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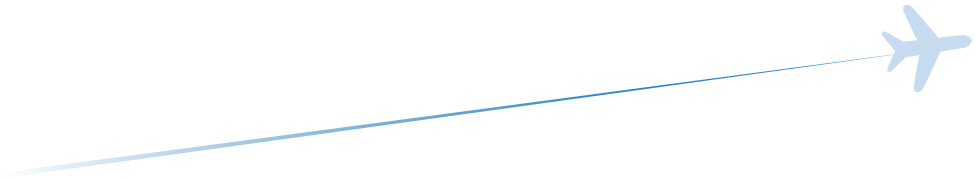

Evaluation plan

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Authoring & Approval

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Name/Beneficiary	Position/Title	Date
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Rejected By - Representatives of beneficiaries involved in the project

Name/Beneficiary	Position/Title	Date

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SAFELAND

SAFE LANDING THROUGH ENHANCED GROUND SUPPORT

This deliverable is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 890599 under European Union's Horizon 2020 research and innovation programme.

Abstract

SAFELAND is developing a future concept of operations, dealing with the single pilot incapacitation problem. The concept is developed with the contribution of different stakeholders and will be validated by internal and external experts.

This Deliverable contains the Evaluation Plan Part 1, planning and guiding the preliminary evaluation of the initial SAFELAND concept. The Deliverable is the partial outcome of T3.1 and it will be followed by a second Deliverable (Evaluation Plan Part 2), to be delivered at the end of February 2021.

Evaluation Plan Part 1 identifies the activities related to the evaluation of three alternative concepts of operations that have been developed in Task 1.2 – Concept Development. The activities consist in the first Workshop with the stakeholders of the Advisory Board. Its outcome will serve as an input to Task T1.4 for the revision of the concept (Concept refinement). The Plan identifies aims, roles and responsibilities, aspects to be analysed, evaluation criteria and timing.

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1 Introduction

1.1 Purpose and scope of this document

Evaluation Plan Part 1 is developed within WP3, and it is the partial outcome of Task T3.1. It is the reference document that will be used to organize and manage the preliminary validation (T3.2 – Preliminary Evaluation) of the SAFELAND concept developed in WP1, task T1.2 – Concept Development. Its outcome will serve as an input to Task T1.4 for the revision of the concept (Concept refinement).

Evaluation Plan Part 1 will be followed by a second Deliverable (Evaluation Plan Part 2), to be delivered at the end of February 2021. **Evaluation Plan Part 2** will plan and guide the final validation (T3.3 - Simulations and T3.4 – Final Evaluation) of the SAFELAND concept developed in task T1.4 – Concept Refinement.

Evaluation Plan Part 1 identifies the activities related to the evaluation of three alternative concepts of operations that have been developed in WP1, Task 1.2 – Concept Development. It describes the validation objectives, the relevant stakeholders, the validation requirements and approach, and the planned validation activities.

