Safer Airports and Flights for Europe

PJ.03b Final Project Report

Deliverable ID:	**D1.2**
Dissemination Level:	**PU**
Project Acronym:	**PJ.03b-SAFE**
Grant:	**734139**
Call:	**H2020-SESAR-2015-2**
Topic:	**Airport Safety Nets**
Consortium Coordinator:	**DSNA**
Edition date:	**15.11.2019**
Edition:	**02.00.00**
Template Edition:	**02.00.01**

Founding Members
EUROPEAN UNION EUROCONTROL
SESAR JOINT UNDERTAKING

Authoring & Approval

Authors of the document

Name/Beneficiary	Position/Title	Date
Nicolas LEON / DSNA	PJ.03b Project Manager (WP1-WP6) PJ.03b PCIT Leader PJ.03b-01 Solution Leader (WP2)	13/09/2019
Silvia GUSMANO / LEONARDO	PJ.03b-03 Solution Leader (WP3)	13/09/2019
Pierre NIERADKA / AIRBUS	PJ.03b-05 Solution Leader (WP4)	13/09/2019
Patrick BOULET / DSNA	PJ.03b-06 Solution Leader (WP5)	13/09/2019

Reviewers internal to the project

Name/Beneficiary	Position/Title	Date
Nicolas LEON / DSNA	PJ.03b Project Manager (WP1-WP6) PJ.03b PCIT Leader PJ.03b-01 Solution Leader (WP2)	15/11/2019
Silvia GUSMANO / LEONARDO	PJ.03b-03 Solution Leader (WP3)	13/11/2019
Pierre NIERADKA / AIRBUS	PJ.03b-05 Solution Leader (WP4)	23/09/2019
Patrick BOULET / DSNA	PJ.03b-06 Solution Leader (WP5)	13/11/2019
Marc-Antoine LACLAUTRE / DSNA	PJ.03b PCIT member	23/09/2019
Eric LEROUX / AIRBUS	PJ.03b PCIT member	23/09/2019

Approved for submission to the SJU By - Representatives of beneficiaries involved in the project

Name	Beneficiary	Date	Position/Title
Nicolas Leon	DSNA	15/11/2019	Project Manager PCIT Leader
Pierre Nieradka	AIRBUS	Silent Approval	PJ.03b EPMB Member
Petr Hlousek	ANS CR (B4)	14/11/2019	PJ.03b EPMB Member
Ondrej Priboj Vladimira Canadyova	LPS SR (B4)	Silent approval	PJ.03b EPMB Member
Jaroslaw Niewiński	PANSA (B4)	Silent approval	PJ.03b EPMB Member
Marie-Gabrielle Lafoucriere François Salmon Legagneur	DASSAULT	Silent approval	PJ.03b EPMB Member

Stephen Straub Jan Rabold	DFS	Silent approval	PJ.03b EPMB Member
Carlo Persiani Giovanni Riccardi	ENAV	Silent approval	PJ.03b EPMB Member
Roger Lane	EUROCONTROL	13/10/2019	PJ.03b EPMB Member
Susanne Buchholzer	FREQUENTIS	Silent approval	PJ.03b EPMB Member
Tomas Kabrt Tereza Spalenkova	HONEYWELL	Silent approval	PJ.03b EPMB Member
Sarai Costa	INDRA	14/11/2019	PJ.03b EPMB Member
Olivier Delain	ADP (SEAC2020)	Silent approval	PJ.03b EPMB Member
Silvia Gusmano	LEONARDO	14/11/2019	PJ.03b EPMB Member
Cédric Rahatoka Nathalie Pacaud	THALES AIR SYS	Silent approval	PJ.03b EPMB Member
Pascal Combe	THALES AVIONICS	Silent approval	PJ.03b EPMB Member
Ana Martin	DLR (AT-ONE)	Silent approval	PJ.03b EPMB Member
Juergen Teutsch Ronald Grosmann	NLR (AT-ONE)	Silent approval	PJ.03b EPMB Member

Rejected By - Representatives of beneficiaries involved in the project

Name/Beneficiary	Position/Title	Date

Document History

Edition	Date	Status	Author	Justification
02.00.00	15/11/2019	Final	DSNA	Updated FPR with SJU comments delivery to H2020

Copyright Statement

PJ.03b-SAFE

PJ.03B AIRPORT SAFETY NETS

This Final Project Report[1] is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 734139 under European Union's Horizon 2020 research and innovation programme.

Abstract

SESAR **PJ.03b** project aka **SAFE Safer Airports and Flights for Europe**, aims at supporting even safer airport operations by defining, consolidating and validating additional safety support tools for Pilots Controllers and Airport Operators, to mitigate the risks of incidents, accidents, and any conflicting situations involving aircraft at airports.

SAFE delivered four (4) SESAR Solutions through which dedicated tasks to support standardization activities have been performed: Enhanced Airport Safety Nets for Controllers, Conformance monitoring alerts for Pilots, Traffic alerts for pilots for airport operations, Safety support tools for avoiding runway excursions.

[1] The opinions expressed herein reflect the author's view only. Under no circumstances shall the SESAR Joint Undertaking be responsible for any use that may be made of the information contained herein.

Table of Contents

List of Tables

List of Figures

Executive Summary

Safety is aviation's top priority. The main objective of the project is to improve the level of safety at airports of different operational complexity and size (small, medium and large), by providing advanced safety support functions to the pilots, the controllers and to the airport operators.

SAFE delivered four (4) solutions to reach its objectives:

- **PJ.03b-01 "Enhanced Airport Safety Nets for Controllers"**

  This solution aims to provide Air Traffic Controllers with means to prevent the delivery of conflicting clearances and detect non-conformance to clearances on the entire airport.

  Real Time Simulations, involving ANSPs, research centres, Eurocontrol and industry were completed in 2018 and 2019 to validate the V2 specifications. These validation activities showed that the studied concepts are fully interoperable.

  In order to further achieve a V3 maturity level, at the Solution PJ.03b-01 level, Ground Safety Nets deployment criteria are to be driven by the local set of selected alerts and the airport specific characteristics. Further validation activities should consider the specificities of particular types of aircraft (e.g. Rotorcraft or RPAS), so as to express the potential limitations or recommendations for the applicability of the concept to these specific aircraft categories.

- **PJ.03b-03 "Conformance monitoring alerts for pilots"**

  This Solution aims to warn pilots when an inconsistency between the aircraft behaviour with ATC Clearance or procedure is detected or a non-compliance between the aircraft state and the airport characteristics or configuration.

  The concept has been evaluated for Business and Regional aircrafts in medium and large airports through real time simulations. Those activities showed the improvement of flight crew situational awareness when the aircraft is equipped with the Solution on-board alerting function, particularly when taxiing in low visibility conditions. The further development of the current function will require to re-analyse the impacts of the integration of the function on aircraft. Also further investigation and clarification of the interoperability matters between on-board and ground sides, following the introduction of the on-board alerting capability, should be accomplished.

  The validated alerts proved to be ready to move to next maturity phase. The alerting function can be integrated on existing aircrafts as long as they are equipped with the airport moving map. The function integration remains strictly dependent on the different avionics configurations.

  For achieving V3 maturity level, the Solution should take into account the recommendations and the requirements arisen as outcome of the V2 activities in Wave 1. The Solution should address the Safety and Human Performance Key Performance Area with the main target to increase the Flight Crew Situation Awareness. Interoperability is also expected to be further investigated.

- **PJ.03b-05 "Traffic alerts for pilots for airport operations"**

  This Solution aims to decrease significantly the risk of collision with any mobile on runway and taxiways, improving safety on the airport surface.

  An on-board function has been prototyped, implemented and tested on mainline aircraft (equipped with SURF-A) and business jet (equipped with SURF-ITA), and several exercises (FTS and RTS) have been completed, intending to demonstrate the validity of the concept developed. A flight test gathering an Airbus A320NEO (equipped with SURF-A) and a Falcon from Honeywell (equipped with SURF-ITA) has been performed with ten ground and air scenarios, and the alerts worked perfectly in both aircraft.

  The solution is reaching a full V3 maturity and is paving the way for large scale demonstration and deployment in the next wave, to bridge between industrial research and deployment. Function will be developed and certified and revenue aircraft will be equipped.

- **PJ.03b-06 "Safety support tools for avoiding runway excursions"**

  This Solution aims to mitigate runway excursions, as the most frequent type of runway safety accident, by on-board and ground systems that could warn pilots, controllers or airport operators when appropriate.

  The Solution defines procedures and tools to provide airport operators and pilots with the appropriate alerts to current surface conditions, where there is a risk of runway excursion at take-off and landing and to focus on how the risk of runway excursion can be mitigated by on-board systems (ROAAS) and ground based systems (ground sensors or even landing aircraft).

  Several validation exercises have been completed in different meteorological and runway conditions.

  Regarding ROAAS, function adaptation to business aircraft is confirmed. Further development on ROAAS will be conducted by Dassault for industrialization and short term deployment of the concept.

  Regarding runway condition assessment and use, two technologies were used in the three prototypes developed: machine learning and decision tree algorithms. Feasibility and benefits in safety for any kind of airports are confirmed.

  The Solution achieved V2 maturity level and should reach V3 during next R&D phase.

  Next R&D phase should consider the integration of runway condition in on-board tools to assess take-off performance.

  Wave 1 development delivered no result regarding controller alert in case of runway excursion risk. Next activities should consolidate display of runway condition to controllers and their alert needs.

1 Project Overview

The project SAFE proposes the development of new airport safety nets and safety support tools for Pilots, air traffic Controllers and Airport Operators, taking account of existing airport safety support tools (e.g. A-SMGCS Runway Monitoring and Conflict Alerting). These new airport safety support tools aim at mitigating the risks of incidents and accidents involving aircraft at airports (runway incursion, runway excursion, conflictual situation on taxiways or apron, etc.).

In Wave 1, SAFE delivered four (4) solutions, namely:

- **PJ.03b-01 "Enhanced Airport Safety Nets for Controllers"** aims to provide Air Traffic Controllers with means to prevent the delivery of conflicting clearances and detect non-conformance to clearances on the entire airport (V2 Solution maturity achieved[2]).
- **PJ.03b-03 "Conformance monitoring alerts for pilots"** aims to warn pilots when an inconsistency between the aircraft behaviour with ATC Clearance or procedure is detected or a non-compliance between the aircraft state and the airport characteristics or configuration (V2 Solution maturity achieved[2]).
- **PJ.03b-05 "Traffic alerts for pilots for airport operations"** aims to decrease significantly the risk of collision with any mobile on runway and taxiways, improving safety on airport surface (V3 Solution maturity achieved).
- **PJ.03b-06 "Safety support tools for avoiding runway excursions"** aims to mitigate runway excursions (as the most frequent type of runway safety accident), by on-board and ground systems that could warn pilots, controllers or Airport Operators when appropriate (V2 Solution maturity achieved[2]).

1.1 Operational/Technical Context

1.1.1 PJ.03b-01 "Enhanced Airport Safety Nets for Controllers"

At some airports, the current automated ATC alerting system is limited to the runway and is based upon a set of rules that assist controllers in detecting the most serious aircraft conflicts. This current system has no knowledge of aircraft intent or clearances, and in some cases the time window to determine and communicate a resolution may be very limited. At those airports, Airport Safety Nets for the controllers need to be developed and take into account aircraft kinematics as well as given clearances, to avoid the precursors of aircraft conflicts (i.e. conflicting clearances or non-conformances to instructions or procedures).

Airports listed in [8] already embed automated ATC alerting systems on the whole manoeuvring area, based on ATC clearances and Surveillance means. At those airports, Airport Safety Nets for the controllers need to be extended to the entire airport surface, including aprons.

[2] Solution self-assessment – cf. Appendix B.1

At smaller airports, there is currently no automated ATC alerting system, and those airports would benefit from such Airport Safety Nets on their whole surface, even with limited surveillance means.

Based on airport surveillance data and electronic environment integrating ATC clearances, taxi-routes and local procedures, and in the continuity of the PCP Sub-functionality 'A-SMGCS Safety Support Service', this Solution develops tools allowing the ATC system to detect more conflicting situations during take-off, landing and surface operations to alert the Controller. The System detects conflicting ATC clearances and non-conformance to procedures or clearances for traffic throughout the airport: on runways, taxiways and in the apron/stand/gate area. Appropriate alerts are provided to controllers.

1.1.2 PJ.03b-03 "Conformance monitoring alerts for pilots"

The Solution addresses on-board airport safety net for improving safety in runway and taxiway operations, in particular at airports where no safety net is provided to controllers.

Runway incursions are one of the most serious safety issues for ATM. In addition to runway incursions, a significant number of incidents / accidents occur on taxiways and apron areas.

Improvement of safety nets for Flight Crews, providing an earlier or more efficient detection of hazardous situations (e.g. in low visibility conditions), can contribute to satisfy the Stakeholders expectations of minimising such situations.

PJ.03b-03 deals with a specific alerting system from airborne side aiming to contribute improving Flight Crew situation awareness of critical situations, not only runway incursions, but also deviations from the cleared route.

All airports are potentially concerned whether they are equipped with ATC ground services (e.g. A-SMGCS[3]) or not. The main use is mostly intended at airport where the airport size or characteristics (e.g. number, layout and types of taxiways) can be complex to crews not familiar with the given airport. The on-board airport safety net developed in this Solution is conceptually applicable to the whole airport movement area.

1.1.3 PJ.03b-05 "Traffic alerts for pilots for airport operations"

This Solution builds on the work conducted on the SURF-IA application (RTCA DO-323), which supports pilots in avoiding runway accidents and collisions by alerting the flight crew in case an imminent risk of collision on the runway is detected by the aircraft systems. Initial work has also been conducted in through former SESAR 1 programme, as project 09.14 (Airport Surface Alerts) conducted between 2010 and 2016 allowed proceeding with the technical definition & validation of an on-board system warning flight crews about potential conflict with other traffic on the whole aerodrome manoeuvring

[3] A-SMGCS: Advanced-Surface Movement Guidance and Control System

area, both for mainline and business aircraft[4]. At the end of SESAR 1, this Solution reached a V2 maturity level (i.e. demonstration of feasibility) according to the E-OCVM methodology.

The Solution defines different implementations for mainline and business aircraft that expands the scope of SURF-IA to taxiway areas, as no on-board safety net currently exists that can warn flight crews of an imminent collision with another aircraft on taxiways. Although extremely rare events, collisions on the runway remain ones of the most serious types of aviation accidents (e.g. Tenerife in1977, Madrid in 1983, Milan-Linate in 2001). Taxiways collision are more frequent and generally result in much fewer fatalities, but can induce very high operating costs to the airlines involved (grounded aircraft, rescheduled flights, delayed passengers, etc.) but also to the airport where the event occurs.

Implementations range from aural warnings and cautions to aural and visual alerts integrated in a Cockpit Display of Traffic Information (CDTI) or on an Airport Moving Map (AMM). The Solution benefits from the forthcoming widespread availability of ADS-B data in Europe to allow on-board systems to detect and track converging traffic on the ground and warn the flight crew when a collision is predicted.

This Solution relies entirely on aircraft systems, working independently from ATC or airport systems, and can thus complement equivalent ATC safety nets (e.g. Runway Monitoring and Conflict Alerting) or operate at aerodromes not equipped with these ATC tools.

1.1.4 PJ.03b-06 "Safety support tools for avoiding runway excursions"

Runway excursions are the most frequent type of runway safety accident (22% of all accidents over the 2010-2014 period according to IATA's Safety Report) and often involve a contaminated runway among causal factors. The most straightforward way to prevent such events is to give to Flight Crews clear and objective information on runway surface contamination for them to make the right decisions in the preparation and execution of take-off, approach, and landing phases.

The Solution defines procedures and tools that can prevent overruns caused by the wrong estimation of runway surface condition and can also contribute to the prevention of other types of excursions by increasing the awareness of all involved actors. The Solution is compatible with the ICAO Global Reporting Format (GRF) which uses the Take-off and Landing Performance Assessment (TALPA) matrix and resulting Runway Condition Code (RWYCC) as a means to uniformly communicate the runway condition to all stakeholders.

[4] Cf. https://www.sesarju.eu/sites/default/files/9.14-D000_Final_Project_Report_ALERTS_00.01.00.pdf.

1.2 Project Scope and Objectives

This Horizon 2020 Project is an industrial research project which takes place in the scope of the Wave 1 of the SESAR 2020 Programme. This wave 1 is part of the SESAR development phase expected to develop and validate the new generation of ATM technological systems, components and operational procedures in support of the implementation of the Single European Sky.

The main objective of the project is to improve the level of safety at airports of different operational complexity and size (small, medium and large), by providing advanced safety support functions to the Pilot, Controller, or Airport Operator.

In SESAR 1, three SESAR Solutions were delivered with a V3 maturity level and two additional SESAR Solutions were started to be developed. This project built on these outputs from SESAR 1 in view of defining and validating the four SESAR Solutions addressed by SAFE for meeting the project objective.

1.2.1 Organisation

The project activities were carried out as project tasks, milestones and deliverables under six work packages (WPs) initially:

- WP1 (Project Management),
- WP2 (Solution PJ.03b-01),
- WP3 (Solution PJ.03b-03),
- WP4 (Solution PJ.03b-05),
- WP5 (Solution PJ.03b-06) and
- WP6 (Ethics)

They have all started in November 2016 at the beginning of the execution of the Action and are planned to be closed at the end of December 2019 as for the project action.

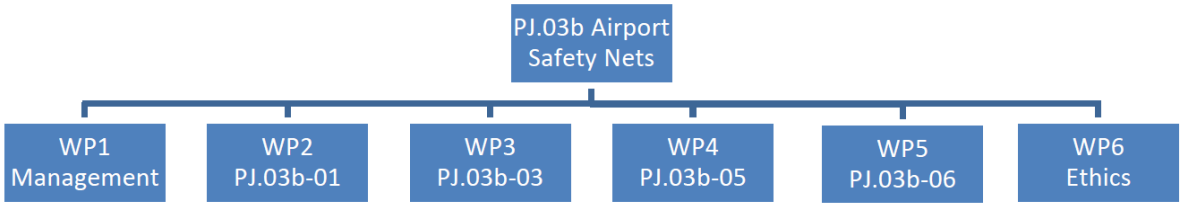


Figure 1: PJ.03b Work Break Down Structure

1.2.2 Solution PJ.03b-01 "Enhanced Airport Safety Nets for Controllers"

Safety is aviation's top priority. To ensure even safer airports, this solution sets out to mitigate the risks of runway incursion, and more generally the risk of incidents and accidents involving aircraft at the airport. Different, innovative types of controller alerts are being developed for the airport environment, targeting those equipped with Advanced Surface Movement Guidance and Control Systems (A-SMGCS) as well as those without A-SMGCS.

New generation automation tools at A-SMGCS airports offer improved Conflicting ATC Clearances (CATC) and Conformance Monitoring (CMAC) Alerting functions for Controllers, extended to cover the entire airport, some are already under deployment across Europe. Going beyond these, where there

is no alerting capability, for example at secondary airports where the operational and technical environment does not justify their implementation, the solution takes account of new surveillance capabilities, such as video-based surveillance and ADS-B, to trigger controller alerts for conflicting situations and incursions on the runways, taxiways and apron areas.

Further alerts can be displayed when weather hazard situations occur in any airport environment, and can detect, calculate, and provide time-critical weather related alerts to tower controllers in reference to ATC clearances and the current weather. These indications serve to maximise situational awareness and to highlight areas where higher attention is needed. The solution also addresses the challenges of integrating different safety nets - and controller alerts - including those delivered in earlier SESAR Solutions.

