of the guidelines.

---

5 Theory refers to a causal explanation of how the DRMGs bring about change in a given scenario.
The focus group participants will be end users internal to the project. Each end user organisation will be invited to nominate 2-3 participants from the internal end users’ organizations. Participants will be given the generic DRMGs and the set of non-functional requirements set out in D1-3. In addition to this, the attendants will have an opportunity to review the guidelines with a view to the non-functional requirements prior to the stakeholder workshop.

The focus group will consist of the following activities:

**Generic DRMG overview**  
The DRMGs, their key features, and the relationship to the requirements set out in D1-3 are presented to project participants in order to establish a common interpretation.

**Requirements met**  
Participants are invited to discuss main requirements that the guideline did well to address.

**Requirements not met**  
Participants identify the main requirements that the guideline does not address satisfactorily, and discuss the reasons for this perceived shortfall.

**Feedback**  
Participants discuss and agree the main feedback and areas for improvement that should be provided to the guideline developers.

The key findings of the focus group will be captured in a dedicated part of D4.2 (Initial Evaluation of Guidelines) as well as in the dataset “DS.WP4.DBL.Pilots.Healthcare and Air Traffic Management” described in 2.2.3. Such information will be made available to the resilience management guidelines developers in WP2 for their consideration.

### 3.4 Evaluation with functional requirements based on the I-CMO framework

The set of functional requirements identified in D1.3 [3] specifies, by definition, what the DRMGs should do, albeit at an abstract level at this stage. The functional requirements are those that relate to the concept. In D1-3, the concept has already been broken down into functional blocks. For example, there are functional blocks around supporting communication, planning and the provision of training.

The initial evaluation of the generic DRMG is based on two steps:

1. A set of **semi-structured interviews** to build an **initial theory**.
2. A **focus group**\(^6\) to support building a **shared understanding**, and to identify gaps and areas for further development.

---

\(^6\) This focus group activity has a different scope compared to the one for the “validation with non-functional requirements”. For practical reasons – such as difficulties to organise two separate face-to-face meetings with end users – it may be decided to combine the two focus groups in a unique event. It should be however ensured that the two different methodological goals are not mixed up.
3.4.1 Initial theory development

Semi-structured interviews will be conducted with members of the guideline development team and with project partners with an operational background (end users) based on the I-CMO framework to elicit for each core function an emerging theory to explain (see Table 3):

<table>
<thead>
<tr>
<th>Intervention</th>
<th>What is the nature of the core function, and what might this look like in practice?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanisms</td>
<td>How will this function support practitioners, and how will it lead to change in practices?</td>
</tr>
<tr>
<td>Outcomes</td>
<td>What kind of outcomes and changes would this function help to bring about?</td>
</tr>
<tr>
<td>Context</td>
<td>For what kind of stakeholders would this function work well? What kind of stakeholders might not benefit? In what kind of circumstances would this function work well, and in what kind of circumstances would it not work?</td>
</tr>
</tbody>
</table>

Even though the DRMGs are generic at this stage, it is useful to document the underlying rationale for their development in the form of an initial theory. For each core function, an I-CMO description will be developed to describe the emerging theory about how the DRMG brings about successful change, for whom, and under what circumstances. This description provides the starting point for subsequent iterative revision and refinement once the DRMGs are instantiated in different settings as the project progresses.

3.4.2 Shared understanding and identification of areas for development

It is highly likely that at an early stage, the perceptions of different stakeholders about what the core functions of the DRMG look like and how they will work in practice show only partial overlap, or might even be in conflict. Therefore, following the interviews, a focus group will be held with guideline developers and end users (project internal) to discuss the initial theories, and to identify gaps and areas that require further development or clarification.

The WP2 from one side and the WP4 end-user partners on the other side will be invited to nominate 1-3 participants for the focus group. The focus group will consist of the following activities:

| Initial theory | The findings from the interviews are presented in order to provide participants an overview of the initial theory in the form of I-CMO configuration. |
| Theory review  | Participants discuss each I-CMO configuration in turn, and resolve conflicting views through discussion and refinement of the I-CMO configuration. I-CMO configurations may be revised or deleted, and new I-CMO configurations might be produced. |
| Guideline review | Participants discuss and agree the areas for improvement or clarification that should be considered in the guideline development. |
A summary report in D4.2 will document the findings of the focus group. The report will include:
1. A summary description of the initial theory in the form of revised I-CMO configurations
2. The key areas for improvement and clarification for the guidelines that have been identified.

3.5 Maturity assessment of generic guidelines

The initial maturity assessment of the generic DRMGs is expected to be at TRL 2. The validation will be undertaken through at the end of the focus group described in 3.4.2. The same group of stakeholders will be invited to discuss the generic guidelines, to provide feedback on strengths and weaknesses, and to make suggestions for areas for improvement and greater specificity in order to progress the DRMGs to higher levels of maturity. To note that for most of the concepts originating the DRMGs, a maturity assessment based on TRL levels is available in D1.2 (Consolidation of resilience concepts and practices for crisis management) [2]. When applicable, this assessment will be taken as reference for the determination of the maturity baseline.
4 Scenarios for pilots exercises

4.1 Strategy for Scenario Development

As explained in Chapter 2, the identification of a relevant set of scenarios is an essential element of the plan for the evaluation of the DRMGs. In Task 4.1 it was therefore decided to dedicate a considerable amount of effort to define examples of crisis events, which are of interest for the end users represented inside the DARWIN consortium (i.e. ENAV, ISS and KMC) and useful for testing the effectiveness of the guidelines that WP2 is going to produce.

The scenarios intended here are essentially accounts of realistic but fictitious crisis events, designed in a way to highlight all the critical aspects that may be successful address through resilience engineering practices. Together with the account of the critical event, the scenarios provide all the information considered relevant for the management crisis based on state of the art knowledge of the domain experts.

The primary reason for developing the scenarios is the preparation of the pilot exercises that will be conducted as part of Task 4.2 (Implementation of Pilot Cases). At this stage of the project it is not yet possible to fully anticipate the specific method and technique that will be adopted for the pilot exercises, as well as it is not yet possible to predict the exact number and size of such exercises. In fact, these aspects will heavily depend on the type and number of DRMGs that will be actually developed in the project. Nonetheless, the preparation of the scenarios gives an opportunity for an initial investigation of the panel of subject matter experts that will be required in each exercise and of the most important elements to be considered for providing a valuable feedback to the DRMG design process. In this respect, the scenarios described in this chapter will not be used only for the purposes of pilot exercise preparation, but also as a reference for the evaluation of the initial set of generic guidelines to be done in D4.1.

For what specifically concern the organization of the pilot exercises, it is anticipated that the subject matter experts who accept the invitation will be given an information sheet and consent form containing information on what type of data will be collected during the exercises sessions. The information sheet will describe the aims, methods and implication of the research and will clarify the nature of participation, including benefits, risk or discomfort that might be involved. This procedure will be followed in accordance with the overall ethical strategy of DARWIN, described in D7.4 “Ethic Approvals” [9]. An excerpt of this deliverable specifying the DARWIN Ethical Requirements is also available in Appendix 1.

4.1.1 Criteria for scenario selection

The development of the scenarios has been arranged in a way to reflect the envisaged organisation of the pilot exercises, taking into account both the domain of competence and geographical location of the end users internal to the DARWIN consortium. Based on these two elements it was agreed that:

- One part of the pilot exercises will be conducted in Italy, i.e. the country where both ENAV and ISS are located, while another part of the exercises will be conducted in Sweden, the country of KMC and FOI.
- The pilot exercises will have to cover the different domains of competence of the end user, i.e. Air Traffic Management (ATM) for ENAV and Healthcare (HC) for ISS and KMC. Ideally, some of the pilots will have to consider crises involving both the ATM and HC.
- To the extent possible, the pilots will also have to investigate the cascading effects of the crises on other neighbouring domains, such as those of the critical infrastructures that may be indirectly affected by the crisis (e.g. other transportation systems or public services).

Since the scope of possible events with relevance for the evaluation of the DRMGs is quite wide, the WP4 partners discussed a set of criteria to choose and then select a limited number of scenarios. Such criteria are briefly presented below in the form of requirements that the scenarios should follow.
D4.1—Evaluation Plan

- **Domain Coverage** (ATM/HC/both). As mentioned before, both ATM and HC should be covered by the scenarios. In addition, some of them should address the interfacing aspects between the two domains.

- **Main Cause of the Crisis** (natural/man made). The scenarios should describe both crisis events caused by natural factors (e.g. earthquakes or severe weather phenomena) and by mistakes or deliberate actions by a human or organization.

- **Crisis type** (Regular, Irregular, Unexamplied). The scenarios should ideally cover different events types in terms of frequency of occurrence and predictability. The distinction between Regular, Irregular and Unexampled events by Westrum [10] is taken as reference.

- **Number of involved people** (Low, Medium, High). The scenarios should cover events of different magnitude in terms of number of affected people. From a low number to a very high one (e.g. an entire community or population).

- **Temporal Scale** (Low, Medium, High). The scenarios should cover events characterized by different temporal scales in terms of duration of the effects and time for recovery to a normal state.

- **Feasibility for pilots** (Low, Medium, High). The selection of scenarios should favour the crisis situations that are feasible to address in a pilot exercise. This feasibility aspect should consider aspects such as: (a) the availability of subject matter experts to involve in the exercise, (b) the possibility to establish good relationships with representatives of the organizations involved in the management of crises like those described in the scenarios, (c) the availability of simulation facilities or other tools/resources to support the conduction of the pilot exercise, (d) the compatibility with the effort allocated to each partner involved in the preparation and conduction of the pilot exercise.

Other potential criteria have been also considered, but the information available at the time of preparing the present deliverable is insufficient to fully exploit them. Examples are the potential synergy with WP3 (“Simulation and serious gaming tools”) and the expected relevance of the scenario for specific resilience management concepts. For what concern the first criterion more information will be available when the Task 3.2 will start and investigate the feasibility of simulating at least some aspects of the scenarios developed in WP4. While for what concern the focus on specific resilience concepts, an important factor for deciding will be the DRMGs to be evaluated, as soon as they will be developed by WP2.

In conclusion, it is important to clarify that the scenarios are designed to reflect concrete and specific local needs that may be different from those of other geographical areas or cultural contexts. This choice is made on purpose to remain consistent with the realist evaluation approach presented in the chapters 2 and 3, based on analysing the DRMGs under specific circumstances and on understanding the successful or unsuccessful factors in a specific context. However, the evaluation scenarios should not be confused with the DRMGs as such. Although these will be also adapted to specific domains, their underlying principle will need to be generalizable to a wide variety of contexts and to different types of crisis management situations.

### 4.1.2 Final selection of scenarios

So far, the following five scenarios have been selected, each one identified with a code reflecting the name of the DARWIN end-user partner proposing it:

- **ENAV 1**: Aircraft crashing in urban area close to Rome Fiumicino Airport shortly after taking off
- **ENAV 2**: Blackout in Rome Area Control Centre
- **ISS 1**: Disease outbreak during flight due to land at Rome Fiumicino
D4.1 – Evaluation Plan

- ISS2: Organ transportation in severe weather conditions
- KMC-FOI: Collision between oil tanker and passenger ferry leaving Gotland islands in severe weather conditions.

A detailed description and analysis of each scenario is available in the sections 4.2, 4.3 and 4.4. The Table 5 highlights how the five scenarios have been classified according to the above mentioned selection criteria.

For what concern the **main cause of the event**, both **man-made** and **natural events** have been considered. However, one may argue whether the severe weather phenomena associated to climate change identified in the scenarios ISS2 and KMC-FOI (see 4.3.2 and 4.4.1) are sufficient to cover the analysis of crisis situations deriving from natural causes. As well as the natural origin of the disease outbreak in the scenario ISS 1 (see 4.3.1) may be questioned by the possibility that the disease is caused by other long term factors determined by human action.

For what concern the **number of involved people**, one may argue that the two crises expected to affect the larger number of people (although with effects of very different severity) - i.e. the ACC blackout in ENAV 2 (see 4.2.2) and the Passenger Ferry Collision KMC-FOI (see 4.4.1) - do not represent examples of the most large-scale crises imaginable. Nonetheless, the identification of other very large scale crises (e.g. the effect of a chemical attack on a large population or the consequence of a natural disaster over an entire nation) might quite easily go against the **feasibility for pilots** criterion also indicated above.

**Table 5: classification of the scenarios according to the agreed selection criteria**

<table>
<thead>
<tr>
<th>Domain Coverage</th>
<th>Sc. ENAV 1 Aircraft crashing</th>
<th>Sc. ENAV 2 ACC Blackout</th>
<th>Sc. ISS 1 Disease outbreak</th>
<th>Sc. ISS 1 Organ transportation</th>
<th>Sc. KMC-FOI Passenger Ferry collision</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ATM</strong></td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td><strong>HC</strong></td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td><strong>Both</strong></td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Main Cause</th>
<th>Sc. ENAV 1 Aircraft crashing</th>
<th>Sc. ENAV 2 ACC Blackout</th>
<th>Sc. ISS 1 Disease outbreak</th>
<th>Sc. ISS 1 Organ transportation</th>
<th>Sc. KMC-FOI Passenger Ferry collision</th>
</tr>
</thead>
<tbody>
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<tr>
<th>Crisis Type</th>
<th>Sc. ENAV 1 Aircraft crashing</th>
<th>Sc. ENAV 2 ACC Blackout</th>
<th>Sc. ISS 1 Disease outbreak</th>
<th>Sc. ISS 1 Organ transportation</th>
<th>Sc. KMC-FOI Passenger Ferry collision</th>
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<th>N. of people</th>
<th>Sc. ENAV 1 Aircraft crashing</th>
<th>Sc. ENAV 2 ACC Blackout</th>
<th>Sc. ISS 1 Disease outbreak</th>
<th>Sc. ISS 1 Organ transportation</th>
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<tr>
<th>Temporal Scale</th>
<th>Sc. ENAV 1 Aircraft crashing</th>
<th>Sc. ENAV 2 ACC Blackout</th>
<th>Sc. ISS 1 Disease outbreak</th>
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For similar reasons, it should be also observed that none of the selected scenarios seems to represent an ‘unexampled event’ as such, thus covering only partially the crisis type criterion. On the other hand, virtually all scenarios combine expected aspects - in the sense that they include regularly happening events in a crisis - with unexpected aspects, which may be considered irregular or even unexampled.