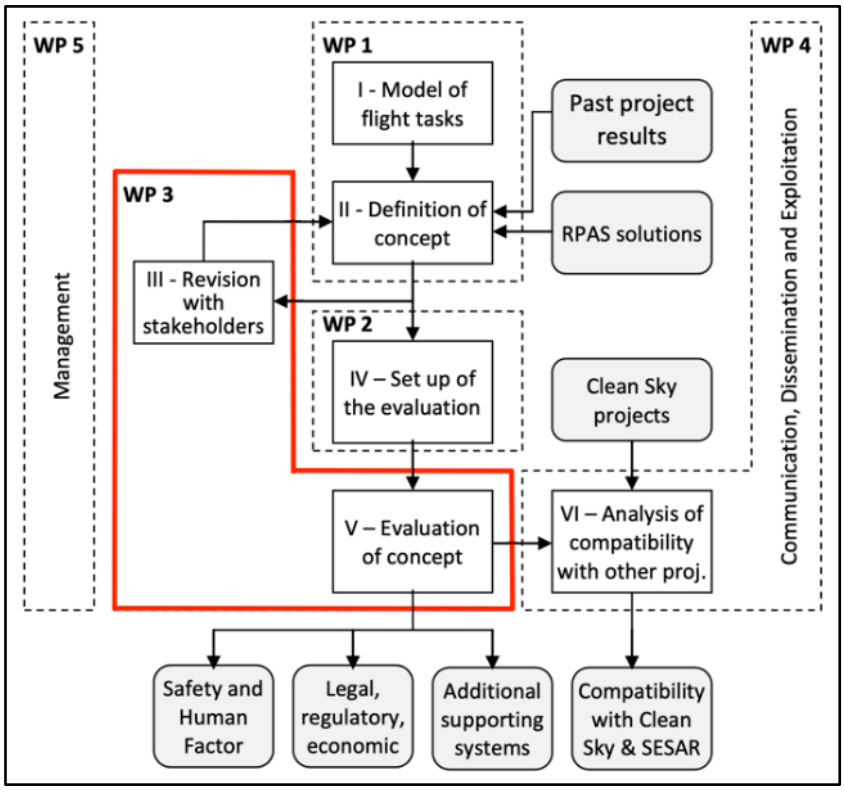

Figure 1: Relationship among WP 3 Concept Evaluation (in red) and the other work packages of the project.

1.2 Structure of the document

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This deliverable presents the plan of the SAFELAND preliminary validation, and it is structured as follows:

- Chapter 1 is the current one, introducing the purpose of the document and its structure
- Chapter 2 describes the context of the validation activities of SAFELAND, including the schedule of validation activities, and the related validation approach and objectives
- Chapter 3 contains the plan of the Preliminary Evaluation
- Chapter 5 provides the references.

1.3 List of acronyms

Term	Definition
AB	Advisory Board
ANSP	Air Navigation Service Provider
AOCC	Airline Operation Control Centre
ATC	Air Traffic Control
ATPL	Airline Transport Pilot Licence
GS	Ground Station
GSO	Ground Station Operator
OESD	Operational Event Sequence Diagram
SecRAM	Security Risk Assessment Methodology
SPO	Single Pilot Operation
WP	Work Package

Table 1: Acronyms

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2 Context of the validation

2.1 Scope of the validation

The objective of WP3 **is to evaluate the intermediate and final results of the project**. Evaluation will include the safety and cyber-security preliminary assessment as well as legal, regulatory and economy aspects, supporting the project in the refinement and improvement of the SAFELAND concept.

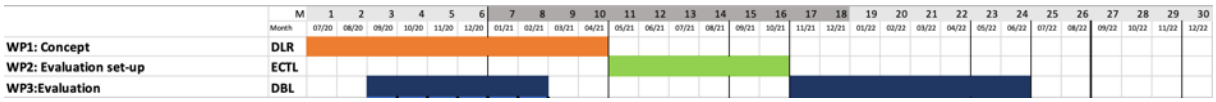

Figure 2: SAFELAND GANTT chart [2], focus on work packages WP1, WP2 AND WP3

The Evaluation Plan Part 1 (this document) and **Part 2** (to be delivered in February 2021) are generated within Task 3.1 to present the key elements for guiding all the Evaluation Activities of the WP, supporting a proper evaluation of the SAFELAND concept. Overall, the key elements can be detailed as follows:

- the evaluation activities to be conducted (e.g., workshops with the stakeholders, simulations, analysis and assessment activities),
- aims and objectives,
- roles and responsibilities,
- aspects to be analysed,
- evaluation criteria for each aspect,
- timing.

The Evaluation Plan Part 1 is the reference document that will be used to organize and manage the preliminary validation (T3.2 – Preliminary Evaluation) of the SAFELAND concept.

Task 3.2, **Preliminary Evaluation,** is the first set of evaluation activities and it will focus on the evaluation of the initial SAFELAND concepts developed in Task T1.2. The evaluation will be based on a *workshop* with the stakeholders of the Advisory Board (T0+6). The evaluation results will be included in *D3.2 – Preliminary Evaluation Results (T0+7)***.** Thanks to these results (and the ones included in D1.3 - Legal, Regulatory & Economy Constraints) a final concept will be developed in Task 1.4.

Since the results of the Preliminary Evaluation will affect the objectives, criteria, methods and experimental design of the following validation activities, a second deliverable (**Evaluation Plan Part 2**) will be produced to organize and manage the final validation (Task 3.3, **Simulations and** Task 3.4, **Final Evaluation)** of the SAFELAND concept.