The SESAR Solution PJ.03b-01 consists of the following three new sub-services[5] available to the **Tower Controllers**:

1. **Extended Airport Safety Nets for Controllers at A-SMGCS Airports – AO-0104-B -** Airport safety is improved at airports with an Advanced-Surface Movement Guidance and Control System (A-SMGCS) thanks to detection of potential and actual conflicting situations, incursions and non-conformance to procedures or ATC clearances, involving mobiles (and stationary traffic) on runways, taxiways and in the apron/stand/gate area as well as unauthorized / unidentified traffic. Appropriate predictive indications and alerts are provided to the Controllers. The Conflicting ATC Clearances (CATC) and Conformance Monitoring Alerts for Controllers (CMAC) alerting functions defined in the scope of the SESAR 1 Solution #02 are updated and extended to cover the entire airport surface. These types of alerts are provided in addition to the CMAC/CATC (SESAR Solution #02), which are deployed on top of the Runway Monitoring and Conflict Alerting (RMCA) function, together with the Routing & Planning service (SESAR Solution #22).
2. **Airport Safety Nets for Controllers at Secondary Airports – AO-0108 -** Airport Safety is improved at Secondary Airports thanks to detection of potential and actual conflicting situations and incursions, involving mobiles and stationary traffic on runways, taxiways in the apron/stand/gate areas at the secondary (small/medium) airports, adjusted to the available infrastructure (alternative ground surveillance e.g. video camera, ADS-B only, etc.) and operational environment. Appropriate alerts are provided to the Controllers. It provides a subset of the alerts defined for the Runway Monitoring and Conflict Alerting (RMCA) function and for the SESAR Solution #02, taking account of the alternative surveillance capabilities available at these airports.
3. **Enhanced Airport Safety thanks to Time Critical Weather Alerts – AO-0109 -** Airport operational safety is improved thanks to an enhanced weather alerting system supporting the tower controllers with respect to better situational awareness, workload anticipation and air situation overview. Thanks to an integration of weather and flight plan data leading to critical weather alerts, appropriate indications will be displayed to the tower controllers, offering suggestions for probable areas of higher attention need. This improvement is targeting all

[5] During the project a fourth Operational Improvement has been studied, AO-0110, that covers Airport Safety Enhanced by Prediction and by Detection of Adverse Traffic Patterns based on Ground Surveillance as in Amsterdam-Schiphol airport configuration, but this OI did not reach the desired maturity level.

types of airports but was validated for the small/medium airports only. It provides Time Critical Weather alerts to the tower controllers, taking account of local real-time weather information.

The **objective** of this solution is to develop enhanced controller tools to **boost airport safety**.

The **benefits** of Solution PJ.03b-01 are expected in **safety** and in **human performance** for Tower Controllers (improved situational awareness and reduced workload) because these improvements are expected:

- To further reduce the number of airport surface incidents at the main airports with A-SMGCS,
- To reduce the severity of runway incursions and the number of airport surface incidents at the secondary airports with Alternative Surveillance, and
- To reduce the number of weather related incidents at airports.

This objective led to deliver at the end of Wave 1 a Solution pack including a validation report, validated specification in a V2 maturity level and a CBA.

1.2.3 Solution PJ.03b-03 "Conformance monitoring safety net for Pilots"

Failure to comply with ATC instructions while operating on the airport surface can lead to unintended runway incursions or incidents on taxiways or apron areas. Building on research undertaken in SESAR 1, the Conformance Monitoring Alerts for Pilots (CMAP) provides visual and audio alerts when the on-board systems detect a non-conformance to ATC clearances/instructions or procedures or a non-compliance to the airport configuration. The alerts are generated by an autonomous aircraft capability on the basis of discrepancies detected between the aircraft position and the Airport Mapping Database (AMDB), and between the aircraft position and clearance instructions issued by air traffic control. The main benefits are realised when the aircraft operates in low visibility conditions and/or the aircraft is operating at an airport where the ATC is not equipped with equivalent alerting systems.

The SESAR Solution PJ.03b-03 **"Conformance Monitoring Alerts for Pilots"** (CMAP) provides three services available for the Pilots:

1. **Detection of Non Conformance to ATC instructions and/or procedures**: the solution provides conformance monitoring safety alerts for the flight crew, when the system detects a non-compliance with the ATC instructions and/or procedures. For example when an aircraft deviates from its cleared route.
2. **Detection of Non Compliance to airport specificities, its associated environment**: the solution provides conformance monitoring safety alerts for the flight crew, when the system detects a non-compliance with airport configuration. For example closed runway, non-compliant taxiway, and restricted area (when an aircraft is cleared to roll on an airport area that is forbidden due to its size or there is an incompatibility between taxiway or runway and aircraft type)
3. **Providing alerts (Visual + Aural) to the crew in the primary field of view**: the solution provides conformance monitoring safety alerts for the flight crew (visual + aural), generated by the on-board system when the system detects a non-compliance with airport configuration as well as a non-conformance to ATC procedures or clearances. The main benefit of the Solution is when the aircraft operates in low visibility conditions.

Even if the main benefits of the Solution are intended for flight crews operating at large and/or complex airports with which they may not be familiar, all airports are potentially concerned whether they are equipped with ground services (RMCA, A-SMGCS) or not.

As part of the PJ.03b overall objective to assess the interoperability amongst the existing systems and the various airport safety nets under development within the project, the operational interoperability between CMAP and ground safety nets (e.g. CMAC, solution PJ.03b-01) was investigated with external stakeholders.

The on-board airport safety net developed in this Solution is applicable on the whole airport movement area.

The **objective** of this solution is to develop tailored **pilot alerts to reduce the risk of runway incursion** and **ATC violation.**

The **benefits** of this SESAR Solution are expected in **Safety** and **Human Performance** through the on-board availability of an independent detection system that informs the flight crew through an alerting presentation in the Flight Crew's primary field of view (improved with respect to SESAR 1):

- The Flight Crew get an alert when the aircraft is operating at an airport where the ATC is not equipped with such alerting systems;
- Reaction time to any potential risk can be shorter if the flight crew receives an alert as well as the ATCO.

The **objective** of the PJ.03b-03 Solution was to validate at V2 maturity level an on-board safety net concept which aims to alert the Flight Crew when the aircraft, taxiing on the airport surface, deviates from ATC instructions or procedures or in case of non-compliance between the aircraft state and the airport configuration, potentially placing the aircraft at risk.

This objective led to deliver at the end of Wave 1 a Solution pack including a validation report, validated specification in a V2 maturity level and a CBA.

1.2.4 Solution PJ.03b-05 "Traffic alerts for pilots for airport operations"

Traditionally, pilots rely on their line of sight and instructions from air traffic control to avoid collisions at airports. The solution "traffic alerts for pilots for airport operations" – a software-based system – provides a very last warning to pilots in case of imminent collision on runways or taxiways.

Specifically, the system analyses aircraft position data and calculates factors, such as time to collision, through specialised algorithms to alert pilots of approaching aircraft. In the case of business aircraft, the system provides surface traffic indications and timely warnings to the flight crew. These include visual awareness on the airport moving map display as well as an audio alarm.

The solution is designed to require minimal changes to existing avionics and makes use of ADS-B, a globally mandated technology upgrade due by 2020, to make the installation of the solution quick and simple. The solution is applicable to commercial aircraft and business aircraft with varying degrees of functionality. Its success depends on the performance and quality reception of broadcast ADS-B aircraft data and compliance with the relevant standards.

The SESAR Solution PJ.03b-05 covers two validated implementations:

1. **The mainline aircraft** implementation addresses runway operations and provides the Flight Crew with aural and text alerts on Primary Flight Display (PFD) ('warning' alert level).
2. **The business aircraft** implementation addresses runway and taxiway operations and provides the Flight Crew with visual and aural alerts (indication, caution and warning alert levels).

The **objective** of this solution is to develop pilot alerts that help to avoid collisions at airports, **enhancing on-board systems in order to detect potential and actual risks of collision** with other traffic during runway and taxiway operations. In all cases, the flight crew is provided with appropriate alerts.

The **benefits** of this SESAR Solution are expected in term of **Safety** on the airport surface.

The **objective** was to achieve a V3 maturity level at the end of Wave 1, starting at V2 maturity level based on SESAR 1 validation results (project 09.14).

This objective led to deliver at the end of Wave 1 a Solution pack including a validation report, validated specification in a V3 maturity level[6] and a CBA.

1.2.5 Solution PJ.03b-06 "Safety support tools for avoiding runway excursions"

This solution aims to improve the assessment of runway surface contamination and global awareness in order to help preventing runway excursions during take-off and landing. Providing the flight crew with information related to the runway contamination status and braking efficiency will help them make the right decisions in the preparation and execution of take-off, approach and landing.

The solution also proposes to use the landing aircraft as a sensor to automatically provide additional information to airport operations, which can be used for runway surface condition assessment by airport ground systems. The flight crew of a landed aircraft can also communicate to air traffic control the braking action through a pilot air report (PIREP) spontaneously or upon request from ATC. Runway surface conditions can be disseminated to other stakeholders, such as through the airport operations centre and airline flight operations centre to enhance their situational awareness.

In addition, an on-board Runway Overrun Awareness and Alerting System (ROAAS) can alert the flight crew when a risk of runway overrun is detected during final approach or landing , advising them on going-around if still possible or on the braking configuration to adopt.

The **objective** of this solution is to provide Airport Operators and Pilots with the appropriate alerts to current surface conditions where there is a risk of runway excursion at take-off and landing and to focus on how the risk of runway excursion can be mitigated by:

[6] The formal Maturity Gate confirming that V3 maturity has effectively been reached by the Solution has not taken place at the time of writing of this document. Therefore, the claimed V3 maturity level remains to be confirmed.

1. On-board systems (ROAAS, On-board Braking Action Computation System to compute and report Braking Action after landing, Take-Off Monitoring System), and
2. Ground based systems (ground sensors to identify the runway contaminant type and depth, weather observations and forecasts, surveillance radar data input data to consolidate runway surface condition for all stakeholders)

The Solution is based on the Global Reporting Format implementation (ICAO Amendment 13 to Annex 14) which uses Runway Condition Code (RWYCC) for flight crews to make the right decisions in the preparation and execution of take-off, approach, and landing phases.

The **benefits** of this SESAR Solution are primarily expected in term of **Safety;** but also of **Resilience** of airport operations in adverse weather conditions.

This objective led to deliver at the end of Wave 1 a Solution pack including a validation report, validated specification in a V2 maturity level and a CBA.

1.3 Work Performed

1.3.1 WP2 - Solution PJ.03b-01 "Enhanced Airport Safety Nets for Controllers"

Work Package 2 was led by DSNA with the contribution of twelve (12) PJ.03b beneficiaries, namely: ANS CR, DFS, DLR, ENAV, EUROCONTROL, FREQUENTIS, INDRA, LEONARDO, LPS SR, NLR, PANSA, and THALES AIR SYSTEMS.

1.3.1.1 Solution scope definition

The work actually started in November 2016, with the review of SESAR 1 Solution #02 upon which the Solution PJ.03b-01 is based. Initially, the WP2 partners refined the high level Solution description and clarified its content as being made of a set of **four** Operational Improvements (OIs), each of them supported by enablers:

- **AO-0104-B**: Extended Airport Safety Nets for Controllers at A-SMGCS Airports;
- **AO-0108**: Airport safety nets for controllers at secondary airports;
- **AO-0109**: Enhanced airport safety thanks to time critical weather alerts and
- AO-0110**:** Airport safety enhanced by prediction and by detection of adverse traffic patterns based on surveillance
  It is important to note that, during the project, the Operational Improvement **AO-0110**, **has not reached the desired V2 maturity level** and therefore has been taken out of the final scope of SESAR Solution PJ.03b-01.

OI	OI description	Enablers (Dataset 19)	Enabler description
AO-0104-B	Extended Airport Safety Nets for Controllers at A-SMGCS Airports	AERODROME-ATC-06b	A-SMGCS incorporating the function that detects Conflicting ATC Clearances (CATC) on the entire airport surface
		AERODROME-ATC-07b	A-SMGCS incorporating the function that provides an advanced set of Conformance Monitoring Alerts for Controllers (CMAC) on the movement area
		AERODROME-ATC-61b (Optional)	Advanced surface guidance management services to process the automatic triggering of airport ground signs and lighting according to the route issued by ATC
AO-0108	Airport Safety Nets for Controllers at Secondary Airports	AERODROME-ATC-03a	Runway monitoring and conflict alerting (RMCA) system based on alternative aerodrome surveillance
		AERODROME-ATC-06a	Alternative aerodrome surveillance incorporating the function that detects Conflicting ATC Clearances (CATC) for runway operations

OI	OI description	Enablers (Dataset 19)	Enabler description
.....		AERODROME-ATC-07a	Alternative aerodrome surveillance incorporating the function that provides Conformance Monitoring Alerts for Controllers (CMAC) on the movement area
		AERODROME-ATC-50	Advanced Airport Tower Controller Working Position (A-CWP)
		AERODROME-ATC-12 (Optional)	Provision of automatically generated taxi routes for aircraft and vehicles
AO-0109	Enhanced Airport Safety thanks to Time Critical Weather Alerts	AERODROME-ATC-89	Controller working position equipped with tools providing time critical weather alerts
AO-0110	Airport Safety Enhanced by Prediction and by Detection of Adverse Traffic Patterns based on Surveillance	AERODROME-ATC-23a	Enhanced A-SMGCS Core Surveillance function for new A-SMGCS Services
		AERODROME-ATC-90	ATC Tower System equipped with Taxiway Conflict Detection
		AERODROME-ATC-91	ATC Tower System equipped with Traffic Density Estimation

Table 1: PJ.03b-01 OI description and enablers

1.3.1.2 Validation activities definition

During the first year of Project's execution (2017), the WP2 partners have developed **interim V2 Specifications** (operational, safety and technical) encompassing the four (4) identified OIs, to be covered by the V2 validation activities. An interim Cost-Benefit Analysis report was also initiated. In addition a V2 Validation Plan (V2 VALP) was prepared for the **four (4) identified OIs** including the definition of common validation objectives and success criteria for a total of **seven (7) validation exercises**.

These seven Real Time Simulations (RTS) were confirmed for 2018, with the aim to deliver a PJ.03b-01 Solution at a validated V2 maturity level in the scope of SESAR Release 9. In parallel, the partners involved in the V2 validation activities started the development of prototypes for their validation exercises.

The table below recaps the validation exercises with their **initial planned dates**.

EXE ID	Maturity Level	Involved partners	Airport environment	Validation activities Platform location	Date
EXE.03b-01.01	V2	DSNA	LFMN airport (Nice, France)	Toulouse, France	24/09 – 15/10/2018
EXE.03b-01.02	V2	EUROCONTROL ANS CR (B4) INDRA	LKPR airport (Prague, Czech Republic)	EUROCONTROL Experimental Centre (EEC)	01 –26/10/2018

EXE ID	Maturity Level	Involved partners	Airport environment	Validation activities Platform location	Date
		DLR (AT-ONE)		Brétigny, France	
EXE.03b-01.03	V2	DFS DLR (AT-ONE)	EDDL airport (Düsseldorf, Germany)	DFS premises, Langen, Germany	17 –28/09/2018
EXE.03b-01.04	V2	LPS SR (B4)* FQR (FSP)	LZIB airport (Bratislava, Slovakia)	LZIB airport, Bratislava, Slovakia	07/05 – 01/06/2018
EXE.03b-01.05	V2	PANSA (B4) Thales Air Systems	EPGD airport (Gdańsk, Poland)	EPGD airport, Gdańsk, Poland	01 to 28/06/2018
EXE.03b-01.06	V2	LEONARDO	LBSF airport (Sofia, Bulgaria)	LBSF airport, Sofia, Bulgaria	03 to 14/09/2018
EXE.03b-01.07	V2	NLR (AT-ONE)	EHAM airport (Amsterdam, Netherlands)	NLR Amsterdam	25/06 to 06/07/2018

Table 2: PJ.03b-01 Validation Exercises (initial dates)

1.3.1.3 Validation activities implementation

During the second year of Project's execution, (2018), the WP2 partners focused on the preparation and execution the V2 validation activities that were performed and finished for all exercises (development of prototypes with submission of Availability Notes and validation activities) except for PANSA RTS Exercise 5, which was postponed to early 2019.

Figure 2: PJ03.01 Validation activities (view of the DSNA 'TANGO' Tower Simulator)

In parallel, the WP2 partners updated the Project's documentation and started EATMA and SE-DMF modelling of the Solution into MEGA (EATMA diagrams NOV-2 (Node), NOV-5 (Activity) as well as NSV-4 (Function).

After finalisation of the V2 validation activities planned for the solution, the modelling activities into MEGA and SE-DMF have been finalised. It has been the opportunity to refine the solution EATMA

model by rationalizing the OI's descriptions and the list of supporting enablers. **Several change requests were engaged which results are available in DS19 of EATMA.**

1.3.1.4 Solution assessment and deliverables

As already mentioned, an interim **Maturity Assessment** ended with the rejection of the OI AO-0110 for which validation results clearly demonstrated that V2 Maturity was not reached. In agreement with NLR (AT-ONE), the concerned partner, with the other Solution partners and with the SJU, it was decided to remove AO-0110 from the final scope of solution PJ.03b-01. It is worth noting the information related to this OI has been kept in annexes of the Project's documents.

The final Solution's documentation was released in 2019, as follows:

- A consolidated **V2 Validation Report**,
- A **V2 Cost-Benefit Analysis** which, based on the benefit impact mechanisms described in the OSED, provides the cost estimates, an initial quantitative assessment of the safety benefits and a qualitative description of the human performance benefits (situational awareness and workload).
- The final **V2 OSED** that contains the operational, safety, performance and interoperability requirements of the SESAR Solution PJ.03b-01. It includes a Safety Assessment Report, a note on Security aspects, a Human Performance Assessment Report and a Performance Assessment Report;
- The final **V2 TS/IRS** which contains the technical requirements of the Solution, including the interface requirements.
- The **V3 validation roadmap** that describes how stakeholder's needs are intended to be validated for the solution PJ.03b-01 to reach maturity V3 at the end of the next R&D activities.

The **V2 Contextual Note** has been finalised in coordination with Project management so that it can be used as communication material and support for further coordination with the SJU.

During the Project, the Solution has also provided a continued contribution to the "Standardization Support" task with the participation to EUROCAE WG-41, which produces the MASPS ED-87D, embedding the alerts defined in the SESAR Solution #02 (AO-0104-A), which is itself a predecessor of AO-0104-B.

1.3.2 WP3 - Solution PJ.03b-03 "Conformance monitoring safety net for Pilots"

Work Package 3 was led by LEONARDO with the contribution of THALES AVIONICS.

1.3.2.1 Solution scope definition

The first topic addressed by the Partners was to clarify and agree on the Solution scope. The operational concept apportioned to the Solution was also stabilized according to the Solution scope.

At the completion of the work, the EATMA Operational Improvement assigned to the Solution was:

- AUO-0614 "Conformance monitoring Safety Nets for Pilots", described as:

The System detects non-compliance with airport configuration (e.g. closed runway, non-compliant taxiway, restricted area or taxiways limited to a/c types) as well as non-conformance to ATC clearances. Whatever the case, the Flight Crew is provided with the appropriate alert generated by the on-board system.

The rationale behind is that a full on-board airport safety net will improve safety in runway and taxiway operations, mostly at airports where no safety net is provided to controllers, when the aircraft is not equipped with datalink or in case of failure occurred to the data-link.

Also the technical enablers associated to Solution were analysed to stabilize the correct links to the OI and their role in the Solution development.

The overall ATM architecture was aligned to the Solution scope, incorporating in the EATMA the following updates:

- PJ.03b-03 Solution refined description
- OI AUO-0614 "Conformance monitoring safety nets for pilots" refined description
- Update of the links of AUO-0614 to Enablers

At the project conclusion, the EATMA reference release is DS19.

The outcome of this work is reflected within the PJ.03b-03 V2 SPR-INTEROP/OSED Part I and in the V2 TS/IRS.

1.3.2.2 Concept and functional development

The Partners worked on the detailed definition of the PJ.03b-03 operational concept identifying the characteristics of the operational environment, the actors involved, their roles and responsibilities, the previous operating method and the new operating method, introduced exploiting the Solution.

The operating situations which the aircraft encounters moving on the airport surface were analysed to identify the ones which would benefit of an on-board alert to the Flight Crew. This analysis led to the definition of the use cases to be considered for proving the concept. The relevant functional diagrams which illustrate the considered use cases were included in the ATM architecture, EATMA DS19.

The relevant operational, safety and interoperability requirements for the development of the Solution were also identified.

The operational concept developed by the Solution and the relevant operational requirements are described in the V2 SPR-INTEROP/OSED Part I.

As a next step the Partners worked on the functional development of the Solution.

The functional architecture of the Solution was developed finding the actors and the technical systems involved and identifying the set of functionalities provided by the systems, split in different Functional Blocks. The Functions needed to implement the capability were also identified. All these elements allowed to build the functional architecture, sketching the relevant diagrams, which were included in the ATM architecture, EATMA DS19. The diagrams illustrate how the human and the technical resources cooperatively interact in the airport operating environment to achieve the targeted capability and how the systems interact at the infrastructure level.

The technical system requirements, which guided the development and implementation of the conformance monitoring alerting function, were derived from the operational requirements defined in the V2 SPR-INTEROP/OSED.

The outcome of the described work is reflected within the PJ.03b-03 V2 Technical Specification (TS/IRS).

The Solution participated to the Global Airport Safety Net Forum organised by DSNA in Toulouse in 2018 with the objective to present the Solution content to representative Stakeholders - airport operators, air traffic controllers and airspace users – and to analyse the interoperability and the consistency of the on-board alerts with the corresponding ATCO alerts. The suggestions received for the future improvement of the Solution are summarised in the PJ.03b-03 V2 Validation Report (VALR).