Anyhow, in the context of Task 4.2 (Implementation of Pilot Cases), the possibility to identify a scenario with these characteristics will be reconsidered, although still keeping in mind its concrete applicability in a pilot exercise. While for what concern the distinction between ‘regular’ and ‘irregular’ events, it is worth noting that this is not straightforward for all the scenarios. For example, the ‘Air crashing in an urban area close to Rome Fiumicino Airport’ has been classified as a regular event, but only if considered from the perspective of the entire aviation system. At this level, one could easily argue that lots of experience has been achieved with this kind of accidents. On the other hand, the same classification would not work if seen for the perspective of an individual airport, for which these kind of accidents are luckily extremely rare.

### 4.1.3 Template for scenario development

In order to facilitate the development of scenarios with the involvement of all the DARWIN end users, we designed a standard template aimed at collecting all the information that we considered relevant for each specific scenario.

The template included guidewords to facilitate the most consistent possible way to fill it in among the different partners. It took a tabular format and was structured around the items listed below.

- Description and Characteristics of the Scenario
  - Critical Event
  - Context
  - Concerned DARWIN domain
  - Magnitude of the event and duration of the effects
- Baseline Information relevant for the Scenario
  - Organizations involved in the management of the crisis
  - Current applicable laws and regulations and national and local level
  - Knowledge from previous events
- Aspects of the Scenario relevant for the Pilot Exercise
  - Goal
  - Main area(s) of resilience being analysed/tested
  - Subject Matter Experts to involve in the Pilot Testing

The description of the scenarios included in the following sections 4.2, 4.3, 4.4 follows the same structure.

### 4.2 Scenarios proposed by ENAV

This section will illustrate the two scenarios proposed by ENAV: one focussed on ATM and Healthcare, one only on ATM.
### 4.2.1 Aircraft crashing in urban area close to Rome Fiumicino Airport shortly after taking off

#### 4.2.1.1 Description and Characteristics of the Scenario

<table>
<thead>
<tr>
<th>Critical Event</th>
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</thead>
<tbody>
<tr>
<td><strong>A narrative describing the crisis situation to be handled</strong></td>
</tr>
</tbody>
</table>

It is 12:00 am o’clock in Fiumicino and a sunny summer day (CAVOK – Ceiling and Visibility OK according to standard phraseology). As usual, in Fiumicino Airport, midday is the peak hour for departures (55 movements per hour).

An Airbus A321 taking off from RWY 16R crashes outside Fiumicino airport on an urban area (see picture below as reference).

The aircraft, belonging to a major extra-European airline, carries approximately 180 passengers, two pilots and 5 flight attendants.

During take-off, a Foreign Object Debris on the runway (also known as FOD), which fell off from an aircraft that had taken off about three minutes earlier, is sucked into the left engine causing serious damages. The engine explodes making the pilot unable to fly the aircraft.

The aircraft crashes on an urban area, (highlighted with a red icon in the figure below). The area (approx. 100m x 100m) is characterized by several parking, car rentals, and streets and also a restaurant is concerned.

Streets and buildings in the area of the accident are damaged. The debris is spread all over the area.

It is evident since the beginning that there will be several injured and dead people (both passengers/crew and people on the ground). Search and rescue services encounter some problems to reach the area due to traffic and unavailability of some streets, which have been closed for two weeks for maintenance work.

In order to manage the consequences of the accident, Fiumicino Control Tower (a.k.a. TWR) activates - by means of a dedicated alarm system - all the concerned actors. In so doing the apply the “ADR Manuale rosso” (“Red Manual”).

The firefighters of the airports are the first to intervene in the area of the accident and the airport is suddenly closed to traffic as follows:

- Traffic departing from Fiumicino is stopped immediately;
- Airborne traffic supposed to land in Fiumicino is diverted to alternate airports (i.e. Ciampino, Naples, Firenze, Pratica di Mare, etc.);
- Traffic on ground with destination Fiumicino is stopped on ground and delayed.

From Air Traffic Services point of view there is an increase of workload for:

- ATCOs (Planner and Executive) in ACCs due to an increase of coordination, communications with pilots and nearby ATS Units, management of diverted traffic
- ATCOs in nearby ATS Units due to an increase of coordination and communications with pilots
- ATCOs in Fiumicino due to management of the crisis.

Also, Network Manager (EUROCONTROL) is involved in order to apply traffic restrictions: airport capacity (number of aircraft landing and taking off per hour) is reduced by 30% due to RWY 16R closed. This capacity restriction is maintained for two days.

Immediate cascade effects on aviation system regard flight cancellations and delays, implying passengers’ assistance (from both airlines and airport management company). The aircraft manufacturer and the ANSV will be involved for investigation purposes.

The first hypothesis from media concerns a terrorist attack with ground to air missile or small bomb onboard. It will be refuted a couple of days after the accident, thanks to investigations and analysis of video.
The victims are distributed as following:

- **Dead people** – 20 passengers/crew and 10 people on the ground. For these people it is necessary to organize removal of corps.
- **Injured people** – 120 passengers/crew and 40 people on the ground. The type of expected casualties is severe life-threatening injuries (traumatic, burns, asphyxiation, and collapses).
- **lightly and moderately injured (traumatic and stress reaction)** people - 47 passengers/crew and 30 people on the ground

The activities regarding healthcare domain will be: checking available hospitals and ambulances, organizing a triage and life-saving treatment on site, organize evacuation of the casualties to hospitals and trauma centres for definitive care, ensuring coordination among the rescue teams on site and hospitals (as expected, a massive quantity of blood for transfusion will be necessary).

Also psychological assistance for survivors and relatives is needed.
D4.1—Evaluation Plan

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 653289.

Figure 4-1: Map of the area interested by the accident
The research leading to these results has received funding from Horizon 2020, the European Union’s Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 653289.

Figure 4-2: Map of the urban area interested by the accident.

Context

A description of the geographical area/location in which the critical event occurs (to be integrated with a description of cultural elements if considered useful)

The accident occurs nearby Fiumicino airport which is the major international airport in Rome and one of the busiest airports in Europe by passenger traffic with approx. 40.5 million passengers served in 2015 (eighth airport in Europe in 2015), as reported by Assaeroporti.

It is located in Fiumicino, 35.0 km west of Rome’s historic city centre. The airport is served by a six-lane motorway, a railway station and numerous buses and taxis.

The area is close to the sea and flat, also characterized by cultivated fields and farms.

Following recent tragic events in Brussels airport, aviation is one of the domains under observation with respect to security and terrorism.

Concerned DARWIN Domain

The identification of the specific domain(s) interested by the scenario
The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 653289.

### Evaluation Plan

The identification of other possible infrastructure operators suffering the consequences of the critical event (directly or as a result of a cascading effect)

- Transportation services ensuring connections to and from a city where it has become very difficult to depart/arrive with any flight;
- Tourism: some hotels will host passengers of cancelled flights and host victims’ relatives. At the same time several cancellations of reservations have to be expected;
- Economic and commercial fields (import/export);
- International, national and local media and press (including social networks).

Magnitude of the event and duration of the effects

**A description of the space and time scale characterizing the events**

Airport infrastructures are not damaged by the accident, ATS can be restored as soon as the “Livello Rosso” (Red Level) ends. The effects on the Air Traffic Services point of view will last for about two days. The airport will be re-opened to traffic as soon as the firefighters of the airport will ensure the normal operations. Anyway in the following couple of days after the re-opening, the capacity of the airport will be reduced by 30% due to the possible unavailability of RWY 16R for landing/departures (possible interactions with search and rescue activities with departures and missed approach procedures of RWY 16R, and continuous RWY inspections to retrieve debris of exploded engine).

It is expected that the emergency (i.e. search and rescue activities) will last for a couple of days.

#### 4.2.1.2 Baseline Information relevant for the Scenario

**Organizations involved in the management of the crisis**

The organizations, institutional bodies, authorities involved in the management of the crisis (and the individual operators inside them)

**ATM sector:**
- **Enav S.p.A.**: it provides the air traffic services;
- **ENAC** – Italian Civil Aviation Authority: it is responsible for the supervision and of the monitoring of airports situation (during the crisis);
- **Firefighters**: they provide the rescue services and they are in charge of the technical management of operations;
- **AdR**: it is the company which guarantees that the assistance services are provided to passengers;
- **Airline operators**: they have the responsibility to provide information about the aircraft involved in the accident;
- **“Forze di polizia (Polizia di Frontiera, Carabinieri e Guardia di Finanza)”**: they ensure protection, patrol and order of the concerned areas.

**Health care sector:**

☐ ATM
☐ Healthcare
☒ ATM and Healthcare

Other domains
**Airport E.R. (Pronto Soccorso Aeroportuale ADR).** It is triggered by Fiumicino TWR that communicates the specific type of accident (red level). The Airport E. R.:

- activates the ADR “flight line” physician ("Medico Linea di Volo ADR"). who reaches the place of the accident (by means of the unit BIANCO/ZERO) and coordinates via radio with the Airport E. R. (particularly with the “Sala operativa del pronto soccorso” and the “Posto fisso del pronto soccorso”) to request internal additional emergency means (ambulances, human resources);

- calls the Regional emergency agency (118) – Head Office in S. Camillo Hospital (external to the airport) to communicate the type of accident, and other information as type of aircraft, number of passengers, fuel data, possible presence of dangerous goods on-board. The 118 head office starts the procedures to activate the medical rescue chain, alerts hospitals and obtains information on beds availability at regional and extra-regional level. Meanwhile, 118 intervenes with ambulances in the place of accident, evaluates and monitors the accident scenario with the ADR “flight line” physician in order to coordinate the medical rescue chain with the head office;

- warns USMAF (Sanità aerea: Ufficio di Sanità Marittima, Aerea e di Frontiera – Maritime, Air and Border Health Office – Ministry of Health) that activates the Airport Physician (“Medico dell’aeroporto” or “Medico Sanità Aerea”). He will follow the internal expected procedures in order to guarantee the fulfilment of the law obligations regarding the air traffic international preventive medicine, the public hygiene and the sanitary police (for example by assisting the police in removing corps).

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**Current applicable laws and regulations and national and local level**

A list of references to the laws and regulations in force relevant for the situation

- **ENAC, Aeroporti di Roma, Aeroporto “Leonardo Da Vinci”- Fiumicino- “Norme e Procedure per Stati di Emergenza o Incidente Aereo”- Allegato all’ordinanza 26/2014:** it contains the procedures for the management of an incident/accident occurring inside/outside Fiumicino airport;

- **ENAV MOATS - Manual Of Air Traffic Services:** it is the manual used by ATCOs to manage daily operations in terms of separations, clearances, instructions and information to be issued when providing air traffic services;

- **IPI Fiumicino TWR - permanent internal instructions:** they are internal instructions, compliant whit MOATS, but especially referred to the air traffic services provided by local ATS unit (TWR, APP, ACC);

- **IPI Roma ACC- permanent internal instructions:** they are internal instructions, compliant whit MOATS, but especially referred to the air traffic services provided by local ATS unit (TWR, APP, ACC);

- **“Criteri di massima per i soccorsi sanitari nelle catastrofi”** (Decreto ministeriale del 13 febbraio 2001) [Civil Protection - Criteria for first aid in disasters];

- **“Criteri di massima sugli interventi psico-sociali da attuare nelle catastrofi”** (Direttiva del Presidente del Consiglio dei Ministri del 13 giugno 2006) [Civil Protection - Criteria for psychosocial interventions in disasters].

---

**Knowledge from previous events**

The lessons learned from previous events that could be relevant to know to manage the crisis event.
### Investigation reports from past similar accidents:

- **4 October 1992 - Amsterdam Schipol – El Al 1862:**
  
  El Al Flight 1862, a Boeing 747 cargo aircraft of the state-owned Israeli airline El Al, crashed into the Groeneveen and Klein-Kruitberg flats in the Bijlmermeer (colloquially "Bijlmer") neighborhoods of Amsterdam, the Netherlands. A total of 43 people were officially reported killed, including the aircraft's three crew members, a non-revenue passenger in a jump seat, and 39 people on the ground. Many more were injured. The exact number of people killed on the ground is in dispute, as the building had a high concentration of illegal immigrants. The cause was engine detachment due to metal fatigue causing disrupted aerodynamics of aircraft and loss of control.

- **12 November 2011 – Queens, New York City - American Airlines 587:**
  
  American Airlines Flight 587 was a regularly scheduled passenger flight from John F. Kennedy International Airport in New York City to Santo Domingo's Las Américas International Airport in the Dominican Republic. On November 12, 2001, the Airbus A300-600 flying the route crashed into the Belle Harbor neighborhood of Queens, a borough of New York City, shortly after takeoff. All 260 people on board the flight were killed, along with 5 people on the ground. The location of the accident and the fact that it took place two months and one day after the September 11 attacks on the World Trade Center in Manhattan initially spawned fears of another terrorist attack. Terrorism was officially ruled out as the cause by the National Transportation Safety Board, which instead attributed the disaster to the first officer's overuse of rudder controls in response to wake turbulence, or jet wash, from a Japan Airlines Boeing 747-400 that took off minutes before it. According to the NTSB, this aggressive use of the rudder controls by the co-pilot caused the vertical stabilizer to snap off the plane. The plane's two engines also separated from the aircraft before it hit the ground.

- **25 July 2000 – Gonesse, France - Air France 4590**
  
  Air France Flight 4590 was an Aérospatiale - BAC Concorde on a scheduled international flight from Paris, France, to New York City. On 25 July 2000, local time 16:43 CET, while taking off it ran over debris on the runway, blowing a tyre and puncturing a fuel tank, leading to fire and engine failure. All 100 passengers and 9 crew members aboard the Concorde died when it crashed into a hotel in nearby Gonesse, while on the ground four people were killed and one was critically injured.

