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SESAR Solution PJ.02-W2-21.1 SPR/INTEROP-OSED for V3 - Part V - Performance Assessment Report (PAR)

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AART

AIRPORT AIRSIDE AND RUNWAY THROUGHPUT

This **PJ.02-W2-21.1 Performance Assessment Report for V3** is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874477 under European Union's Horizon 2020 research and innovation programme.

Abstract

This document provides the V3 **Performance Assessment Report** for Solution **PJ.02-W2-21.1 — Extended Airport Safety Nets for Controllers at A-SMGCS Airports**.

The Extended Airport Safety Nets for Controllers at A-SMGCS Airports extend the scope of the Safety Nets developed in SESAR1 Solution #02 to the entire movement area and the arrival and departure airspace, improve existing concepts and add new ones.

The PAR consolidates solution performance validation results and estimates where no validation results are present. The solution PJ.02-W2-21.1 addresses the impact on the KPA targets **Safety and Human Performance** (as defined in the Validation Targets)**.**

Moreover, Solution PJ.02-W2-21.1 has assessed the impact on **Resilience.** The reduction of incidents in the airport would lead to an improvement of Resilience by means of a reduction of delays, diversions and cancelations caused by these incidents.

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Table of Contents

EUROPEAN PARTNERSHIP
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EUROPEAN PARTNERSHIP
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List of Tables

EUROPEAN PARTNERSHIP

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List of Figures

1 Executive Summary

This document[1] provides the Performance Assessment Report (PAR) for Solution PJ.02-W2-21.1-Enhanced airport safety support tools for controllers at A-SMGCS Airports.

The PAR is consolidating Solution performance validation results addressing KPIs/PIs and metrics from the SESAR2020 Performance Framework [3].

Description:

The Solution PJ.02-W2-21.1- Enhanced airport safety support tools for controllers at A-SMGCS Airports aims at enhanced Safety for airport operations as Support Tools for controllers at A-SMGCS Airports detect 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 unauthorised/unidentified traffic. Controllers are provided in all cases with the appropriate alerts.

Based on airport surveillance data and electronic environment integrating ATC clearances, taxi-routes and local procedures the Safety Support Tools for controllers upgrade the Advanced Surface Movement Guidance and Control System (A-SMGCS) to **detect 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 unauthorised/unidentified traffic.

The solution targets traffic Safety on the **entire movement area** on **medium, large and very large airports** and during take-off and landing.

Appropriate predictive indications and alerts are provided to controllers, increasing situational awareness and giving automated support in order to avoid hazardous situations. This is expected to raise benefits mainly in **RESILIENCE, SAFETY AND HUMAN PERFORMANCE.**

The solution has performed 3 validation exercises:

- EXE-02.21.1-V3-VALP-001 (shadow mode). "V3 Validation of Extended Airport Safety Nets for Controllers at Düsseldorf Airport" led by DFS;
- EXE-02.21.1-V3-VALP-003 (Real Time Simulation). "Real Time Simulation of Extended SMGCS Safety Nets (V3)" led by ENAIRE;
- EXE-02.21.1-V3-VALP-004 (Real Time Simulation). "Innovative Surface Management combined with Safety Nets" led by LEONARDO.

[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.

The results of these validation exercises and additional activities (i.e workshops) have been described in the Validation Report. This document, the Safety Assessment Report and Human Performance Report has been used as inputs to perform the Performance Assessment Report.

More Information can be found in Chapter 2!

Assessment Results Summary:

The following tables summarises the assessment outcomes per KPI (Table 1) and mandatory PI (Table 2) puts them side-by side against Validation Targets in case of KPI from PJ19 [7]. The impact of a Solution on the performances are described in Benefit Impact Mechanism. All the KPI and mandatory PI from the Benefit Mechanism were the Solution potentially impact have to be assessed via validation results, expert judgment etc.

There are three cases:

1. An assessment result of 0 with confidence level other level High, Medium or Low indicates that the Solution is expected to impact in a marginal way the KPI or mandatory PI.
2. An assessment result (positive or negative) different than 0 with confidence level High, Medium or Low indicates that the Solution is expected to impact the KPI or mandatory PI.
3. An assessment result of N/A (Not Applicable) with confidence level N/A indicates that the Solution is not expected to impact at all the KPI or mandatory PI consistently with the Benefit Mechanism.

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits at Network Level (ECAC Wide or Local depending on the KPI)[2]	Confidence in Results[3]
SAF1: Safety - Total number of estimated accidents with ATM Contribution per year	See Section 4.3		
FEFF1: Fuel Efficiency - Actual average fuel burn per flight	N/A	N/A	N/A

[2] Negative impacts are indicated in red.

[3] High – the results might change by +/-10%
Medium – the results might change by +/-25%
Low – the results might change by +/-50% or greater
N/A – not applicable, i.e., the KPI cannot be influenced by the Solution

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CAP1: TMA Airspace Capacity - TMA throughput, in challenging airspace, per unit time.	N/A	N/A	N/A
CAP2: En-Route Airspace Capacity - En-route throughput, in challenging airspace, per unit time	N/A	N/A	N/A
CAP3: Airport Capacity – Peak Runway Throughput (Mixed mode).	N/A	N/A	N/A
TEFF1: Gate-to-gate flight time	N/A	N/A	N/A
PRD1: Predictability – Average of Difference in actual & Flight Plan or RBT durations	N/A	N/A	N/A
PUN1: Punctuality – Average departure delay per flight	N/A	N/A	N/A
CEF2: ATCO Productivity – Flights per ATCO -Hour on duty	N/A	N/A	N/A
CEF3: Technology Cost – Cost per flight	N/A	N/A	N/A

Table 1: KPI Assessment Results Summary

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Mandatory PI	Performance Benefits Expectations at Network Level (ECAC Wide or Local depending on the KPI)[4]	Confidence in Results[5]
SAF1.X: Mid-air collision - En-Route		
SAF2.X: Mid-air collision - TMA		
SAF3.X: RWY-collision accident	64,1% (52, 7 % at ECAC level)	High
SAF4.X: TWY-collision accident	55,5% (45,7 % at ECAC level)	High
SAF5.X: CFIT accident		
SAF6.X: Wake related accident		
SAF7.X: RWY-excursion accident		
SAF8.X ...: Other SAF Risks		
SEC1: A security risk assessment has been carried out		
SEC2: Risk Treatment has been carried out		
SEC3: Residual risk after treatment meets security objective.		
ENV1: Actual Average CO2 Emission per flight		
NOI1: Relative noise scale		
NOI2: Size and location of noise contours		
NOI4: Number of people exposed to noise levels exceeding a given threshold		
LAQ1: Geographic distribution of pollutant concentrations		
CAP3.1: Peak Departure throughput per hour		

[4] Negative impacts are indicated in red.

[5] High – the results might change by +/-10%
Medium – the results might change by +/-25%
Low – the results might change by +/-50% or greater
N/A – not applicable, i.e., the KPI cannot be influenced by the Solution

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(Segregated mode)		
CAP3.2: Peak Arrival throughput per hour (segregated mode)		
CAP4: Un-accommodated traffic reduction		
RES1: Loss of Airport Capacity Avoided	19,82% (local)	
RES1.1: Airport time to recover from non-nominal to nominal condition		
RES2: Loss of Airspace Capacity Avoided.		
RES2.1: Airspace time to recover from non-nominal to nominal condition.		
RES4: Minutes of delays.	1761,8 Minutes (local)	
RES5: Number of cancellations.	6,7 (local)	
TEFF2: Taxi in time		
TEFF3: Taxi out time		
TEFF4: TMA arrival time		
TEFF5: TMA departure time		
TEFF6: En-Route time		
PRD2: Variance of Difference in actual & Flight Plan or RBT durations		
PUN2: % Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather-related delay causes		
CEF1: Direct ANS Gate-to-gate cost per flight		
AUC3: Direct operating costs for an airspace user		
AUC4: Indirect operating costs for an airspace user		
AUC5: Overhead costs for an airspace user		
CMC1.1: Allocated vs. Requested ARES duration		
CMC1.2: Allocated vs. Requested ARES dimension		
CMC1.3: Deviation of Transit Time to/from airbase to ARES		

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CMC 1.3.1: Allocated ARES duration vs. total mission duration		
CMC 1.3.2: Deviation of total mission duration by iOAT FPL validation		
CMC 1.4.1: Rate of iOAT FPLs acceptance by NM systems		
CMC 1.4.2: Rate of iOAT FPLs acceptance by ATC systems		
CMC2.1: Fuel and Distance saved by GAT		
HP1: Consistency of human role with respect to human capabilities and limitations	See section 4.17	
HP2: Suitability of technical system in supporting the tasks of human actors		
HP3: Adequacy of team structure and team communication in supporting the human actors		
HP4: Feasibility with regard to HP-related transition factors		
FLX1: Average delay for scheduled civil/military flights with change request and non-scheduled or late flight plan request		

Table 2 Mandatory PIs Assessment Summary

Additional Comments and Notes:

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2 Introduction

2.1 Purpose of the document

The Performance Assessment covers the Key Performance Areas (KPAs) defined in the SESAR2020 Performance Framework [3]. Assessed are at least the Key Performance Indicators (KPIs) and the mandatory Performance Indicators (PIs), but also additional PIs as needed to capture the performance impacts of the Solution. It considers the guidance document on KPIs/PIs [3] for practical considerations, for example on metrics.

The purpose of this document is to present the performance assessment results from the validation exercises at SESAR Solution level. The KPA performance results are used for the performance assessment at strategy level and provide inputs to the SESAR3 Joint Undertaking (S3JU) for decisions on the SESAR2020 Programme.

In addition to the results, this document presents the assumptions and mechanisms (how the validation exercises results have been consolidated) used to achieve this performance assessment result.