1.3.2.3 Verification and Validation activities

The Solution performed the following two validation activities:

- EXE.03b-03.01 V2 Business aircraft trials – executed on the 13th of November 2018.
- EXE.03b-03.02 V2 Regional aircraft trials – executed on 22nd of November 2018.

The two validation exercises were Real Time Simulations executed on different simulation platforms, but using the same prototype.

The EXE.03b-03.01 “V2 Business aircraft trials” were executed on the Thales Avionics “The Link” flight simulator (below on the left), whilst the EXE.03b-03.02 “V2 Regional aircraft trials” were executed on the LEONARDO General Regional Aircraft (GRA) flight simulator (below on the right).
The simulators were configured for executing the use cases defined for the concept validation.

The conformance monitoring alerts for pilots were developed on a prototype which was based on a Thales Avionics product.

The verification and integration activities for the preparation of the validation exercise were performed on each validation platform integrating the developed prototype.

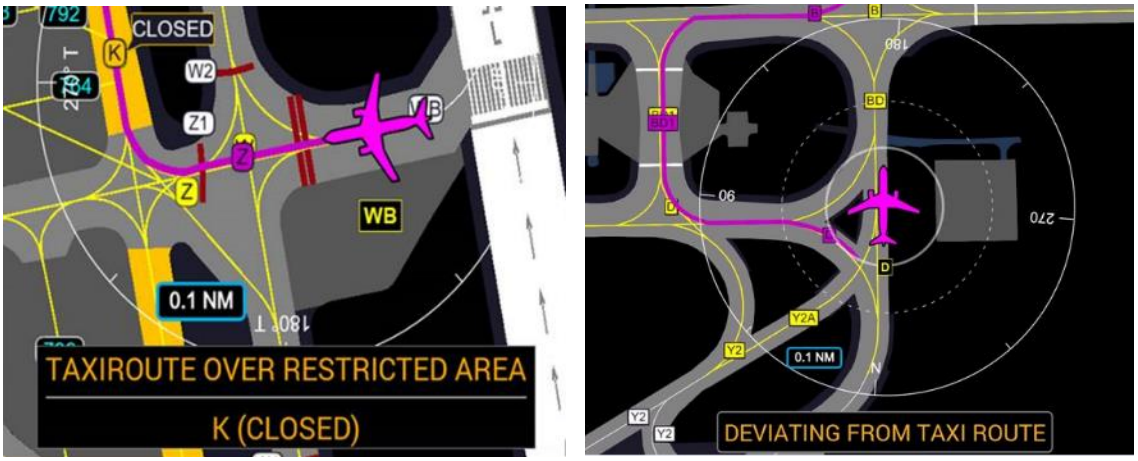


Figure 3: Verification and integration activities – Screen display

The table here below recaps the characteristics of the validation exercises of the Solution.

EXE ID	EXE Type (RTS, Flight test, Shadow mode, Workshop)	Involved partners (leader in bold)	Airport environment	Validation activities	
				Period	Platform location
EXE.03b-03.01	RTS (Business trials)	**THALES AVIONICS**	LFBO (Blagnac airport/Toulouse/ France)	13/11/18	Thales Avionics Premises, Toulouse
EXE.03b-03.02	RTS (Regional trials)	**LEONARDO**	LIMC (Malpensa airport/Milan/Italy)	22/11/18	Leonardo premises, Turin

Table 3: PJ.03b-03 Validation Exercises

The description of the validation platforms, of the prototype and the summary of the performed verification, integration and preparatory activities are reported in the V2 Availability Note for Business aircraft and in the V2 Availability Note for Regional aircraft.

The detailed outcome of the validation activities is reported in the PJ.03b-03 V2 Validation Report (VALR).

1.3.2.4 Solution assessment and deliverables

The results of the assessment of the V2 validation exercise conducted within the PJ.03b-03 Solution were evaluated and reported in the relevant deliverables.

The detailed results of the V2 validation exercises are reported in the V2 VALR. The results obtained in each test run were collected through questionnaires and debriefing from Pilots, which conducted the exercises, and from HMI experts, witnessing the validation exercises. The Partners analysed the collected results and reported in the VALR document each finding associated to the relevant validation objective defined during the phase of validation planning. A list of recommendations and suggestions for further improvement of the conformance monitoring alerts for pilot function were derived from the exercise results and presented in the document.

The results of the assessment are reported in the V2 SPR-INTEROP/OSED Part I, as far as the validated operational, safety and interoperability requirements are concerned. The Partners also ensured that the EATMA architecture reflects the Solution. The relevant operational diagrams which illustrate the considered use cases are included in the document.

The Safety Assessment Results are reported in the V2 SPR-INTEROP/OSED Part II (SAR). The document reports the system safety assessment process conducted to demonstrate that the proposed high-level system architecture design can deliver the required functionality and performance at the required level of integrity. The document ensures that the identified Safety Requirements are complete, correct and realistic.

The Human Performance Assessment Results are reported in the V2 SPR-INTEROP/OSED Part IV (HPAR). This document reports the results of the HP assessment. Results are associated to the HP

arguments which are expressed through the Solution validation objectives. Moreover, the document reports the recommendations and the suggestions arisen during the preparation and the execution of the validation exercises and also collected through questionnaires and debriefings just after the execution of the exercises.

The Performance Assessment Results are reported in the V2 SPR-INTEROP/OSED Part V (PAR). The document assesses the Key Performance Areas apportioned to the Solution as resulting from the V2 validation exercises executed within the Solution. Also the assumptions and mechanisms how the validation exercises results have been consolidated to achieve the performance assessment results are presented.

About the security issues, V2 SPR-INTEROP/OSED Part III was prepared as a note on security aspects, based on the analysis conducted within the Project on the security context within EU and SESAR.

The functional assessment results are reported in the V2 TS/IRS as far as the validated requirements are concerned. The Partners also ensured that the EATMA architecture reflects the Solution. The relevant functional diagrams which illustrate how the human and the technical resources interact in the airport operating environment when exploiting the Solution.

A cost benefit analysis of the Solution was also performed by the Partners, providing the costs associated with implementation of the Solution on Regional and Business aircrafts and a qualitative assessment of the benefits provided by the Solution deployment. The benefits deriving from the exploitation of the Solution affect the Safety and Human Performance Key Performance Areas. The results of this assessment are reported in the V2 CBA.

1.3.3 WP4 - Solution PJ.03b-05 "Traffic alerts for pilots for airport operations"

Work Package 4 is led by AIRBUS with the contribution of the following PJ.03b beneficiaries: HONEYWELL, DASSAULT AVIATION and EUROCONTROL.

1.3.3.1 Solution scope definition

WP4 has started the work by reviewing the outcome of former project 09.14 (Airport Surface Alerts) conducted in SESAR 1. Meanwhile, the members refined the high level Solution description and clarified its content as being a set of two Operational Improvements (OIs)

- AUO-0605: “Traffic Alerts for Pilots during Runway Operations”
- AUO-0615: “Traffic Alerts for Pilots during Taxiway Operations”

The technical enablers supporting the above operational improvements were also refined and agreed over the course of the project, in order to stabilize the correct links to the OI and their role in the Solution development. The overall ATM architecture was aligned to the Solution scope and is currently reflected in Data Set 19 of the EATMA.

At Solution level, the outcome of this definition work is reflected in the PJ.03b-05 V3 SPR-INTEROP/OSED Part I and in the V3 TS/IRS (respectively D4.1.191 and D4.1.201 in Table 8 below).

1.3.3.2 Validation activities

The sketch below represents the validation path refined for the Solution function, starting from the existing SESAR 1 inputs and allowing to demonstrate a V3 maturity level (according to the E-OCVM methodology):

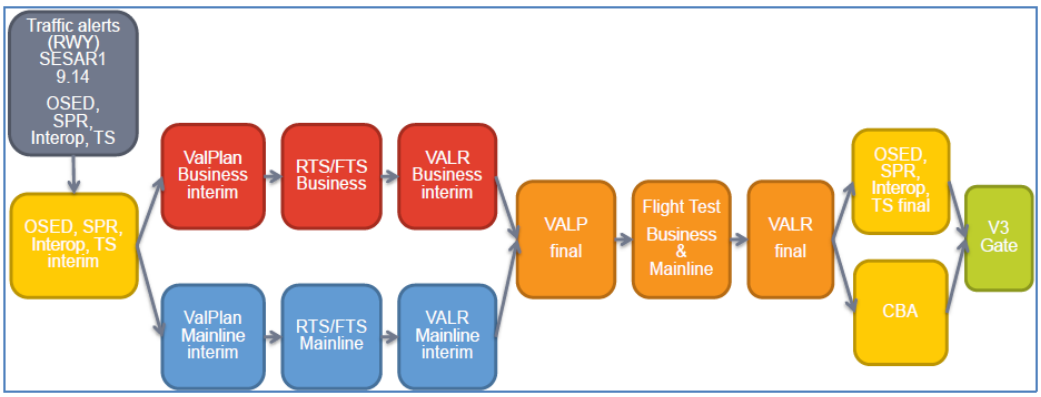


Figure 4: PJ.03b-05 validation path

Validation exercises

The following exercises were conducted along the validation path as depicted in Figure 4:

- EXE01: a fast-time simulation performed by Honeywell in order to demonstrate the performance of the SURF-A/IA functions, in particular w.r.t nuisance rate objectives. These simulations have been consolidated with the analysis of large amount of ADS-B data collected in PJ28-WP3 (see below).
- EXE02 (focused on business aircraft) and EXE03 (focused on mainline aircraft): Real Time Simulations (RTS) that demonstrated the validity of the concept developed, particularly in terms of Human Factor evaluation. To do so, dedicated scenarios (approach, take-off, RWY incursion, crossing runways…) in good and low visibility have been performed.

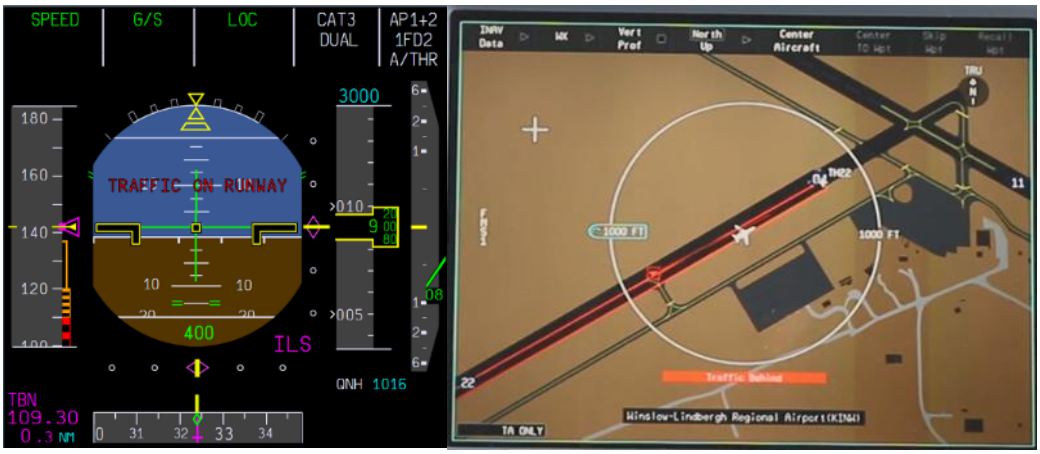


Figure 5: SURF-A/IA HMI in A320 / business jet cockpits

- EXE04: flight tests involving an Airbus A320NEO (equipped with SURF-A) and a Falcon from Honeywell (equipped with SURF-ITA). 10 ground and air scenarios were realized on 13th of June 2019 and the alerts worked perfectly in both aircraft. These flight tests required intensive preparation through simulator sessions in AIRBUS (mainline aircraft architecture), in Brno (business aircraft architecture) and through development flight testing in Phoenix's region (not formally identified as a SESAR validation exercise). The Phoenix flight test campaign also allowed to validate the taxiway alerts, as documented in the V3 Validation Report (D4.1.181 below).

Figure 6: PJ.03b-05 EXE04 flight test – Ground conflicting scenario & aircraft involved

The above RTS and flight tests were enabled by a SURF-A/ITA prototype developed iteratively by Honeywell. A first prototype was delivered in early November 2017 and system & functional integration tests were subsequently conducted in Airbus premises. In 2018, a second prototype was developed by Honeywell to address the issues identified through these tests and was delivered early 2019. This second prototype was the baseline for the common flight test mid-2019.

As part of a dissemination effort around the above validation exercises, AIRBORNE SURVEILLANCE Open Days were organised jointly in November 2018 by solutions PJ.01-07, PJ.03b-05 and PJ.11-A3 in Airbus premises. These Open Days involved presentations of the scope and benefits of the Solutions, workshops with ATM actors attending the event, including airlines and suppliers, and demonstrations on simulators.

ADS-B performance assessment

As ADS-B IN capability is a key enabler for the Solution, it was also essential to further investigate the availability and quality of this data in the airport environment. In SESAR1, ADS-B data was collected on two SWISSAIR aircraft (Apr/Sept 2016). 32 airports were visited and 228 ownship flights were recorded, after deletion of non-eligible quality data. In 2017, Honeywell replayed with the SURF-A/ITA function simulator for two purposes:

- Assess whether the ADS-B has the appropriate quality to achieve an on-board traffic runway and taxiway safety net
- Stress the function to real data & possibly improve the algorithm.

In addition, a much larger ADS-B data collection campaign was conducted within PJ.28-WP3 (Demo on-board traffic alerting) to support an ADS-B performance assessment (cf. 1.4.3), and which has been a key input for validating the performance of the functions. At the end of collection campaign, more than 2000 ownship operations on 100 different airports and 17 million ADS-B messages have been collected.

It has already permitted an increase in the robustness of SURF-A/ITA to particular environments. For instance, the algorithm has been improved to take into account specific geometries or operations:

- Nearly crossing runways (e.g. LSZH airport)
- Stop-bars not placed according to ICAO-Annex 14 requirements
- Curved trajectories in approach
- Conditional clearances “Landing-behind procedures”
- Land and Hold Short Operations (LAHSO)

Thanks to these improvements, not a single nuisance alert was generated out of ~2000 operations recorded in SESAR2020-Wave1-VLD-PJ28. WP4 organised a workshop in May 2019 to assess the ADS-B performance evidence through the data and to define eligibility criteria for SURF-A/ITA applications.

1.3.4 WP5 - Solution PJ.03b-06 "Safety support tools for avoiding runway excursions"

WP5 is led by DSNA with the contribution of the following PJ.03b beneficiaries: ADP (SEAC 2020), AIRBUS, DASSAULT, LPS-SR (B4) and PANSA (B4).

1.3.4.1 Solution scope and validation activities definition

WP5 has started the work in November 2016 by reviewing the regulatory framework in link with the Solution scope. WP5 partners then refined their plan for the validation exercises. Thus, 4 validation exercises were confirmed for 2018 with the goal to deliver a PJ.03b-06 Solution with a V2 maturity level and in the frame of the SESAR Release 9.

The figure below depicts the WP5 validation path.

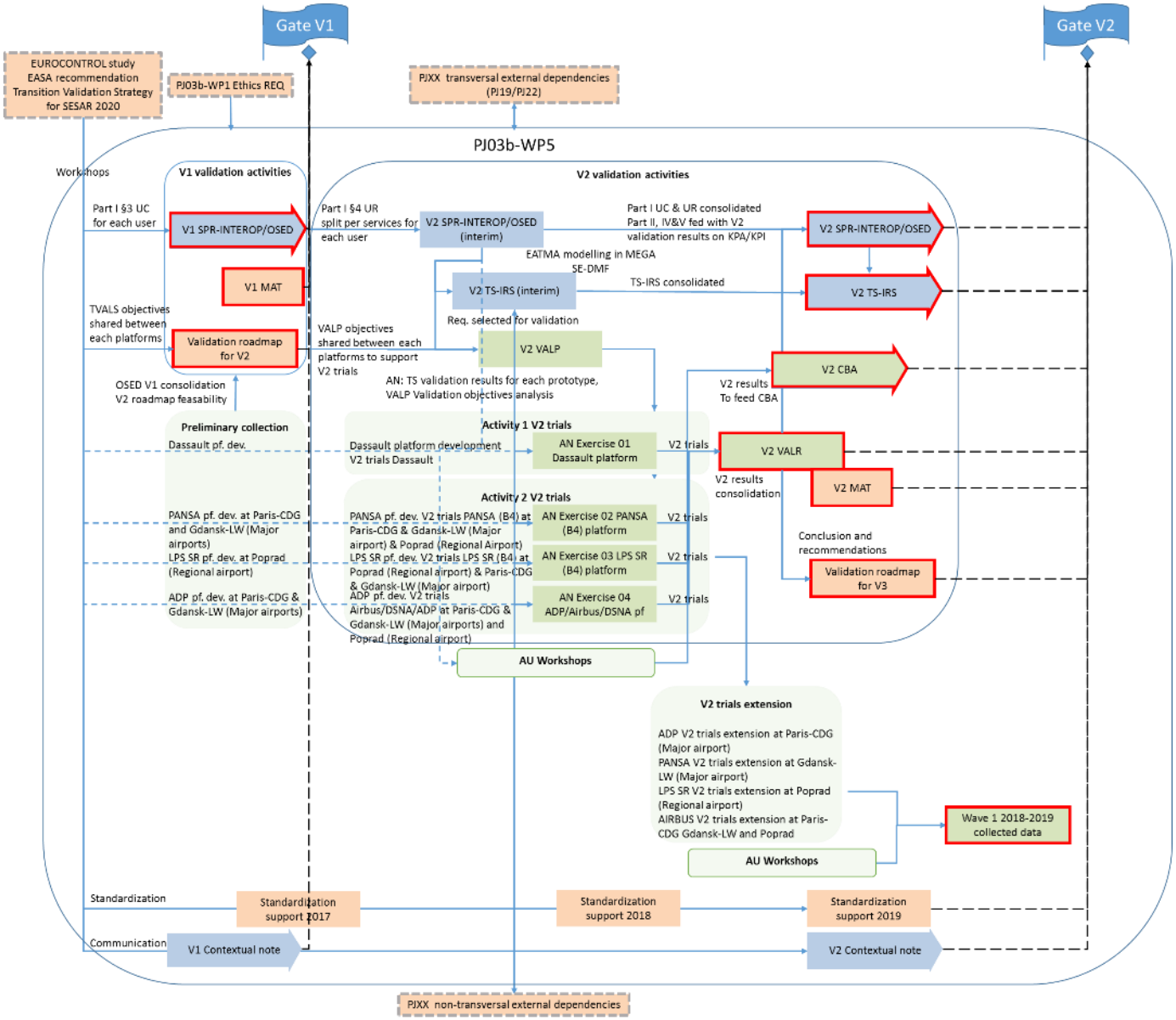


Figure 7: PJ.03b-06 Validation Path

V1 Maturity Gate took place on 25th September 2017, based on D5.1.030 V1 MAT, D5.1.010 SPR-INTEROP/OSED for V1 - Part I and D5.1.020 V2 Roadmap. The main risk identified during this Gate on the Solution was about the variety of the meteorological situations. The decision was made that each Fast Time Simulation (FTS) exercise would share its collected data with the two other ones.

Another outcome of the Gate was the identification of a need for workshops, mainly to involve Airspace Users in the Solution. V2 validation activities refinement during the V2 VALP development confirmed the need to organize a transversal forum with the participation of all the stakeholders of the Solution PJ.03b-06, so considered as a fifth exercise.

The table here below recaps the confirmed validation exercises.

EXE ID	Maturity Level	Involved partners	Airport environment	Validation activities Platform location	Date
EXE-03b.06-V2-VALP-0001	V2	DASSAULT	N/A	Dassault V2 trials Dassault flight test	05/11/2018
EXE-03b.06-V2-VALP-0002	V2	PANSA (B4), ADP (SEAC 2020), LPS-SR (B4), AIRBUS	Gdańsk-LW, Poland Paris-CDG, France Poprad-Tatry, Slovakia	PANSA V2 trials Gdańsk-LW, Warsaw	17/05/2018 28/09/2018
EXE-03b.06-V2-VALP-0003	V2	LPS-SR (B4), ADP (SEAC 2020), PANSA (B4), AIRBUS		LPS SR V2 trials Poprad-Tatry	12/02/2018 31/03/2018
EXE-03b.06-V2-VALP-0004	V2	ADP (SEAC 2020), LPS-SR (B4), PANSA (B4), AIRBUS		ADP V2 trials Paris-CDG	11/01/2018 30/04/2018
WKS-03b.06-V2-VALP-0001	V2	DSNA, ADP (SEAC 2020), DASSAULT, LPS-SR (B4), PANSA (B4)	N/A	Workshop Toulouse	04/04/2018 05/04/2018

Table 4: PJ.03b-06 Validation Exercises

1.3.4.2 Validation activities implementation

Data collection in Paris started in December 2017. Ground sensor installation took delay in Poprad (delay caused by getting all necessary permissions for installation from the Civil Aviation Authority) and data collection in Gdansk needed prior agreement with Gdansk airport. So data collection in Poprad and Gdansk did not start as initially expected in 2017. Non-Disclosure Agreement for collected data sharing (EXE-03b.06-V2-VALP-0002, EXE-03b.06-V2-VALP-0003 and EXE-03b.06-V2-VALP-0004) to mitigate the risk not to meet enough variety in meteorological situations) was signed end of June 2018.