- **8 June 2013 – Fiumicino - Wizz Air 3141**
  
  On 8 June 2013, Wizz Air Flight 3141, an Airbus A320-232 from Bucharest - Henri Coandă Airport, Romania to Rome-Ciampino, Italy, made an emergency landing at Leonardo da Vinci–Fiumicino Airport when the crew encountered problems getting one of the main undercarriage down and locked. The aircraft diverted to Fiumicino because of the longer runway, and firefighters applied foam after landing as a precautionary measure. The aircraft was evacuated using slides. There were 165 passengers and 5 crew members on board. 3 occupants were injured.

### 4.2.1.3 Aspects of the Scenario relevant for the Pilot Exercise

<table>
<thead>
<tr>
<th>Goal</th>
<th>A description of what we want to test with scenario</th>
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<tbody>
<tr>
<td></td>
<td>The scenario will allow to test the improvement of the guidelines under analysis on the following aspects:</td>
</tr>
<tr>
<td></td>
<td>• Internal coordination/communication among ENAV Units (Fiumicino TWR, ROMA ACC, nearby airports and ACCs);</td>
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<tr>
<td></td>
<td>• Coordination and synchronization among the ATM organizations involved in the management of</td>
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the crisis (i.e. ENAV, ENAC, AdR, airlines, etc)
- Coordination and synchronization among organizations that are part of the health care domain (i.e.: AdR E.R. (Medico Linea di Volo ADR), USMAF (Medico dell’aeroporto/ Medico sanità aerea), Regional emergency agency (118);
- Transversal coordination and synchronization between ATM and healthcare organizations involved in the management of the emergency;
- Transversal coordination and synchronization between ATM and healthcare organizations and other organizations (i.e. civil protection, firefighters, police, etc) involved in the management of the emergency;
- The capability of all involved organizations to cope with unexpected;
- The availability of human resources and equipment in case of emergency/crisis.

Main area(s) of resilience being analysed/tested

☐ Anticipate
☐ Monitor
☒ Respond & Adapt
☒ Learn & Evolve

Rationale

The theory (or logic model) describing how and why the concerned resilience management guidelines will achieve the desired outcomes in one or more of the above areas.

Respond & Adapt: The interaction between ATM and Healthcare domains can represent a challenge to the respond and adapt capability and to its boundaries, especially in regard to the coordination of the required resources and to the flexibility of the available resources. This necessary aspect for the control of a critical situation will be tested during the pilots’ exercises, with the DRMGs that could also provoke an adjustment of the system (environment, actors and procedures) to new conditions.

Learn & Evolve: During this scenario, it will be analysed whether any learning actually occurred and if the changes in behaviours determined the desired effects. One of the form that learning and evolve could take in this critical event is the (re)education of personnel through the update and implementation of training and a revision of existing procedures and guidelines.

Subject Matter Experts to involve in the Pilot Testing

<table>
<thead>
<tr>
<th>The experts to involve in the pilot testing as representatives of the organizations involved in the management of the crisis</th>
<th>Estimated possibility to involve the specific SME in a Pilot Exercise (Low – Medium - High)</th>
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<tbody>
<tr>
<td>Air Traffic Controller(s)</td>
<td>High</td>
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<tr>
<td>Pilot</td>
<td>High</td>
</tr>
<tr>
<td>Civil Protection Department Representative</td>
<td>Medium</td>
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<tr>
<td>AdR</td>
<td>Medium</td>
</tr>
<tr>
<td>ENAC</td>
<td>Medium</td>
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<tr>
<td>ANSV</td>
<td>Low</td>
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</table>
4.2.2 Blackout in Rome Area Control Centre

4.2.2.1 Description and Characteristics of the Scenario

Critical Event

*A narrative describing the crisis situation to be handled*

During a routine summer day (August, weekend), at about 07.00 pm o’clock (which is the peak hour for arrival traffic), a sudden catastrophic blackout occurs at the transformer room in Rome Area Control Center. The cause is a cable being accidentally cut by men at work nearby. Unfortunately, due to inadequate maintenance, Uninterruptable Power Supply (UPS) are unavailable causing a shutdown of all the electrical devices in the operational room.

![Diagram of the Control Room energy supplier systems]

Figure 4-3: A functional scheme of the Control Room energy supplier systems

Suddenly, ATCOs working in all sectors (approximately 16 sectors) lose all information and visual presentation about flights they are managing. Only radio communication is available between ATCOs and pilots, because it is supported by an independent, separate power supply. All operational (i.e. civil and military ATCOs, supervisors, Ops room director, Rome ACC director and ENAV management) and technical staff (i.e. maintenance) is concerned and involved in solving the crisis. ATCOs start to manage the situation asking pilots’ and other ACC/APP cooperation in order to keep...
operations safe, informing all aircraft in the area about the contingency in progress and transferring in contact to other ACC/APP all possible aircraft, if radio and radar coverage of this ATC units is available. All departures that are going to affect Rome Area Control Center (see figure in “context”, red boundaries), are immediately suspended and delayed for several hours. A lot of aircraft have to be diverted to available airports and several international crossing flights are re-routed to avoid the affected area. Also coordination activities with EUROCONTROL flow management are in place in order to manage traffic flows in the next hours. The blackout lasts for about 1 hour but its effects affect aircraft and passengers waiting at airports for all the day.

Context

A description of the geographical area/location in which the critical event occurs (to be integrated with a description of cultural elements if considered useful)

Rome Area Control Center is the most important ENAV centre with respect to the volume of controlled airspace and managed traffic. The operations room is one of the most advanced in Europe. It controls more than 4,000 flights per day during peak periods of the year (e.g. Summer season). At the moment of the black out about 280 flights are managed by Roma ACC sectors. The controlled airspace (see figure) extends from Tuscany to Sicily. This area of responsibility shares its borders with: Milan ACC, Padua ACC, Brindisi ACC, Malta FIR, Tunis FIR, Athens FIR and Marseille FIR.

Figure 4-4: Map of the airspace controlled by Roma ACC
The research leading to these results has received funding from Horizon 2020, the European Union’s Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 653289.

Figure 4-5: ENAV units (Airports managed by Military Authority are not included)

**Concerned DARWIN Domain**

*The identification of the specific domain(s) interested by the scenario*

- ✗ ATM
- ☐ Healthcare
- ☐ ATM and Healthcare

**Other domains**

*The identification of other possible infrastructure operators suffering the consequences of the critical event (directly or as a result of a cascading effect)*

- Other public transports (train, highways);
- Public services like mail and couriers;
- Medical centres at the airports providing assistance to passengers;
- Accommodation facilities (hotels, b&b, etc.) at all destinations impacted by the critical event.
## Magnitude of the event and duration of the effects

*A description of the space and time scale characterizing the events*

All Italian airspace and almost every Italian airport are affected. Thousands of passengers will have to be managed at airports. The blackout lasts for approx. 1 hour but there will be cascade effects for at least a couple of days.

### 4.2.2.2 Baseline Information relevant for the Scenario

#### Organizations involved in the management of the crisis

*The organizations, institutional bodies, authorities involved in the management of the crisis (and the individual operators inside them)*

- **Enav S.p.A.** : it provides the air traffic services;
- **Techno Sky** - electrical/technical maintenance service: they are immediately called by Air traffic Controllers in order to restore/fix the systems;
- **ENAC** – Italian Civil Aviation Authority: it is responsible for the supervision and of the monitoring of airports situation (during the crisis);
- **Airline operators** : they are in charge of managing and rearranging flights and eventually planning hotel reservations for passengers;
- **Civil Protection** : it manages critical situations arising at airports (or in other transport infrastructures) that could be very crowded by upset and tired passengers.

#### Current applicable laws and regulations and national and local level

*A list of references to the laws and regulations in force relevant for the situation*

- **ENAV MOATS - Manual Of Air Traffic Services**: it is the manual used by ATCOs to manage daily operations in terms of separations, clearances, instructions and information to be issued when providing air traffic services;
- **IPI Roma ACC - permanent internal instructions**: they are internal instructions, compliant with MOATS, but especially referred to the air traffic services provided by local ATS unit (TWR, APP, ACC);

#### Knowledge from previous events

*The lessons learned from previous events that could be relevant to know to manage the crisis event.*

- **Belgocontrol blackout – 27 May 2015**: due to a technical problem to the control system, no landing or take off were possible in Brussels; moreover some flights were sent to other airports and other were waiting for permission to land. This event had a huge impact on the European traffic management, on the passengers as well as on other domains, as the accommodation infrastructures.
4.1.2 Evaluation Plan

The research leading to these results has received funding from Horizon 2020, the European Union’s Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 653289.

4.2.2.3 Aspects of the Scenario relevant for the Pilot Exercise

Goal

A description of what we want to test with scenario

The scenario will allow to test the improvement of the guidelines under analysis on the following aspects:

- Tactical management of the crisis at Rome ACC (i.e. internal coordination and communication between sectors, availability of ATCOs, involvement of maintenance and technicians, etc.);
- Coordination/communication among ENAV ACC Units (ROMA ACC, Milano ACC, Brindisi ACC and Padua ACC);
- Coordination/communication between Rome ACC and ENAV Units at airports;
- Coordination/communication with EUROCONTROL Flow Management.

Main area(s) of resilience being analysed/tested

☐ Anticipate
☐ Monitor
☒ Respond & Adapt
☒ Learn & Evolve

Rationale

The theory (or logic model) describing how and why the concerned resilience management guidelines will achieve the desired outcomes in one or more of the above areas.

Respond & Adapt: In the face of potential changes in the environment that can lead to an emergency, like in this scenario, the anticipation ability will be tested in terms of tactical and strategica management of the coordination and communication between the actors involved (ATM sectors, ATCOs, ENAV, ACC Units, EUROCONTROL, etc.), adapting existing or new procedures and guidelines in order to control the crisis.

Learn & Evolve: The experience gained during the execution of this scenario can represent a starting point for the improvement of strategies and tactics to adopt in future similar emergencies. The lesson learnt after a crisis ends can provide more knowledge to the organizations, institutions and all the different stakeholders involved in the preparedness and in the respond phases.

Subject Matter Experts to involve in the Pilot Testing

<table>
<thead>
<tr>
<th>The experts to involve in the pilot testing as representatives of the organizations involved in the management of the crisis</th>
<th>Estimated possibility to involve the specific SME in a Pilot Exercise (Low – Medium - High)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACC Air Traffic Controller(s)</td>
<td>High</td>
</tr>
<tr>
<td>Pilots</td>
<td>High</td>
</tr>
<tr>
<td>ENAC</td>
<td>Medium</td>
</tr>
</tbody>
</table>
4.3 Scenarios proposed by ISS

This section will illustrate the two main scenarios proposed by ISS: one primarily focused on Healthcare, but with an important role of some aviation stakeholders, one focused on both Healthcare and ATM.

4.3.1 Disease outbreak during flight due to land at Rome Fiumicino

4.3.1.1 Description and Characteristics of the Scenario

<table>
<thead>
<tr>
<th>Critical Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>A narrative describing the crisis situation to be handled</td>
</tr>
</tbody>
</table>

During an incoming flight, one passenger shows symptoms like severe cough. The other passengers complain to the hostess. In addition the passenger begins to vomit. After asking the pilot in command, the hostess makes an announcement in the cabin asking for a physician on board. A passenger traveling with his family claims to be one and checks the passenger accurately by measuring his temperature and finds high fever and excessive sweating. The physician states to the on-board personnel that the case has to be notified to the pilot in command.

There are 20 minutes left before landing at the Fiumicino airport. The pilot in command advises Roma Area Control Centre (ACC) that there is a suspicious case on board. The air traffic controller asks for pilot in command’s “intentions”. He decides to land at Fiumicino as expected in his flight plan, requesting to land without delay. ACC warns TWR supervisor that notifies the circumstance to the ENAC DCA which, in turn informs USMAF (Maritime, Air and Border Health Office).

The on-board personnel ask the other passengers to fill in a “passenger locator card”.

ENAC DA FCO calls the USMAF and the airport E.R. in order to take the passenger when the flight lands and to carry him through the sanitary dedicated area, for further medical screenings. The case is visited by a medical doctor and the clinical suspicious is for a severe acute respiratory disease and therefore the patient is moved to the negative pressure room. The National Red Cross or the Regional emergency agency (118) provides the transfer to the nearest Hospital specialized in infectious diseases.

There, physicians provide the first aid to the patient and indicate the diagnostic test to be performed considering the country of origin of the patient and the type of symptoms. The first laboratory results are suggestive for a novel influenza virus. The tested sample is immediately sent to the National Influenza Center.

Within twelve hours the patient dies.

What about the other passengers that in the meantime have left the airport and reached their destinations (families, workplaces, perhaps other countries)?

Soon after media report the news that there are unconfirmed reports of several cases of severe, influenza-like illness in another European city. Some of the people who have fallen ill have developed very serious symptoms, and three patients have died. There are also rumours that staffs of the hospitals, where several of the ill people have been sent for treatment, have developed symptoms. Healthy staffs are afraid, and some of them have refused to get into close contact with the patients; the disease appears to have developed quickly and infected a number of family members and friends in a matter of a few days. Three
nurses are said to have developed symptoms, too.

### Context

A description of the geographical area/location in which the critical event occurs (to be integrated with a description of cultural elements if considered useful)

Fiumicino airport is a hub that connects Rome with other capitals and big cities in Europe and in other foreign countries. It is the major international airport in Rome and one of the busiest (eighth airport in Europe in 2015) airports in Europe by passenger traffic with approx. 40.5 million passengers served in 2015 (source Assaeroporti). It is located in Fiumicino, 35.0 km west of Rome’s historic city centre. The airport is served by a six-lane motorway, a railway station and numerous buses and taxis. It is also to take the airport capacity in terms of services offered inside, personnel, etc. to underline the huge flow of people crossing the place every day.

Given the unpredictability of risk factors, WHO has recommended to implement a pandemic plan to be systemically updated in order to set up a preparedness and risk reduction strategy.