One Performance Assessment Report shall be produced or iterated per Solution.

2.2 Intended readership

In general, this document provides the ATM stakeholders (e.g., airspace users, ANSPs, airports, airspace industry) and S3JU performance data for the Solution addressed.

The main recipient in the SESAR performance management process is PJ19, which will aggregate all the performance assessment results from the SESAR2020 solution projects and provide the data to PJ20 for considering the performance data for the European ATM Master Plan. The aggregation will be done at higher levels suitable for use at Master Planning Level, such as deployment scenarios.

2.3 Inputs from other projects

The document includes information from the following SESAR 2020 Wave1 projects:

- PAGAR 2019[3]: Performance Assessment and Gap Analysis Report (2019), which collected the final benefits from SESAR 2020 Wave1.

PJ19 will manage and provide:

- SESAR Performance Framework (2019) [3], guidance on KPIs and Data collection supports.
- S2020 Common Assumptions [8], used to aggregate results obtained during validation exercises (and captured into validation reports) into KPIs at the ECAC level, which will in turn be captured in Performance Assessment Reports and used as inputs to the CBAs produced by the Solution projects. Where are also included performance aggregation assumptions, with traffic data items.

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- For guidance and support PJ19 have put in place the Community of Practice (CoP)[6] within STELLAR, gathering experts and providing best practices.

2.4 Glossary of terms

See the AIRM Glossary [1] [6] for a comprehensive glossary of terms.

Term	Definition	Source of the definition
A-SMGCS	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.	[27]
Alert	An indication of an existing or pending situation during aerodrome operations, or an indication of abnormal A-SMGCS operation, that requires attention/action.	[28]
CATC	CATC provides an alert when the Controller inputs an electronic clearance via the Human Machine Interface (HMI), which according to a set of locally agreed rules is not permitted from an operational and safety point of view when compared to any other previously input electronic clearance.	[27]
Clearance	Authorisation for an aircraft to proceed under conditions specified by an air traffic control unit. Note 1: For convenience, the term 'air traffic control clearance' is frequently abbreviated to 'clearance' when used in appropriate contexts.	[27]

[6] Go to "Advanced Portfolio Manager" on the left navigation menu, and select "Coordination Group – ATM Performance Assessment (APA)" in STELLAR:

https://stellar.sesarju.eu/?link=true&domainName=saas&redirectUrl=%2Fjsp%2Fproject%2Fproject.jsp%3FobjId%3Dxrn%3Aview%3Axrn%3Adatabase%3Aondb%2Ftable%2FSYS_MESSAGE%402333834.13%40xrn%3AprototypeView%3Adatabase.view.message.private.AllMyMessages

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Conditional Clearance	A conditional clearance is a clearance issued by an air traffic controller which does not become effective until a specified condition has been satisfied.	[30]
CMAC	CMAC provides Controllers with appropriate alerts when the A-SMGCS detects the non-conformance to procedures or clearances for traffic on runways, taxiways and in the apron/stand/gate area.	[27]
Predictive Indication	The Predictive Indication is displayed on a track label or electronic flight strip (or any aircraft representation on the controller's main screen) that is associated with a clearance that has not yet been given to a mobile, showing that this clearance, if given, would be conflictual with another active clearance given to another mobile.	[27]

Table 3: Glossary of terms

2.5 Acronyms and Terminology

Term	Definition
ANS	Air Navigation Service
ANSP	Air Navigation Service Provider
ATFM	Air Traffic Flow Management
A-SMGCS	Advanced Surface Movement Guidance and Control System
ATC	Air Traffic Control
ATCO	Air Traffic Control Operator (i.e., the Controller)
ATM	Air Traffic Management
BIM	Benefit Impact Mechanism
CATC	Conflicting ATC Clearances
CBA	Cost Benefit Analysis
CMAC	Conformance Monitoring Alerts for Controllers
DB	Deployment Baseline
DFS	Deutsche Flugsicherung (German ANSP)

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ECAC	European Civil Aviation Conference
EXE	Validation exercise
HPAR	Human Performance Assessment Report
KPA	Key Performance Area
KPI	Key Performance Indicator
LND	Landing
N/A	Not Applicable
OE	Operating Environment
OI	Operational Improvement
PAR	Performance Assessment Report
PI	Performance Indicator
RBT	Reference Business / Mission Trajectory
RWY	Runway
SAF	Safety
SAR	Safety Assessment Report
SESAR	Single European Sky ATM Research Programme
S3JU	SESAR3 Joint Undertaking
SESAR2020 Programme	The programme which defines the Research and Development activities and Projects for the S3JU.
TOF	Take off

Table 4: Acronyms and terminology

The following is a list of the concepts, terms or definitions introduced or commonly referred to in this document.

Term	Definition	Source
Airport Capacity Focus Area	Capture the peak runway throughput in the most challenging (or constrained) environments at busy hours, i.e. the capacity at a "maximum observed throughput" airport.	PAGAR
Airspace Capacity Focus Area	Capture the capability of a challenging volume of airspace to handle an increasing number of movements per unit time – through changes to the operational concept and technology.	PAGAR

Term	Definition	Source
Airspace Reservation/ Restriction (ARES)	Airspace Reservation means a defined volume of airspace temporarily reserved for exclusive or specific use by categories of users (Temporary Segregated Area (TSA), Temporary Reserved Area (TRA), and Cross-Border Area (CBA)) wheras Airspace Restriction designates Danger, Restricted and Prohibited Areas.	EC Regulation No 2150/2005
Airspace User Cost-Efficiency Focus Area	Cost-Efficiency obtained by Airspace Users other than direct gate-to-gate ATS costs (CEF1) or AU cost improvements assessed through other KPIs: Fuel Efficiency, Punctuality, etc. Note: Benefits assessed through other KPIs should not be included in this focus area to avoid double counting of benefits. AU Cost-Efficiency includes reduction of direct (AUC3) and indirect (AUC4) operational costs of the AU, as well as overhead costs (AUC5). In addition there are two specific PIs, Strategic Delay (AUC1) and Sequence Optimisation Benefit (AUC2).	PAGAR
ARES Capacity	The ability of an ATM system to accommodate specific training events which require airspace reservations and/or restrictions during a specific period of time, taking into account the duration of the training events, ATM inefficiency, planning inefficiency and weather impact on training and operations.	Performance Framework 2017
ATM Master Plan	The European ATM Master Plan is the agreed roadmap to bring ATM R&I to the deployment phase, introducing the agreed vision for the future European ATM system. It provides the main direction and principles for SESAR R&I, as well as the deployment planning and an implementation view with agreed deployment objectives. Through the SESAR Key Features, the ATM Master Plan identifies the Essential Operational Changes (both Essential Operational Changes featured in the Pilot Common Project and New Essential Operational Changes) and key R&I activities that support the identified performance ambition. The ATM Master Plan is updated on a regular basis in collaboration and consultation with the entire ATM community. Amendments are submitted to the S3JU Administrative Board for adoption. The content of the European ATM Master Plan is structured in three levels (Level 1 – Executive View, Level 2 – Planning and Architecture View, and Level 3 – Implementation View) to allow stakeholders to access the information at the level of detail that is most relevant to their area of interest. The intended readership for Level 1 is executive-level stakeholders. Levels 2 and 3 of the ATM Master Plan provide more detail on the operational changes and related elements and therefore the target audience is expert-level stakeholders.	SESAR2020 Project Handbook, European ATM Master Plan (9 Edition)
Civil-military coordination and cooperation	The coordination between the civil and military parties authorised to make decisions and agree a course of action.	Performance Framework 2017

Term	Definition	Source
Cost-Benefit Analysis	A Cost-Benefit Analysis is a process for quantifying in economic terms the costs and benefits of a project or a programme over a certain period, and those of its alternatives (within the same period), in order to have a single scale of comparison for unbiased evaluation. This process helps decision-makers to compare an investment with other possible investments and/or to make a choice between different options / scenarios and to select the one that offers the best value for money while considering all the key criteria affecting the decision.	PAGAR
Deployment Scenario	Set of SESAR Solutions selected to satisfy the specific Performance Needs of operating environments in the European ATM System and based on the timescales in which their performance contribution is needed in the respective operating environments.	PAGAR
Flexibility KPA	The ability of the ATM System and airports to respond to changes in planned flights and missions. It covers late trajectory modification requests as well as ATFCM measures and departure slot swapping and it is applicable to military and civil airspace users covering both scheduled and unscheduled flights. In terms of specific military requirements, it also covers the ability of the ATM System to address military requirements related to the use of airspace and reaction to short-notice changes.	Performance Framework 2017
Focus Area	Within each KPA, a number of more specific “Focus Areas” are identified in which there are potential intentions to establish performance management. Focus Areas are typically needed where performance issues have been identified.	ICAO Doc 9883
Fuel Efficiency Focus Area	The SESAR performance Focus Area concerned with fuel efficiency. How much fuel is used by aviation or by extension “Fuel efficiency” (how much fuel can be saved?) is one of the performance aspects. Note: Policy places considerable focus on this. Fuel efficiency contributes to 3 of the 11 KPAs defined by ICAO: Cost-efficiency, Efficiency, and Environment.	PAGAR