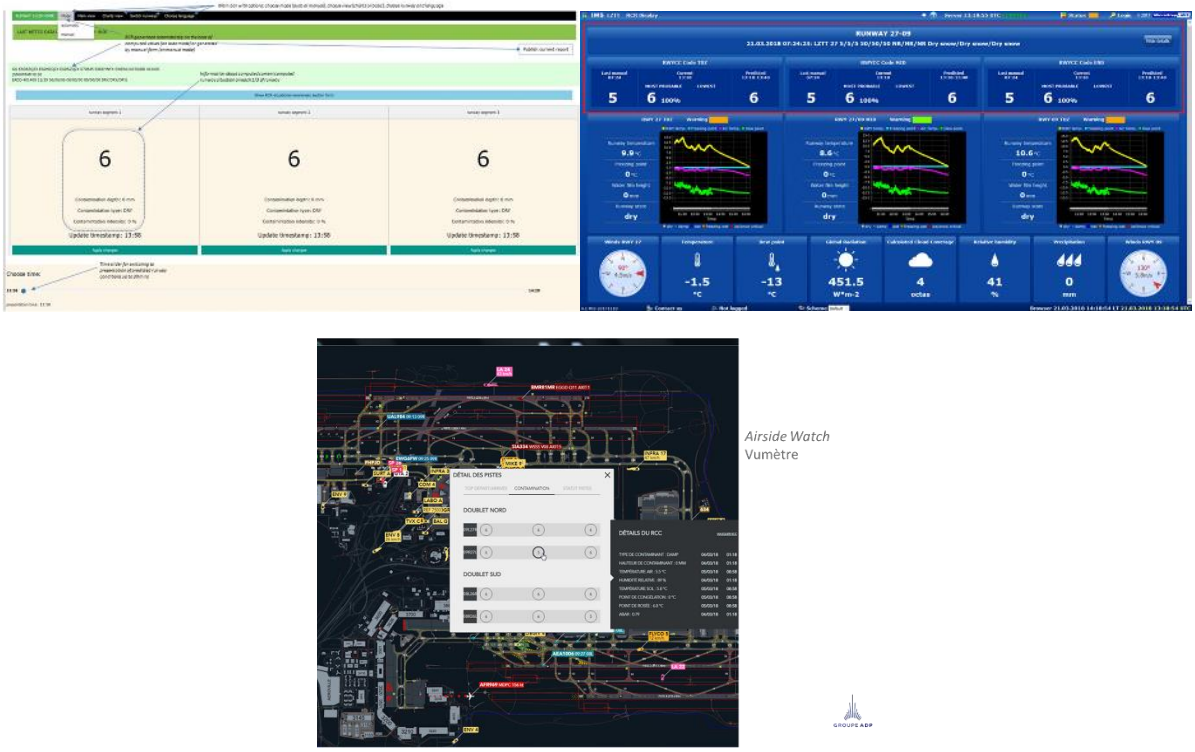


Figure 8: PJ.03b-06 – PANSA, LPS SR and ADP prototypes

Flight trials were used to validate ROAAS adaptation to business aircraft.

All V2 trials of the Solution were executed during 2018, as well as the PJ.03b Forum which was used to collect many of the results regarding human aspects of the Solution.

A trial extension campaign has also been decided in 2018, to enrich collected data with other weather situations. This extension was initially thought to last until the end of winter 2018/2019, but ended on the 31/12/2018, the limit date mentioned in the current agreement used by Solution beneficiaries to share the collected data. These data will be used in next development phase of the Solution.

The Solution participated to the Global Airport Safety Net (GASN) Forum organised by DSNA in Toulouse on the 4th and 5th of April (its fifth exercise above). For PJ.03b-06 the aim of the Forum was to present and validate the Solution with all its stakeholders: airport operators, air traffic controllers and airspace users.

MEGA tool was used to model the Solution in EATMA:

- At Operational Layer: NOV-2 (Node) and NOV-5 (Activity) diagrams, used in V2 SPR-INTEROP/OSED
- At Technical Layer: NSV-1/NSV-2 and NSV-5 (functions) diagrams, used in V2 TS-IRS

Operational and technical requirements, platforms and exercises, validation objectives and their traceability were documented in SE-DMF tool.

1.3.4.3 Solution deliverables

PJ.03b-06 V1 Solution Pack (D5.1.030, D5.1.010 and D5.1.020) was handed over to SJU to pass V1 Maturity Gate on 25th September 2017.

Following the V1 maturity gate, all V2 documents were first developed in interim version, to support exercises preparation and execution; and updated using validation results (D5.2.090, D5.2.091, D5.2.092, D5.2.093, D5.2.094, and D5.2.100). Following exercises and conclusion and recommendations from validation results, a costs benefits analysis D5.2.110 which focused on ROAAS and RCAMS was developed and a V3 Roadmap D5.2.120 was drafted for further activities.

1.4 Key Project Results

1.4.1 Solution PJ.03b-01 "Enhanced Airport Safety Nets for Controllers"

The main findings from the validation exercises are reported in the **PJ.03b-01 V2 Validation Report**. They can be summarised as follows:

1.4.1.1 Solution scope

The concept of the enhanced safety nets and associated enablers within the Solution PJ.03b-01 is established at a generic level. Nevertheless, the modelling and simulations were performed in different operational contexts to demonstrate its fitness for purpose across various European environments.

1.4.1.2 Solution key results

The conclusions on the performance, operability, technical feasibility and acceptability of the concept have been established based on the results obtained through **real-time simulations and workshops**. These validation activities showed that the studied concepts are fully interoperable. Namely, different safety nets (Runway Status Lights, Alerts for Vehicle Drivers, and Conformance Monitoring alerts for Pilots) can be used together with Conflicting ATC clearances alerts, Conformance Monitoring Alerts for Controllers and Time Critical Weather Alerts, on main or secondary airports. The aim is to improve overall safety by providing more barriers to the corresponding Reason's model, each of the new improvements being independent of the others from a safety benefit point of view, provided that alerts are fine-tuned and used only by the actor they target.

Considered aircraft were without distinction any aircraft (e.g. fixed wing aeroplanes, rotorcraft or Remotely Piloted Aircraft Systems (RPAS)), with the restriction of the applicability of specific functions to individual type of aircraft (e.g. Rotorcraft do not perform Push-back).

Regarding the three new sub-services covered by the solution PJ.03b-01 findings are as follows:

- **AO-0104-B "Extended Airport Safety Nets for Controllers at A-SMGCS Airports"**

  All the alerts validated in the frame of this OI proved to be ready to move to V3 phase, namely CATC Ground and Runway alerts, RMCA and CMAC vs Clearance alerts and new CMAC alerts (No Taxi supported by Follow the Greens and Stand Occupied). However, locally agreed parameters and settings are required to take the most benefits of the latter, so as to secure its acceptability by the controllers, given the responsibility of stand allocation.

  These alerts are built on top of RMCA and SESAR Solution #2 alerts, embedding algorithms improvements so as to minimize the occurrence of nuisance alerts and improve the usability of CATC predictive indicator. They can be easily integrated as an addition to existing systems knowing that in some cases, due to the complexity of the operational environment and airport layout, more extensive work will be required in order to tune and integrate them.

  Validation results indicate that all tested alerts provide better situational awareness and give automated support to controllers in order to avoid hazardous situations, and do not lead to a workload increase.

- **AO-0108 "Airport Safety Nets for Controllers at Secondary Airports"**

All the alerts validated in the frame of this OI proved to be ready to move to V3 phase, namely RMCA, CMAC and CATC alerts. Alternative surveillance means have proven to efficiently support those sets of alerts, and thus increase Safety and Situational Awareness at airports not equipped with A-SMGCS, the principal differences being operational/performance parameters and limitations of the surveillance system as input, which affect capabilities of Safety Nets as output. However, it was demonstrated that a combination of ADS-B receivers, EHF radar network, video cameras and AIS data input provides well-suited surveillance environment for the generation of RMCA, CATC and CMAC alerts.

These alerts are considered useful and help decreasing the number of conflicting situations. Moreover, they help controllers maintain overall traffic picture, especially during foggy weather conditions with reduced visibility, and they generally positively affect their workload.

- **AO-0109 "Enhanced Airport Safety thanks to Time Critical Weather Alerts"**

  Automated Runway Lighting Operations (reminding the controllers to check the RWY lighting during subtle weather changes) and SIGMET on SID alerts have successfully passed the V2 maturity level, whereas De-icing Check and Wind Component on Final Approach alerts have not been considered as useful, given the share of responsibility between Flight Crew and Controllers.

  Time critical weather alerts should be seen as indications meant to improve the controllers' situational awareness, as they are not meant as a change in responsibilities between controller and pilot.

  Besides the operational and technical design of the Solution, the Solution built a V2 Cost Benefit Analysis in considering a potential ECAC-level deployment of the Solution. The key benefits are safety-related and an initial approach to monetise the benefits of avoiding hazardous situations has been developed and applied. The CBA results do not accurately reflect the quality of the Solution but rather, the limitations on the data available for the CBA; due to this, the confidence in these overall CBA results is low. It reports a Solution Net Present Value (NPV) of -100 M€. The benefits are expected to be much higher once the full set of Airspace User and Airport Operator benefits have been monetised, especially once aircraft damage is included.

1.4.1.3 Solution maturity

The maturity of the Solution was self-assessed using the maturity assessment tool provided by the SJU. The assessment criteria covered the following threads: operational, performance, program, standards and regulations, system, transversal and validation. The overall results obtained from the assessment of the Solution tend to confirm the achievement of the V2 maturity level. An illustration of the assessment per thread is illustrated in the appendix B.1.

1.4.2 Solution PJ.03b-03 "Conformance monitoring safety net for Pilots"

1.4.2.1 Solution scope

Solution PJ.03b-03 is a continuation of SESAR 1 activities, but, following the gained experience and, in particular, the outcome of the Stakeholder evaluations conducted in SESAR 1, some pillars changed in

the approach to conformance monitoring alerting for pilots. The scope of this Solution was to validate alerts autonomously generated by the on-board system during airport operations, with no data link required for the communication with the Tower. Clearances/instructions were provided by ATC via voice.

Non-conformances with airport configuration were managed based on the airport information available by the ANSP (airport database). Dynamic aspects, even if not time critical, were intended to be managed via voice (out of PJ.03b-03 scope). The Solution relied on static airport information in the cockpit systems (airport map) complemented by dynamic information (e.g. sudden closure of a taxiway or a runway) provided via voice (clearances). No further integration between the ground and the cockpit was addressed.

1.4.2.2 Solution key results

The most relevant achievements of the Solution were obtained through Real Time Simulations (RTS) covering two sub-operating environments: large and medium airport.

Different type of alerts were validated related to the non-conformances to ATC clearances and non-compliances to airport configuration. The areas affected by the validation were the Safety and the Human Performance.

Both RTS exercises were executed by Pilots with the participation of HP experts. Feedbacks from participants were collected through questionnaires and de-briefings.

The validation activities showed that the Pilots definitely provided a positive evaluation in terms of Situational Awareness improvement in any visibility conditions, but the improvement was judged particularly significant when the taxi operation is conducted in low visibility conditions.

The alerts presentation, the function usability and utility and the Flight Crew workload was also positively evaluated. In particular, the overall Flight Crew workload, which includes several parameters, like mental and physical demand, performance, time pressure, was considered reduced when the alerting function is available on an aircraft operating in low visibility conditions compared to the one evaluated when the aircraft is not equipped with the alerting function.

The validated alerts proved to be ready to move to next maturity phase. The alerting function can be integrated on existing aircrafts as long as they are equipped with the airport moving map. The function integration remains strictly dependent on the different avionics configurations.

Another relevant achievement for the Solution was the analysis of the aspects of interoperability / consistency of on-board and ATCO alerts, which were discussed with the relevant Stakeholders in the Global Airport Safety Net Concept Forum in 2018. During the Forum several suggestions were presented for the future improvement of the Solution, as consistency of on-board airport databases and actual infrastructure status, dynamic updates of the on-board airport databases, provision of ATC clearances to the avionics in a timely and consistent manner to prevent ground/on-board inconsistencies.

1.4.2.3 Solution maturity

The maturity of the Solution was self-assessed using the maturity assessment tool provided by the SJU. The assessment criteria covered the following threads: operational, performance, program, standards and regulations, system, transversal and validation. The overall results obtained from the assessment

of the Solution tend to confirm the achievement of the V2 maturity level. An illustration of the assessment per thread is illustrated in the appendix B.1.

1.4.3 Solution PJ.03b-05 "Traffic alerts for pilots for airport operations"

1.4.3.1 Solution Scope

One of the main initial activity of Solution PJ.03b-05 consisted in the clarification of its scope. Actually, since the early developments in 2010 in SESAR 1, the exact scope of the surface alert function differed depending on:

- Presence of airport moving map (AMM) or not
- Presence of cockpit display traffic information (CDTI) or not
- Presence of caution/advisory level before warning or not
- The alert messages, directional or not

Also, existing standards (RTCA DO-323) already defined safety, performance and interoperability requirements for indications and alerts on the airport surface (SURF IA). Therefore, this initial scoping task had to take into account the work already performed outside of SESAR. This activity led to refine the different possible implementations of the function, depending on the presence of the aforementioned features.

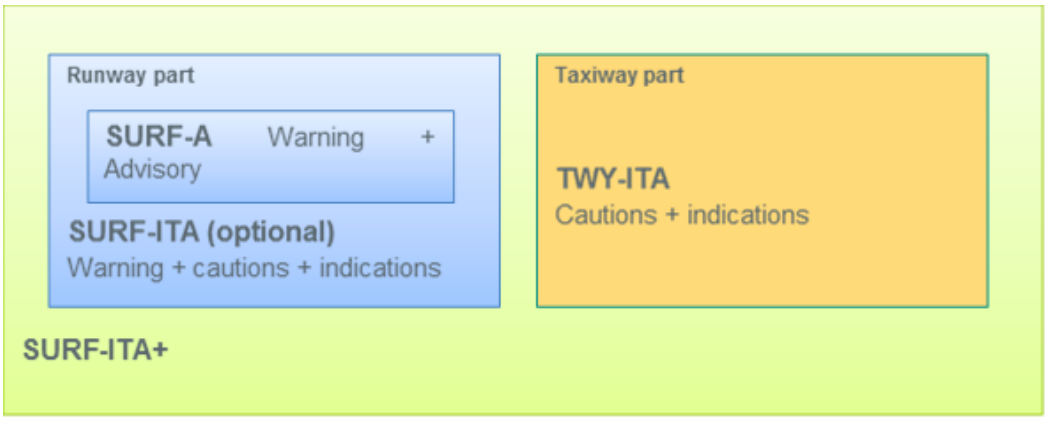


Figure 9: Definition of main implementations of Solution PJ.03b-05

- SURF-A: Surface Traffic Alerts on runways for pilots without traffic display and Warning alerts only.
- SURF-ITA7: Surface Traffic Alerts & Indication on runways for pilots with optional display, Caution and Warning alerts.
- TWY-ITA: Surface Traffic Indication & Alerts on taxiways for pilots (Caution alerts only with traffic display).

[7] SURF-ITA wording is used in SESAR PJ.03b-05 to distinguish the European version of the application from SURF IA defined in RTCA DO-323.

- SURF-ITA+: Surface Traffic Indication & Alerts on runways and taxiways for pilots including both applications SURF-ITA and TWY-ITA.

1.4.3.2 Solution key results

Solution PJ.03b-05 had designed its validation path with the end goal to conduct flight trials with test aircraft in order to demonstrate that it has reached a V3 maturity level and in a way to assess the Solution in increasingly realistic conditions.

- Fast Time Simulation (FTS), complemented by the analysis of ADS-B data collected in PJ.28, allowed consolidating the Solution performance in terms of performance regarding both coverage (missed alerts) and risk of false alerts.
- Several campaigns of Real Time Simulation (RTS) were conducted to assess the operational usability, including human factor aspects, of the Solution and led to a positive feedback from flight crews that it is useable in situations considered during the evaluations. These situations covered a large part of the incidents that are currently observed or reported.
- Finally, flight tests (Honeywell's Phoenix flight test + SESAR flight test EXE04) have allowed to validate the aircraft installation and perform some initial tests in live conditions based on scenarios similar to the ones used for the RTS.

Thanks to this in-depth validation, it can be concluded that SURF-A/ITA is an efficient tool against the risk of collision on runway. Some recommendations were raised to refine some aspects. No showstopper appears that could prevent bringing the improvements associated with the recommendations. Similarly, it is concluded that TWY-ITA is efficient to prevent collision on taxiways, although some tuning of the alert timing is required to allow better pilot's reaction, while keeping a rate of spurious alerts below 3%. It has to be noted that the Solution's performance strongly depends on ADS-B OUT equipment level, which highlights the importance of DO-260B mandates in the different world regions

Lastly, the operational interoperability of the traffic alerts issued by the Solution with existing ATM environment and procedures and other airport safety nets was addressed during a workshop involving ATCOs & pilots held at DSNA premises in November 2017.

1.4.3.3 Solution maturity

The maturity of the Solution was self-assessed using the maturity assessment tool provided by the SJU. The assessment criteria covered the following threads: operational, performance, program, standards and regulations, system, transversal and validation. The overall results obtained from the assessment of the Solution tend to confirm the achievement of the V3 maturity level. An illustration of the assessment per thread is illustrated in the appendix B.1.

1.4.4 Solution PJ.03b-06 "Safety support tools for runway excursions"

1.4.4.1 Solution Scope

The V1 activities and a dedicated workshop in 2017 with Airspace users, pilots and controllers[8] led to confirm the Solution scope in term of OIs and operating environments.

Next V2 development confirmed the Solution scope on mitigating the risk of runway excursion by providing the flight crew with more accurate and harmonised information about the runway condition for them to plan and execute take-off and landing, and by developing systems that detect risks of runway excursions and alert pilots. The Solution should provide the Airport Operator with a range of sensors and information (runway surface sensors to identify the runway contaminant type and depth, airborne sensors (OBACS - see below), AIREP, landing trajectory and deceleration analysis based on surveillance data) that continuously assesses the runway surface condition and computes RWYCCs. By adding other weather parameters like ground and air temperatures and forecast weather data, beyond the calculation of the current RWYCC, a prediction can be made on the evolution of the runway surface condition and RWYCC. This prediction may support the Airport Operator decision making process regarding runway decontamination.

Additionally, the Solution should take benefit of the On-board Braking Action Computation System (OBACS), an airborne system which assesses a computed braking action after each landing when conditions are met (runway friction assessment is possible when anti-skid had to apply limitation on braking).

1.4.4.2 Solution key results

ROAAS adapted to business aircraft

The EUROCAE ED-250 ROAAS MOPS (Runway Overrun Alerting and Awareness System Minimum Operational Performance Specifications) adaptation to business aircraft was confirmed as successful by DASSAULT flight trials. Even if trials were only executed on dry runway, simulation adaptations were able to confirm the good behaviour of the ROAAS algorithm implemented.

Airport operations system to assess runway condition

Three exercises in Paris-CDG, Gdansk-LW and Poprad-Tatry airports concerned the runway condition assessment mainly using runway embedded sensors. Two technologies were used, machine learning and decision tree algorithms in the 3 prototypes developed. All exercises confirmed the system developed was able to avoid most of the runway inspections the Global Reporting Format implementation will need. Machine learning limitations were identified as the “learning” set of records concerning rare weather events was of course limited. So next development phase should combine both algorithms technologies.

Key perspectives

The Solution identified the need for an advanced ROAAS development which would consider any RWYCC value for landing preparation and execution.

[8] Global Airport Safety Net (GASN) Forum organised by DSNA in 2017

No development nor exercises addressed specifically take-off. Next R&D phase should consider the integration of runway condition (RWYCC plus contaminant type and depth) in on-board tools to assess take-off performance.

Surveillance additional inputs increased the performance of the system. Even if not directly validated in the framework of SESAR activities, input of braking action, reported by pilots after landing or computed by the On-board Braking Action Computation System – OBACS, were identified as very promising during the validation activities.

1.4.4.3 Solution maturity

The maturity of the Solution was self-assessed using the maturity assessment tool provided by the SJU. The assessment criteria covered the following threads: operational, performance, program, standards and regulations, system, transversal and validation. The overall results obtained from the assessment of the Solution tend to confirm the achievement of the V2 maturity level. An illustration of the assessment per thread is illustrated in the appendix B.1.