Under these guidelines, the Italian Ministry of Health and the Civil Protection Dept. decided to establish the “National Plan for Preparedness and Response to influenza pandemics”. Following its guidelines the critical event described hereunder will place itself under Phase 3 – Level 0, within the alert period, i.e.:

- Phase 3: Human infection through a new subtype, but not human-to-human transmission or with rare infectious evidences. Level 0, no presence of infections in the country.

Civil Protection Dept. requested ENAC and other organizations involved in the services provision to prepare their own airport plan against influenza pandemics.

The critical phases outlined in this ENAC airport plan are:

- Pandemic Alert phase (Phase 4), lev. 1 (Phase 4: Small clusters with limited inter-human transmission and highly localized diffusion, indicating that the virus did not adapt to human host; Lev. 1: small clusters in the country or intensive commercial exchange with countries with infection clusters);

- Pandemic Alert period (Phase 5), lev. 1 (Phase 5: Large clusters with limited inter-human transmission indicating that virus is better adapting to human host, however, not showing risk for a real pandemics; Lev. 1: Large clusters in the country or intensive commercial exchange with countries with large infection clusters);

- Declaration of Pandemic (Phase 6) - Increased and prolonged transmission to population.

Besides emergency measures, the airport plan of preparedness sets up prevention requirements that will be enforced regardless any epidemiologic influenza symptoms onset (Interpandemic period – phase 1 and 2). These measures aim to set up necessary procedures to halt spreading.

Emergency measures instead are enforced when disease is transmitted to a human, even without human-to-human transmission (Alert pandemic period). Thus, in the critical event described hereunder, emergency measures turned out to be already activated.

The effectiveness of the plan is periodically demonstrated during a program of training sessions. ENAC promotes all the initiatives devoted to check the Plan’s validity and well-functioning and the preparation of exercises and relevant possible review.
**Concerned DARWIN Domain**

*The identification of the specific domain(s) interested by the scenario*

- ☐ ATM
- ☒ Healthcare
- ☐ ATM and Healthcare

**Other domains**

The identification of other possible infrastructure operators suffering the consequences of the critical event (directly or as a result of a cascading effect)

- • ENAC (DA FCO, Airline operators);
- • ENAV (Roma ACC, Fiumicino TWR);
- • Aeroporti di Roma - ADR (Airport operators);
- • Transportation from/to the airport;
- • Tourism/ Accommodation sector (hotels, etc.).

**Magnitude of the event and duration of the effects**

*A description of the space and time scale characterizing the events*

For diseases with similar symptoms (e.g. avian influenza with high transmission to human), the virus can be transmitted by air - especially by saliva secretions - which on an airplane is considered likely to spread up to 3 rows ahead of the passenger. Thus, we hypothesize that another passenger is contracting the disease during the flight.

Assuming that the incubation period is also similar to that of the avian influenza (about 2 or 3 days) and that each infected person infects another one, it is likely to suppose that in 15 days around 10 people can be infected. We can also imagine that a similar scenario will occur in the different countries where flights departing from this country will land.

**4.3.1.2 Baseline Information relevant for the Scenario**

**Organizations involved in the management of the crisis**

*The organizations, institutional bodies, authorities involved in the management of the crisis (and the individual operators inside them)*

**Aviation sector:**

ENAV (Roma ACC, Fiumicino TWR). ENAV is the Air Navigation Service Provider.

Roma ACC provides the routine Air Traffic Service. It manages the communication with the pilot in command and warns the TWR supervisor that there is a suspicious case on an incoming flight.
Fiumicino TWR is the one responsible for traffic management at Fiumicino airport (landing and departure clearances, aircraft movements on the ground). The TWR supervisor notifies to ENAC DA FCO that there is a suspicious case on an incoming flight.

**ENAC DA FCO.** ENAC is the Italian Civil Aviation Authority. ENAC DA FCO is the General Directorate of the Fiumicino Airport. It enforces the airport plan to manage the influenza pandemics and provides guidelines in collaboration with the USMAF (Maritime, Air and Border Health Office), ADR (Aeroporti di Roma – managing authority of Rome airports) and the Prefecture or the Civil Protection Dept..

In the pandemic phases (3-4-5-6) the ENAC DA FCO sets up a Health Emergency Committee to evaluate the effects of the pandemic phase number 3 on the airport activities. Furthermore, it keeps connections with institutions outside the airport (for example Prefecture, Civil Protection, Regional Health System, etc.).

**Aeroporti di Roma (AdR – Rome airports general management company).** AdR draws up the Airport plan in case of influenza pandemics and verifies:

- the application of procedures;
- the coordination and control among the private companies operators involved;
- the dissemination of information to media, passengers and the generic public.

In the pandemic phases, AdR supplies information to the Airport operators about the type of influenza pandemic and distributes equipment for the operators’ safety (called DPI – disposizione di protezione individuale - individual safe equipment). In case of passengers affected by unremarkable fever symptoms, AdR organizes their transportations to the AdR E. R. (isolation room).

**Airline operators and Airport operators**, provide information, data and resources that could be useful in the management of the crisis. Furthermore, they carried out USMAF and ADR recommendations (for example precautionary measures to inbound or outbound passengers; prophylaxis for inbound “suspected cases”; on board questionnaires distribution, etc.).

**Health care sector:**

**USMAF (Ufficio di Sanità Marittima, Aerea e di Frontiera – Maritime, Air and Border Health Office) - Ministry of Health.** It is responsible for the technical management of the health emergency according to the Ministry of Health instructions, identifies hospitals to send passengers affected by suspected symptoms and coordinates the identification of healthcare channels.

**Ministry of Health,** appoints a task force composed by experts for the infection risk assessment and management.

**Airport E.R.,** guarantees further medical screenings to the passenger affected by suspected symptoms.

**Regional emergency agency (118) or the National Red Cross,** provides the transfer of the passenger to the nearest Hospital specialized in infectious diseases.

**Hospital specialized in infectious disease/ Regional Hospital systems,** provides the first aid to the patient and performs the diagnostic procedures in order to identify the novel influenza virus.

**Other organizations:**

**Civil Protection,** is involved in the application of the airport plan to manage the influenza pandemics and provides guidelines in collaboration with the USMAF and the Prefecture.

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The research leading to these results has received funding from Horizon 2020, the European Union’s Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 653289.
A list of references to the laws and regulations in force relevant for the situation

Aviation:

- **ICAO DOC4444** (International Civil Aviation Organization - Guidelines for states concerning the management of communicable disease posing a serious public health risk);
- **MOATS (Manual of Air Traffic Services)**: is the manual used by ATCOs to manage daily operations in terms of separations, clearances, instructions and information to be issued when providing air traffic services;
- **Roma ACC and Fiumicino TWR IPI (permanent internal instructions)**: IPI are internal instructions, compliant with MOATS, but especially referred to the air traffic services provided by local ATS unit (TWR, APP, ACC);
- **“Piano aeroportuale in caso di pandemie influenzali” (Airport plan in case of influenza pandemics) (2009)**: The airport plan includes procedures to follow within Fiumicino airport in order to cope with influenza pandemics. The plan is applicable within the airport grounds and specifies roles and responsibilities of the actors involved, actions and interventions to be carried out, emergency measures to be adopted and laws and regulations to be taken into account.

Health Care:

- **WHO (2005). International Health Regulations (IHR)**: The IHR aims at preventing, protecting against, controlling and providing a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks, and which avoid interference with international traffic and trade. It contains: a) definitions, scopes, principles and responsible authorities; b) State Party obligations to develop certain minimum core public health capacities; c) obligations on States Parties to notify WHO of events that may constitute a public health emergency of international concern; d) provisions authorizing WHO to take into consideration unofficial reports of public health events and to obtain verification from States Parties concerning such events; e) procedures for the determination by the Director-General of a “public health emergency of international concern” and issuance of corresponding temporary recommendations, after taking into account the views of an Emergency Committee; f) protection of the human rights of persons and travellers; g) the establishment of National IHR Focal Points and WHO IHR Contact Points for urgent communications between States Parties and WHO.

- **“Piano nazionale di preparazione e risposta ad una pandemia influenzale”, Ministry of Health, 2006 [National preparedness and response plan to an influenza pandemic]**: The plan aims at strengthening the pandemics preparation both at national and local level: a) identifying, confirming and quickly describing novel influenza virus in order to promptly recognize the pandemic beginning; b) minimizing the risk of transmission and the people mortality; c) reducing the pandemic impact on health and social services to guarantee the maintenance of the minimum level of services; d) assuring the personnel involved in the emergency response of an adequate training; e) guaranteeing up-to-date and prompt information to health care responders, media and generic public; f) monitoring the efficacy of the interventions carried out.

- **Serious Cross-border Health Threats**: The Decision adopted by the EU in 2013 aims at improving preparedness across the EU and strengthening the capacity to coordinate response to health emergencies. It will help Member States prepare for and protect citizens against possible future pandemics and serious cross-border threats caused by communicable diseases, chemical, biological or environmental events. The Decision provides four major benefits: a) to strengthen preparedness planning capacity at EU level by re-enforcing co-ordination as well as sharing best practices and information on national preparedness planning; b) to improve risk assessment and management of cross-border health threats, by providing risk assessment for threats that are not
The research leading to these results has received funding from Horizon 2020, the European Union’s Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 653289.

D4.1—Evaluation Plan

Knowledge from previous events

The lessons learned from previous events that could be relevant to know to manage the crisis event.

**SARS virus –2003:** SARS, or Severe Acute Respiratory Syndrome, is the disease caused by SARS coronavirus. In the SARS outbreak of 2003, about 7% of patients, with confirmed SARS infection, died (WHO). The mortality rate was much higher for those over 50 years old, with mortality rates approaching 50% for this subset of patients.

SARS epidemic begun in the Chinese province of Guangdong, in 2002. The case 0 died in the hospital and no diagnosis was carried out. The representatives of the Chinese government did not warn the WHO until February 2003, by limiting the media communication in order not to trigger alarm. The lack of communication delayed the response against the epidemic.

The virus reached Hong Kong from China by means of a physician who stayed some days at the hotel Metropol in the Kowloon peninsula. He infected other 16 customers of the hotel. They travelled to Canada, Singapore, Taiwan, Vietnam bringing the infection in these places.

**Severe respiratory disease associated with Middle East respiratory syndrome coronavirus (MERS-CoV) – 2012:** MERS CoV is caused by a virus. Typical symptoms include fever, cough and shortness of breath. Pneumonia is common, but not always present. Gastrointestinal symptoms, including diarrhea, have also been reported.

Since April 2012 and as of 13 October 2015, 1616 cases of MERS, including 624 deaths, have been reported by health authorities worldwide. Saudi Arabia has reported 90 new cases and 41 deaths, Jordan has reported 14 new cases and seven deaths and Kuwait has reported one fatal case.

Between 26 August and 13 October 2015, Jordan reported 16 MERS cases including seven deaths. The probable place of infection for all the cases is Amman. The first case reported on 26 August 2015 had recently travelled from Saudi Arabia and infection in Saudi Arabia cannot be excluded.

In the “Middle East respiratory syndrome coronavirus (Mers-CoV): Summary of Current Situation, Literature Update and Risk Assessment—as of 5 February 2015”, WHO recommended urgent epidemiologic investigations to better understand the transmission patterns of MERS-CoV since the source of infection and the transmission mode have not yet been confirmed.

The most urgent needs include:

- Understanding how humans become infected from animal or environmental source(s);
- Identifying risk factors for infection in health care settings, (i.e. healthcare workers), even though it is not always possible to identify patients with MERS-CoV early because some have mild or unusual symptoms;
- Enhancing community studies and surveillance for community-acquired pneumonia.

4.3.1.3 Aspects of the Scenario relevant for the Pilot Exercise

**Goal**

*A description of what we want to test with scenario*
D4.1 – Evaluation Plan

The scenario will allow to test the improvement of the guidelines under analysis on the following aspects:

- The coordination among organizations involved in the management of the emergency at policy maker level (among: ENAC DA FCO, USMAF, Prefecture/ Civil Protection Dept., AdR);

- The coordination among organizations that are part of the healthcare domain at local and national level (among: USMAF, AdR E. R., Regional emergency agency (118)/ National Red Cross, Hospital specialized in infectious disease/ Regional Hospital system);

- The inter-agencies communication during the emergency (among: ENAC DA FCO, USMAF, Prefecture/ Civil Protection Dept., AdR, Airline operators, Regional emergency agency (118)/ National Red Cross, Regional Hospital system);

- The capability of risk assessment during the health emergency in order to promptly identify the novel influenza virus and recognize the pandemic beginning (among: Ministry of Health task force, USMAF, Hospital specialized in infectious disease/ Regional Hospital system);

- The capability to apply the plan for the immediate response and to adjust the existing procedures to cope with the emergency (among: ENAC DA FCO, USMAF, Prefecture/ Civil Protection Dept., AdR, Airline operators, Airport operators);

- The capability to communicate the health threat and to provide information of relevant emergency procedures to the generic public (USMAF/ Ministry of Health, AdR).

### Main area(s) of resilience being analysed/tested

- Anticipate
- Monitor
- Respond & Adapt
- Learn & Evolve

### Rationale

The theory (or logic model) describing how and why the concerned resilience management guidelines will achieve the desired outcomes in one or more of the above areas.

**Anticipation:** A pandemic is a type of known event even if it is impossible to prevent it. A new type of virus could be characterized by unknown symptoms and ways of transmission. Given the unpredictability of risk factors, WHO has recommended to implement a Pandemic plan in each country to be systematically updated in order to set up a preparedness and risk reduction strategy. In the scenario described, the resilience management guidelines should test the system preparedness (“system” since several actors are involved and should operate together) by verifying if measures provided by the already existing pandemic plan are appropriate and suit the novel epidemic event. This assessment would improve the risk assessment method already established and enhance it in terms of resilience.