Term	Definition	Source
Gap Analysis	Difference between the validation targets and the performance assessment. It is used to: 1. Anticipate any deviation from the design performance targets; 2. Identify the underlying reasons; 3. Derive the appropriate recommendations to be taken on board to redirect the R&D activities within the Programme towards the ultimate achievement of SESAR2020's performance ambitions.	PAGAR
G2G ANS Cost-Efficiency Focus Area	One of the SESAR performance Focus Areas concerned with Cost Efficiency. Direct G2G ANS costs are those costs that are charged to Airspace Users via unit rates, including ATM/CNS costs, regulatory costs, Met costs and EUROCONTROL Agency costs.	Performance Framework new
Human Performance (HP)	Human capabilities and limitations which have an impact on the safety, security and efficiency of aeronautical operations.	EUROCONTROL ATM Lexicon
Key Performance Area	A way of categorising performance subjects related to high level ambitions and expectations. ICAO Global ATM Concept sets out these expectations in general terms for each of the 11 ICAO defined KPAs.	EUROCONTROL ATM Lexicon
Key Performance Indicator	Current/past performance, expected future performance (estimated as part of forecasting and performance modelling), as well as actual progress in achieving performance objectives is quantitatively expressed by means of indicators (sometimes called Key Performance Indicators, or KPIs). To be relevant, indicators need to correctly express the intention of the associated performance objective. Since indicators support objectives, they should not be defined without having a specific performance objective in mind. Indicators are not often directly measured. They are calculated from supporting metrics according to clearly defined formulas, e.g. cost-per-flight-indicator = Sum (cost)/Sum (flights). Performance measurement is therefore carried out through the collection of data for the supporting metrics." In SESAR2020 Performance Framework, Key Performance Indicators are those that have a validation target associated derived from the corresponding Performance Ambition.	ICAO Doc 9883 Performance Framework

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Term	Definition	Source
Local Air Quality Focus Area	One of the SESAR performance Focus Areas concerned with Environment. Local air quality is a term commonly used to designate the state of the ambient air to which humans and the ecosystem are typically exposed at a specific location. In the case of aviation, local air quality studies are generally conducted near airports.	PAGAR
Noise Focus Area	One of the SESAR performance Focus Areas concerned with Environment. The term Noise is used in this document to designate noise pollution, which is defined as unwanted sound. The impact of unwanted sounds on the recipients (in this case, people living around airports) causes adverse effects.	PAGAR
Operational Environment (OE)	An environment with a consistent type of flight operations.	EUROCONTROL ATM Lexicon
Performance Ambitions	Performance capability that may be achieved if SESAR Solutions are made available through R&D activities, deployed in a timely and, when needed, synchronised way and used to their full potential.	EUROCONTROL ATM Lexicon
Performance assessment	This term relates to the quantitative estimate of the potential performance benefit of an operational improvement based on outputs from validation projects, collected and analysed by PJ19.04.02	ICAO Doc 9883 updated in PAGAR
Performance Framework	1) The overall performance-driven development approach that is applied within the SESAR development programme to ensure that the programme develops the operational concept and technology needed to meet long-term performance expectations. 2) The set of definitions and terminology describing the building blocks used by a group of ATM community members to collaborate on performance management activities. This set of definitions includes the levels in the global ATM performance hierarchy, the eleven Key Performance Areas, a set of process capability areas, focus areas, performance objectives, indicators, targets, supporting metrics, lists of dimension objects, their aggregation hierarchies and classification schemes.	EUROCONTROL ATM Lexicon

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Term	Definition	Source
Performance Indicator	PIs are defined in the SESAR performance framework and relate to performance benefits in specific KPAs. However, no validation targets are assigned to PIs. SESAR Solutions projects use the results of validation exercises to report performance assessment in terms of the PIs, reporting the expected positive and negative impacts. Certain PIs are mandatory for measurement and reporting by Solution projects.	SESAR2020 Project Handbook
Performance metrics	Sometimes proxies may be used in a validation exercise when it is not possible to measure an impact directly using the specified KPIs and PIs. In these cases, other metrics may be used provided the solution project later converts the results into the reporting KPIs and PIs.	SESAR2020 Project Handbook
Predictability Focus Area	Predictability is focused on in-flight (i.e. off-block to on-block) variability of flight duration compared to the planned duration. It is expected that this area will be extended in the future to reflect the improvement derived from better planning in pre-tactical phase.	Performance Framework 2019
Punctuality Focus Area	Refers to “ATM Punctuality”. It captures ATM issues as well as events related to ATM that cause a temporal perturbation to airspace user schedules.	PAGAR
Resilience Focus Area	Resilience focuses on the ability to withstand and recover from planned and unplanned events and conditions which cause a loss of nominal performance.	Performance Framework updated
Safety	The state to which the possibility of harm to persons or damage to property is reduced, and maintained at or below, an acceptable level through a continuing process of hazard identification and risk management.	EUROCONTROL ATM Lexicon
Security	(aviation) Safeguarding civil aviation against acts of unlawful interference. This objective is achieved by a combination of measures and human and material resources. Note: ATM Security is concerned with those threats that are aimed at the ATM System directly, such as attacks on ATM assets, or where ATM plays a key role in the prevention of or response to threats aimed at other parts of the aviation system (or national and international assets of high value). ATM security aims to limit the effects of a threats on the overall ATM Network. ATM Security is a subset of Aviation Security (as defined by ICAO in Annex 17).	EUROCONTROL ATM Lexicon, Note are from PAGAR

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Term	Definition	Source
SESAR2020	The Programme for SESAR2020 was created with a clear and agreed need for continuing research and innovation in ATM beyond the SESAR 1 development phase. SESAR2020 is structured into three main research phases, starting with Exploratory Research, which is then further expanded within a Public-Private-Partnership (PPP) to conduct Industrial Research and Validation. Finally, it further exploits the benefits of the PPP in Demonstrating at Large Scale the concepts and technologies in representative environments to firmly establish the performance benefits and risks.	Performance Framework 2017
SESAR Programme	The programme which defines the Research and Development activities and Projects for the S3JU.	EUROCONTROL ATM Lexicon
SESAR Solution	A term used when referring to both SESAR ATM Solution and SESAR Technological Solution.	SESAR2020 Project Handbook
SESAR ATM Solution	SESAR Solutions relate to either an Operational Improvement (OI) step or a group of OI steps with associated Enablers (technical system, procedure or human), which have been designed, developed and validated in response to specific Validation Targets and that are expected deliver operational and/or performance improvements to European ATM, when translated into their effective realisation. SESAR Technological Solutions relate to verified technologies proven to be feasible and profitable, which may therefore be considered to enable future SESAR Solutions.	SESAR2020 Project Handbook
Single European Sky High Level Goals	The SES High Level Goals are political targets set by the European Commission. Their scope is the full ATM performance outcome resulting from the combined implementation of the SES pillars and instruments, as well as industry developments not driven directly by the EU.	SESAR2020 Project Handbook
Sub-OE	A subcategory of an Operating environment, classified according to its complexity (e.g. high complexity TMA, medium complexity TMA, low complexity TMA).	EUROCONTROL ATM Lexicon
Validation targets	Validation targets are the targets that focus on the development of enhanced capabilities by the SESAR Solutions. They aim to secure from R&D the required performance capability to contribute to the achievement of the Performance Ambitions and, thus, to the SES high-level goals. In SESAR2020 validation targets are associated with a KPI.	EUROCONTROL ATM Lexicon

Table 5: Terminology

3 Solution Scope

3.1 Detailed Description of the Solution

The Solution21.1 aims at enhanced Safety for airport operations as Support Tools for controllers at A-SMGCS Airports detect 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 unauthorised/unidentified traffic. Controllers are provided in all cases with the appropriate alerts.

This solution is the evolution of PJ.03b-01 in Wave 1 (addressing the Operational Improvement AO-0104-B) that updates and extends the Airport Safety Nets **Conflicting ATC Clearances** (CATC) and **Conformance Monitoring Alerts for Controllers** (CMAC) to cover the entire airport surface.

Based on airport surveillance data and electronic environment integrating ATC clearances, taxi-routes and local procedures the Safety Support Tools for controllers upgrade the Advanced Surface Movement Guidance and Control System (A-SMGCS) to detect 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 unauthorised/unidentified traffic.

The solution targets traffic Safety on the entire movement area on medium, large and very large airports and during take-off and landing.

Appropriate predictive indications and alerts are provided to controllers in all cases, increasing situational awareness and giving automated support in order to avoid hazardous situations. The solution has demonstrated to provide benefits in Safety and Human Performance.

A short description of the Solution can be found in the Executive Summary!

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3.2 Detailed Description of relationship with other Solutions

This solution has two dependencies with the following solutions:

- Solution PJ.02-W2-21.1 depends on SESAR 1 Solution #02. PJ.02-W2-21.1 extends the scope of Solution #02 improving Safety Support Tools and adding new Support Tools.
- Solution PJ.02-W2-21.1 depends on SESAR 1 Solution #22. The Routing and Planning is a pre-requisite to deploy PJ.02-W2-21.1.

Solution Number	Solution Title	Relationship	Rational for the relationship
#02	Airport Safety Nets for controllers: conformance monitoring alerts and detection of conflicting ATC clearances	Dependent; Depends on prerequisite	PJ.02-W2-21.1 depends on Solution #02 (extends the scope of Solution #02 improving it) **The extension of #02 by PJ.02-W2-21.1 increases Safety. At some airports the deployment of #02 makes no sense without PJ.02-W2-21.1 since only PJ.02-W2-21.1 supports the local procedures.**
#22	Automated Assistance to Controller for Surface Movement Planning and Routing	Dependent; Depends on prerequisite	PJ.02-W2-21.1 depends on Solution #22 Routing and Planning, which is a pre-requisite to deploy PJ.02-W2-21.1. **Routing and Planning provide essential information to identify traffic deviations from planned trajectories.** Note: (Routing and Planning is also a prerequisite of #02)

Table 6: Relationships with other Solutions

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4 Solution Performance Assessment

4.1 Assessment Sources and Summary of Validation Exercise Performance Results

The Solution PJ.02-W2-21.1 builds on the work performed in:

- in **SESAR 1 Solution #02** (Operational Improvement OI AO-0104-A),
- in **SESAR 2020 Wave 1** Solution PJ.03b-01 (Operational Improvement OI AO-0104-B).