1.5 Technical Deliverables

1.5.1 Project Management

The following Project Management documents were submitted to the SJU as planned in the PJ.03b PMP:

Reference	Title	Delivery Date[9]	Dissemination Level[10]
Description			
D1.1	Project Management Plan	12/12/2017	CO
This document provides the planning of the project: the deliverables to be submitted, the exercises to be performed, the communication activities, the maturity gates… and the associated deadlines.			
D1.3	Quarterly Progress Report 01 Q4 2016	31/01/2017	CO
This document provides a summary of the project activities from the beginning to December 2016.			
D1.4	Quarterly Progress Report 02 Q1 2017	30/04/2017	CO
This document provides a summary of the project activities from January to March 2017.			
D1.5	Quarterly Progress Report 03 Q2 2017	31/07/2017	CO
This document provides a summary of the project activities from April to June 2017.			
D1.6	Quarterly Progress Report 04 Q3 2017	14/12/2017	CO
This document provides a summary of the project activities from July to September 2017.			
D1.7	Quarterly Progress Report 05 Q4 2017	29/01/2018	CO
This document provides a summary of the project activities from October to December 2017.			
D1.8	Quarterly Progress Report 06 Q1 2018	25/04/2018	CO
This document provides a summary of the project activities from January to March 2018.			
D1.9	Quarterly Progress Report 07 Q2 2018	01/08/2018	CO
This document provides a summary of the project activities from April to June 2018.			
D1.10	Quarterly Progress Report 08 Q3 2018	25/10/2018	CO
This document provides a summary of the project activities from July to September 2018.			

[9] Delivery data of latest edition

[10] Public or Confidential

Reference	Title	Delivery Date[9]	Dissemination Level[10]
	Description		
D1.11	Quarterly Progress Report 09 Q4 2018	31/01/2019	CO
This document provides a summary of the project activities from October to December 2018.			
D1.12	Quarterly Progress Report 10 Q1 2019	30/04/2019	CO
This document provides a summary of the project activities from January to March 2019.			
D1.13	Quarterly Progress Report 11 Q2 2019	31/07/2019	CO
This document provides a summary of the project activities from April to June 2019.			
D1.14	Quarterly Progress Report 12 Q3 2019	24/10/2019	CO
This document provides a summary of the project activities from July to September 2019.			
D1.2	Final Project Report (this document)	17/10/2019	PU
This document provides a summary of PJ.03 work and results.			

Table 5: PJ.03b Project Management deliverables

1.5.2 Solution PJ.03b-01 "Enhanced Airport Safety Nets for Controllers"

The following PJ.03b-01 documents were submitted to the SJU as planned in the PJ.03b PMP:

Reference	Title	Delivery Date	Dissemination Level
	Description		
D2.1.010	V2 VALP	20/03/2019	CO
The V2 Validation Plan (VALP) document describes the validation activities planned for solution to achieve V2 level of maturity. It covers the **4** operational improvements initially addressed by the solution, namely: • AO-0104-B: Extended Airport Safety Nets for Controllers at A-SMGCS Airports; • AO-0108: Airport Safety Nets for Controllers at Secondary airports; • AO-0109: Time Critical Weather Alerts for Controllers; • AO-0110: Airport Safety Enhanced by Prediction and by Detection of Adverse Traffic Patterns based on Surveillance. This VALP gives an overview of validation activities planned for the solution and provides detailed information on the plans proposed by the seven (7) validation activities.			
D2.1.020	V2 EXE.03b-01.01 Platform Availability Note	17/01/2019	CO
The document provides the description of the Validation Platform and Prototype implemented by DSNA for their exercise **EXE3B-01.01** to assess the specification related to **AO-0104-B**.			
D2.1.030	V2 EXE.03b-01.02 Platform Availability Note	17/01/2019	CO

Reference	Title	Delivery Date	Dissemination Level
	Description		
The document provides the description of the Validation Platforms and Prototypes implemented by EUROCONTROL, ANS-CR, INDRA and DLR for their exercise **EXE3B-01.02** to assess the specification related to **AO-0104-B**.			
D2.1.040	V2 EXE.03b-01.03 Platform Availability Note	17/01/2019	CO
The document provides the description of the Validation Platforms and Prototypes implemented by DFS for their exercise **EXE3B-01.03** to assess the specification related to **AO-0104-B**.			
D2.1.050	V2 EXE.03b-01.04 Platform Availability Note	17/01/2019	CO
The document provides the description of the Validation Platforms and Prototypes implemented by LPS SR in cooperation with Linked Third Party - R-SYS and Frequentis for their exercise **EXE3B-01.04** to assess the specification related to **AO-0108** and **AO-0109**.			
D2.1.060	V2 EXE.03b-01.05 Platform Availability Note	01/03/2019	CO
The document provides the description of the Validation Platforms and Prototypes implemented by PANSA and THALES for their exercise **EXE3B-01.05** to assess the specification related to **AO-0108**.			
D2.1.070	V2 EXE.03b-01.06 Platform Availability Note	09/11/2018	CO
The document provides the description of the Validation Platforms and Prototypes implemented by LEONARDO with the support of the BULATSA controllers for their exercise **EXE3B-01.06** to assess the specification related to **AO-0104-B**.			
D2.1.080	V2 EXE.03b-01.07 Platform Availability Note	17/01/2019	CO
The document provides the description of the Validation Platforms and Prototypes implemented by NLR (AT-ONE) controllers for their exercise **EXE3B-01.07** to assess the specification related to **AO-0110**.			
D2.1.090	V2 VALR	23/07/2019	PU
The VALR V2 provides the results obtained during the validation activities of the solution PJ.03b-01 Enhanced Safety Nets for Controllers performed to achieve V2 level of maturity.			
D2.1.100	V2 CBA	17/07/2019	PU
The final CBA V2 provides the cost estimates, an initial quantitative assessment of the safety benefits and a qualitative description of the human performance benefits (situational awareness and workload).			
D2.1.110	V3 Roadmap	30/07/2019	PU
The V3 Roadmap describes how stakeholder's needs are intended to be validated for the solution PJ.03b-01 to reach maturity V3 at the end of the next R&D activities.			
D2.1.120	V2 SPR-INTEROP/OSED	23/07/2019	PU

Reference	Title	Delivery Date	Dissemination Level
Description			
The final SPR-INTEROP/OSED V2 contains the operational, safety, performance and interoperability requirements of the SESAR Solution PJ.03b-01. It includes a Safety Assessment Report, a note on Security aspects, a Human Performance Assessment Report and a Performance Assessment Report.			
D2.1.130	V2 TS	16/09/2019	PU
The final TS-IRS V2 contains the technical requirements of the Solution, including the interface requirements.			
D2.1	V2 Data Pack	01/08/2019	PU

Table 6: PJ.03b-01 PMP deliverables

Note: The double numbering for the documents (one for delivery to the SJU (noted D2.2.xx1) for review and second one for the final version (noted D2.2.xx0)) have been included in the GANTT by the SJU once the interim V2 SPR-INTEROP/OSED, SAR, TS and CBA documents were delivered.

1.5.3 Solution PJ.03b-03 "Conformance monitoring safety net for Pilots"

The following table documents the PJ.03b-03 Solution:

Reference	Title	Delivery Date	Dissemination Level
Description			
D3.1.030	V2 VALP	31/01/2019	CO
The V2 Validation Plan (VALP) describes the validation activities planned for the Solution to achieve V2 maturity level. • Part I describes the validation approach: Stakeholder expectations, Solution validation objectives and assumptions, the two planned exercises with specific objectives, scenarios, platforms and techniques for the V2 validation. • Part II describes the safety-assessment process, stating the safety criteria, describing what is covered in each phase of the safety lifecycle and identifying roles and responsibilities. • Part IV describes the first two steps of the Human Performance assessment process: scenarios, assumptions, nature of change, arguments to be validated and HP activities.			
D3.1.040	V2 Availability Note for Business Aircraft	31/01/2019	CO
D3.1.050	V2 Availability Note for Regional Aircraft	31/01/2019	CO
The Availability Notes of the two V2 validation exercises conducted within the Solution describe the V&V infrastructures (prototype and validation platforms) and the verification and integration activities performed in preparation of the validation activities.			

Reference	Title	Delivery Date	Dissemination Level
Description			
D3.1.060	V2 VALR	16/09/2019	PU
The V2 Validation Report (VALR) provides the results of the two validation exercises executed within the Solution. The results are presented with respect to the planned validation objectives. Recommendations and suggestions for further improvement of the conformance monitoring alerts for pilot function are also provided.			
D3.1.100	V2 TS/IRS (Final)	16/09/2019	PU
The V2 Technical Specification (TS/IRS) contains the functional architecture of the Solution and the relevant functional requirements. The document includes the functional diagrams illustrating how the human and the technical resources interact in the airport operating environment. The outcome of the V2 validation exercises conducted in the Solution are also included.			
D3.1.090	V2 SPR-INTEROP/OSED	16/09/2019	PU
V2 SPR-INTEROP/OSED: • Part I describes the operational concept, the new operating method and the relevant operational, safety and interoperability requirements. • Part II is the Safety Assessment Report: presents the assurance that the identified Safety Requirements are complete, correct and realistic. • Part III is a Note on Security Aspects, reporting the security context within EU and SESAR. • Part IV is the Human Performance Assessment Report: describes the HP activities, the assessment results, recommendations and requirements arisen. • Part V is the Performance Assessment Report: assesses the Key Performance Areas apportioned to the Solution as resulting from the V2 validation exercises.			
D3.1.080	V3 Roadmap	20/09/2019	CO
The V3 Roadmap presents a validation planning to guide the achievement of the V3 maturity level. The document provides preliminary information of recommended validation activities, considering the outcome of the validation exercises conducted in the Solution for achieving V2 level. As extension of the activities performed by the Solution in V2, the focus of the document is on Regional and Business aircrafts.			
D3.1.070	V2 CBA	16/09/2019	PU
The V2 Cost Benefit Analysis (CBA) presents the analysis performed for the conformance monitoring alerts for pilots function. The document provides the costs associated with implementation of the Solution on Regional and Business aircrafts and a qualitative assessment of the benefits provided by the Solution deployment. The benefits affect the Safety and Human Performance KPAs.			
D3.1	V2 Data Pack	16/09/2019	PU

Table 7: PJ.03b-03 deliverables

1.5.4 Solution PJ.03b-05 "Traffic alerts for pilots for airport operations"

Accordingly with validation path presented in 1.3.4.1, initial datapack was delivered end of 2017, early 2018, and final datapack was delivered mid-2019.

Reference	Title	Delivery Date	Dissemination Level
Description			
D4.1.150	V3 VALP Business & Mainline	01 Feb 18	CO
The VALP for V3 consisted of the following parts: • Part I (Validation Plan); • Part II (Safety Assessment Plan); • Part IV (Human Performance Assessment Plan). Part I detailed the validation activities planned for Solution PJ.03b-05 to demonstrate that V3 has been reached. The document described these activities in terms of validation objectives (in relationship with validation targets), scenarios and validation exercises. Part II identified all the safety assessment activities that are needed in order to generate the evidence that V3 is achieved from a safety perspective. The outcome of these activities are documented in Parts I and II of the Interim V3 SPR-INTEROP/OSED (see above). Part IV was the counterpart to Part II for Human Performance and described the HP assessment activities planned to feed Parts I and IV of the Interim V3 SPR-INTEROP/OSED (see above).			
D4.1.065	Availability Note Business RTS/FTS	30 Oct 17	CO
D4.1.165	Availability Note Mainline RTS/FTS	16 Oct 17	CO
The Availability Notes of the prototypes and validation platforms supporting the FTS and RTS exercises (EXE01, EXE02 and EXE03) conducted by the Solution describe the verification and validation infrastructures, as well as the verification and integration activities performed in preparation of the validation activities.			
D4.1.180	V3 VALR Business & Mainline	21 Aug 19	CO
The V3 Validation Report aims at describing the results of validation activities performed to demonstrate the V3 maturity of Solution PJ.03b-05 for business and mainline aircraft and covering, both runway and taxiway operations. The validation activities included fast time simulations, real time simulations and flight tests. The trials were performed from end 2017 to June 2019, mainly in Honeywell and Airbus facilities.			
D4.1.190	V3 OSED/SPR/INTEROP	21 Aug 19	PU
The V3 SPR-INTEROP/OSED that was delivered to the SJU consisted of the following parts: • Part I (SPR-INTEROP/OSED); • Part II (Safety Assessment Report); • Part IIIA (Security Assessment Report); • Part IV (Human Performance Assessment Report); • Part V (Performance Assessment Report). Parts I, II and IV updated the corresponding Interim version following validation activities, notably taking account of the validation results reported in the V3 VALR (see above) in the operational service description			

Reference	Title	Delivery Date	Dissemination Level
Description			
and the operational requirements. These versions also included the modelling of Solution PJ.03b-05 performed in the EATMA. Part IIIA provided the outcome of the security assessment resulting from the application of the SESAR Security Risk Assessment Methodology to Solution PJ.03b-05. Part V documented the expected performance benefits in 4 Key Performance Areas (safety, security, human performance, cost efficiency) that could be achieved by deploying Solution PJ.03b-05.			
D4.1.200	V3 TS/IRS	21 Aug 19	PU
The V3 TS/IRS updated the Interim V3 TS/IRS by providing an architectural view of the Solution developed through the modelling performed in the EATMA and by taking account of the validation results documented in the V3 VALR (see above).			
D4.1.210	V3 Performance Assessment and CBA	21 Aug 19	PU
This document provided the Cost Benefit Analysis (CBA) for Solution PJ.03b-05, first defining the objective and the scope of the CBA following the main concepts defined previously in the V3 OSED/SPR/INTEROP and then assessing the costs of implementing the Solution and corresponding benefits.			

Table 8: PJ.03b-05 PMP deliverables

1.5.5 Solution PJ.03b-06 "Safety support tools for avoiding runway excursions"

The following PJ.03b-06 documents were submitted to the SJU as planned in the PJ.03b PMP. In 2017, to deliver a Solution PJ.03b-06 V1 Pack and to progress towards the V2 validations. In 2018, in order to refine the Solution specification and progress towards the V2 validations.

Reference	Title	Delivery Date	Dissemination Level
Description			
D5.1.030	V1 MAT	25/07/2017	CO
The V1 Maturity Assessment Tool was delivered to the SJU as evidence that V1 maturity level had been achieved by Solution PJ.03b-06, with links to the documents demonstrating that the various V1 maturity criteria had been met.			
D5.1.010	SPR-INTEROP/OSED for V1 - Part I	26/07/2017	PU
This document was limited to Part I (SPR-INTEROP/OSED) and consisted in the review of the stakeholders in the Solution, their expectations, and the forthcoming change to their working methods			

Reference	Title	Delivery Date	Dissemination Level
Description			
due to the new operational environment. It prepared the definition of an initial set of operational requirements.			
D5.1.020	V2 Roadmap	26/07/2017	PU
The V2 Roadmap provided the roadmap of validation activities required to reach a V2 maturity level and presented: • High level objectives of the solution and how they are shared between exercises; • High level schedule of activities for each exercise; • Way forward to further maturity level (only outlined).			
D5.2.035	Airbus platform Availability Note	22/05/2018	CO
This document described the status of one of the platforms developed to support the V2 validation exercises conducted by Solution PJ.03b-06 to achieve V2 maturity level, notably tracing the technical requirement from the V TS/IRS (interim) (see above) implemented by this platform.			
D5.2.040	Dassault platform Availability Note	23/07/2018	CO
This document described the status of one of the platforms developed to support the V2 validation exercises conducted by Solution PJ.03b-06 to achieve V2 maturity level, notably tracing the technical requirement from the V TS/IRS (interim) (see above) implemented by this platform.			
D5.2.050	PANSA platform Availability Note	03/10/2018	CO
This document described the status of one of the platforms developed to support the V2 validation exercises conducted by Solution PJ.03b-06 to achieve V2 maturity level, notably tracing the technical requirement from the V TS/IRS (interim) (see above) implemented by this platform.			
D5.2.060	LPS SR platform Availability Note	20/04/2018	CO
This document described the status of one of the platforms developed to support the V2 validation exercises conducted by Solution PJ.03b-06 to achieve V2 maturity level, notably tracing the technical requirement from the V TS/IRS (interim) (see above) implemented by this platform.			
D5.2.070	ADP platform Availability Note	20/04/2018	CO
This document described the status of one of the platforms developed to support the V2 validation exercises conducted by Solution PJ.03b-06 to achieve V2 maturity level, notably tracing the technical requirement from the V TS/IRS (interim) (see above) implemented by this platform.			
D5.2.090	V2 OSED-SPR-INTEROP Part I	21/06/2019	PU
Part I of the V2 OSED-SPR-INTEROP updated the corresponding Interim version following validation activities, notably taking account of the validation results reported in the V2 validation report in the operational service description and the operational requirements. This version also included the modelling of Solution PJ.03b-05 performed in the EATMA.			

Reference	Title	Delivery Date	Dissemination Level
Description			
D5.2.091	V2 OSED-SPR-INTEROP Part II	02/07/2019	PU
This report was an outcome of conducting safety assessment/assurance activities supporting the work within the scope of Solution PJ.03b-06. This document contains the results of the solution level safety assurance up to V2 maturity level (incl. V1 and V2) according to the methodology described in SESAR Safety Reference Material. In line with the maturity of the solution, this document contains both OSED and SPR level safety analyses but not the technical/physical level analysis. The detailed plan and aims of the safety activities were defined in the Safety Assessment Plan.			
D5.2.093	V2 OSED-SPR-INTEROP Part III	19/07/2019	PU
This note reported on the security aspects, based on the PJ.03b analysis of the security context within EU and SESAR.			
D5.2.092	V2 OSED-SPR-INTEROP Part IV	23/05/2019	PU
This document collated the findings on Human Performance activities performed in the project and described in the V2 VALP Part IV Final delivery (see above). The purpose of the HP assessment process was to provide assurance that HP aspects related to Solution PJ.03b-06 technical and operational developments were systematically identified and managed; all the actions necessary to provide adequate confidence that a product, a service or a system is compatible with human capabilities are conducted.			
D5.2.094	V2 OSED-SPR-INTEROP Part V	21/06/2019	PU
This document documented the expected performance benefits in two Key Performance Areas (safety, and Resilience to adverse weather conditions) that could be achieved by deploying Solution PJ.03b-06.			
D5.2.100	V2 TS/IRS		PU
The V2 TS/IRS Final delivery updated the V2 TS/IRS (interim) by providing an architectural view of the Solution developed through the modelling performed in the EATMA and by taking account of the results obtained through the V2 validation activities.			
D5.2.110	V2 CBA	19/07/2019	PU
This document provided the Cost Benefit Analysis (CBA) for Solution PJ.03b-06, first defining the objective and the scope of the CBA following the main concepts defined previously in the V2 OSED-SPR-INTEROP Part I (see above) and then assessing the costs of implementing the Solution and corresponding benefits.			
D5.2.120	V3 Roadmap delivery	03/09/2019	CO
The V3 Roadmap provided the roadmap of validation activities required to reach a V3 maturity level and presented: • High level objectives of the solution and how they are shared between exercises; • High level schedule of activities for each exercise;			

Reference	Title	Delivery Date	Dissemination Level
	Description		
	• Way forward to further maturity level (only outlined).		

Table 9: PJ.03b-06 PMP deliverables

2 Links to SESAR Programme

2.1 Contribution to the ATM Master Plan

Code	Name	Project contribution	Maturity at project start	Maturity at project end
PJ.03b-01	Enhanced Airport Safety Nets for Controllers	Definition and validation of the V2 Operational, performance and technical specification set and alignment of EATMA (Release DS19) with project outcomes. Production of a CBA. Support to the PCP referential regulatory framework by contributing to EUROCAE ED87-D and EUROCONTROL A-SMGCS Specification.	V1	V2
PJ.03b-03	Conformance monitoring safety net for Pilots	Definition and validation of the V2 Operational, performance and technical specification set and alignment of EATMA (Release DS19) with project outcomes. Production of a CBA.	V2 on going	V2
PJ.03b-05	Traffic alerts for pilots for airport operations	Definition and validation of the V3 Operational, performance and technical specification set and alignment of EATMA (Release DS19) with project outcomes. Production of a CBA. Support to the certification process of the solution.	V2	V3
PJ.03b-06	Safety support tools for avoiding runway excursions	Definition and validation of the V1 and V2 Operational, performance and technical specification set and alignment of EATMA (Release DS19) with project outcomes. Production of a CBA.	V0	V2

Code	Name	Project contribution	Maturity at project start	Maturity at project end
		Support to the standardisation of Runway Weather Information Systems (EUROCAE WG-109).		