**Monitor:** If the anticipation is associated with strategies and it concerns the possibility to be prepared for future critical events, the monitoring is associated with what is being done here and now in the sense of opportunities and threats. In the scenario described, the resilience management guidelines will test which kind of information from the crisis should be necessarily collected in order to monitor the ongoing emergency. Particularly in this specific case, the monitoring must include what happens in the environment (for example on board), and within and across the organizations/ institutions involved in the emergency (i.e. application or not of the existing procedures, communications and interactions among organizations/ institutions/ authorities in charge).
Respond & Adapt: the ability to respond is the major challenge when a crisis occurs. In the scenario the readiness to respond could be evaluated both in terms of the implementation of the existing procedures (i.e. pandemic plan), and the adjustment of the ongoing functioning to match new critical conditions (for example an unknown influenza virus that has to be yet assessed).

In the event described, the ability to respond particularly entails the procedures of the health care authorities involved, the medical response operations (also including the readiness to assess the novel influenza virus) and the collaboration between the major domains involved (health care and civil aviation).

Learn & Evolve: The possible magnitude of the event and its large scale impact will provide learning opportunities for the organizations/ institutions/ authorities involved in the management of the crisis. Particularly, a meaningful lesson learned could concern the preparedness of the organizations for similar future events (the anticipation phase) and the response phase (especially for what concern the collaboration among stakeholders).

### Subject Matter Experts to involve in the Pilot Testing

<table>
<thead>
<tr>
<th>The experts to involve in the pilot testing as representatives of the organizations involved in the management of the crisis</th>
<th>Estimated possibility to involve the specific SME in a Pilot Exercise (Low – Medium - High)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USMAF (Ministry of Health)</td>
<td>High</td>
</tr>
<tr>
<td>Regional emergency agency (118)/ Red Cross</td>
<td>Medium</td>
</tr>
<tr>
<td>Civil Protection Representative</td>
<td>Medium</td>
</tr>
<tr>
<td>Airport ER staff (AdR)</td>
<td>Medium</td>
</tr>
<tr>
<td>Hospital specialized in infectious disease</td>
<td>Medium</td>
</tr>
<tr>
<td>ENAV (Roma ACC, Fiumicino TWR)</td>
<td>High</td>
</tr>
<tr>
<td>ENAC DA FCO</td>
<td>Medium</td>
</tr>
<tr>
<td>Airline operators</td>
<td>Medium</td>
</tr>
<tr>
<td>Airport operators</td>
<td>Medium</td>
</tr>
</tbody>
</table>
4.3.2 Organ transportation in severe weather conditions

4.3.2.1 Description and Characteristics of the Scenario

Critical Event

<table>
<thead>
<tr>
<th>A narrative describing the crisis situation to be handled</th>
</tr>
</thead>
<tbody>
<tr>
<td>The National Italian Transplant Centre (CNT) has to cope with a national paediatric emergency. A 12 year-old boy from Turin (Piedmont region) - who is affected by a severe congenital heart disease – needs a heart transplant. His clinical conditions are quickly getting worse.</td>
</tr>
<tr>
<td>The heart surgery team from the Turin Transplant Centre is waiting for a call from the CNT for a heart donation by a donor with compatible blood group.</td>
</tr>
<tr>
<td>Time passes and while the patient’s conditions are worsening, CNT finally calls.</td>
</tr>
<tr>
<td>The donor is a 14 year-old boy from Potenza, a city of the South of Italy (Basilicata region). He died for a cranial trauma.</td>
</tr>
<tr>
<td>The heart surgery team from the Turin Transplant Centre has to reach the Potenza hospital through the coordination among Piedmont Regional Transplant Centre, CNT and Regional Basilicata Transplant Centre.</td>
</tr>
<tr>
<td>The Regional Basilicata Transplant Centre has to organize:</td>
</tr>
<tr>
<td>- the surgery team transportation to the donor hospital and back to the airport (with the transplanted heart);</td>
</tr>
<tr>
<td>- the surgery team flights and transport by ambulance.</td>
</tr>
<tr>
<td>It is 1 o’clock in the morning and the surgery team carries out the organ retrieval and drives up to the Foggia airport – Apulia region - airport as soon as possible in order to reduce the high risk of ischemic time of the heart.</td>
</tr>
<tr>
<td>The flight takes off. 20 minutes before landing at Turin airport, a violent and unexpected clouds’ burst falls down on the city. The aircraft cannot land. The pilot in command informs Turin APP ATCo and requests weather information and availability for other airports in the vicinity to Turin APP ATCo. Then, the pilot communicates his intention both to the air traffic controller of Turin APP ATCo and to the surgery team on board. The aircraft will land at the nearest available airport, Milano Malpensa, that must be, at most, one hour distance by car from the hospital. Turin APP ATCo coordinates the diversion of the flight with Milano Area Control Center Supervisor. About 20 minutes later the aircraft is landing at Milano Malpensa.</td>
</tr>
<tr>
<td>By means of the Turin TWR ATCo and local Airport Authority (ENAC office of the receiving airport), the crew notifies the new operational landing to Piedmont Regional Transplant Centre for the ground transportation from Milan Malpensa airfield to the hospital where the receiving patient lies. Piedmont Regional Transplant Centre has a very short time to check the coordination among the Civil Protection, the Regional emergency agency (118) and the traffic corps.</td>
</tr>
</tbody>
</table>

Context
In order to manage organs transplant, physicians of the National Italian Transplant Centre (CNT) have to cope with several constraints, which is the management - at the same time - of all organs that can be transplanted. It means:

- sorting out of physical compliant receiving patients in all Italian territory;
- timing of ischemic time of each organ;
- coordination of the several medical teams involved in the transplant considering the different phases of the transplant (i.e. pre-transplant phase; organs retrieval phase; post-retrieval phase).

For example, the scenario for the above mentioned critical event could be implemented as follows:

The heart has been accepted in Turin (Piedmont region), the lungs in Udine (Friuli-Venezia Giulia region), the right part of the liver in Palermo (Sicily region), the left part of the liver in Padua (Veneto Region), the right kidney in Rome (Lazio region) and the left kidney in Bergamo (Lombardy region).

Thus, all the six medical teams are expected to perform the retrieval in the same operating theatre in Potenza, and each medical team has to travel back-usually flying-in order to reach the receiving patient as soon as possible.

Thus, CNT has to manage the transplant phases accordingly by:

- planning outbound flights for each medical team in collaboration with the Regional Transplant Centres (CRT) of each;
- planning inbound flights for each medical team in collaboration with the Regional Transplant Centre of the donor. In the case that an airport (for example Palermo) does not manage to have the flight ready for the scheduled departure time, CNT has to coordinate the delay with the other teams’ departures, and time of organs retrieval, accordingly.
- recruiting physicians for the surgery teams;
- organizing the organs transportation by ambulance by supporting (if needed) the coordination among the Regional Transplant Centre of the donor and the receiving patients and the institutional actors that could be involved in the ground transportation of the organs (i.e. Regional Emergency Agency-118; Civil Protection and the traffic corps).

In view of all above, in Italy there is not an official collaboration among the institutional actors involved in the organ transplant and transportation. The collaboration depends on the actors’ sensitivity and awareness of the issue. With respect to this point, what could it happen if the Civil Protection or the traffic corps are not available to carry out the organ transportation by ambulance? Or if the Regional Emergency Agency (118) is not assisted by the traffic corps in order to gain time in difficult conditions?

Furthermore, due to the legislative autonomy of the Italian regions, each region follows a specific organizational model in the management of organs transportation by ambulance (except for Lombardy, Veneto, Trentino, Friuli-Venezia Giulia, Liguria e Marche that have a unified model called NITp - North Italy Transplant Programme).

Other constraints to take into account are:

- The unpredictability of some specific weather conditions and events associated to the climate change (e.g. example “cloud-bursts”, floods, etc.). They have the potential to compromise the organ transportation by both air and land in the required time constraints. The unpredictability of the “clouds burst” depends on the speed they move. So far, current mathematical models in meteorology are not able to predict them.
- The uneven airports distributions and accessibility within the Italian territory. Airports are fewer in Southern Italy than in Northern and Central Italy. Some cities in the south of Italy (for example Matera...
The research leading to these results has received funding from Horizon 2020, the European Union’s Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 653289.

and Potenza) - that record a high number both of organ donors and receiving patients - are not provided of close airports. Furthermore, the closing time for small airfields are variable, often jeopardizing the exit of the whole process.

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**Figure 4-6: ENAV units (Airports managed by Military Authority are not included)**

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**Concerned DARWIN Domain**

- The identification of the specific domain(s) interested by the scenario
  - ATM
  - Healthcare
  - Healthcare and ATM

**Other domains**

- The identification of other possible infrastructure operators suffering the consequences of the critical event (directly or as a result of a cascading effect)
  - Airline operating Ambulance Flights;
  - Civil Protection;
  - Traffic corps.

**Magnitude of the event and duration of the effects**

- A description of the space and time scale characterizing the events
- High costs for the management and coordination of each medical team involved in the organs transplant (around 20.000/ 30.000 euro);
- Human lives at risk.

4.3.2.2 Baseline Information relevant for the Scenario

Organizations involved in the management of the crisis

<table>
<thead>
<tr>
<th>The organizations, institutional bodies, authorities involved in the management of the crisis (and the individual operators inside them)</th>
</tr>
</thead>
</table>

**Aviation sector:**

**ENAC:** the ENAC office of the receiving airport has to be informed if the flight enrolled to transport the organ is diverted to an airport different from the ‘Alternate Airport’;

**ENAV:** the actors involved in this scenario are Turin TWR and APP air traffic controllers; Milano ACC supervisor; Milano ACC air traffic controllers; Milano Malpensa air traffic controllers:

- **Turin TWR ATCo** is the one responsible for traffic management at Turin airport (landing and departure clearances, aircraft movements on the ground). It communicates with the pilot in command of the ambulance flight providing weather information and availability of other airports in the vicinity in order to land;
- **Turin APP ATCo** is the one responsible for the approach phase at the airport, providing traffic sequencing of landing traffic and separation between arriving and departing aircraft. It coordinates the diversion of the flight with Milano Area Control Center Supervisor (Milano ACC supervisor);
- **Milano ACC air traffic controllers** provide the routine Air Traffic Services in the North West area of Italy (en-route traffic);
- **Milano Malpensa air traffic controllers** are responsible for traffic management at Malpensa airport (landing and departure clearances, aircraft movement on the ground). They communicate with the pilot in command of the ambulance flight providing weather information and landing clearance to Malpensa.

**Airline operating Ambulance Flights:** transport the surgery team to the donor hospital and back to the recipient hospital (with the transplanted organ). In the case of severe weather conditions, the pilot in command has to coordinate with the Turin TWR ATCo or the Turin APP ATCo of the expected landing airfield in order to find the most suitable solution and land at the nearest available airport.

**Health care sector:**

**Organizations at national level:**

**National Italian Transplant Centre (CNT):** coordinates with the Regional Transplant Centre of the receiving patient and the Regional Transplant Centre of the donor in order to achieve the goal to allocate the organ to the identified recipient patient. CNT supports both the Regional Transplant Centres in the organization of the surgery team transportation (with the transplanted organ).

**Organizations at regional and local level:**

**Regional Transplant Centre:** has to organize the surgery team transportation (with the transplanted organ) from the new flight destination to the organ recipient by ambulance. CRT has to coordinate with the Regional emergency agency (118), and/ or the traffic corps and/ or Civil Protection.

**Regional emergency agency (118):** has to transport the surgery team with the transplanted organ from the new flight destination to the organ recipient.
### Other sectors:

**Traffic corps**: can be involved both for the transportation of the surgery team with the transplanted organ to the organ recipient or to assist the regional emergency agency during the transportation in order to gain time.

**Civil Protection**: can be involved both for the transportation of the surgery team with the transplanted organ to the organ recipient or to assist the regional emergency agency during the transportation.

### Current applicable laws and regulations and national and local level

**A list of references to the laws and regulations in force relevant for the situation.**

**Aviation sector:**

**ENAV MOATS (Manual of Air Traffic Services)**: is the manual used by ATCOs to manage daily operations in terms of separations, clearances, instructions and information to be issued when providing air traffic services.

**Turin, Milan ACC and Milano Malpensa IPI (Permanent Internal Instructions)**: IPI are internal instructions, compliant with MOATS, but especially referred to the air traffic services provided by local ATS unit (TWR, APP, ACC).

**Health care sector:**

**Directive 2010/53/EU on standards of quality and safety of human organs intended for transplantation**: It: a) lays down rules to ensure quality and safety standards for organ transplantation by covering the entire organ chain from donation to transplantation or disposal; b) seeks to ensure donors and recipients are guaranteed the same quality, safety and legal standards no matter where they live; c) covers organ donation, testing, procurement, preservation, transport and transplantation. The directive guarantees that the transport of organs meets certain requirements. Particularly, it puts in place a system to report, investigate, register and transmit relevant information about any serious adverse event or reaction.

**“Linee guida per il prelievo, la processazione e la distribuzione di tessuti a scopo di trapianto” (CNT, 2013) (Guidelines for organs retrieval, processing and distribution for transplant purpose)**: These guidelines allow to manage the ordinary process for the donor selection, organs retrieval, processing and distribution to the transplant centres. Guidelines for the management of extraordinary situations have not been set up. In these cases, past experience and lessons learnt – that have not been formalized – lead the decision-making process and interventions.

**Coordinamento dei trasporti connessi con le attività trapiantologiche (Allegato A – Conferenza Stato-Regioni il 25 marzo 2015 (Rep. Atti n.55/CSR) [Coordination of transportation connected with transplant activities – State-Regions Conference]**: It establishes the institutional actors that have been identified to manage the transportation of organs, biological materials, surgery teams, patients, by pointing out their specific functions and responsibilities. The regulation also specifies the role of the National Transplant Centre with respect to the transportation connected with transplant activities.

### Knowledge from previous events

**The lessons learned from previous events that could be relevant on how to manage the crisis event.**
• **27 November 2000 – Car accident involves 4 surgeons during a mission to retrieve a liver:**

Four surgeons from Rome were involved in a severe car accident while traveling along the highway Salerno – Reggio Calabria to retrieve a liver for transplantation. The accident was due to a violent cloudburst. The car – probably for the aquaplaning phenomenon – crushed the guard-rail and drove off the road. All surgeons survived. One of them warned the Transplant Centre of Rome which promptly sent another surgery team to retrieve the organ. Despite the accident, the mission succeeded because of the capability of the Transplant Centres which promptly used their network to handle the emergency. As the CNT expert explained “in this case the emergency was put in the centre of the organization and the different internal actors involved cooperated to cope with the problem”. When the accident occurred, the Transplant Centre organization was composed by Regional Transplant Centres and Interregional Transplant Centres.