The work by PJ.03b-01 on OI AO-0104-B reached maturity level V2 and is continued by this solution targeting V3.

PJ.02-W2-21.1 provides different types of safety alerts (CATC and CMAC) to Controllers at airports with A-SMGCS, extending Solution #02 to taxiways, apron and stand areas. Runway related alerts developed in Solution #02 are enhanced.

Previous Validation Exercises and documents (pre-SESAR2020 Wave 2, etc.) relevant for this assessment are listed below.

Organisation	Document Title	Publishing Date
SESAR 1 Solution #02	**D32** SESAR P06.07.01 OSED for Conflicting ATC Clearances and Conformance Monitoring Alerts for Controller [23]	20/07/2016
SESAR1	Consolidated DEL Release 5 Validation Report (with 06.09.02 T1031) [33]	14/10/2016
SESAR Wave1 (PJ03b-01)	**D2.1.120** - PJ03b-Solution 01 SPR-INTEROP/OSED for V2 [21]	31/07/2019
	D2.1.090 - PJ.03b Solution 01 Validation Report for V2 [22]	31/07/2019

Table 7: Pre-SESAR2020 Deliverables

Organisation	Document Title	Publishing Date
SESAR 1	Consolidated DEL Release 5 Validation Report (with 06.09.02 T1031) [33]	20/07/2016

Table 8: Pre-SESAR2020 Exercises

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Three Validation Exercises were executed in the scope of Solution PJ.02-W2-21:

Exercise ID	Exercise Title	Release	Maturity	Status
PJ.02-21.1 VAL EXE 1	Safety Net Düsseldorf Shadow Mode Trials (V3)	13	V3	Closed
PJ.02-21.1 VAL EXE 3	Real Time Simulation of A-SMGCS Safety Nets (V3)	13	V3	Closed
PJ.02-21.1 VAL EXE 4	Innovative Surface Management combined with Safety Nets (V3)	13	V3	Closed

Table 9: SESAR2020 Wave 2 Validation Exercises

The reference and solution scenarios defined by the solution are different for Runway and Ground Operations:

- **Reference Scenario*:***
  - **CATC Alerts for Runway Operations**: **Solution #02** is the reference for Runway Operations. It implements the detection of the clearance conflicts LND/LND, CROSS/LND and TOF/LND which are enhanced in Solution PJ.02-W2-21.1. The Reference Scenario provides also all other CATC and CMAC alerts implemented in Solution #02.
  - **Ground Operations**: to detect potential clearance conflicts, ATCO **situational awareness** is the reference for Ground Operations, since no CATC alerts for Ground Operations were defined in Solution #02.

  Additional Features:

  - **CATC Predictive Indication** is available in the reference scenario for the CATC alerts supported by **Solution #02**, i.e., CATC for Runway Operations only.
  - **Conditional Clearances** are not available in combination with CATC alerts for Runway Operations (not considered in Solution #02).
- **Solution Scenario:**
  - **Routing and Planning**: Like Solution #02 the CATC alerts in Solution PJ.02-W2-21.1 require Routing and Planning (Solution #22).
  - **CATC Alerts for Runway Operations**: The enhanced CATC Alerts for Runway Operations LND/LND, CROSS/LND and TOF/LND (subject of the validation) replace the Solution #02 alerts for LND/LND, CROSS/LND and TOF/LND conflict. The Solution Scenario provides also all other CATC and CMAC alerts implemented in Solution #02.
    Runway operations are also supported by the new alarms CATC TOF/TOF (converging SID) and RMCA/CMAC versus ATC Clearance.
    - **CATC Alerts for Ground Operations** (subject of the validation)
    - **CMAC Stand occupied** (subject of the validation)

  Additional features:

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- **CATC Predictive Indication** (subject of the validation) for all CATC alerts supported by Solution #02 and PJ.02-W2-21.1.
- **Runway Situational Notifications** (subject of the validation) for runway occupancy and alert status.
- **Conditional Clearances** (subject of the validation) in combination with CATC alerts for Runway Operations.

The following table summarizes the description of the scenarios:

Functions	Reference Scenario	Solution Scenario
Routing and Planning	Solution #22	Solution #22[7]
CATC for Runway Operations	Solution #02	Solution #02 [8] + enhanced CATC Alerts for Runway Operations + new CATC TOF/TOF (converging SID) + RMCA/CMAC versus ATC Clearance
CATC for Ground Operations	"ATCO situational awareness"	CATC Alerts for Ground Operations + CMAC Stand occupied
Additional Features		
Predictive Indication	CATC Predictive Indication for Runway Operations (Sol. #02) No support for Ground Operations	CATC Predictive Indication for Runway Operations CATC Predictive Indication for Ground Operations
Runway Situational Notifications	Not supported	Integrated indication of runway occupancy and alert status.
Conditional Clearances	Not supported	Conditional Clearances used with CATC

Table 10: Summary of Scenarios.

[7] Solution #22 — Automated Assistance to Controller for Surface Movement Planning and Routing

[8] Solution #02 — Airport Safety Nets for controllers: conformance monitoring alerts and detection of conflicting ATC clearances

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The following table provides a summary of information collected from available performance outcomes.

Exercise	OI Step	Exercise scenario & scope	Performance Results	Notes
PJ.02-21.1 VAL EXE 1	AO-0104-B	See Table 7 that provides a summary of the reference and solution scenarios.	Resilience, Safety and Human Performance Results.	
PJ.02-21.1 VAL EXE 3				
PJ.02-21.1 VAL EXE 4				

Table 11: Summary of Validation Results.

This document has been performed mainly using as inputs the following deliverables:

- D6.1.006 Validation Report [24]
- D6.1.001 SPR-INTEROP/OSED- Part V HPAR[31]
- D6.1.001 SPR-INTEROP/OSED- Part II SAR[32]

4.2 Conditions / Assumptions for Applicability

The following Table 12 summarises the applicable operating environments. The benefits reported here are limited to airports equipped with A-SMGCS.

OE	Applicable sub-OE	Special characteristics
Airports	very large / large / medium	Airports with A-SMGCS

Table 12: Applicable Operating Environments.

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4.3 Safety

4.3.1 Safety Design drivers and Performance Mechanism

The Solution PJ.02-W2-21.1- Enhanced airport safety support tools for controllers at A-SMGCS Airports aims at the specification and validation of automated capabilities to detect **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 unauthorised/unidentified traffic. Controllers are provided with alerts generated by such capabilities deployed in the tower environment.

These enhanced and new **alerts** increase controllers' situational awareness and give automated support to avoid hazardous situations. Hence the solution provides relevant **improvements on safety.**

The SAR [32] defines the Safety Criteria **(SAC)** or the acceptable level of safety (i.e., incident and accident risk level) to be achieved by the Solution under assessment, considering its impact on ATM/ANS functional system and its operation.

To obtain these safety benefits, improvements in the performance of the barriers of Accident Incident Model (AIM) were defined. Thus, in SESAR 2020, the Accident Incident Model (AIM) for the Runway Collision and for Taxiway Collision was used to derive the following Safety Acceptance Criteria[9]:

- **SAC #1: The number of Runway Conflicts** arising from inefficient entry/exit management, take-off management or landing management shall be reduced by 7% when ATCO is supported by new notifications and alerts.
- **SAC #2: The number of Taxiway/Apron**[10] conflicts arising from taxiway /apron conflict and from pre-tactical taxiway/apron conflicts shall be reduced by 5% when ATCO is supported by new notifications and alerts.

After considering the pre-existing and system-generated hazards that are impacting the concept studied by PJ02-W2-21.1 it is considered that the new alerting functions impact mostly the Runway Conflict Prevention barrier (B3) and Taxiway Conflict Management barrier (B3). The objective is therefore to improve the performance of these safety barriers to reduce the number of conflicts at the output of these barriers.

The following figures show the Benefit Impact Mechanism for Safety

[9] These SACs have been obtained during an expert session, in which experts have analysed the solution.

[10] Note that there is no specific Accident Incident Model (AIM) for Apron operations and, therefore, the one for Taxiway Collision was adapted as much as possible to apply it to Apron.