Table 10: Project Maturity

2.2 Contribution to the Programme

The Project proposed to the SESAR JU a possible way to address the security aspects within the Programme.

In order to further strength the link between the Industrial research and the exploratory research, the project will make proposals at the SESAR Innovation days in December 2019.

2.3 Contribution to Standardisation and regulatory activities

The support of the Solutions to standardization is described in the solutions' standardisation annual reports (see deliverables D2.2.010 D2.2.020 D4.2.010 D4.2.020 D5.3.010 D5.3.020).

2.3.1 Solution PJ.03b-01 "Enhanced Airport Safety Nets for Controllers"

EUROCAE, through its Working Group WG-41 (A-SMGCS) was supported by the Project for the update of the Minimum Aviation System Performance Standards (MASPS) for the A-SMGCS for the coverage of the SESAR Solution #02[11].

Depending on the results of the next R&D validation phase, the WG-41 will need to update the MASPS to also integrate the **"Extended CMAC and CATC"** function. Similarly, the **A-SMGCS Specification Document** will need to be updated by EUROCONTROL to also integrate this sub-function of the SESAR Solution.

2.3.2 Solution PJ.03b-03 "Conformance monitoring safety net for Pilots"

No activity related to the standardization or to the regulatory framework was conducted within the Solution. Analysis of the standardization and the regulatory framework aspects should be dealt with during next maturity phase, when PJ.03b-03 Solution addresses V3 maturity. In this phase, the involvement of EASA should be considered.

[11] EUROCAE ED-87 Rev. D, 01/07/2019

2.3.3 Solution PJ.03b-05 "Traffic alerts for pilots for airport operations"

Solution PJ.03b-05 did not contribute directly to standardization or regulatory activities during SESAR-wave 1.

Roadmap for the SURF-A/IA functions is to go in direct certification in future R&D activities, with both EASA & FAA. According to this roadmap, SURF-A/IA would be installed on revenue aircraft for in-service exposition. This controlled entry into service will feed standardization groups for a future standard (MOPS), after 2022. This approach certification > entry-into-service > standardization is classical for on-board functions.

2.3.4 Solution PJ.03b-06 "Safety support tools for avoiding runway excursions"

Solution PJ.03b-06 contributed in the following ways:

- ICAO
  PJ.03b-06, represented by PANSA (UNIWARSAW) and MICROSTEP-MIS, attended the ICAO GRF Symposium (March 26-28, 2019)

- EASA
  Notice of Proposed Amendment 2018-12 – Reduction of runway excursions has been proposed for review in October 2018.
  Notice of Proposed Amendment 2018-14 – Runway safety RMT.0703 (includes also RMT.0704 'Runway surface condition assessment and reporting) has been proposed for review on 17/12/2018.
  Comments from PJ.03b-06 partners for both NPA have been sent to EASA early 2019.

- EUROCAE WG-109 MASPS12 for Runway Weather Information Systems.
  PJ.03b-06 partners involved in the WG-109 are AIRBUS, ADP, MICROSTEP-MIS and DSNA. 2 meetings occurred in 2018 and 2019.

- SAPOE/ASTM E17.26
  ASTM E17.26, a subgroup of E17 Vehicle – Pavement Systems, conducts a standardization activity to codify industry best practices regarding the creation of an aircraft braking action report. The standard addresses data parameters, techniques, and quality assurance practices so that an applicant may use an aircraft's data to create a report of friction limited wheel braking levels that reference a standard scale.

    - WK63444 Aircraft Braking Performance
    - WK64909 Friction Limited Aircraft Braking Measurements and Reporting

  NAVBLUE (AIRBUS) became ASTM E17.26 member in 2019.

[12] Minimum Aviation System Performance Standard

3 Conclusion and Next Steps

3.1 Conclusions

3.1.1 Solution PJ.03b-01 "Enhanced Airport Safety Nets for Controllers"

The Solution definition was refined in coordination with the SESAR JU to take into account the Project outcomes. A set of operational, performance and technical specifications was defined with the contribution of Air Traffic Controllers and Safety experts.

Then, seven Real Time Simulations, involving ANSPs, research centres, Eurocontrol and industry were completed in 2018 and 2019 to validate the V2 specifications. Moreover, the integration of the Solution within the current and foreseen ATM environment was reviewed with Pilots, Airspace User Representatives, ATCOs and Experts in the scope of a dedicated interoperability workshop. Those activities led to validate the Solution specification in a V2 Maturity level.

The Solution benefits in safety and in human performance have been confirmed for small, medium and large airports.

In addition, besides the development activities, the Partners involved in PJ.03b-01 actively supported the production of the PCP Referential, thanks to the Memorandum of Cooperation between SESAR and EUROCAE. EUROCONTROL A-SMGCS Specification was published in March 2018 and EUROCAE ED-87D in July 2019. Both documents are aligned on SESAR 1 outcomes and themselves are considered by PJ3b-01 as references.

In order to further achieve a V3 maturity level, a set of recommendations is expressed in the PJ.03b-01 Validation Report and in the V3 Validation Roadmap delivered to the SESAR JU. A contextual note recaps the main WP2 findings and recommendations. Among them, those already pointed out for the deployment of SESAR 1 – PCP Solution #02 are confirmed: Ground Safety Nets deployment criteria are to be driven by the local set of selected alerts and the airport specific characteristics (e.g. airport layout complexity, A-SMGCS sensors). A-SMGCS Surveillance performance as well as the Electronic Flight Strip environment and HMI usability must be considered as key enablers.

3.1.2 Solution PJ.03b-03 "Conformance monitoring safety net for Pilots"

The concept has been evaluated for Business and Regional aircrafts in medium and large airports through real time simulations. Moreover, important inputs have been also received from a dedicated Airport Safety Support tools interoperability aspects review with Pilots, AUs, ATCO and Experts (the GASN Forum held in 2018).

During the validation exercises the Flight Crew has expressed a definitely positive opinion on the improvement of their Situational Awareness when the aircraft is equipped with the PJ.03b-03 on-board alerting function. This improvement is particularly significant when the taxi operation is conducted in low visibility conditions, but the function is considered certainly useful also in normal visibility conditions.

Also the assessment of the Safety and the Human Performance aspects was positive. During the validation exercises and at the debriefing the Flight Crew declared a clear improvement in safety. Moreover, the Flight Crew considered the overall workload reduced when using the PJ.03b-03 alerting function in low visibility conditions compared to the overall workload assessed with an aircraft not equipped.

Flight Crew involved in the exercises provided suggestions and recommendations to improve and refine the concept. Where possible, these inputs were considered in the validation activities.

The Solution self-assessment resulted in the achievement of V2 maturity level. The maturity claimed has not been reviewed by the SJU in a maturity assessment process.

The further development of the current function, taking into account the suggestions and recommendations received from the Flight Crew and the interoperability aspects highlighted by the Stakeholders, will require to re-analyse the impacts of the integration of the function on aircraft. Also further investigation and clarification of the interoperability matters between on-board and ground sides, following the introduction of the on-board alerting capability, should be accomplished

3.1.3 Solution PJ.03b-05 "Traffic alerts for pilots for airport operations"

Full V3 was achieved on the Solution PJ.03b-05 both for traffic alerts on runway and for traffic alerts on taxiways).

Two different implementation of the function have been prototyped and tested:

- SURF-ITA (Surface Indication and Traffic Alert) on business jet avionics. This implementation includes the display of surrounding traffic on an airport moving map and provides indications & alerts. As such, SURF-ITA is close from the function SURF-IA as defined in RTCA DO-323.
- SURF-A (Surface Alert) on mainline jet avionics. This implementation is a subset of SURF-IA: it is a pure warning system without traffic display and indications.

Both implementations have demonstrated their benefits and V3 maturity.

For both architecture, validation included real-time simulation, fast-time simulation, real ADS-B IN data analysis (coming from PJ28-WP3) and flight tests. In addition to this purely airborne validation, interoperability workshops were conducted with ATCo to ensure the good integration of such safety net in existing and future airport environment.

Moreover, EASA & FAA issued a mandate requiring that all aircraft with Maximum Take-Off Weight (MTOW) higher than 5700kg need to be equipped with “ADS-B out” in 2020. This will enable every aircraft equipped with SURF-A/IA function to detect ground collision, regardless of the airport size and infrastructure. Nevertheless, it is known that not 100% of aircraft will comply to these mandates early 2020; main commercial aviation bodies (manufacturers, suppliers, ANSPs, IATA…) pay strong attention to the evolution of compliance rate and exchange regularly with EU commission on status and required efforts.

3.1.4 Solution PJ.03b-06 "Safety support tools for avoiding runway excursions"

The Solution achieved V2 maturity level and should reach V3 during next R&D phase.

Regarding ROAAS, function adaptation to business aircraft is confirmed and further development will be conducted by DASSAULT for industrialization and short term deployment of the concept.

Regarding runway condition assessment and use, feasibility and benefits in safety for any kind of airports are confirmed. Initial concepts are defined and even if not validated, automatic braking action and report by landing aircraft (OBACS) has proved to be a promising source to assess runway condition. However, weather situations with RWYCCs lower than 5 were rare and such conditions, or even runway contaminated by heavy rain, still need to be investigated. Different technologies (using big data or decision tree algorithms) successfully addressed the operational concept.

The airport operators confirmed the utility of the computed predicted RWYCC. However, there is no working method defined to communicate this information to other stakeholders and its use by airspace users would still need consolidation.

3.2 Plan for next R&D phases (Next steps)

3.2.1 Solution PJ.03b-01 "Enhanced Airport Safety Nets for Controllers"

The following recommendations stem from the consolidated results of the six V2[13] validation trials completed in the Project.

- **AO-0104-B "Extended Airport Safety Nets for Controllers at A-SMGCS Airports"**
  - It is recommended to improve the HMI usability as a means to input clearances in the ATC System, including prioritisation of clearances and conditional clearances, so as to minimise the rate of nuisance alerts and consequently improve the system's acceptability among the controllers.
  - Triggering and displaying conditions of the Ground CATC alerts should be improved, raising the alert soon enough to be operationally relevant, not too soon so as not to become a nuisance alert, but still early enough for the controller to solve the problem.
  - The Stand Occupied alert should be further refined in V3, so as to clearly define its implications in terms of controller's responsibility and means to solve the alert in all operating environments.

[13] The seventh exercise addressing the AO-0110 failed to validate a V2 maturity level. Consequently, it was removed from the Solution scope and its results were not considered in the PJ.03b-01 Solution pack. In case of further R&D activity on this OI, a V2 Roadmap will be necessary and will have to consider the recommendations expressed in the PJ.03b-01 D2.1.090 VALR. In particular, any further validation activity on AO-0110 will have to consider the PCP targeted environment for major airports, involve a significant number of ATCOs and review any possible interoperability or functional overlap aspects with AO-0224 addressed by PJ.03a-01.

- For V3 validation, conditions should be created as close as possible to real operational environment in order to eliminate side-effects in controllers' behaviour during the trials.
- CATC Ground alerts should be evaluated through live trials to further refine the associated requirements.
- It is also recommended to perform additional activities, e.g. with real airport surveillance data and during a sufficiently long period, in order to verify the assumption made about the airport surveillance performance and the validation of performance requirements.

- **AO-0108 "Airport Safety Nets for Controllers at Secondary Airports"**
  - It is recommended to optimise the alerts so that they appear in timely and safe manner on HMI in order to support human performance and safety.
  - The use of an adequate category of ASTERIX messages should be evaluated for the distribution of issued clearances.
  - Further validation activities should evaluate the required ADS-B performance so as to secure the Airport Safety Nets deployment at secondary airports.
- **AO-0109 "Enhanced Airport Safety thanks to Time Critical Weather Alerts"**
  - It is recommended to improve the presentation of the alerts and the way they can be handled by the controllers.
  - Next validation activities should make sure a sufficient number of controllers participate in order to obtain a better feedback on time critical weather alerts.

3.2.2 Solution PJ.03b-03 "Conformance monitoring safety net for Pilots"

For achieving V3 maturity level, the Solution should take into account the recommendations and the requirements arisen as outcome of the V2 activities in Wave 1.

The following areas would also require further analysis:

Aircraft systems

- Consistency of on-board airport data bases and actual infrastructure
- More dynamic updates taking into account closures/openings of airport areas.

ATC clearances

- ATC clearance delivery to the aircraft to prevent inconsistencies between the aircraft and the ATC views.

Additional alerts

- Aircraft not lined-up on the runway
- Aircraft lined-up on a parallel taxiway, on a high speed exit.

Human Performance aspects

- Analysis of side effects in case of false or nuisance alerts on board.

The Solution should address the Safety and Human Performance Key Performance Area with the main target to increase the Flight Crew Situation Awareness. Interoperability is also expected to be further investigated.

3.2.3 Solution PJ.03b-05 "Traffic alerts for pilots for airport operations"

PJ.03b05 partners are recommending to perform a Very Large Demonstration (VLD), as part of future R&D activities, to bridge between industrial research and deployment. Function will be developed and certified and revenue aircraft will be equipped. The main purpose would be to validate the performance of the function after entry into service (in particular ensure the absence of nuisance alerts).

A TRL7 maturity level would be targeted at the end of this VLD.

3.2.4 Solution PJ.03b-06 "Safety support tools for avoiding runway excursions"

Next activities of Solution PJ.03b-06 should occur to consolidate the Solution at V3 level:

- **RCAMS/OBACS/ROAAS integrated shadow mode exercise**
  RCAMS prototypes already used in SESAR 2020 wave 1, using OBACS inputs to provide runway surface condition (based on RCR, plus forecast or trend), providing airport operation in shadow mode with current and predicted runway condition to help flight crews in their take-off and landing performance assessments.

- **Take-off monitoring system integrating runway surface condition**
  System definition for runway surface condition integration to support flight crew in their take-off performance assessment before departure

- **Controller alert in case of runway excursion risk**
  Wave 1 development delivered no result. Next activities should consolidate display of runway condition to controllers and their alert needs.

- **Workshops**
  Mainly in preparatory phase, workshops will define with end users their performance expectations. After trials, results presentation during workshops will permit a larger audience for validation and conclusions and recommendations on results.

4 References

[1] https://www.skybrary.aero/index.php

[2] https://www.sesarju.eu

[3] https://www.atmmasterplan.eu

[4] https://www.eurocae.net

[5] https://ext.eurocontrol.int

[6] https://www.se-dmf.eu

[7] EUROCONTROL Specification for Advanced-Surface Movement Guidance and Control System (A-SMGCS) Services, EUROCONTROL-SPEC-171 Edition 1.0, date 01/03/2018

[8] Commission Implementing Regulation (EU) No 716/2014 of 27 June 2014 on the establishment of the Pilot Common Project supporting the implementation of the European Air Traffic Management Master Plan

[9] https://cordis.europa.eu

4.1 Project Deliverables

All project public (PU) deliverables are intended to be published on the European Commission CORDIS website [9]. The confidential ones (CO) were delivered to Horizon 2020 and to the SESAR JU. Please refer to the column 'dissemination level' into the tables of the section 1.5.

SESAR 2020, **PMP**, D1.1, V01.00.00, December 2017

SESAR 2020, **FPR**, D1.2, V01.00.00, October 2019

SESAR 2020**, QPR 01** Q4 2016, D1.3, V01.00.00, January 2017

SESAR 2020, **QPR 02** Q1 2017, D1.4, V01.00.00, April 2017

SESAR 2020, **QPR 03** Q2 2017, D1.5, V01.00.00, July 2017

SESAR 2020, **QPR 04** Q3 2017, D1.6, V01.00.00, December 2017

SESAR 2020, **QPR 05** Q4 2017, D1.7, V01.00.00, January 2018

SESAR 2020, **QPR 06** Q1 2018, D1.8, V01.00.00, April 2018

SESAR 2020, **QPR 07** Q2 2018, D1.9, V01.00.00, August 2018

SESAR 2020, **QPR 08** Q3 2018, D1.10, V01.00.00, October 2018

SESAR 2020, **QPR 09** Q4 2018, D1.11, V01.00.00, January 2019

SESAR 2020, **QPR 10** Q1 2019, D1.12, V01.00.00, April 2019

SESAR 2020, **QPR 11** Q2 2019, D1.13, V01.00.00, July 2019

SESAR 2020, **QPR 12** Q3 2019, D1.14, V01.00.00, October 2019

SESAR 2020, PJ.03b-01 **V2 VALP**, D2.1.010, V01.00.00, March 2019

SESAR 2020, PJ.03b-01 **V2 EXE.03b-01.01 Platform Availability Note**, D2.1.020, V01.00.00, January 2019

SESAR 2020, PJ.03b-01 **V2 EXE.03b-01.02 Platform Availability Note**, D2.1.030, V01.00.00, January 2019

SESAR 2020, PJ.03b-01 **V2 EXE.03b-01.03 Platform Availability Note**, D2.1.040, V01.00.00, January 2019

SESAR 2020, PJ.03b-01 **V2 EXE.03b-01.04 Platform Availability Note**, D2.1.050, V01.00.00, January 2019

SESAR 2020, PJ.03b-01 **V2 EXE.03b-01.05 Platform Availability Note**, D2.1.060, V01.00.00, March 2019

SESAR 2020, PJ.03b-01 **V2 EXE.03b-01.06 Platform Availability Note**, D2.1.070, V01.00.00, November 2018

SESAR 2020, PJ.03b-01 **V2 EXE.03b-01.07 Platform Availability Note**, D2.1.080, V01.00.00, January 2019

SESAR 2020, PJ.03b-01 **V2 VALR**, D2.1.090, V01.00.00, July 2019

SESAR 2020, PJ.03b-01 **V2 CBA**, D2.1.100, V01.00.00, July 2019

SESAR 2020, PJ.03b-01 **V3 Roadmap**, D2.1.110, V01.00.00, July 2019

SESAR 2020, PJ.03b-01 **V2 SPR-INTEROP-OSED Part I**, D2.1.120, V01.00.00, July 2019

SESAR 2020, PJ.03b-01 **V2 SPR-INTEROP-OSED Part II – SAR**, D2.1.120, V01.00.00, July 2019

SESAR 2020, PJ.03b-01 **V2 SPR-INTEROP-OSED Part III – Note on Security Aspects**, D2.1.120, V01.00.00, July 2019

SESAR 2020, PJ.03b-01 **V2 SPR-INTEROP-OSED Part IV – HPAR**, D2.1.120, V01.00.00, July 2019

SESAR 2020, PJ.03b-01 **V2 SPR-INTEROP-OSED Part V – PAR**, D2.1.120, V01.00.00, July 2019

SESAR 2020, PJ.03b-01 **V2 TS/IR** delivery, D2.1.130, V01.00.00, September 2019

SESAR 2020, PJ.03b-01 **V2 Data Pack**, D2.1, V01.00.00, August 2019

SESAR 2020, PJ.03b-01 **Support to standardization annual report 2017**, D2.2.010, V01.00.00, December 2017

SESAR 2020, PJ.03b-01 **Support to standardization annual report 2018**, D2.2.020, V01.00.00, January 2019

SESAR 2020, PJ.03b-03 **V2 VALP**, D3.1.030, V01.00.00, January 2019

SESAR 2020, PJ.03b-03 **V2 Availability Note for Business aircraft**, D3.1.040, V01.00.00, January 2019

SESAR 2020, PJ.03b-03 **V2 Availability Note Regional aircraft**, D3.1.050, V01.00.00, January 2019

SESAR 2020, PJ.03b-03 **V2 VALR**, D3.1.060, V01.00.00, September 2019

SESAR 2020, PJ.03b-03 **V2 CBA**, D3.1.070, V01.00.00, September 2019

SESAR 2020, PJ.03b-03 **V3 Roadmap**, D3.1.080, V01.00.00, September 2019

SESAR 2020, PJ.03b-03 **V2 SPR-INTEROP-OSED**, D3.1.090, V01.00.00, September 2019

SESAR 2020, PJ.03b-03 **V2 TS/IRS**, D3.1.100, V01.00.00, September 2019

SESAR 2020, PJ.03b-03 **V2 Data Pack**, D3.1, V01.00.00, September 2019

SESAR 2020, PJ.03b-05 **ADS-B Data Performance Assessment Report**, D4.1.010, V01.00.00, July 2017

SESAR 2020, PJ.03b-05 **V3 Availability Note Business RTS/FTS**, D4.1.065, V01.00.00, May 2018

SESAR 2020, PJ.03b-05 **V3 Availability Note Mainline RTS/FTS**, D4.1.115, V01.00.00, May 2018

SESAR 2020, PJ.03b-05 **V3 VALP Business & Mainline**, D4.1.150, V01.00.00, February 2018

SESAR 2020, PJ.03b-05 **V3 Flight test Availability Note**, D4.1.160, V01.00.00, June 2019

SESAR 2020, PJ.03b-05 **V3 VALR Business & Mainline**, D4.1.180, V01.00.00, August 2019