Task 3.3, **Simulations** will deal with the *simulation exercise* to be organised and held to test the final SAFELAND concept (as described in D1.4). The simulations will take place on the platforms developed in WP2 (Set up of the Evaluation) using the facilities of ECTL and DLR. ECTL will host the Control Work Position, and the Pseudo-pilot Position, DLR will host the Cockpit simulator, the remote ground cockpit simulator and the Airline OCC simulator. Personnel for the simulation will be pilots and controllers from LFV, EMB, ECTL and DLR and flight dispatchers from SWR. The main aim of the simulation will be

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to evaluate Human Factor aspects, using a set of scenarios designed ad-hoc. Human Factors will be evaluated using the criteria identified in Task T3.1 and described in D3.1 Evaluation Plan Part 2. The simulation will also provide supporting information for the Safety and Cyber-security preliminary assessment, in particular simulating safety and cyber-security related events that would be difficult to study only in theory. It will produce *D3.3 – Simulation Results and New Systems (T0+20).*

Task 3.4, **Final Evaluation**, will deal with the safety and cyber-security preliminary assessment, the second evaluation workshop with the stakeholders of the Advisory Board and the final analysis and integration of the different evaluation exercises. Safety will be analysed by comparing the possible effect of the new hazards due to the introduction of the new concept with the current hazards of the baseline, and identifying safety requirements that, if satisfied, will ensure the achievement of the safety objectives. The hazards resulting from cyber-security issues will be analysed using the SESAR ATM security risk assessment methodology SecRAM [3], identifying the impact of cyber-security threats on safety. The Task will also analyse the legal, regulatory and economy aspects of the implementation options selected for the simulation, using the specialized competencies of some consortium partners. In particular, EUI for the legal aspects, EUSC for the regulatory ones, DLR for economy. The related possible advantages and disadvantages of each option will be identified. The second evaluation workshop with the stakeholders of the Advisory Board will be organized to present the results of the simulation and of the safety and cyber-security preliminary assessment. The aim will be to discuss and verify with them the project results and collect final feedback and remaining open issues. From the analysis of the simulation results and the Workshop with the stakeholders the Task will also identify the functionalities of possible new additional systems that could help the ground personnel, and in particular the air traffic controller and the remote pilot in their activity in support to the flight management. The identification will also address the related information flow between the different actors (air traffic controller, pilot, remote pilot) and with automation. The Task will conclude its activities by integrating and synthesizing the results of all the evaluation exercises, providing final conclusions for the evaluation and identifying possible remaining open issues. It will produce *D3.4 – Final Evaluation Results at T0+24.*

2.2 Structure of the validation activities

SAFELAND will have two sets of validation activities, with different objects, aims, levels of analysis and methods used:

- **Preliminary evaluation:** it will evaluate the alternative operational concepts generated in WP1, with the objective of selecting the most promising one or a combination of the different variants and providing recommendations for the development of the final concept (Task 3.2).

- **Final evaluation:** it will evaluate the final concept as implemented in the simulation exercises, gathering a more detailed feedback and generating the final results of the project (Task 3.3 and 3.4). Final evaluation activities, objectives and success criteria will be detailed in **Evaluation Plan Part 2**.

2.2.1 Schedule of the validation activities

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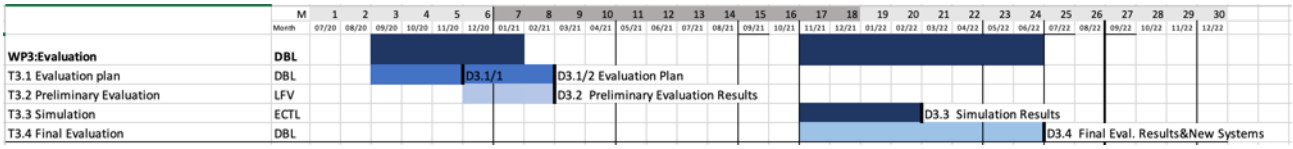

Figure 3: SAFELAND GANTT chart, focus on validation tasks

Different activities (see SAFELAND GANTT [2]) are foreseen for the two evaluations:

- **Preliminary evaluation:**
  - First workshop with the Advisory Board (T0+7)
    - → D3.2 – Preliminary Evaluation Results (T0+8)

- **Final evaluation:**
  - Human in the loop simulation activities will span from M17 to M20
    - → D3.3 – Simulation Results and New Systems (T0+20)
  - Second workshop with the Advisory Board (T0+22) and integration of the results of the different evaluation activities (M17 to M24)
    - → It will produce D3.4 – Final Evaluation Results (T0+24)

2.3 Validation approach and objectives

The validation activities of SAFELAND are organised into interrelated steps. As a first step (Preliminary evaluation), the three different variants of the SAFELAND operational concept developed by internal partners will be **assessed by the stakeholders of the Advisory Board in a dedicated workshop**, in order to be further developed and expanded by possible implementation options.