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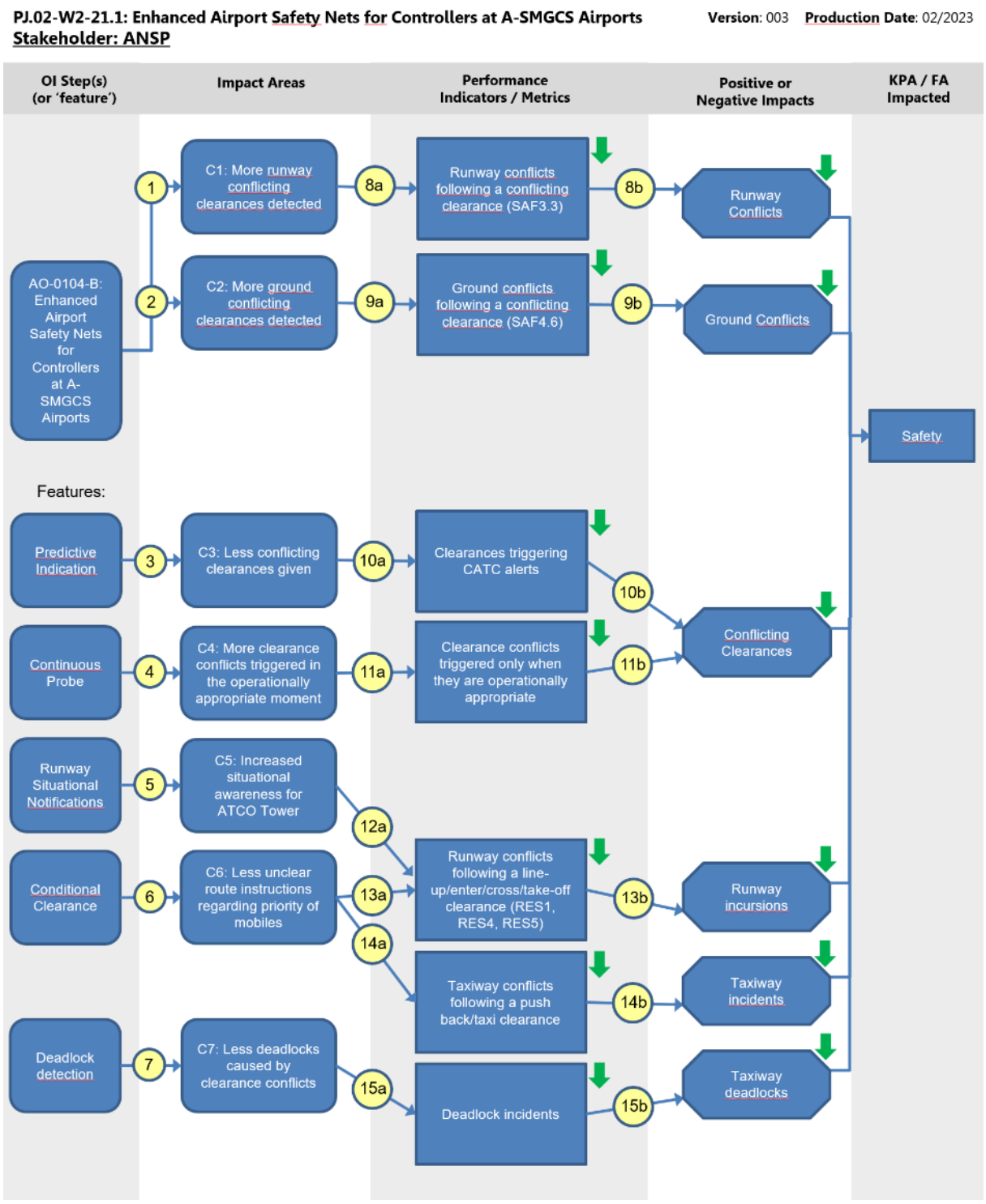

Figure 1 Diagram of stakeholder benefit mechanisms for ANSP [26].

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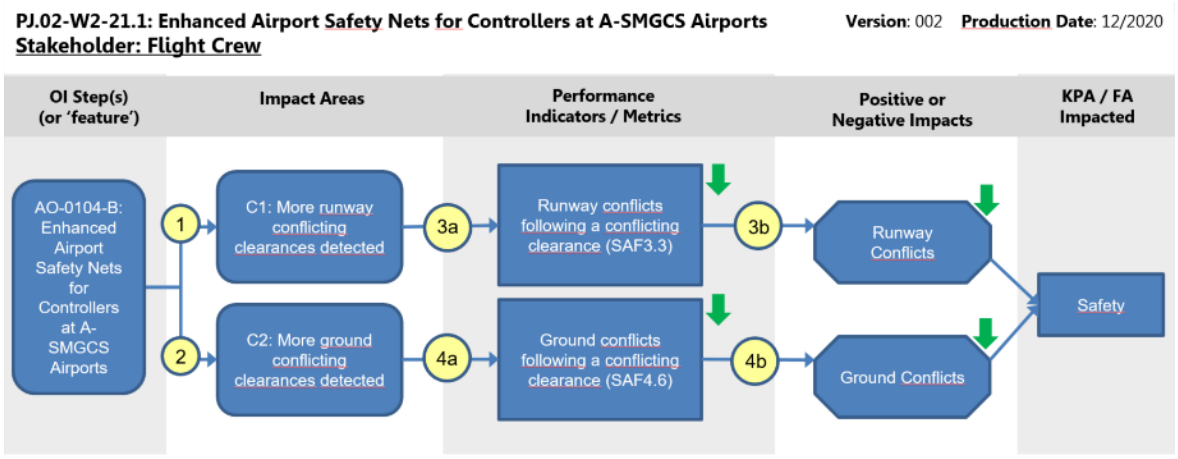

Figure 2 Diagram of stakeholder benefit mechanisms for Flight Crew [26].

4.3.2 Data collection and Assessment

The following safety objective was defined in the VALR [24] (see section 4.2.7.1) to cover safety aspects:

- **OBJ-02.21.1-V3-VALP-SAF-001. To assess the impact in terms of Safety of the introduction of the Enhanced Safety Support Tools.**
  - **CRT-0.21.1-V3-VALP-SAF-001-001.** The situational awareness will be improved
  - **CRT-0.21.1-V3-VALP-SAF-001-002.** The proportion of Runway conflicts will decrease (compared to the reference)
  - **CRT-0.21.1-V3-VALP-SAF-001-003.** The proportion of Ground Conflicts (taxiway and apron) will decrease (compared to the reference)

This objective was covered by the 3 validation exercises performed within the solution.

A qualitative analysis was performed in all the exercises based on questionnaires, interviews and debriefings providing the following results:

- ATCOs confirm that the validated safety support tools improve situational awareness.
- The number of conflicts on runways, taxiways and apron is reduced by the validated safety support tools (Alerts and Predictive Indication) compared to the reference.

Moreover, the validation exercise PJ.02-21.1 VAL EXE 3 performed a quantitative analysis to assess SC002 and SC003 providing the following results:

	Reference Scenario	Solution Scenario	% improvement
Runway Conflicts	3	0	100%
Ground Conflicts	3	0	100%

Table 13: Reduction of Runway and Ground Conflicts in PJ.02-21.1 VAL EXE 3

More details can be found in VALR [24] (section B.3.2.29).[24]

However, the **confidence in performance results** was rated as **medium/low** due to the following limitations that made it difficult to quantify conflicts:

- limited number of runs.
- difficulties for causing conflicts simulating a realistic environment.

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Although confidence in the metrics obtained cannot be considered high, this assessment, along with the qualitative analysis, showed a positive impact of the new enhanced safety net alerts.

In order to complement this metrics and with the aim of providing a more realistic results a last safety analysis based on statistics has been performed by the safety experts. The analysis collects and analyses the incidents that happened in Madrid-Barajas, Barcelona-El Prat and Palma de Mallorca Airports from January 2019 to June 2022. This activity analyses the **causes of the incident** and evaluate if the incident could have avoided with the use of these new enhanced alerts or with the predictive indicator.

These factors are based on expert judgment and the positive results that the concept has demonstrated.

The analysis of each specific incident occurred in these 3 Spanish airports suggests that with the use and implementation of the PJ.02-W2-21.1 concept the incidents could have reduced by:

	% Improvement
Runway Incidents	75% reduction of incidents
Ground Conflicts (Taxiways/Apron)	65% reduction of incidents

Table 14: Quantitative conflicts analysis based on statistics

This analysis was performing assuming that:

- the system works 100% (without any failure, false or missing alert)
- the controller pays attention to the alert
- The controller acts properly to solve the conflict.

Despite the good results obtained during the validation exercises there is a possibility that the controllers cannot avoid the incident (i.e., he/she ignores the alert, or doesn´t understand the alert, etc.), or the system does not work properly, hence the following assumptions have been performed:

Assumptions		% Improvement
1	% of the alerts correctly perceived and understood by the controller (controller acts on and resolves the incident)	95%
2	% of the alerts showed properly by the system	90%
3	The % of reduction of incidents with the use of the new enhanced safety nets will be the same than the reduction of accidents (based on the diagrams of AIM model)	---

Table 15: Assumptions 1 & 2 & 3

Hence, applying the assumptions described in Table 15, the following results in SAF3.X and SAF4.X were obtained:

	% Improvement
SAF3.X: RWY-collision accident	75% x 0,95 x0,90 = **64,1%**
SAF4.X: RWY-collision accident	65% x 0,95 x0,90 = **55,5%**

Table 16: Estimation of indicators: SAF3.X and SAF4.X

4.3.3 Extrapolation to ECAC wide

As mentioned in section 4.2 the solution PJ.02-W2-21.1 will be applied to the following OE: very large, large and medium airports.

The following values (except fourth column) extracted from the Common Assumption [8] (Aggregation Assumptions_2035) were considered to extrapolate them to ECAC level:

Sub-OE	Year	Value	%Traffic per OE	Unit	Comment
Very Large Airport	2035	0,711	42,5% ECAC traffic	Movements/flight	contribution to total APT traffic from the specific sub-OE
Large Airport	2035	0,2130	12,75% ECAC traffic	Movements/flight	contribution to total APT traffic from the specific sub-OE
Medium Airport	2035	0,4527	27,1% ECAC traffic	Movements/flight	contribution to total APT traffic from the specific sub-OE
Small Airport	2035	0,1505	9% ECAC traffic	Movements/flight	contribution to total APT traffic from the specific sub-OE
Other Airport	2035	0,1436	8,65% ECAC traffic	Movements/flight	contribution to total APT traffic from the specific sub-OE

Table 17: SAF3.X and SAF4.X Extrapolation to ECAC Area

The following assumption was taken into account to perform the extrapolation to the ECAC level:

Assumption 4
The proportion of incidents/accidents is proportional to the volume of traffic at the airport

Table 18: Assumption 4

Considering the proportion of traffic per OE presented in the fourth column of Table 17 (calculated based on the values of the third column in Table 17), the indicators SAF3.X and SAF4.X extrapolated to ECAC level are as follows:

	% improvement ECAC area
SAF3.X: RWY-collision accident	64,1 % x (0,425+0,1275+0,271) = **52,7%**
SAF4.X: RWY-collision accident	55, 5% x (0,425+0,1275+0,271) = **45,7 %**

Table 19: SAF3.X and SAF4.X extrapolated to ECAC Area

The results obtained are conservative considering “Assumption 3” (probably the proportion of incidents/accidents is higher at very large and large airports and not directly proportional to traffic volume).