SESAR 2020, PJ.03b-05 **OSED-SPR-INTEROP Part I**, D4.1.190, V01.00.00, August 2019

SESAR 2020, PJ.03b-05 **OSED-SPR-INTEROP Part II**, D4.1.190, V01.00.00, August 2019

SESAR 2020, PJ.03b-05 **OSED-SPR-INTEROP Part III**, D4.1.190, V01.00.00, August 2019

SESAR 2020, PJ.03b-05 **OSED-SPR-INTEROP Part IV**, D4.1.190, V01.00.00, August 2019

SESAR 2020, PJ.03b-05 **V3 TS/IRS**, D4.1.200, V01.00.00, August 2019

SESAR 2020, PJ.03b-05 **V3 CBA**, D4.1.210, V01.00.00, August 2019

SESAR 2020, PJ.03b-05 **V3 Data Pack**, D4.1, V01.00.00, August 2019

SESAR 2020, PJ.03b-05 **Support to standardization annual report** 2017, D4.2.010, V01.00.00, January 2018

SESAR 2020, PJ.03b-05 **Support to standardization annual report 2018**, D4.2.020, V01.00.00, January 2019

SESAR 2020, PJ.03b-06 **V1 OSED-SPR-INTEROP**, D5.1.010, V01.00.00, November 2017

SESAR 2020, PJ.03b-06 **V2 Roadmap**, D5.1.020, V01.00.00, November 2017

SESAR 2020, PJ.03b-06 **V1 MAT**, D5.1.030, V01.00.00, July 2017

SESAR 2020, PJ.03b-06 **V1 Data Pack**, D5.1, V01.00.00, July 2017

SESAR 2020, PJ.03b-06 **V2 VALP Part I**, D5.2.030, V01.03.00, March 2018

SESAR 2020, PJ.03b-06 **V2 VALP Part IV**, D5.2.031, V01.01.00, March 2018

SESAR 2020, PJ.03b-06 **Airbus platform Availability Note**, D5.2.035, V01.00.00, May 2018

SESAR 2020, PJ.03b-06 **Dassault platform Availability Note**, D5.2.040, V01.00.00, July 2018

SESAR 2020, PJ.03b-06 **PANSA platform Availability Note**, D5.2.050, V01.00.00, October 2018

SESAR 2020, PJ.03b-06 **LPS platform Availability Note**, D5.2.060, V01.00.00, April 2018

SESAR 2020, PJ.03b-06 **ADP platform Availability Note**, D5.2.070, V01.00.00, April 2018

SESAR 2020, PJ.03b-06 **V2 VALP Part I**, D5.2.078, V01.06.00, October 2018

SESAR 2020, PJ.03b-06 **V2 VALP Part II**, D5.2.079, V01.02.00, March 2019

SESAR 2020, PJ.03b-06 **V2 VALR**, D5.2.080, V01.00.00, March 2019

SESAR 2020, PJ.03b-06 **V2 OSED-SPR-INTEROP Part I**, D5.2.090, V01.00.00, October 2019

SESAR 2020, PJ.03b-06 **V2 OSED-SPR-INTEROP Part II**, D5.2.091, V01.00.00, June 2019

SESAR 2020, PJ.03b-06 **V2 OSED-SPR-INTEROP Part IV**, D5.2.092, V01.00.00, May 2019

SESAR 2020, PJ.03b-06 **V2 OSED-SPR-INTEROP Part III**, D5.2.093, V01.00.00, July 2019

SESAR 2020, PJ.03b-06 **V2 OSED-SPR-INTEROP Part V**, D5.2.094, V01.00.00, June 2019

SESAR 2020, PJ.03b-06 **V2 TS/IRS**, D5.2.100, V01.00.00, October 2019

SESAR 2020, PJ.03b-06 **V2 CBA**, D5.2.110, V01.00.00, July 2019

SESAR 2020, PJ.03b-06 **V3 Roadmap**, D5.2.120, V01.00.00, October 2019

SESAR 2020, PJ.03b-06 **V2 Data Pack**, D5.2, V01.00.00, October 2019

SESAR 2020, PJ.03b-06 **Support to standardization annual report 2017**, D5.3.010, V01.00.00, February 2019

SESAR 2020, PJ.03b-06 **Support to standardization annual report 2018**, D5.3.020, V01.00.00, March 2019

SESAR 2020, **POPD-OEI- Requirement No.1**, D6.1, V01.00.00, March 2018

SESAR 2020, **M – Requirement No.2**, D6.2, V01.00.00, March 2018

All the Project Management deliverables identified in the Grant Agreement have been submitted and approved by all PJ.03b Beneficiaries before submission to Horizon 2020.

4.2 Project Communication and Dissemination papers

PJ.03b used social media to communicate on Project main events and progress: https://twitter.com/safe_eu

4.2.1 Project communication events

The following table reports communication and dissemination events where PJ.03b actively participated.

Date	Place	Title	PJ.03b Objectives	Communication material	Audience
11-12/01/2017	Toulouse	DSNA Innovation Open Days	Presentation of PJ.03b SAFE project with its SESAR 1 Baseline (SESAR Solution#01, Solution #02, Solution #04)	PPT presentations + Video	European Commission (EC), ATM Stakeholders, SESAR and non SESAR contributors
6-7/06/2017	Brussels, Eurocontrol HQ	Flight Safety Foundation, EUROCONTROL and the European Regions Airline Association Safety Forum	SJU communication and dissemination objectives with presentation of SESAR Solution #01 and Solution #04	PJ.03b PPT presentations + Video	Airspace Users, ATM Stakeholders, SESAR and non SESAR contributors
30/10/2017	Paris CDG, ADP	CPS 2017 Safety Promotion Committee – "Groupe ADP" and DSNA	SJU communication and dissemination objectives with presentation of SESAR PJ.03b-06 Solution.	PJ.03b PPT presentation	Airline Pilots, Safety Officers, Safety Managers, ATM Stakeholders, SESAR and non SESAR contributors
15-16/11/2017	Toulouse, DSNA	Global Airport Safety Net (GASN) Concept Forum –	SJU communication and dissemination objectives and: - To analyse how various ground-based and airborne alerts for controllers, pilots and drivers can coexist in the same airport environment.	PJ.03b PPT presentations, PJ.03b Booklet COM.060	Airspace Users, ATM Stakeholders, SESAR and non SESAR contributors.

Date	Place	Title	PJ.03b Objectives	Communication material	Audience
		2017[14] (PJ.03b-01) and PJ.03b-05)	- To analyse how the specificities of Remotely Piloted Aircraft Systems (RPAS) and their integration in the airport environment can impact the alerts defined in the scope of the SESAR Programme.		
23/11/2017	Frankfurt, Fraport	ACI EUROPE-SESAR Workshop on improving low-visibility operations at airports	SJU communication and dissemination objectives with presentation of SESAR Solutions #01 and Solution #02 and #04 and overview on PJ.03b Solutions	PJ.03b PPT presentation	Airspace Users, ATM Stakeholders, SESAR and non SESAR contributors
11/01/2018	Paris, DSNA HQ	DSNA SESAR Forum	SJU communication and dissemination objectives with presentation of SESAR Solution PJ.03b-06	PJ.03b PPT presentations COM.080	Airspace Users, ATM Stakeholders, SESAR and non SESAR contributors
07-09/03/2018	Madrid	WAC Madrid – DSNA Stand & SESAR Walking Tour	SJU communication and dissemination objectives with presentation of SESAR Solutions #01, #02, #04,PJ.03b-01, PJ.03b-03, PJ.03b-05, PJ.03b-06	PPT Presentation, Video, leaflet prepared by DSNA COM.090	EC, Airspace Users, ATM Stakeholders, SESAR and non SESAR contributors
04-05/04/2018	Toulouse	GASN Concept Forum 2018[14]	SJU communication and dissemination objectives with assessment of Operational interoperability of Solutions PJ.03b-03 and PJ.03b-06	PJ.03b PPT presentations, leaflet prepared by DSNA COM.070	Airspace Users, ATM Stakeholders, SESAR and non SESAR contributors
11/04/2018	Toulouse	Entretiens de Toulouse 2018	SJU communication and dissemination objectives with presentation of PJ.03b-06	PJ.03b and PJ.03b PPT presentations (AIRBUS, DGAC-STAC) COM.100	Airspace Users, ATM Stakeholders, SESAR and non SESAR contributors.

[14] PCIT organised and prepared GASN forum gathering airlines, IATA, ICAO, pilots, drone pilots and experts.

Date	Place	Title	PJ.03b Objectives	Communication material	Audience
26/04/2018	Paris CDG	ICAS Forum	Communication on PJ.03b scope	PJ.03b and non PJ.03b PPT presentations	Airspace Users, ATM Stakeholders, SESAR and non SESAR contributors
23-24/05/2018	Paris, EUROCAE HQ	EUROCAE Project presentation and focus on PJ.03b-06 – WG-109	Presentation of PJ.03b-06	PJ.03b and PJ.03b-06 PPT presentations	Airspace Users, ATM Stakeholders, SESAR and non SESAR contributors
June 2018	Toulouse	ENAC training	Communication on SESAR 1 A-SMGCS Solutions and PJ.03b scope (especially PJ.03b-01 and PJ.03b-05)	PJ.03b and non PJ.03b PPT presentations	ATM Engineers
27-29/11/2018	Oslo	ACI-EU/ASIA	Communication on PJ.03b scope	PJ.03b presentations by SJU	Airspace Users, ATM Stakeholders, SESAR and non SESAR contributors
12-14/03/2019	Madrid	WAC Madrid – DSNA Stand & SESAR Walking Tour	SJU communication and dissemination objectives with presentation of SESAR Solutions #01, #02, #04,PJ.03b-01, PJ.03b-03, PJ.03b-05, PJ.03b-06	PPT Presentation, Video, leaflet prepared by DSNA COM.230	EC, Airspace Users, ATM Stakeholders, SESAR and non SESAR contributors
25/09/2019	Brussels	European Research and Innovation Days	Communication on SESAR 1 and SESAR 2020: From research to deployment	VIDEO COM.240	EC, Airspace Users, ATM Stakeholders, SESAR and non SESAR contributors, EU Citizens
02-06/12/2019	Athens	9th SESAR Innovation Days	Communication on SESAR 1 and SESAR 2020: From research to deployment	POSTER and Paper COM.250	EC, Airspace Users, ATM Stakeholders, SESAR and non SESAR contributors
03/02/2020	Paris, DGAC	DGAC SESAR Forum	Communication on SESAR R&D and deployment activities	PJ.03b PPT presentation COM.260	DGAC and its stakeholder Representatives
10-12/03/2020	Madrid	WAC 2020	SJU communication and dissemination objectives with presentation of SESAR Solutions #01, #02,	VIDEO Leaflet COM.270	EC, Airspace Users, ATM Stakeholders, SESAR and non

Date	Place	Title	PJ.03b Objectives	Communication material	Audience
			#04,PJ.03b-01, PJ.03b-03, PJ.03b-05, PJ.03b-06		SESAR contributors

Table 11: PJ.03b communications events

Besides those communication events, PJ.03b completed 17 validation exercises. Many of them were an opportunity for the project and beneficiaries to communicate on PJ.03b activities to an internal and external audience, mainly through open days:

- Open day of PJ.03b-01-01 EXE DSNA – Toulouse – 15/11/2018 - COM.160
- Open day of PJ.03b-01-02 EXE ANS-CR(B4), EUROCONTROL, INDRA, DLR – Bretigny – 24/10/2018 - COM.170
- Open day of PJ.03b-01-03 EXE DFS, DLR – Langen – 20/09/2018 - COM.120
- Open day of PJ.03b-01-04 EXE LPS SR(B4), Frequentis - Bratislava – 04/09/2018 - COM.110
- Open day of PJ.03b-01-07 EXE NLR – Schiphol – 21/11/2018 - COM.190
- Open day of PJ.03b-01-07 EXE PANSA - Warsaw – 30/04/2019 - COM.180
- Open day of PJ.03b-03-01 EXE (Business a/c) THAV – Toulouse - 27/11/2018 - COM.200
- Demo on PJ.03b-03-02 EXE (Regional a/c) LEONARDO – Turin - 22/11/2018 - COM.210 - and open day 22/02/2019 - COM.220
- Open day of PJ.03b-05 EXE Airbus, Honeywell – Toulouse – 23/11/2018 - COM.130
- Open day of PJ.03b-06 EXE LPS SR (B4) – Poprad – 22/03/2018 - COM.140
- Open day of PJ.03b-06 EXE PANSA (B4) – Gdansk – 16/10/2018 - COM.150

4.2.2 Contextual notes

Other communication material are Contextual Note documents, public documents meant as synthetic and high level presentation of all aspects of Solutions.

SESAR 2020, **Contextual Note PJ.03b-01 Solution**, COM.010, December 2019

SESAR 2020, **Contextual Note PJ.03b-03 Solution**, COM.020, December 2019

SESAR 2020, **Contextual Note PJ.03b-05 Solution**, COM.030, December 2019

SESAR 2020, **V1 Contextual Note PJ.03b-06 Solution**, COM.040, November 2017

SESAR 2020, **V2 Contextual Note PJ.03b-06 Solution**, COM.050, December 2019

Project PJ.03b Beneficiaries

AIRBUS

dgac DSNA

Honeywell

AT-One

DFS Deutsche Flugsicherung

indra

enav

LEONARDO

Air Navigation Services of the Czech Republic
B4 CONSORTIUM

EUROCONTROL

SEAC

DASSAULT AVIATION

FREQUENTIS SESAR PARTNERS

THALES

Project PJ.03b Active Organizations

ADP	ENAV	LPS SR
AIRBUS SAS	EUROCONTROL	MICROSTEP-MIS
AIRBUS OPS	FREQUENTIS	NLR
ANS CR	HONEYWELL SAS	PANSA
BULATSA	HONEYWELL Inc.	TECHNO SKY
DASSAULT	HONEYWELL Sro	THALES LAS
DFS	INDRA	THALES AVIONICS
DLR	INDRA NAVIA	R-SYS
DSNA	INTEGRA	UNIWARSAW
EDISOFT	LEONARDO	UNIZA

End of the document

Appendix A Glossary of Terms, Acronyms and Terminology

A.1 Glossary of terms

Term	Definition	Source of the definition
AIR-REPORT	A report from an aircraft in flight prepared in conformity with requirements for position, and operational and/or meteorological reporting.	*ICAO Annex 3*
A-SMGCS	Advanced Surface Movement Guidance Control System A system providing as a minimum Surveillance and can include Airport Safety Support, Routing and Guidance to aircraft and vehicles in order to maintain the airport throughput under all local weather conditions whilst maintaining the required level of safety.	**[1]**
B4	B4 is a consortium of four partners: PANSA (Poland), ANS CR (Czech Republic), LPS SR (Slovak Republic) and Valstybes imone „Oro navigacija" (Lithuania)	**[2]**
EATMA	European ATM Architecture The common architecture framework for SESAR 2020, means of integrating the ATM operational and technical content developments produced by SESAR 2020 Projects in a consistent and coherent way. The modelling concerns: information systems, processes, actors and operations involved and exchanges between them.	**[2] [3]**
Enabler	New or modified technical system/infrastructure, human factors element, procedure, standard or regulation necessary to make (or enhance) an operational improvement.	**[3]**
EUROCAE	A non-profit organisation dealing exclusively with aviation standardisation, for both airborne and ground systems and equipment.	**[4]**

MEGA	A collaborative tool to support EATMA modelling.	**[2]**
SAFE	A SESAR project whose objective is even safer airports, defining, consolidating and validating additional safety barriers to mitigate the risk of incidents and accidents involving aircraft at the airport.	**[2]**
SEAC 2020	SESAR European Airports Consortium which gather Amsterdam Schiphol Airport, Oslo Avinor Airports, Paris Groupe ADP, Heathrow Airport, Munich Airport, Swedavia Airports, Zürich , ACI-Europe.	
SE-DMF	The System Engineering Data Management Framework (SE-DMF), part of SESAR transversal activities, aims to support the proper management of the information and outputs produced by the SESAR solution projects, with particular regards to the Requirement Management.	**[6]**
SESAR	Single European Sky ATM Research The EU Programme for Single European Sky which coordinates and concentrates all EU R&D activities in ATM, pooling together a wealth experts to develop the new generation of ATM.	**[2]**
STELLAR	A collaborative SharePoint for SESAR projects contributors and SJU.	
SURF-A	SURFace Alerts Surface Traffic Alerts on runways for pilots without display (CDTI) (Warning alerts)	**[3]**
SURF-IA	SURFace Indication and Alerts Enhanced Traffic Situational Awareness on the Airport Surface with Indications and Alerts. SURF IA is the RTCA application DO-323.	**[3]**

Table 12: Glossary of terms

A.2 Acronyms and Terminology

Term	Definition
A/C	Aircraft
ACI	Airport Council International
ADP	Aéroports de Paris
ADS-B	Automatic Dependent Surveillance-Broadcast
ANS CR	Air Navigation Services of the Czech Republic The Czech ANSP
ANSP	Air Navigation Service Provider
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATM	Air Traffic Management
CATC	Conflicting ATC clearances
CBA	Cost Benefit Analysis
CDG	Paris Charles de Gaulle Airport
CMAC	Conformance monitoring ATC Clearance
CMAP	Conformance Monitoring Alerts For Pilots
CR	Change Request
CWP	Controller Working Position
DS	Dataset
DSNA	Direction des Services de la Navigation Aérienne The French ANSP.
EC	European Commission
ECC	EUROCONTROL Experimental Centre
ENAC	Ecole Nationale de l'Aviation Civile The French national civil aviation university

ENAV	Ente Nazionale Assistenza al Volo The Italian ANSP.
EPMB	Extended Project Management Board
EU	European Union / Europe
EXE	Exercise
FPR	Final Project Report
FTS	Fast Time Simulation
GA	Grant Agreement
GASN	Global Airport Safety Net Concept
GRF	Global Reporting Format
H2020	Horizon 2020
HP	Human Performance
IATA	International Air Transport Agency
ICAO	International Civil Aviation Organisation
ICAS	International Council of Aeronautical Sciences
INTEROP	Interoperability Requirements
KoM	Kick-off meeting
KPA	Key Performance Area
LPS SR	Letové Prevádzkové Služby Slovenskej Republiky The Slovak ANSP
LTP	Linked Third Party
MASPS	Minimum Aviation System Performance Specification
NDA	Non-Disclosure Agreement
NLR	Nationaal Lucht - en Ruimtevaartlaboratorium The National Aerospace Laboratory of the Netherlands.
NPV	Net Present Value
OI	Operational Improvement.