• **26 February 2004 – Mountain “Sette Fratelli” near Cagliari (Sardinia Island):**

An aircraft (from Roma to Cagliari) carrying a heart to be transplanted, while performing a visual approach at night, due to the fog, crashed into a mountain. 6 people (3 crew member, 2 doctors and a technician) died. The responsibilities of the accident was attributed to the army air traffic controllers who authorized the visual approach without giving to the pilot in command all necessary information about the orography of the territory.

• **7 February 2009 – An ambulance flight – struck by a lightning - falls down near Rome:**

The ambulance aircraft (from Roma Ciampino to Bologna and to Cagliari) - just taken off and flying to Bologna (Emilia- Romagna Region) in order to pick up a surgery team for a liver transplant - exploded in flight close to Rome, disintegrating. Two pilots died. The flight had been organized by the Emilia-Romagna Transplant Centre after the communication that a liver was available in Cagliari (Sardinia island). The surgery team from Bologna would have retrieved the liver in Cagliari and transplanted it in Modena (Emilia- Romagna Region) where a recipient patient was waiting in critical conditions. Despite the critical event, the liver transplant was carried out, by the intervention of another surgery team from Cagliari that retrieved and transported the liver to the Hospital in Modena. The responsibilities of the accident were attributed to unpredictable severe weather conditions. Also in this case – as in the first event described above – the emergency was managed because of the coordination and cooperation capabilities of the Transplant Centre which promptly used it network to handle the emergency.

4.3.2.3 Aspects of the Scenario relevant for the Pilot Exercise

<table>
<thead>
<tr>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A description of what we want to test with scenario</strong></td>
</tr>
<tr>
<td>The scenario will allow to test the improvement of the guidelines under analysis on the following aspects:</td>
</tr>
<tr>
<td>- the coordination among organizations that are part of the health care domain at local and national level (among: CNT, CRT, Regional emergency agency - 118);</td>
</tr>
<tr>
<td>- the coordination and synchronization with other organizations involved in the management of the emergency (not HC) at national and local level (among: CNT, CRT, Regional emergency agency – 118; Traffic Corps, Civil Protection; Airline operating Ambulance Flights; ENAV, ENAC);</td>
</tr>
<tr>
<td>- the inter-agencies communication during the emergency (among CNT, CRT, Regional emergency agency – 118; Traffic Corps, Civil Protection; Airline operating Ambulance Flights; ENAV, ENAC);</td>
</tr>
<tr>
<td>- the capability of risk assessment during the emergency (capability to understand the dimensions of the</td>
</tr>
</tbody>
</table>
The research leading to these results has received funding from Horizon 2020, the European Union’s Framework Programme for Research and Innovation (H2020/2014–2020) under grant agreement n° 653289.

Critical event within the context) (CNT, CRT);
- the capability to develop a shared plan for the immediate response among the institutional actors involved (among: CNT, CRT, Regional emergency agency – 118; Traffic Corps, Civil Protection; Airline operating Ambulance Flights; ENAV, ENAC);
- the capability to cope with unexpected situations (CNT, CRT, Airline operating Ambulance Flights, ENAV, ENAC);
- the availability of human resources and equipment, its integration and optimization in case of emergency (CNT, CRT, Regional emergency agency – 118; Traffic Corps, Civil Protection).

<table>
<thead>
<tr>
<th>Main area(s) of resilience being analysed/tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>☒ Anticipate</td>
</tr>
<tr>
<td>☐ Monitor</td>
</tr>
<tr>
<td>☒ Respond &amp; Adapt</td>
</tr>
<tr>
<td>☒ Learn &amp; Evolve</td>
</tr>
</tbody>
</table>

**Rationale**

The theory (or logic model) describing how and why the concerned resilience management guidelines will achieve the desired outcomes in one or more of the above areas.

**Anticipation:** Some specific weather conditions and events associated to the climate change are unpredictable and they could severely compromise the organ transplantation and transportation by both air and land. Despite of the unpredictability of these specific kind of risks, the preparedness could be evaluated in terms of redundancy of the resources available to cope with the emergency (for example with respect to the actors to join for guaranteeing the ground transportation of organs), and the possibility to systematically plan their involvement.

The purpose of looking for what may potentially happen is to identify possible future events and conditions that may affect the organisation’s ability to positively handle the emergency.

**Respond & Adapt:** In the scenario, the readiness to respond refers particularly to the capability to promptly understand the dimensions of the critical event within the context in order to centrally coordinate the local network of response. Since there are no specific procedures and contingency plans for these kinds of “extraordinary” events in the organ transplant and transportation (as an expert explained), the resilience management guidelines should provide an opportunity to start working on this specific issue.

Furthermore, in the critical event described above, the ability to respond mainly depends on the cooperation and collaboration among institutions/actors/domains involved at central and peripheral level (e.g. health care at national and regional level, civil aviation, ATM, etc.), and their inter-agencies capability to communicate during the emergency.

**Learn & Evolve:** Learning opportunities will be provided both in terms of coordination and cooperation among stakeholders - from different domains and levels -, and capability to elaborate systematic contingency plans to cope with unexpected and extraordinary events.

<table>
<thead>
<tr>
<th>Subject Matter Experts to involve in the Pilot Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>**The experts to be involved in the pilot testing as representatives</td>
</tr>
</tbody>
</table>
4.4 Scenario proposed by KMC and FOI

This section will illustrate the scenario proposed by FOI and KMC focussed on Healthcare and dealing with an accident occurring in the maritime domain. The description might be complemented by the identification of different ‘episodes’ connected to the same scenario, to be used for different pilot exercises.

For what concern the use of this scenario in future pilot cases, it is worth noting that the DRIVER project has recently tested their testbed infrastructure and experiment/exercise methodology in their Exercise 43 at the Swedish Civil Contingencies Agency MSB in Revinge, Sweden. The experiment tested the connection between simulation (scenario generation and execution) tools and operative (crisis management) tools through the DRIVER testbed, as well as exercise/experiment observation/evaluation tools, distributed over several sites in several countries. DARWIN project members from FOI were present. Furthermore, aspects of the scenario proposed here were also present in the scenario of DRIVER Experiment 43, which provided valuable lessons for DARWIN pilot exercises in terms of what can be simulated and how, and which stakeholders are involved. Task 4.2 (Implementation of Pilot Cases) will consider the contribution that these tools could make and if they could be made available also to the DARWIN project for the pilot studies, after a promising demonstration of testbed and tools as part of DRIVER Experiment 43. Both simulation and operational tools will be considered.

4.4.1 Collision between oil Tanker and passenger ferry leaving Gotland islands in severe weather conditions

4.4.1.1 Description and Characteristics of the Scenario

<table>
<thead>
<tr>
<th>Critical Event</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>A narrative describing the crisis situation to be handled</em></td>
</tr>
</tbody>
</table>
A cruise ship (11,000 GT\textsuperscript{7}; 1,800 PAX\textsuperscript{8}) is leaving the Gotland island towards the Swedish eastern coast. Most of the passengers are from the Nordic countries and Germany. There is also a large group of Italians on board. There are mainly adolescents and middle age people on board and several are drinking alcohol during the cruise, but also a number of families with children and a few elderly.

At the same time an oil tanker (62,000 GT) is heading towards the passage between the Gotland and Öland islands.

Due to climate change there have been considerable weather changes during the past years with increased storms and rainfall/snowfall during this period of year. On this specific day, the temperatures around 1°C, several ships in this area started to face moderate gale with a rough sea, accompanied by intensive rainfall just after leaving the harbour.

Due to a combination of navigation difficulties, severe wind, and high wave conditions, the cruise ship and oil tanker collide. The ships are severely damaged but stay afloat. Nonetheless, a fire arises on the oil tanker. The initial firefighting measures on the oil tanker are ineffective and the cargo continues to burn. Before the waves push the two ships apart a spark from the fire on the oil tanker spreads to the cruise ship. The fire spreads rapidly and reaches the stair-well on the starboard side; from there the fire spreads to an additional deck. The fixed automatic firefighting system activates and relevant procedures are executed. The crew also deploys portable firefighting equipment. The fire is extinguished relatively quickly. A rescue operation is launched to transport injured passengers and crew members from the cruise ship to health care facilities.

There are 72 injured people to be evacuated. 15 people have serious injuries with different levels of burns, in some cases combined with other types of injuries. There are 12 additional seriously injured besides others with falling-down injuries and hypothermia. Furthermore there are also 45 people with less serious injuries, but these still require medical attention due to relatively severe cuts and bruises, as well as cases of shock. Some of the injured passengers are intoxicated with alcohol.

The firefighting operation for the oil tanker as well as the emergency tow of both ships is outside the scope of the scenario.

The Joint Rescue Co-Ordination Centre (JRCC) of the Swedish Maritime Administration receives an alarm from the cruise ship and launches a search and rescue operation (SAR-operation). The primary objective of the SAR-operation is medical evacuation of the injured passengers and crew members from the cruise ship. A number of SAR-helicopters from Sweden, Finland and Denmark are dispatched to the incident. Vessels from the Coast Guard and the Swedish Sea Rescue Society are also dispatched to the incident area together with passenger and merchant ships nearby by the incident. One of the Coast Guard vessels is assigned the role of On-Scene Coordinator.

The injured passengers and crew members are evacuated to the nearest mainland, which are in this case the Swedish eastern coast and the County of Östergötland. The Region Östergötland, as the health care and ambulance service provider in the county, is alerted by the JRCC.

The On-Duty Chief Medical Officer of the Region Östergötland acts upon the information from the JRCC and executes relevant procedures and plans for a major medical incident. This includes activation of the regional Medical Coordination Staff and the Hospital Coordination Staff in all the three hospitals in the county. The On-Duty Chief Medical Officer also activates Collaboration Östergötland, a regional emergency coordination function, in order to get multi-agency coordination in place early on.

The Region Östergötland, as the national medical authority for burn injuries, also launches procedures for this type of situations. This includes alerting the National On-Duty Officer at the Swedish National Board of Health and Welfare as the nationwide coordination among healthcare and ambulance service providers is necessary and people with burn injuries transported abroad. The National On-Duty Officer contacts in

\textsuperscript{7} GT stands for Gross Tonnage and describes the overall internal volume of a ship.
\textsuperscript{8} PAX stands for Passengers.
The research leading to these results has received funding from Horizon 2020, the European Union’s Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 653289.

### Context

**A description of the geographical area/location in which the critical event occurs (to be integrated with a description of cultural elements if considered useful)**

The location of the collision is about 70 km from the Swedish east coast, at the latitude of Valdemarsvik (see mark on the picture on below). The coastal area is a sparsely populated with limited infrastructure. The nearest airports are in Visby on the Gotland island (~60 km), Västervik (~90 km), Nyköping (~100 km), Norrköping (~120 km) and Linköping (~145 km).

### Concerned DARWIN Domain

**The identification of the specific domain(s) interested by the scenario**

- ☒ ATM
- ☐ Healthcare
- ☐ ATM and Healthcare
- ☐ Other domains Maritime

### Other domains

**The identification of other possible infrastructure operators suffering the consequences of the critical event (directly or as a result of a cascading effect)**

- Aviation: aircrafts, helicopters, airports and service providers;
- Transportations: air traffic and road traffic near the landing zones and on roads from the landing zones;
- Healthcare and emergency services;
- Municipal administrations: all the municipalities to which the passengers are evacuated;
- Maritime sector at national and international level: Coast Guard and ships nearby are likely asked to assist; specialised firefighting entities from Baltic countries are deployed.

### Magnitude of the event and duration of the effects

**A description of the space and time scale characterizing the events**

The weather situation disqualifies the use of fast small rescue vessels. The medical evacuation of the injured passengers and crew members is therefore almost entirely dependent on the available helicopter capacity. The helicopter activities are constrained by their action range as well as the prevailing weather conditions, refuelling possibilities and the endurance of the crews, especially rescue swimmers. The medical evacuation lasts for several hours even if relatively limited number of injured passengers and crew members (in total 72 injured) need to be transported. Primary medical transports take place across distances as far as 150 km. There are point-to-point helicopter transports but it also includes reloading of the injured to other helicopters and ambulances. Secondary medical transports are nationwide with ambulances, helicopters and fixed-wing aircraft. Some of the secondary medical transports (burn injuries) are international, to Italy, Denmark, Norway, and other parts of Europe.
4.4.1.2 Baseline Information relevant for the Scenario

<table>
<thead>
<tr>
<th>Organizations involved in the management of the crisis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region Östergötland: is a regional body, which is the healthcare and ambulance service provider in the Östergötland County. The body is also responsible for advanced burn care nationwide.</td>
</tr>
<tr>
<td>Swedish Maritime Administration: is a national body responsible besides others for the Joint Rescue Coordination Center (JRCCC). The JRCCC is a national function for coordination of SAR- and other airborne operations, including dispatching SAR- and HEMS-helicopters as well as rescue vessels from Sweden and other Baltic countries.</td>
</tr>
<tr>
<td>Swedish Coast Guard: is a national body responsible for safety at sea, bordering control and maritime environmental protection. It is one of the actors from which On-Scene Coordinators of SAR-operations are assigned.</td>
</tr>
<tr>
<td>Swedish National Board of Health and Welfare: is a national body responsible for healthcare and public health issues. The body is also Sweden’s contact point for EU, WHO and UN with respect to healthcare issues and emergency medical situations.</td>
</tr>
<tr>
<td>Swedish Police: is a national body responsible, besides others, for registration of injured and deceased as well as person identification in case of international transports.</td>
</tr>
<tr>
<td>DG SANTE and DG ECHO of the European Commission: are two European bodies that are involved in coordinating of assistance from other Member States in case of medical emergencies.</td>
</tr>
<tr>
<td>Ministero degli Affari Esteri e della Cooperazione Internazionale (MAECI) - (Ministry of Foreign Affairs): is the foreign Ministry of the Italian government, also known as the Farnesina. It represents, guards and guarantees the economic, social, political and cultural interests of the Italian Republic. It also manages the direct relations with other states and international organizations, as well as the implementation of treaties and international conventions.</td>
</tr>
</tbody>
</table>

Current applicable laws and regulations and national and local level

A list of references to the laws and regulations in force relevant for the situation

Swedish national laws and regulations:

- Health and medical service act (1982:763) and Disaster medicine preparedness ordinance (SOSFS 2013:22) regulate healthcare in Sweden, including allocation of responsibilities, definition of healthcare services and requirements on healthcare providers, including large scale emergencies and crises. The Region Östergötland and the Swedish National Board of Health and Welfare operate under this law.