4.3.4 Discussion of Assessment Result

The quantitative and qualitative results shows that the solution PJ.02-W2-21.1 provides an important improvement on safety.

4.3.5 Additional Comments and Notes

The benefits reported here are limited to airports equipped with A-SMGCS.

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4.4 Environment: Fuel Efficiency / CO2 emissions

Does the Solution impact this KPA? No

4.4.1 Performance Mechanism

Is there a Benefit Mechanism available? No

4.4.2 Assessment Data (Exercises and Expectations)

4.4.3 Extrapolation to ECAC wide

4.4.4 Discussion of Assessment Result.

4.4.5 Additional Comments and Notes

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4.5 Environment / Emissions, Noise and Local Air Quality

Does the Solution impact this KPA? No

4.5.1 Performance Mechanism

Is there a Benefit Mechanism available? No

4.5.2 Assessment Data (Exercises and Expectations)

4.5.3 Extrapolation to ECAC wide.

4.5.4 Discussion of Assessment Result

4.5.5 Additional Comments and Notes

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4.6 Airspace Capacity (Throughput / Airspace Volume & Time)

Does the Solution impact this KPA? No

Is there a Benefit Mechanism available? No

4.6.1 Assessment Data (Exercises and Expectations)

4.6.2 Extrapolation to ECAC wide

4.6.3 Discussion of Assessment Result

4.6.4 Additional Comments and Notes

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4.7 Airport Capacity (Runway Throughput Flights/Hour)

Does the Solution impact this KPA? No

4.7.1 Performance Mechanism

Is there a Benefit Mechanism available? No

4.7.2 Assessment Data (Exercises and Expectations)

4.7.3 Extrapolation to ECAC wide.

4.7.4 Discussion of Assessment Result

4.7.5 Additional Comments and Notes

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4.8 Resilience (% Loss of Airport & Airspace Capacity Avoided)

Does the Solution impact this KPA? Yes

4.8.1 Performance Mechanism

Is there a Benefit Mechanism available? Yes (see below)

This solution updates and extends the Airport Safety Nets **Conflicting ATC Clearances** (CATC) and **Conformance Monitoring Alerts for Controllers** (CMAC) to cover the entire airport surface.

The Safety Support Tools for controllers upgrade the Advanced Surface Movement Guidance and Control System (A-SMGCS) to detect **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 unauthorised/unidentified traffic.

Appropriate predictive indications and alerts are provided to controllers increasing situational awareness and giving support in order to **avoid hazardous situations**. Hence, this is expected to raise benefits by reducing:

- Taxiway and runway incidents
- Taxiway and runway collisions

It will lead consequently to an improvement of Resilience by:

- a reduction of delays, diversions and cancelations caused by these incidents
- a reduction of damaged and destroyed aircrafts due to the reduction of collisions.

The following figures show the Benefit Mechanism and the impact on Resilience:

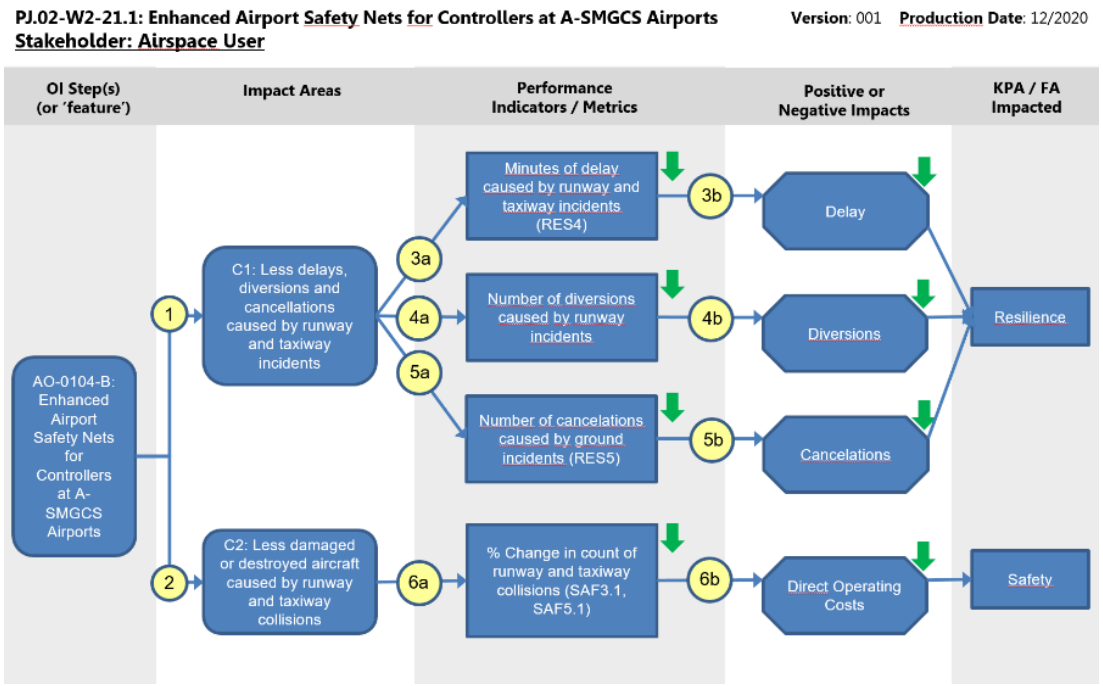

Figure 3 Diagram of stakeholder benefit mechanisms for Airspace User [26].

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Figure 4 Diagram of stakeholder benefit mechanisms for Airport [26].

4.8.2 Assessment Data (Exercises and Expectations)

This solution considers the Resilience **PIs RES1, RES4** and **RES5**. Benefit Impact Mechanisms (BIMs) showed above clearly state how the solution PJ.02-W2-21.1 has impact on Resilience.

The figures provided in this section are based on:

- expert judgment and
- the values obtained in safety section (see 4.3) regarding % of reduction of Ground and Runway conflicts/accidents.

This section considers the following classification of safety accidents and serious incidents (high probability of accident):

- Runway collisions for occurrences in runways,
- Taxiway collisions for occurrences in taxiways,
- Airborne collisions for departure occurrence (climbing phase below 3,000 ft) are considered as runway occurrences.

The safety occurrences will have an impact on the Airport Resilience (considered in the BIMs; see above), enabling the estimation of part of the benefits in terms of avoided costs of delays, cancellations and diversions. Here, the same approach is used to estimate the Resilience PIs (see calculations below).

The followed approach compares the solution scenario (where the hazardous situation is avoided) with the reference scenario (where the hazardous situation occurs), being the benefit delta, the solution could bring.

Other contributions to Resilience are not considered in this assessment:

- No solid public statistics data is available for "disruptions in operations", e.g. missed approach, cancelled take-off, unplanned braking, unplanned stops, etc., which may happen as result of a safety incident. Here **CATC and CMAC alerts** contribute to Resilience by enabling the controller to manage the potentially hazardous situation early enough before an incident evolves and "disruptions in operations" emerge.

- To avoid "disruptions in operations" even earlier the **CATC Predictive Indication** (see D6.1.001 PJ.02-W2-21.1 SPR-INTEROP/OSED for V3[26]) informs the controller in case the intended entering of a clearance will trigger a CATC alert. This Predictive Indication uses the CATC algorithms under the assumption that the intended clearance input is given at this very moment and displays the result of this "What-if test". This supports the controller's decision making, helps to maintain a smooth traffic flow and, consequently, contributes to Resilience.

Both, the CATC and CMAC alerts and the Predictive Indication contribute to Resilience. It is likely that the use of the Predictive Indication sums up to a significant impact on Resilience, **however, it was not possible to measure it directly in the validation exercises, so this impact has been estimated.**

4.8.2.1 Resilience PI Calculations

To follow the calculations below it is recommended to read section 4.2 of the CBA [25]. The calculations here use the same data and assumptions as the CBA calculations.

4.8.2.1.1 RES 1 calculation

The Performance Framework [3] defines the KPI RES1 as follow:

PIs	Unit	Calculation
RES1 Loss of Airport Capacity Avoided	% and Movements per hour	Loss of Airport Capacity with the concept divided by the loss of Airport Capacity without the concept.

Table 20: RES1 Calculation

TWY Capacity loss	Capacity loss	Source or calculation
In peak hour	15%	Expert judgement
In non-peak hour	6%	Expert judgement
75% peak hour + 25% non-peak hour	12.75%	15 x 0.75 + 6 x 0.25 = 12.75%
Avoided Capacity loss	12,75 x 0,457 = **5,82**	(75% Peak hour + 25% Non-peak hour) x (Avoided number of safety occurrences in TWY; see SAF4.X)

Table 21: TWY Capacity loss

RWY Capacity loss	Capacity loss	Source or calculation
In peak hour	33%	Expert judgement
In non-peak hour	7,7%	Expert judgement
75% peak hour + 25% non-peak hour	26,68%	33 x 0.75 + 7.7 x 0.25 = 26.68%
Avoided Capacity loss	26,68% x 0,527= **14,0**	(75% Peak hour + 25% Non-peak hour) x (Avoided runway accident per year, see SAF3.X)

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Table 22: RWY Capacity loss

RES1: Loss of Airport Capacity Avoided:

TWY + RWY Capacity loss	Capacity loss	Source or calculation
Avoided Capacity loss (RES1)	5,82% + 14% = **19,82%**	(TWY Capacity loss avoided per year) + (RWY Capacity loss avoided per year)

Table 23: RWY + TWY Capacity loss

RES1.1: Airport time to recover from non-nominal to nominal condition has not been calculated because "Airport recovery time" doesn´t depend on the Solution PJ.02-21.1. but also other factors and actors.