	Any operational measure or action taken through time in order to improve the current provision of ATM operations.
OCD	Operational Concept Document
OI	Operational Improvement
OSED	Operational Service and Environment Definition
PAGAR	Performance Assessment And Gap Analysis Report
PANSA	Polish Air Navigation Services Agency The Polish ANSP.
PCIT	Project Content Integration Team
PCP	Pilot Common Project (see [8])
PFD	Primary Flight Display
PIREP	Pilot Report
PJ	Project
PjC	Project Coordinator
PMB	Project Management Board
PMP	Project Management Plan
QPR	Quarterly Progress Report
R&D	Research & Development
R&I	Research and Innovation
RMCA	Runway Monitoring and Conflict Alerting
ROAAS	Runway Overrun Awareness And Alerting System
RP	Reporting Period
RTS	Real Time Simulation
RWYCC	Runway Condition Code
SICTA	Sistemi Innovativi per il Controllo del Traffico Aereo The former research centre of ENAV group.
SID	Standard Instrument Departure

SIGMET	Significant Meteorological Information
SJU	SESAR Joint Undertaking
SPR	Safety and Performance Requirements
STAR	Standard Instrument Arrival Route
TALPA	Take-off and Landing Performance Assessment
TCD	Taxiway Conflict Detection
TS/IRS	Technical Specifications / Interface Requirements Specifications
V&V	Verification & Validation
VALP	Validation Plan
VALR	Validation Report
VLD	Very Large Demonstration
WAC	World ATM Congress
WG	Working Group
WP	Work Package

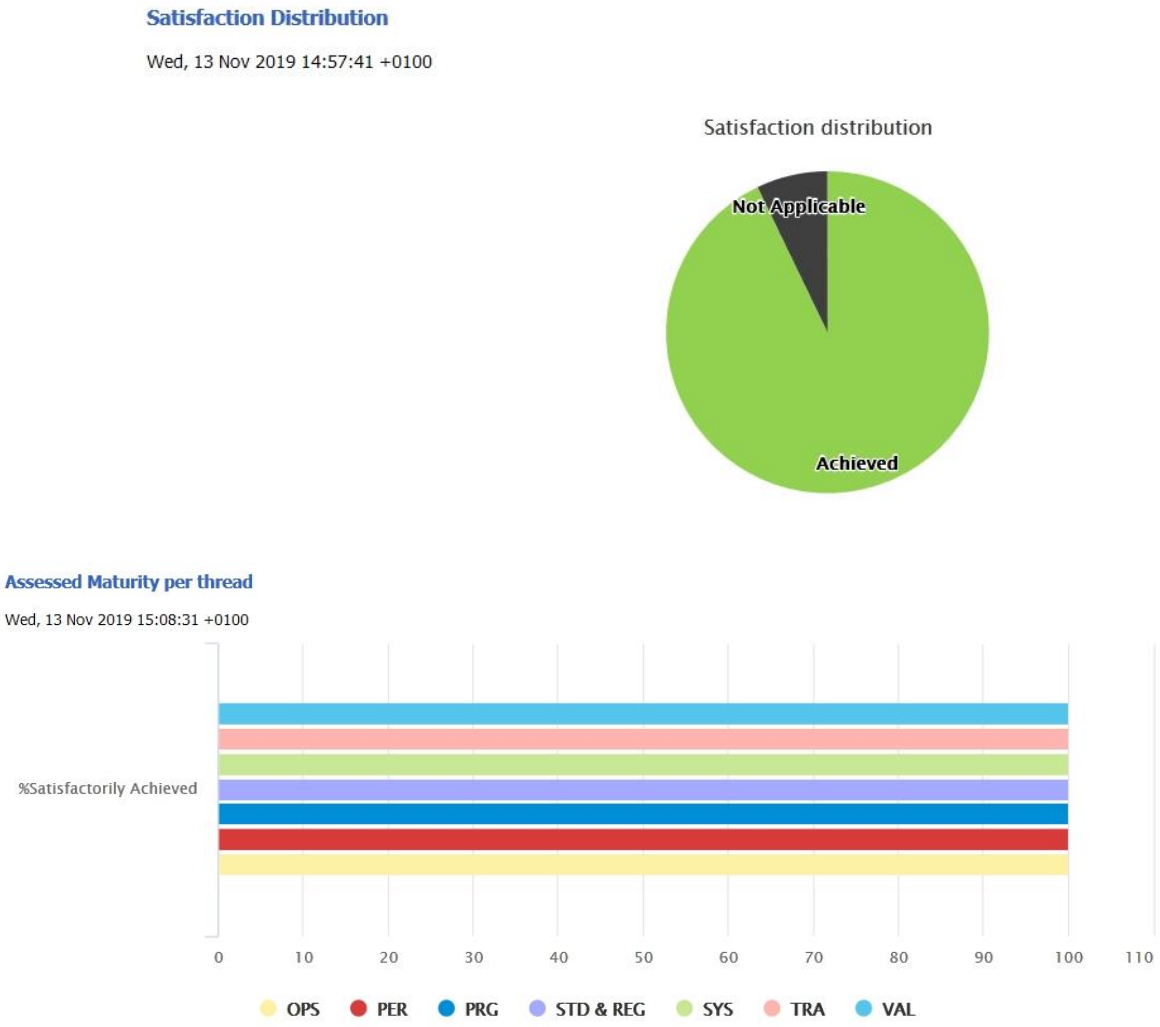
Table 13: Acronyms and terminology

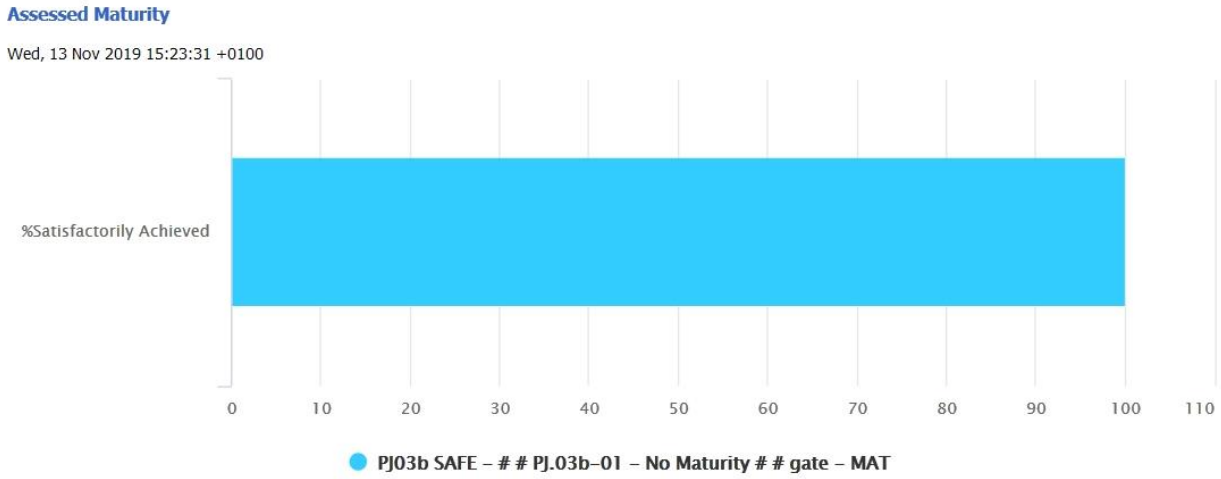
Appendix B Additional Material

B.1 Final Project maturity self-assessment

B.1.1 Solution PJ.03b-01 "Enhanced Airport Safety Nets for Controllers"

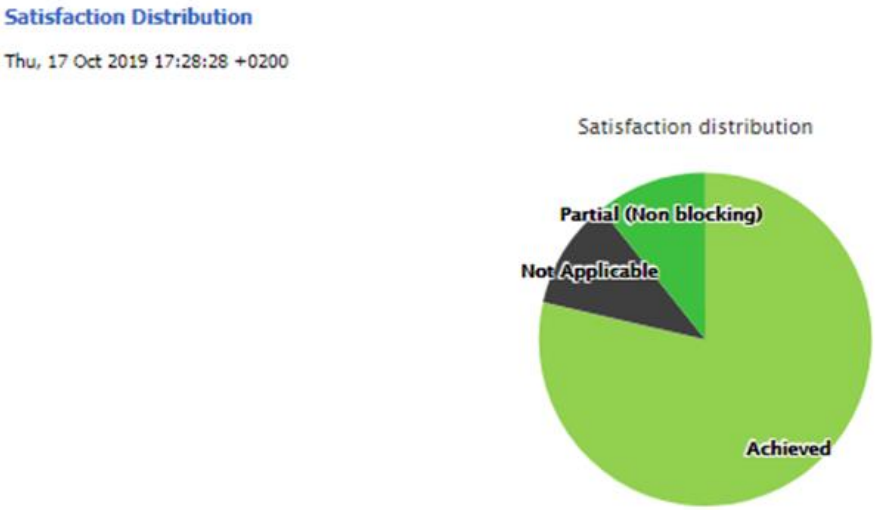
Solution self-assessment resulted in the achievement of V2 maturity level. The maturity claimed by the Solution has not been reviewed by the SJU in a formal maturity assessment process.

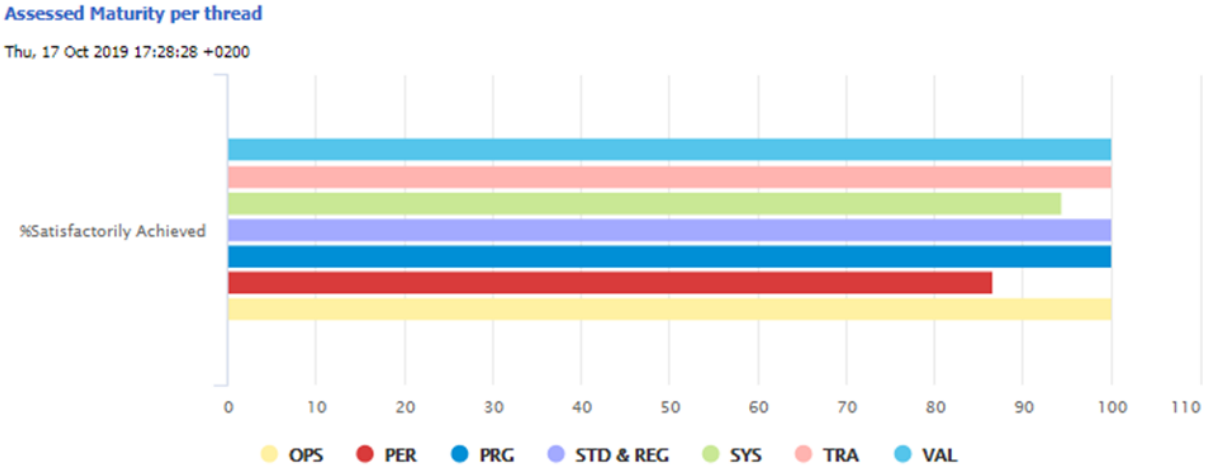


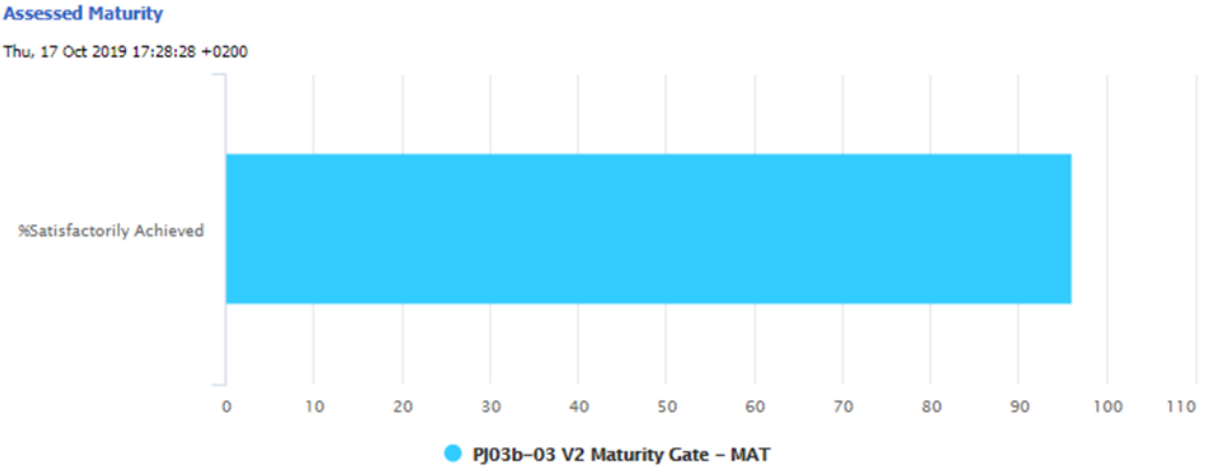


B.1.2 Solution PJ.03b-03 "Conformance monitoring safety net for Pilots"

Solution self-assessment resulted in the achievement of V2 maturity level. The maturity claimed by the Solution has not been reviewed by the SJU in a formal maturity assessment process.





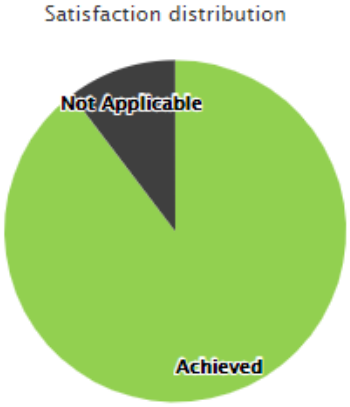


B.1.3 Solution PJ.03b-05 "Traffic alerts for pilots for airport operations"

The review of the Solution's results by the SJU in a formal maturity assessment process has not yet taken place at the time of writing of this report (planned on the 12th of December 2019). However, Solution PJ.03b-05 has aimed at demonstrating that it has reached a V3 maturity level according to the E-OCVM methodology (i.e. pre-industrial stage) by conducting validation activities in a realistic environment (live trials) and developing mature requirements allowing to support initial standardisation, certification and regulation processes.

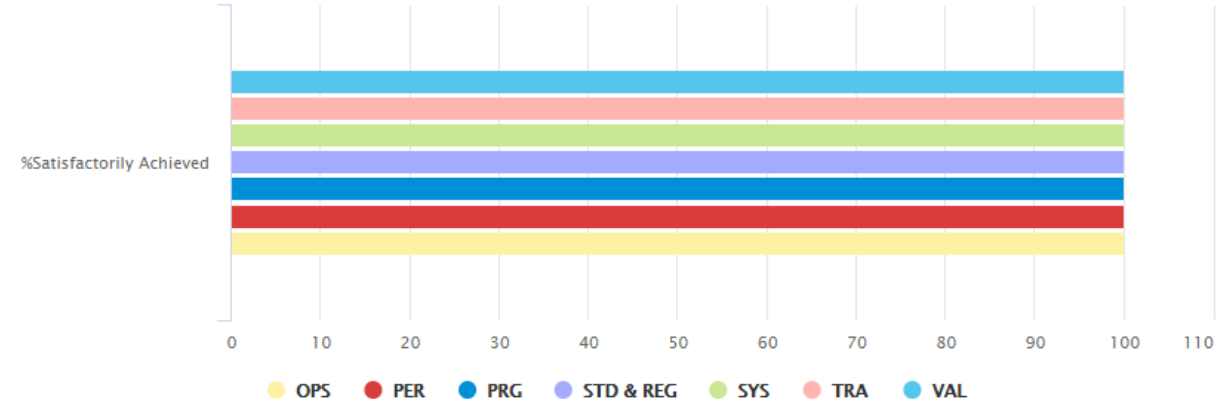
Satisfaction Distribution

Wed, 13 Nov 2019 15:47:59 +0100



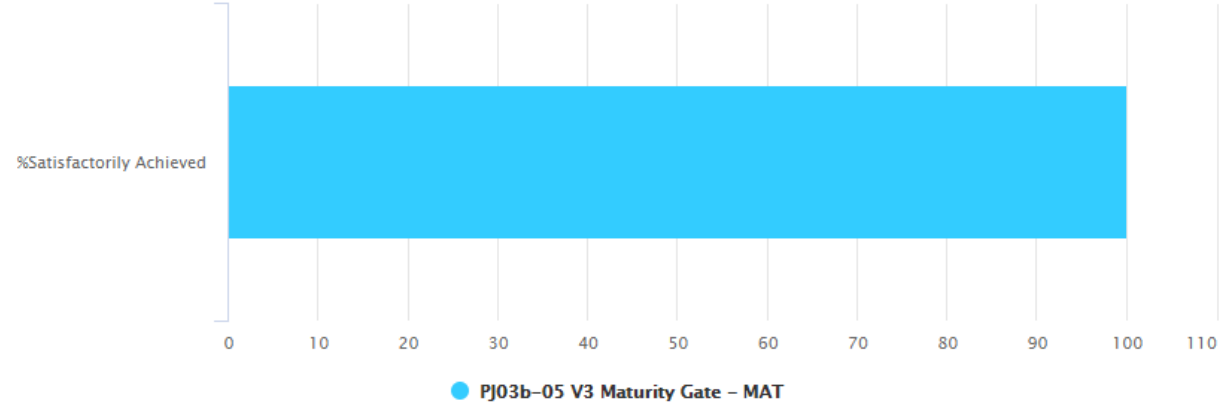
Assessed Maturity per thread

Wed, 13 Nov 2019 15:47:59 +0100



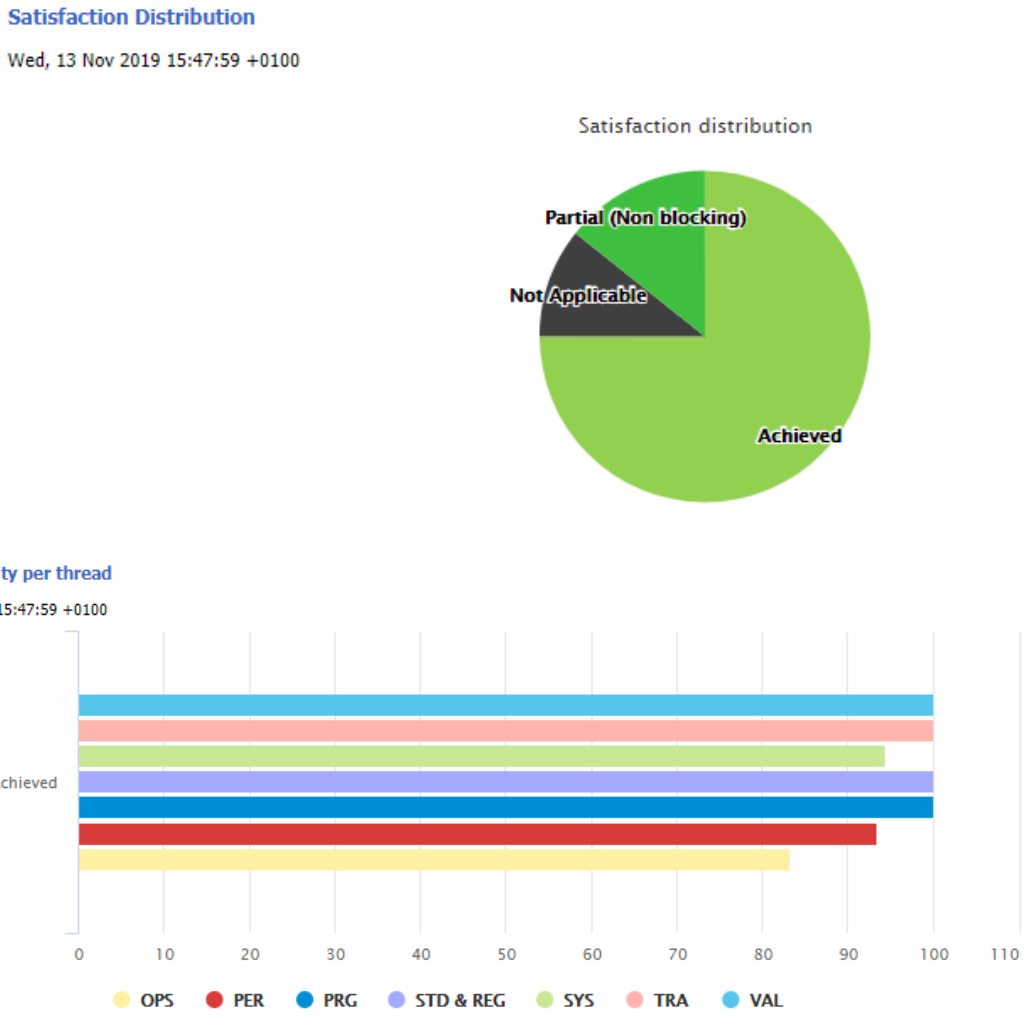
Assessed Maturity

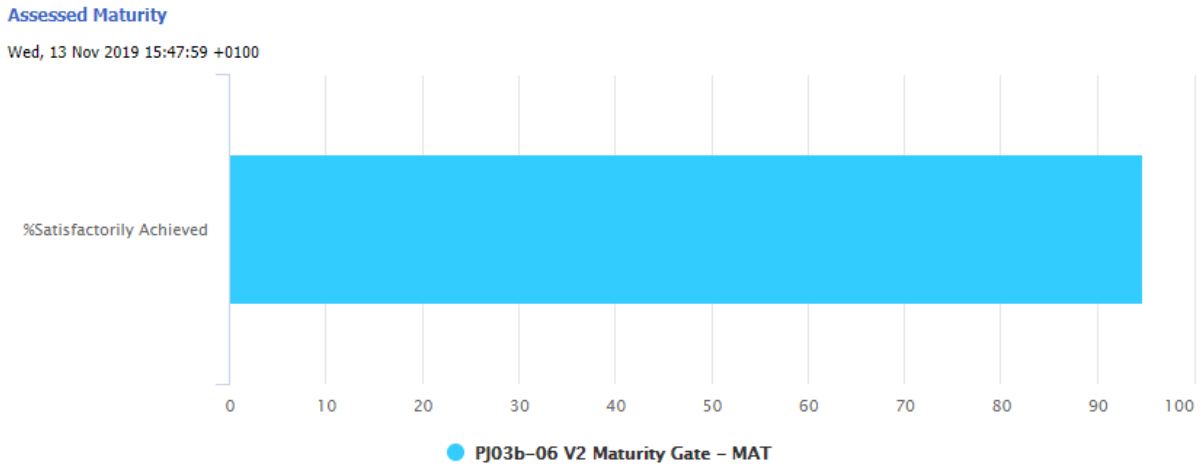
Wed, 13 Nov 2019 15:47:59 +0100



B.1.4 Solution PJ.03b-06 "Safety support tools for avoiding runway excursions"

Solution self-assessment resulted in the achievement of V2 maturity level. The maturity claimed by the Solution has not been reviewed by the SJU in a formal maturity assessment process.




Assessed Maturity
Wed, 13 Nov 2019 15:47:59 +0100
%Satisfactorily Achieved
0
10
20
30
40
50
60
70
80
90
100
PJ03b–06 V2 Maturity Gate – MAT