- Social service act (2001:453) describes besides others responsibilities of and demands on municipal administration with respect assistance to all people affected by emergencies and crisis. This law affects municipal administrations (also members of the Collaboration Östergötland) to which injured are transported.

Act on municipal and county council measures prior to and during extra-ordinary events in
Evaluation Plan

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 653289.

Knowledge from previous events

The lessons learned from previous events that could be relevant to know to manage the crisis event.

Lessons identified from the following events are of relevance for the elaboration of the scenario:

- 1990 M/S Scandinavian Star: fire on board, passenger ferry;
- 1994 M/S Estonia: capsizing, passenger ferry;
- 1998 Gothenburg discotheque fire: mass casualty situation with large number of burn injuries;

...
D4.1 – Evaluation Plan

- **2002 Bali terrorist attack**: air medevac/casevac of burn-injuries;
- **2004 Asian tsunami**: long-distance air medevac, nationwide secondary medical transports;
- **2006 M/S Finnbirch**: capsizing, ro-ro ship;
- **2011 Bombay terrorist attack**: long-distance air medevac;
- **2014 Västmanland forest fire**: coordination of a large-scale helicopter operation.

### 4.4.1.3 Aspects of the Scenario relevant for the Pilot Exercise

<table>
<thead>
<tr>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A description of what we want to test with scenario</strong></td>
</tr>
<tr>
<td>The main challenges of the proposed scenario are in coordinating efforts in three major dimensions and managing constraints associated with these dimensions in order to achieve effective medical response.</td>
</tr>
<tr>
<td>The three major dimension of the medical response operation are:</td>
</tr>
<tr>
<td>- Primary transports of injured passengers and crew members from the cruise ships to receiving healthcare facilities.</td>
</tr>
<tr>
<td>- Scaling up surgery capacity at the receiving healthcare facilities.</td>
</tr>
<tr>
<td>- Secondary transports of injured passengers and crew members to other/specialized healthcare facilities.</td>
</tr>
<tr>
<td>In each of the three major dimensions the coordinating functions must handle different types of constraints that may propagate and have cascading effects on the progress of the medical response operation as a whole.</td>
</tr>
<tr>
<td>In this context the progress of the maritime rescue operation poses a significant challenge with a major impact on the medical response operation.</td>
</tr>
<tr>
<td>At a more abstract level, it is expected that the scenario supports the ability of participants and the DARWIN Resilience Management Guidelines to address the following issues:</td>
</tr>
<tr>
<td>- Having a lack of own resources.</td>
</tr>
<tr>
<td>- Managing additional external resources.</td>
</tr>
<tr>
<td>- Reallocation of tasks between different actors, meaning one actor being helped by, or helping another actor by, performing/coordinating that actor’s tasks.</td>
</tr>
<tr>
<td>- Goal-conflicts, dilemmas between goals.</td>
</tr>
<tr>
<td>- Complexity.</td>
</tr>
<tr>
<td>- Many stakeholders, issues at boundaries/interfaces.</td>
</tr>
<tr>
<td>- Uncertainty, many possible causes/ways of acting.</td>
</tr>
<tr>
<td>- Cope with unexpected situation, low likelihood.</td>
</tr>
<tr>
<td>- Cascading effects, other organizations and domains</td>
</tr>
<tr>
<td>- Knowledge of other stakeholders’ capabilities, common ground.</td>
</tr>
<tr>
<td>- Inter-agency communication and coordination.</td>
</tr>
<tr>
<td>- Limited capability of risk assessment, uncertainty of risk</td>
</tr>
<tr>
<td>- Availability of human resources and equipment.</td>
</tr>
<tr>
<td>- Adapting and changing of roles of personnel.</td>
</tr>
<tr>
<td>The three dimensions of the scenario also means that many of these factors need to be addressed simultaneously.</td>
</tr>
</tbody>
</table>
Main area(s) of resilience being analysed/tested

- Anticipate
- Monitor
- Respond & Adapt
- Learn & Evolve

Rationale

The theory (or logic model) describing how and why the concerned resilience management guidelines will achieve the desired outcomes in one or more of the above areas.

Anticipation: The information provided and the uncertainty in the scenario will vary from time to time during the execution of the scenario so that participants are challenges in their ability to anticipate next events and cascading effects.

Monitor: The monitoring of the situation is a central challenge, in terms gaining information from the accident site and exchanging information between stakeholders in order to make sense of the situation as it unfolds. Other monitoring challenges are to recognize the applicability of procedures, necessary interactions between stakeholders, and ensuring a common strategic, tactical and operational understanding.

Respond & Adapt: The response to the event is the central challenge as described above in the major dimensions of the medical response operation. Adaptation may be challenged as the scale of events is expected to lead to decisions on flexible allocation of tasks and roles and stakeholders supporting each other in non-standard ways.

Learn & Evolve: The unexpectedness and large scale of the accident and response are expected to trigger learning opportunities for the stakeholders involved, and explicit discussion of lessons learned and needs to evolve their response mechanisms during after-action review. The use of several episodes where parts of the pilot studies are simulated in a campaign of several exercises (which will be determined as part of Task 4.2) may be used to allow for participants’ ways of working to manage a crisis of this magnitude to evolve over time within the pilot studies.

Subject Matter Experts to involve in the Pilot Testing

<table>
<thead>
<tr>
<th>The experts to involve in the pilot testing as representatives of the organizations involved in the management of the crisis</th>
<th>Estimated possibility to involve the specific SME in a Pilot Exercise (Low – Medium - High)</th>
</tr>
</thead>
<tbody>
<tr>
<td>JRCC Officer</td>
<td>Medium</td>
</tr>
<tr>
<td>Region Östergötland On-Duty Chief Medical Officer</td>
<td>High</td>
</tr>
<tr>
<td>Region Östergötland Medical Coordination Staff</td>
<td>High</td>
</tr>
<tr>
<td>Linköping University Hospital Coordination Staff</td>
<td>Medium</td>
</tr>
<tr>
<td>Norrköping Vrinnevi Hospital Coordination Staff</td>
<td>Medium</td>
</tr>
<tr>
<td>Motala Hospital Coordination Staff</td>
<td>Medium</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Role</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Scene Coordinator from the Swedish Coast Guard</td>
<td>High</td>
</tr>
<tr>
<td>Collaboration Östergötland (chairman)</td>
<td>High</td>
</tr>
<tr>
<td>Collaboration Östergötland (other members)</td>
<td>Medium</td>
</tr>
<tr>
<td>National On-Duty Officer at the National Board of Health and Welfare</td>
<td>Medium</td>
</tr>
<tr>
<td>Commanding Officer from the Swedish Police</td>
<td>High</td>
</tr>
<tr>
<td>Decision maker from the Emergency Response Coordination Centre of the DG ECHO</td>
<td>Low</td>
</tr>
<tr>
<td>Decision maker from the Health Emergency Operations Facility of the DG SANTE</td>
<td>Low</td>
</tr>
<tr>
<td>Italian Ministry of Foreign Affair - MAECI</td>
<td>Low</td>
</tr>
</tbody>
</table>
5 Initial scheduling of evaluation activities and dependencies with WP2

The first cycle of evaluation activities in the context of Task 4.3 (Evaluation Cycles of Guidelines) will occur in the period included between mid of June 2016 and the end of September 2016. The activity will encompass the evaluation of the initial set of generic DRMGs and will bring to the submission of D4.2 (Initial Evaluation of the Guidelines) at the end of September 2016.

As explained in Chapter 2, the following cycles of evaluation will turn around the Implementation of Pilot Cases (Task 4.2), using as reference for evaluation the scenarios described in Chapter 4. At this stage, it is not possible to define a precise scheduling for the pilot cases and for the corresponding evaluation cycles, due to the following reasons:

- At the time of submitting the present deliverable, the information on the content, size, format and number of DRMGs is still insufficient to determine whether it will possible to evaluate all of them in a single pilot case - e.g. one for DRMGs adapted to ATM and one for those adapted to HC - or if it will be necessary to divide them in different clusters, to be allocated to different exercises.
- The scheduling of the single pilot exercises will be strongly affected by the availability of subject matter experts who will be identified by the DARWIN end user partners among their own personnel, or in other organizations external to the consortium, including those represented in the DCoP. In most of the cases, such experts will be very busy people, with limited availabilities to be used carefully and properly combined among each other. It is therefore advisable to ask their commitment for one or more dedicated meetings only once the final set of crisis types will be agreed and when a decision on how to address the different DRMGs in the different exercises will be made.
- It is not necessary to organize one pilot exercise per each of the five scenarios identified. Depending on the two factors above, it may be decided to test them at different levels of granularity. On the one hand, it may be decided to organize smaller exercises, referring to different episodes of the same scenario (i.e. more pilot cases per scenario). On the other hand, it may be agreed to address in detail – and therefore with a full involvement of the subject matter experts - only some of the scenarios identified and to use others just for reference at a higher level of granularity.
- It should be considered that the feedback expected from the different pilot cases will have two very different natures. On one side, it will serve to guide the work of guidelines developers in D2.2 and D2.3 (“Resilience management guidelines adapted to health care” and “Resilience Management Guidelines adapted to ATM”). On the other side it will serve to provide insight on how to revise the D2.1 generic DRMGs to make them generalizable to the improvement of resilience for all critical infrastructures at a European level, as part of D2.4 (“Revised Generic Resilience Management Guidelines). Once the full set of generic DRMGs will be determined, it may therefore be decided to have some exercises more dedicated to the first objective in the first part of 2017 and other exercises more dedicated to the second objective in the final part of 2017.

Having considered all these aspects, it is however possible to identify in the DARWIN DoA a set of time constraints to be used as reference for the identification and scheduling of the Task 4.3 evaluation cycles that will follow the evaluation of the initial set of generic DRMGs at the end of September 2016.

- The pilot exercises will have to be organized in the period included between December 2016 and December 2017.

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9 To note that according to the DoA the original deadline for D4.2 was at the end of August 2016. It was however agreed with the Project Officer and Project coordinator to postpone it of one month for two main reasons: (a) an initial set of guidelines to be evaluated is expected to be available only in the second half of June 2016; (b) July and August are holiday period respectively in northern and southern European countries. Since the WP4 partners are evenly distributed between north and south, a full availability of DARWIN workforce and end user representatives will be in practice available only in the second part of June, thus allowing a too limited time to perform the initial evaluation activities described in Chapter 3.
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- The 2nd DCoP Workshop, which is a useful opportunity to receive feedback from resilience practitioners, is expected to occur between April and May 2017.
- The final version of D2.2 (“Resilience management guidelines adapted to health care”) and D2.3 (“Resilience Management Guidelines adapted to ATM”) are due at the end of May 2017.
- The final version of D2.4 (“Revised Generic Resilience Management Guidelines”) is due at the end of the project, i.e. at the end of May 2018.

According to this time constraints, it is possible to anticipate that a first set of pilot exercises and a corresponding evaluation cycle should be organized in the first months of 2017 and with an aim of providing feedback to the Task 2.2 and 2.3 before April 2017. On the other hand, a second set of pilot exercises and a corresponding evaluation cycle could be organized in the period between June and December 2017, in order to provide the necessary content for D4.4, including the feedback required by Task 2.1 for the finalization of D2.4 at the end of the project.

Considering that in all cases a certain period of training for practitioners into the DRMGs will be necessary, the above described plan requires a mature draft of both D2.2 and D2.3 to be available at latest at the end of November 2016.

In parallel with the pilot exercises, it will important to take full advantage of the 2nd DCoP Workshop, particularly for what concern the collection of feedback on the applicability and fitness-for-purpose of the DRMGs to domains different from health care and ATM. In this respect, it will be essential to have a consolidated version of DRMGs in D2.2 and D2.3 before April 2017 or to postpone the 2nd DCoP Workshop accordingly.
6 Conclusions

The deliverable has outlined the strategy and plan to evaluate the DRMGs in the context of Task 4.3 (Evaluation Cycles of Guidelines), focusing on four main aspects:

- An illustration of the Realist Evaluation approach and its proposed application to DARWIN evaluation activities, taking into account the functional and non-functional requirements deriving from D1.3 (“Practitioner and academic requirements for resilience management guidelines”).
- A more detailed methodological instantiation of the approach to the initial evaluation of generic DRMGs.
- A set of crisis types (scenarios) developed with the active contribution of the DARWIN end-users, preceded by an elaboration on the method to develop the scenarios themselves and on the criteria to select them.
- An initial scheduling of the pilot exercises and of the associated evaluation cycles that will follow the Initial Evaluation of Guidelines (D4.2), to be held at the end of September 2016.

6.1 Results and Limitations

The work has been successful in defining a concrete plan for the initial evaluation of guidelines to be adopted in D4.2 and in identifying a meaningful set of scenarios for testing resilience management concepts. Particularly the work on scenarios is the one more developed, which allowed the most active and cooperative part of the work in Task 4.1, offering also opportunities for in-depth reflections by the partners on the way resilience concepts might be considered by practitioners in real life situations and on the management of interfacing aspects between different domains. On the other hand, much work has still to be done to define more in detail the planning and practicalities of the evaluation activities that will start at the end of 2016 and will continue until month 34 of the project. The difficulties are mainly related to two aspects. The complexity of organizing pilot exercises which require the involvement of a wide spectrum of subject matter experts, whose availability is not under full control of WP4 partners. The limited information available so far on the DRMGs to be evaluated, which are of course a central element to determine the appropriateness of the evaluation plan. In this respect, the decision to concentrate a considerable amount of the work on the preparation and discussion of scenarios was successful in anticipating topics that will be very useful for the preparation of pilot exercises and prevented the DARWIN end users to remain ‘on hold’ until more information will be available on the DRMGs.