Following (Final evaluation), the final SAFELAND concept and its implementation options (as designed in WP1 and 2) will be **experimentally tested through simulation** in order to evaluate their operational feasibility, collect human performance data, assess legal and regulatory compliance and safety. The simulation exercises will involve controller, pseudo-pilot, remote pilot, single pilot and dispatcher using different scenarios. During the execution of the experimental tasks, both behavioural (e.g., errors, reaction time) and subjective data (attention, stress, workload) will be collected. In this phase, also a safety and cyber security assessment will be carried out. As a conclusive step, the results gathered during the previous phase will be analysed and presented to the stakeholders of the Advisory Board in order to be evaluated and produce the final version of the concept.

Validation Objectives for the Preliminary evaluation are further detailed in subsections 3.1.

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3 Preliminary Evaluation

Since generally a big challenge for system developers is to align the functionality of a newly developed system with the actual needs of the end users (e.g., air traffic controllers) a workshop has been organized together with subject matter experts from the project partners (i.e., air traffic controllers and ATPL licensed pilots) and the concept developers (see D1.2 [1] for more information). The aim of the workshop was to develop three different variants of the operational concept including to explore various alternatives of dynamic function allocation between actors (i.e., automation, ATC, GSO and AOCC).

In an iterative manner, the resulting operational concept variants have been refined against the ideas and needs of the subject matter experts as well as their operational feasibility, the implications for safety, cyber-security and human factors. The team included experts in legal, regulatory and economic aspects to identify in advance those variants that may be affected by showstoppers. These could be related for example to the legal implications of the delegation, relevant remote pilot certification issues, or to the costs of having a ground remote pilot in each AOCC/ATC centre dedicated to possible (infrequent) cases of single pilot incapacitation. Three alternative variants of the SAFELAND concept have been generated and described in D1.2 Initial Concept [1]. Each concept has a different focus as to who is mainly responsible for controlling or issuing commands to the aircraft (GS, automation or ATC) after the pilot incapacitation has occurred.

The variants resulting from this process together with a restricted selection of the most promising implementation options will be the subject of the preliminary evaluation phase; its outcome will serve as an input to Task T1.4 for the revision of the concept (Concept refinement).

3.1 Validation objectives

The main high-level objective of the preliminary evaluation is to support the definition of the final SAFELAND concept. In order to produce the final version of the concept, expert feedback will be collected on each concept variant developed in Task 1.2. Depending on the features of final concept chosen, the simulation used in the Final evaluation will be designed accordingly, to test the concept validity.

The objective of this first evaluation activity is then to evaluate, for each alternative concept, selected relevant topics (e.g., acceptability, impact on workload) (cf. Table 2). This information will be used to select and update the most promising concept or a combination of the different variants.

Objectives	Success criteria
To define a solution that is acceptable from the operational point of view	Positive feedback from the stakeholders of the AB on one of the proposed concept variants or, alternatively, suggestion of an alternative solution.
To define a solution that is safe	Positive feedback from the stakeholders of the AB on one of the proposed concept variants or, alternatively, suggestion of an alternative solution.

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To define a solution that is acceptable from the expected impact on workload point of view	Positive feedback from the stakeholders of the AB on one of the proposed concept variants or, alternatively, suggestion of an alternative solution.
To define a solution that is economically acceptable	Positive feedback from the stakeholders of the AB on one of the proposed concept variants or, alternatively, suggestion of an alternative solution.
To define a solution that complies with regulations and laws	Positive feedback from the stakeholders of the AB on one of the proposed concept variants or, alternatively, suggestion of an alternative solution.

Table 2: Objectives and success criteria

In order to evaluate those aspects, it has been chosen to organise a workshop and to collect the feedback of external experts.