4.8.2.1.2 RES4 and RES5 calculation

The Performance Framework [3] defines the KPI RES4 and RES5 as follow:

PIs	Unit	Calculation
RES4 Minutes of delays	Minutes	Impact on AUs measured through delays resulting from capacity degradation[11]. RES1 and RES2 KPIs drive this PI, though the PI may need to be measured on a condition-by-condition basis (e.g. fog, wind, system outage).
RES5 Number of cancellations	No flights	Impact on AUs measured through Cancellations resulting from capacity degradation[12]. RES1 and RES2 KPIs drive this PI, though the PI may need to be measured on a condition-by-condition basis (e.g. fog, wind, system outage).

Table 24: RES4 + RES5

TWY accidents	Minutes of tactical delay	Number of cancelations	Source or calculation
In peak hour	1800	5	Expert judgement
In non-peak hour	480	1	Expert judgement
75% peak hour + 25% non-peak hour	1470	4	1800 x 0.75 + 480 x 0.25 = 1470
Avoided Capacity loss	1470 x 0.457 = **671,7**	4 x 0.457 = **1,82**	(75% Peak hour + 25% Non-peak hour) x (Avoided number of safety occurrences in TWY, see SAF4.X);

Table 25: TWY accidents RES4 & RES5

RWY accidents	Minutes of tactical delay	Number of cancelations	Source or calculation

[11] Reactionary delay out of the scope since they could be due to many different reasons other than capacity degradation, in addition the cause of reactionary delay are not recorded in detail.

[12] Reactionary delay out of the scope since they could be due to many different reasons other than capacity degradation, in addition the cause of reactionary delay are not recorded in detail.

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In peak hour	2520	12	Expert judgement
In non-peak hour	480	1	Expert judgement
75% peak hour + 25% non-peak hour	2010	9.3	2520 x 0.75 + 480 x 0.25 = 2010
Avoided Capacity loss	2010 x 0.527 = **1059,2**	9.3 x 0.527 = **4.9**	(75% Peak hour + 25% Non-peak hour) x (Avoided runway accident see SAF3.X)

Table 26: RWY accidents RES4 & RES5

RWY safety serious incidents	Minutes of tactical delay	Source or calculation
Avoided Capacity loss	1.03 * 30 = **30,9**	(Avoided runway serious incident) x (Go-around time)

Table 27: RWY safety serious incidents

RES4: Minutes of delays:

TWY accidents + RWY accidents + RWY safety serious incidents	Minutes of tactical delay	Source or calculation
Avoided Capacity loss **(RES4)**	1059,2 + 671,7 + 30,9 = **1761,8**	Expert judgement

Table 28: RES4 Minutes of delays

RES5: Number of cancellations:

TWY accidents + RWY accidents + RWY safety serious incidents	Number of cancelations	Source or calculation
Avoided Capacity loss **(RES5)**	4,9 + 1,8 = **6,7**	Expert judgement

Table 29: RES5 Number of cancellations

Exercise ID or Expert judgement	Benefits contribution to RES1	Benefits contribution to RES4	Benefits contribution to RES5
PJ.02-21.1 VAL EXE 1	The impact on Resilience have been mainly calculated using expert judgement		
PJ.02-21.1 VAL EXE 3			
PJ.02-21.1 VAL EXE 4			

Table 30: Resilience benefits per Exercise

The only OI that has been validated in PJ.02-W2-21.1 is AO-0104-B as can be seen in the following Table:

OI step	Relative benefits contribution to RES1	Relative benefits contribution to RES1.1	Relative benefits contribution to RES2	Relative benefits contribution to RES2.1	Relative benefits contribution to RES4	Relative benefits contribution to RES5
AO-0104-B	100%				100%	100%
TOTAL	100%				100%	100%

Table 31: Resilience relative benefits per OI step

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The following table summarizes the impact of Solution PJ.02-W2-21.1 on the KPIs of Resilience

RES1 Loss of Airport Capacity Avoided	% and Movements per hour	Loss of Airport Capacity with the concept divided by the loss of Airport Capacity without the concept.	YES	**19,82%**	**70%**
RES4 Minutes of delays	Minutes	Impact on AUs measured through delays resulting from capacity degradation[13]. RES1 and RES2 KPIs drive this PI, though the PI may need to be measured on a condition-by-condition basis (e.g. fog, wind, system outage).	YES	**1761,8**	**70%**
RES5 Number of cancellations	No flights	Impact on AUs measured through Cancellations resulting from capacity degradation[14]. RES1 and RES2 KPIs drive this PI, though the PI may need to be measured on a condition-by-condition basis (e.g. fog, wind, system outage).	YES	**6,7**	**70%**

Table 32: Resilience for Mandatory PIs

Were there any benefits obtained in SESAR2020 Wave1 for this Solution?

Yes, but no benefits addressing Resilience.

If yes, does the S2020 Wave2 performance comes in addition to S2020 Wave1 or replace it?

The previous solutions addressing CATC and CMAC were Solution #02 (SESAR 1, V3 maturity reached) and Solution PJ03b-01 (SESAR 2020/Wave 1, V2 maturity reached). Solution PJ.02-W2-21.1 enhances Solution #02 and continues the work of PJ03b-01.

The Performance improvement for Resilience PI was not considered in the scope of solution #02 and solution PJ03b-01 (see D2.1.120 PJ03B-01 SPR-INTEROP/OSED V2 Part V - Performance Assessment Report, ed. 01.00.00).

4.8.3 Extrapolation to ECAC wide

N/A

4.8.4 Discussion of Assessment Result

The above assessment can only infer the impact of the solution on direct incident prevention. It is actually impossible to record how many incidents are prevented early by predictive indication or in time by an alert. And even if there hadn't really been an incident without the safety net support, the

[13] Reactionary delay out of the scope since they could be due to many different reasons other than capacity degradation, in addition the cause of reactionary delay are not recorded in detail.

[14] Reactionary delay out of the scope since they could be due to many different reasons other than capacity degradation, in addition the cause of reactionary delay are not recorded in detail.

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late mitigation actions by the controller might not have prevented a traffic jam on the taxiways or a turnaround due to a blocked runway. The above assessment does not take into account the impact of traffic flow that is incurred or that needs to be rerouted. All the tiny delays avoided will most likely add up to a resiliency impact much larger than the calculations presented above. We are confident that the results represent only the minimum resilience benefit, which will easily be exceeded, especially with the expected increase in traffic in the future.

4.8.5 Additional Comments and Notes

The benefits reported here are limited to airports equipped with A-SMGCS.

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4.9 Flight Times

Does the Solution impact this KPA? No

4.9.1 Performance Mechanism

Is there a Benefit Mechanism available? No

4.9.2 Assessment Data (Exercises and Expectations)

4.9.3 Extrapolation to ECAC wide

4.9.4 Discussion of Assessment Result

4.9.5 Additional Comments and Notes

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4.10Predictability

Does the Solution impact this KPA? No

4.10.1Performance Mechanism

Is there a Benefit Mechanism available? No.

4.10.2Assessment Data (Exercises and Expectations)

4.10.3Extrapolation to ECAC wide

4.10.4Discussion of Assessment Result

4.10.5Additional Comments and Notes

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4.11Punctuality

Does the Solution impact this KPA? No

.Performance Mechanism

Is there a Benefit Mechanism available? No.

4.11.2Assessment Data (Exercises and Expectations)

4.11.3Extrapolation to ECAC wide

4.11.4Discussion of Assessment Result

4.11.5Additional Comments and Notes

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4.12Civil-Military Cooperation and Coordination (Distance and Fuel)

Does the Solution impact this KPA? No

4.12.1Performance Mechanism

Is there a Benefit Mechanism available? No

4.12.2Assessment Data (Exercises and Expectations)

4.12.3Extrapolation to ECAC wide

4.12.4Discussion of Assessment Result

4.12.5Additional Comments and Notes

4.13Flexibility

Does the Solution impact this KPA? No

4.13.1Performance Mechanism

Is there a Benefit Mechanism available? No.

4.13.2Assessment Data (Exercises and Expectations)

4.13.3Additional Comments and Notes

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4.14Cost Efficiency

Does the Solution impact this KPA? No

4.14.1Performance Mechanism

Is there a Benefit Mechanism available? No.

4.14.2Assessment Data (Exercises and Expectations)

4.14.3Extrapolation to ECAC wide

4.14.4Discussion of Assessment Result

4.14.5Additional Comments and Notes

Airspace User Cost Efficiency

Does the Solution impact this KPA? No

4.15.1Performance Mechanism

Is there a Benefit Mechanism available? No.

4.15.2Assessment Data (Exercises and Expectations)

4.15.3Extrapolation to ECAC wide

4.15.4Additional Comments and Notes

4.16Security

Does the Solution impact this KPA? Yes

4.16.1The SecRAM 2.0 methodology and the Security Performance Mechanism

The V3 Security Assessment was performed using SecRAM (SESAR ATM safety risk assessment method) and documented in PJ.02-W2-21.1 Security Risk Assessment, ed. 00.00.02, 2022, but due to the confidentiality of the results, they cannot be shared in this document, except for the safety requirements (see SPR-INTEROP/OSED Part I [26]).

4.16.2Security Assessment Data Collection

The safety assessment was performed based on expert judgments .