6.2 Future work

Despite not being based on real pilot exercises, the initial evaluation of DRMGs will provide first indications on the way representatives of the end users will consider and react to the DRMGs and will offer insights for a more detailed planning of evaluation activities in the context of Task 4.3 (Evaluation Cycles of Guidelines). Based on the time constrains highlighted in section 5, this task will have to consider how to map specific scenarios to specific pilot exercises and how to allocate the evaluation of specific DRMGs (full set or divided in clusters) to specific pilot exercises. In addition, the task will have to determine which part of the pilot exercises will be oriented to provide feedback for the adaptation of DRMGs to ATM (before April 2017) and which part will be used to provide feedback for the generalizability and applicability of DRMGs to different critical infrastructures at a European level (between June and December 2017). This work will pave the way to determine the number of evaluation cycles and their precise scheduling. It will be done in strict cooperation with WP2, taking advantage of the shared teams in WP2 and WP4.
7 References


A Appendix 1 – DARWIN Ethical requirements

Table 6 below lists the DARWIN Ethical Requirements (ER) raised during the DARWIN project proposal evaluation and their mapping to the recommendations from the ESR (Ethics Screening Report). The same table can also be found in the DARWIN DoA Annex 1 of GA, Section 5 “Ethics and Societal Impact”.

It is worth noting that the full details describing the procedures and criteria used to identify and recruit research participants as well as the procedures for obtaining informed consent are not yet available in the presented deliverable, as anticipated in ER1 (see first row of the table below). Due to the impossibility to detail the precise number and types of pilot exercises at this stage of the project and to the consequent difficulties in the determination of the required attendance in terms of subject matter experts, it has been decided to specify these aspects at the beginning of Task 4.2 (“Implementation of Pilot Cases”). These contents will be documented in the D4.3 (“Pilot’s implementation and Evaluation”), but also made available on the DARWIN eRoom, before the actual start of any pilot exercise.

Table 6: Mapping DARWIN Ethical Requirements to ESR Recommendations

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<td>ER1</td>
<td>Details on the procedures and criteria that will be used to identify/recruit research participants must be provided in the Technical Annex.</td>
<td>The full details describing procedures and criteria used to identify and recruit research participants, and procedures for obtaining informed content will be provided in D4.1 (month 12), to be validated by the REA. DARWIN will only recruit professionals and members of the general public to participate in surveys and pilots. Recruitment will be based on profession, geography, gender and demography to ensure a balanced representation. Some potential inclusion criteria: 1. Professional employees of healthcare or ATM systems (service providers); 2. Over 21 years of age. Potential exclusion criteria: 1. Lay personnel unrelated to disaster management and resilience; 2. Minors or individuals unable to freely provide an informed consent. Participation is voluntary and the participants chosen will be invited to participate and given the possibility to decline, or withdraw their participation at any given time. Procedures for case studies is preliminary indicated below: Members within the CoCRP and potential DARWIN end users will be invited (Representing different domains and expertise). Research participants will be recruited among operational and management personnel additional a number of other personnel will also be invited (to represent public view non-experts but with good knowledge of the pilot). They will mainly be recruited between two groups ATM and health care. Information about the pilot will be provided to the research participants in advance to the exercise regarding purpose of the research, scope of the pilots, expected benefits. We will explain the pilot’s activities, the work that is expected from participants, duration and that their feedback will be</td>
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**DARWIN Ethical Requirements (ER)**

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<td>used to improve the resilience guidelines and operationalized concepts (for further information refer to Ethics Requirement (ER2 information sheet and consent form). We will remark that the concepts are under trial. We will summarize lessons learned and send back these summaries to the participants in order to achieve consensus concerning their appropriateness. Contact points will be given for any clarification before, during or after the pilots.</td>
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| ER2 | Detailed information must be provided on the informed consent procedures that will be implemented in the Technical Annex. | Participants who accept the invitation will be given an information sheet and consent form containing information on what type of data will be collected during the surveys/field-studies. Template will be prepared as part of WP4 to the research participants. The template will:  
- Describe the aims, methods and implication of the research, the nature of participation and any benefits, risk or discomfort that might be involved.  
- Explain procedures for gathering and archiving data. It also describes the way data will be de-identified and later anonymised.  
- State that participation is voluntary and that everyone has the right to withdraw their participation or data at any time without any consequences.  
- Indicate procedures that will be implemented in the event of unexpected or incidental findings.  
This template will be adapted for each case study and the customized form must be signed by the individual participants. |
| ER3 | The applicants must clarify in the Technical Annex whether children and/or adults unable to give informed consent will be involved and, if so, justification for their participation must be provided. | DARWIN will only recruit professionals and members of the general public to participate in the project surveys and pilots. There is no plan to involve children or adults with reduced legal capacity. |
| ER4 | The applicants must clarify in the Technical Annex how consent/assent will be ensured in a case where children and/or adults unable to give informed consent are involved. | DARWIN will only recruit professionals to participate in the project surveys and pilots. Consents from children and/or others unable to give consent are not applicable. |
| ER5 | Details on incidental findings policy must be provided in the | We will provide templates for Informed Consent Forms and Information Sheets (in terms understandable to the participants) before the start of WP4 (pilots). On a general note, participants will |
The research leading to these results has received funding from Horizon 2020, the European Union’s Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 653289.

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<td>Technical Annex</td>
<td>be provided with a detailed information and consent sheet including procedures that will be implemented in the event of unexpected or incidental findings (see requirement ER2).</td>
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**ER6**

Copies of the ethical approvals for the involvement of humans in interviews by the competent Ethics Committee must be submitted to the EU by the end of month 7 of the project's lifetime.

Copies of ethical approvals by the competent authorities will be submitted to the REA prior to the start of WP4 (pilots). A deliverable on data protection approval at month 7 compiling including these copies of approvals as requested in the ethics review report will be consolidated and produced in WP7 (D7.4) coordination with WP4. (See also requirement ER7 regarding competent authority)

**ER7**

Copies of approvals for the collection of personal data by the competent University Data Protection Officer / National Data Protection authority must be submitted to the EU by the end of month 7 of the project's lifetime.

Copies of approval by the competent authorities for collecting personal data will be submitted to the REA prior to the start of WP4 (pilots) when such approval is required by the applicable National Legislation. A deliverable on data protection approval at month 7 compiling including copies of approvals as requested in the ethics review report will be consolidated and produced in WP7 coordination with WP4.

The project will investigate which partners are concerned at early stage of the project.

SINTEF has appointed NSD (Norwegian Social Science Data Services) as their Data Protection Official for Research (as it has 150 research and educational institutions, including all Norwegian universities). This means all research projects that involve gathering of personal data must be notified to the NSD for ethical approval.

FOI and KMC store, process, and destroy personal data in accordance with Swedish Law, e.g. in accordance with the Personal Data Act (SFS 1998:204) (based on the Data Protection Directive 95/46/EC), the Archives Act (SFS 1990:782), and the Public Access to Information and Secrecy Act (SFS 2009:400). The Swedish Data Inspection Board is the Swedish supervisory authority under the Personal Data Act. FOI and KMC have each appointed a personal data representative, notified to the Data Inspection Board, independently ensuring personal data to be processed in a lawful and correct manner.

In Italy the treatment of data is regulated by the "Decreto legislativo 30 giugno 2003, n. 196". Data Protection is done by the authority "Garante per la Protezione dei Dati Personali". Data collection processes shall be registered in its "Registro dei Trattamenti".

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### DARWIN Ethical Requirements (ER)

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<td>ER8</td>
<td>Justification must be given in the Technical Annex in case of collection and/or processing of personal sensitive data.</td>
<td>However, this is a self declaration and no authorisation is required. Moreover, our work is likely to be exempted even from this registration because this is included in the research and scientific activities described in the &quot;Provvedimento relativo ai casi da sottrarre all'obbligo di notificazione&quot; published in the &quot;Registro delle Deliberazioni, n. 1 del 31 marzo 2004&quot; of the &quot;Garante per la Protezione dei Dati Personali&quot;.</td>
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<td>ER9</td>
<td>Detailed information must be provided in the Technical Annex on the procedures that will be implemented for data collection, storage, protection, retention and destruction and confirmation that they comply with national and EU legislation.</td>
<td>Within the DARWIN project we do not in general deal with most sensitive categories of personal data, such as financial records, national identity cards and pass numbers. Health data used in workshops and simulations are either fictional or derived from scrambled anonymized data. SINTEF is subject to the laws and guidelines that are relevant for this project in Norway, which are Personal Data Act (LOV 2000-04-14 nr 13) and the Ethical guidelines for Internet Research. The Data Inspectorate is an independent administrative body that ensures the enforcement of the Personal Data Act of 2000. The Norwegian Social Science Data Services (NSD) is its partner for implementation of the statutory data privacy requirements in the research community. At the beginning of the project SINTEF will report all planned studies to NSD. This means that specific efforts must be directed towards ensuring the privacy of participants who take part in DARWIN studies, regardless of whether they live in Norway or in any other partner country. Other partners are similarly bound by local and EU-level legislation as well as following their own in-house ethical procedures in association with research projects (e.g. BGU for example submits research conducted by the university personnel to an Internal Review Board committee that has independent authority, and the studies are conducted only after approval has been provided in writing). We will ensure that procedures will comply with national and EU legislation (in particular EU Directive 95/46/EC). All personal data will be stored (if required in encrypted format) on secure, password/token-protected servers. We will also take into the account future developments in the EU law that is currently under discussion. During the project period, personal data will be de-identified; i.e. name and other characteristics that could identify a person has been removed and replaced by a number, which refers to a separate list of identifiable data. Once the project has finished, data will be completely anonymized, meaning links to lists of names and</td>
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<td>contact-information will be deleted. No personal data will be stored after the end of the project period.</td>
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<td>Original research data (in an anonymized form) will be documented and archived in a research data repository(^{13}), and thus placed at the disposal of colleagues who want to replicate the study or elaborate on its findings(^{14}).</td>
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<td>We ensure that personal data is kept securely. Any publications, including publications online, neither directly or indirectly will lead to a breach of agreed confidentiality and anonymity(^{15}).</td>
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<td>The research outcomes will be reported without contravening the right to privacy and data protection. (Reference to Requirement RE7 regarding FOI and KMC practices concerning personal data)</td>
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<td>ER 10</td>
<td>Detailed information must be provided in the Technical Annex on the informed consent procedures that will be implemented.</td>
<td>Refer to requirements ER1 and ER2 regarding procedures informed consent procedures that will be implemented in DARWIN.</td>
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<td>On the cover page of each questionnaire a clear explanation of the goals and the terms for filling will be provided. The paragraph will clarify that filling the questionnaire denotes acceptance of the terms and &quot;informed consent&quot;.</td>
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<td>ER 11</td>
<td>The applicant must explicitly confirm in the Technical Annex that the existing data are publicly available.</td>
<td>No existing data and/or information to be used in the DARWIN project will be confidential.</td>
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<tr>
<td>ER 12</td>
<td>In case of data not publicly available, relevant authorisations must be provided to the EU by the end of month 7.</td>
<td>Not applicable. See comment above.</td>
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<td>ER 13</td>
<td>The applicant must confirm in the Technical Annex that the ethical standards and guidelines of Horizon2020 will be rigorously applied, regardless of the country in which the research is carried out.</td>
<td>The DARWIN project confirms that the proposed research and consortium participants fully comply with the principles of the European Charter for Researchers and the European Code of Conduct for Research Integrity of ALLEA (All European Academies) and ESF (European Science Foundation), including ethical standards and guidelines regardless country in which research is carried out.</td>
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\(^{13}\) [http://www.nsd.uib.no/cms/nsd/english/archive.html](http://www.nsd.uib.no/cms/nsd/english/archive.html)

\(^{14}\) Aligning with guidelines for good research practice in [http://www.esf.org/fileadmin/Public_documents/Publications/Code_Conduct_ResearchIntegrity.pdf](http://www.esf.org/fileadmin/Public_documents/Publications/Code_Conduct_ResearchIntegrity.pdf)

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<td>ER 14</td>
<td>The applicants must provide details in the Technical Annex on the material, which will be imported to/exported from EU and provide the adequate authorisations by the end of month 7.</td>
<td>Data will only be shared or transferred between partners in accordance with European procedures. The Data Protection Directive applies to all EU countries and in addition, non-EU countries within the European Economic Area (EEA), which includes Norway. The effect of the decision based on Article 25.6 of The Data Protection Directive is that personal data can flow from EU countries and Norway as an EEA-member without any further safeguard being necessary. If there is transfer of data between Israel and EU countries a proper authorization will be requested and included in deliverable M07.</td>
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<tr>
<td>ER 15</td>
<td>The applicants must foresee an independent Ethics Board to manage the ethical issues. This shall be done in collaboration with the existing SINTEF Ethics Council.</td>
<td>The DARWIN project will establish an independent Ethics Board in collaboration with the existing SINTEF Ethics Council. The Ethics Board will be comprised of at least three independent experts with adequate experience within ethics issues. The Coordinator will communicate name of the independent experts to the project officer. Ethics review will be performed through remote evaluations and teleconferences.</td>
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As requires SINTEF will cooperate with the partners’ ethics council as required for example:

- ISS has an internal Ethics Committee providing expertise and advice on the ethical aspects of the activities of the ISS.

It gives advice and opinions concerning all activities pertaining to

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16 http://ec.europa.eu/justice/policies/privacy/docs/international_transfers_faq/international_transfers_faq.pdf
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- the Institute of Health that require ethical evaluation, including those carried out with external funding and multilateral programs with participation of the Institute, also taking into account any views expressed by the ethics committees of the institutions’ participants
- BGU has an internal ethics committee that is responsible for reviewing and approving research proposals prior to their execution

EXPECT THE UNEXPECTED AND KNOW HOW TO RESPOND

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