3.2 Workshop with AB

The **first workshop with the Advisory Board** will help to achieve the objectives of the Preliminary Evaluation**.**

In the workshop, the alternatives concepts will be presented and evaluated against the ideas and needs of the subject matter experts.

The different implementation options associated with the three variants include:

- the distribution of the functions
- the interactions between actors
- the location of the ground station

These implementation options will be presented and discussed with the stakeholders eliciting their opinion on issues such as:

- acceptability by pilot and controller
- workload and situational awareness
- legal and regulatory
- cost/benefit relation.

Requirements to be tested in the Final Evaluation's simulation may also be collected, in order to compile the variables that will determine the scenarios against which the concept will be tested. Recommendations will be, also, produced in this stage, to be taken into consideration for the Final Evaluation activities.

3.2.1 Structure of the workshop

The Workshop with the stakeholders of the Advisory Board will take place remotely in January 2021. The Agenda (cf. Table 3) consists of an introductive theoretical session including an overview of the

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SAFELAND project and of the three variants developed in Task 1.2 (Concept development), and a practical part divided in five separate sessions.

Each session will consider a relevant phase of the flight, from the moment of pilot incapacitation to landing:

1. pilot incapacitation phase
2. handover phase
3. airport selection phase
4. emergency descent and landing phase

Moreover, a final session will be dedicated to discussing the most suitable location of the Ground Station.

Time	Activity	Responsible
09:00 – 09:15	Welcome and Opening	LFV
09:15 – 09:35	Three initial variants of a SAFELAND concept	DLR
09:35 – 09:50	Workshop Overview	DBL
09:50 – 10:00	***Break***	
10:00 – 10:40	Discussion 1: Pilot Incapacitation phase	DLR
10:40 – 10:50	***Break***	
10:50 – 12:00	Discussion 2: Handover phase	DLR
12:00 – 13:10	***Lunch***	
13:10 – 14:20	Discussion 3: Airport Selection phase	ECTL
14:20 – 14:30	***Break***	
14:30 – 15:40	Discussion 4: Emergency descent and Landing phase	EMB
15:40 – 15:50	***Break***	
15:50 – 16:20	Discussion 5: Location of the Ground Station	LFV
16:20 – 16:30	Wrap-up and Closure	LFV

Table 3: Agenda of the first Workshop with the Advisory Board

At the beginning of each session, an explanation of the three variants of the concept will be given to participants highlighting main similarities and differences pertaining the interactions between the

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involved actors (i.e., AOCC, automation, GS and ATC) (cf. Figure 4) for each of the four phases (i.e., from the moment of pilot incapacitation to landing).

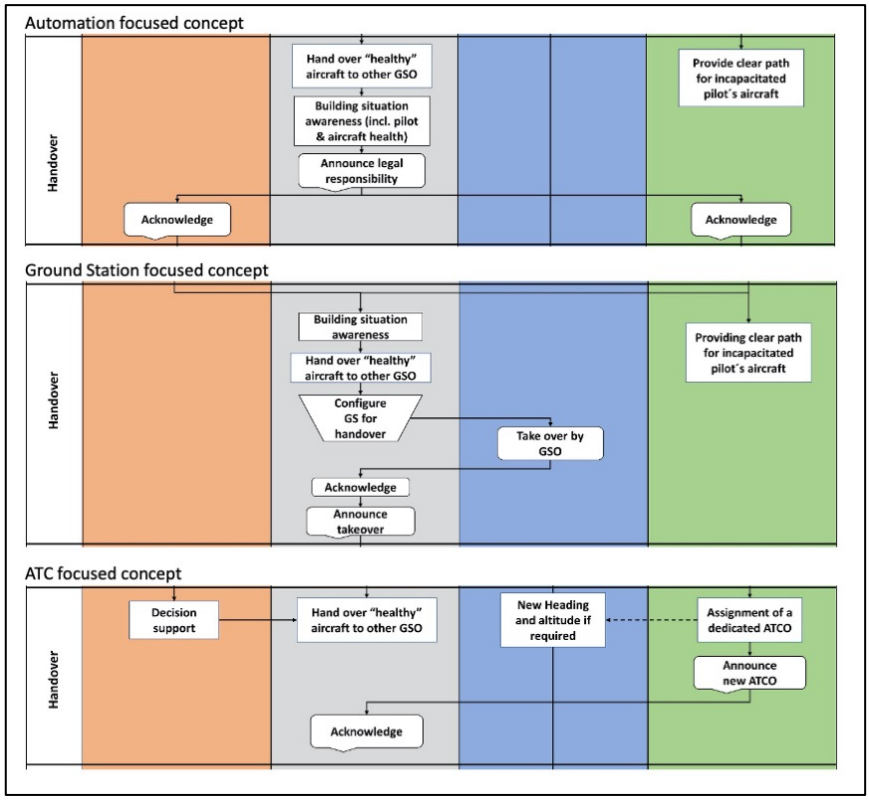

Figure 4: Different variants of Operational Event Sequence Diagram (OESD) for the Handover phase developed in task T1.2

Following the explanation, the AB will be invited to discuss the main points of strength and weakness of each alternative solution. To support feedback collection, an interactive tool called Mentimeter will be also used, allowing participants to directly provide their feedback via answering open questions, rating different statements on a ten points scale, or ranking the alternative proposed solutions.

Below, some examples of open questions:

- According to your area of expertise, what aspects would you consider implementing?
- According to your area of expertise, what aspects would you consider rejecting?
- Have we succeeded to capture all important aspects in the tree concepts, or is something missing?

Below, some examples of rating questions:

- Rate your opinion regarding the acceptability of the concept from an ATCO perspective
- Rate your opinion regarding the acceptability of the concept from a Legal perspective
- Rate your opinion regarding the economic feasibility of the concept

Below, some examples of ranking questions:

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- Which of the three Operational Event Sequence Diagram would you think to be the most robust?
- In case of a pilot incapacitation, considering all factors, which of the three concepts (Automation, ATC, Ground station) would you think to have the highest probability of success in an emergency situation?

In each session, a group leader will facilitate and moderate the discussions while a technical support person will manage the interaction with Mentimeter. Additionally, internal partners will be assigned to keep the meeting minutes on aspects related to their relevant expertise.

3.2.2 Workshop participants

The stakeholders considered in SAFELAND project include: the research community and SESARJU, ANSPs, aircraft manufacturers and system industries, institutional and regulatory bodies, pilot associations, occupational health-care company of the aviation sector. Stakeholders of the Advisory Board (see complete list on Table 4) will provide their expertise in the following subjects:

- Operational
- Human factor
- Legal
- Regulatory
- Certification
- Cost/benefit relation

Name	Type	Company
Christophe Garnavault	Aircraft manufacturer	DASSAULT
Yossi Ben-Nun	System Industry	IAI
Pavel Kolcarek	System Industry	HONEYWELL
Catherine Ronfle-nadaud	Air Traffic Service provider	DSNA
Günter Achatz	Air Traffic Service provider	DFS
Joe Degiorgio	Air Traffic Service provider	MATS
Catalin Nae	Association of European Research	EREA/INCAS
Com.te Andrea Gioia	Pilots representative organizations	STASA
Com.te Yari Franciosa	Pilots representative organizations	STASA
Mario Tortorici	Regulatory Bodies	ENAC
Ron van de Leijgraaf	Institutional Bodies	AIA
Giovanni Riccardi	Air Traffic Service provider	ENAV

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Francesca Romana Proietti	Occupational health-care organization	LAIF
Diana Delfino	Institutional Bodies	AI

Table 4: Composition of the Advisory Board

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4 Next steps

The feedback collected within the workshop will be analysed and the final results will be used, together with the results of the Legal, Regulatory & Economy Constraints analysis, to define the final SAFELAND concept, which will be described in D1.4. WP2 will then develop the evaluation set-up and a second evaluation campaign will deliver the final conclusions on the validity of the developed concept. The evaluation plan for this campaign, describing the activities (which includes a human in the loop simulation), their objectives, experimental plans, analysis methods and participants will be provided in D3.1 Evaluation Plan Part 2, which will be delivered in February 2021.

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5 References

[1] SAFELAND Consortium, D1.2 Initial concept, 2020
[2] SAFELAND Project GANTT available at https://seafile.dblue.it/f/e61e531d9f8d4310a105/
[3] SecRAM version 02.00.00

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