PIs	Unit	Calculation	Mandatory	Current value
SEC1 A security risk assessment has been carried out	Binary Vector – with maximum 7 components with Y/N (according to the prioritization and maturity level of the solution)	A security risk assessment has been carried out applying SecRAM 2.0, and the following steps have each been carried out : The identification of Primary Assets, Supporting Assets, Threat Scenarios and Vulnerabilities. The evaluation of Impacts, Likelihoods and Risks.	YES (different steps are strongly recommended for different maturity levels)	*Y, Y, Y, Y, Y, Y, Y*
SEC2 Risk Treatment has been carried out	Binary Vector – 2 components with Y/N	Following SecRAM 2.0, Security controls have been identified by Security Experts and implemented in the Solution.	YES (Implementation just at higher maturity levels – V4)	*Y, Y*
SEC3 Residual risk after treatment meets security objective.	Risk Level – 2 levels are possible: medium or low	After Security Controls have been implemented, the Risk Level achieved per Supporting Asset decreases (H → M, M→L, H→L). It is important to notice that according to SecRAM the Risk Level achieved should be "Low" otherwise justifications must be provided.	YES	*Low*

Table 33: Security benefit for Mandatory PIs

4.16.3Extrapolation to ECAC wide

No ECAC-wide extrapolation is required for this KPI.

4.16.4Discussion of Assessment Result

For confidentiality reasons, the SRAs performed cannot be disclosed or shared with partners outside the solution.

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In any case, you will find the list of identified safety requirements in the SPR-INTEROP/OSED Part I [26].

4.16.5Additional Comments and Notes

N/A.

4.17Human Performance

4.17.1HP arguments, activities and metrics

This section summarizes the impact of the solution in Human Performance. It has been extracted directly from the HPAR[31].

The following table summarize the HP activities carried out by the solution:

- **Activity 1: Workshop Series**. The workshop series for the preparation of validation exercise EXE 1, conducted by **DFS**, carries out a long-term analysis of recorded EDDL traffic development. The goal is to iteratively improve the CATC alerts in order to optimize their acceptance by the ATCOs. The workshops were used to examine the controller opinions about the new and enhanced CATC alerts introduced by Solution PJ.02-W2-21.1. Getting feedback from controllers on their user experience and iteratively improving the solution accordingly is key to a successful validation exercise.
- **Activity 2:** Shadow-Mode Trial. Validation Exercise **PJ.02-21 Val EXE 1** conducted by **DFS**
- **Activity3:** Real Time Simulation. Validation Exercise **PJ.02-21 Val EXE 3** conducted by **ENAIRE**
- **Activity 4**: Real Time Simulation. Validation Exercise **PJ.02-21 Val EXE 4** "Innovative Surface Management combined with Safety Nets" conducted by **LEONARDO.**

The validation exercises included questionnaires, interviews and debriefing sessions that were analyzed to evaluate the HP aspects impacted by the solution. The following Table summarizes the change assessment included in the HPAR [31] of PJ.02.21-W2-21.1:

- **HP1.3 Tasks.** The main change to controller tasks concerns the management of new and extended alerts on the HMI (the management of the corresponding conflicts is not expected to change). However, there are no changes in working procedures associated with the new alerts.
- **HP2.1 Allocation of Tasks (Human & System).** The detection of conflicts in the solution is performed in parallel by the machine, as it is by the controller.
- **HP2.2 Performance of Technical System.** Technical systems incorporate alert algorithms in the solution, able to:
    - Extrapolate the behaviour of aircraft, and
    - Customise triggering and termination conditions to reduce nuisances and false alerts.
    - Customise the priority of alerts to support the local procedures.
    - The timeliness of the new alerts provided by the system needs to be adequate for triggering the controller's task to manage the corresponding conflict.
- **HP2.3 Human Machine Interface.** The colour-coding, alert-naming, alert label look and feel, predictive indication usability for new and extended alerts in the solution HMI have evolved to provide a global visual coherence and perceived prioritisation. Input devices have not changed.

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- **HP 4.1 Acceptance &Job Satisfaction.** If the system is usable and the automation support provided leads to the expected reduction in mental workload and an improvement in situational awareness, this should have a positive impact on acceptability of the system and procedures and the job satisfaction.
- **HP4.5. Training needs.**

PIs	Activities & Metrics	Second level indicators	Covered
HP1 Consistency of human role with respect to human capabilities and limitations	WORKSHOP INTERVIEW QUESTIONNAIRE DEBRIEFING SESSIONS	**HP1.1** Clarity and completeness of role and responsibilities of human actors	**N/A**
		HP1.2 Adequacy of operating methods (procedures) in supporting human performance	**CLOSED**
		HP1.3 Capability of human actors to achieve their tasks in a timely manner, with limited error rate and acceptable workload level	**CLOSED**
HP2 Suitability of technical system in supporting the tasks of human actors	WORKSHOP INTERVIEW QUESTIONNAIRE DEBRIEFING SESSIONS	**HP2.1** Adequacy of allocation of tasks between the human and the machine (i.e. level of automation).	**CLOSED**
		HP2.2 Adequacy of technical systems in supporting Human Performance with respect to timeliness of system responses and accuracy of information provided	**CLOSED**
		HP2.3 Adequacy of the human machine interface in supporting the human in carrying out their tasks.	**CLOSED**
HP3 Adequacy of team structure and team communication in supporting the human actors	WORKSHOP INTERVIEW QUESTIONNAIRE DEBRIEFING SESSIONS	**HP3.1** Adequacy of team composition in terms of identified roles	**N/A**
		HP3.2 Adequacy of task allocation among human actors	**N/A**
		HP3.3 Adequacy of team communication with regard to information type, technical enablers and impact on situation awareness/workload	**CLOSED**
HP4	WORKSHOP INTERVIEW	**HP4.1** User acceptability of the proposed solution	**CLOSED**
		HP4.2 Feasibility in relation to changes in competence requirements	**N/A**
		HP4.3	**N/A**

PIs	Activities & Metrics	Second level indicators	Covered
Feasibility with regard to HP-related transition factors	QUESTIONNAIRE DEBRIEFING SESSIONS	Feasibility in relation to changes in staffing levels, shift organization and workforce relocation.	
		HP4.4 Feasibility in relation to changes in recruitment and selection requirements .	**N/A**
		HP4.5 Feasibility in terms of changes in training needs with regard to its contents, duration and modality.	**CLOSED**

Table 34: HP arguments, activities and metrics

4.17.2Extrapolation to ECAC wide

Not applicable

4.17.3Open HP issues/ recommendations and requirements

This section collects and quantifies the open issues and benefits, and the number of recommendations and requirements related to HP. All the information has been extracted directly from the HPAR [31].

More details can be seen in HPAR (section 4.4.1).

PIs	Number of open issues/ benefits	Nr. of recommendations	Number of requirements
HP1 Consistency of human role with respect to human capabilities and limitations	0	1	1
HP2 Suitability of technical system in supporting the tasks of human actors	0	3	1
HP3 Adequacy of team structure and team communication in supporting the human actors	0	0	0
HP4 Feasibility with regard to HP-related transition factors	0	0	4

Table 35: Open HP issues/ recommendations and requirements

4.17.4Concept interaction

No interaction has been identified with other solutions.

4.17.5Most important HP issues

The following table shows some important issues that might have a major impact on the performance of the solution PJ.02-W2-21.1.

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No issues that could impact on other solutions have been identified.

PIs	Most important issue of the solution	Most important issues due to solution interdependencies
HP1 Consistency of human role with respect to human capabilities and limitations	N/A	N/A
	N/A	N/A
	In case the new alerts generate too many nuisance alerts this might lead to misunderstandings of the human operator and to mistakes based on the alerts displayed. In addition, the nuisance alerts might distract the human operator from his/her current tasks, leading to a potential increase in human errors.	N/A
HP2 Suitability of technical system in supporting the tasks of human actors	The controller does not understand the rules and conditions that trigger the new CMAC alerts. Consequently, s/he is not able to correctly assess the situation and the conflicting clearances.	N/A
	N/A	N/A
	Identification of mobiles involved in the conflicting situation indicated by the alert is easily recognizable.	N/A
HP3 Adequacy of team structure and team communication in supporting the human actors	N/A	N/A
	N/A	N/A
	Controllers are aware of the critical situations taking place in the AoR of other controllers.	N/A
HP4 Feasibility with regard to HP-related transition factors	If the new alerts are proven to be accurate, complete and usable (timeliness), their operation will not lead to a reduced job satisfaction perceived by the human operator.	N/A
	N/A	N/A
	N/A	N/A
	N/A	N/A
	The information that needs to be given to the controller in the training on the new alerts has to be specified. The adequate training enables the controller to recognise the alert, perceive the information provided and to decide what actions need to be executed.	N/A

Table 36: Most important HP issues

4.17.6Additional Comments and Notes

The benefits reported here are limited to airports equipped with A-SMGCS.

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4.18Other PIs

4.18.1Performance Mechanism

4.18.2Assessment Data (Exercises and Expectations)

4.18.3Additional Comments and Notes

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Gap Analysis

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits at Network Level (ECAC Wide or Local depending on the KPI)[15]	Rationale[16]
SAF1: Safety - Total number of estimated accidents with ATM Contribution per year	The results of the validation activities have demonstrated that Solution PJ.02-W2 provides a positive impact on safety.		
FEFF1: Fuel Efficiency - Actual average fuel burn per flight			
CAP1: TMA Airspace Capacity - TMA throughput, in challenging airspace, per unit time.			
CAP2: En-Route Airspace Capacity - En-route throughput, in challenging airspace, per unit time			
CAP3: Airport Capacity – Peak Runway Throughput (Mixed mode).			
TEFF1: Gate-to-gate flight time			
PRD1: Predictability – Average of Difference			

[15] Negative impacts are indicated in red.

[16] Discuss the outcome if the gap indicates a different understanding of the contribution of the Solution (for example, the Solution is enabling other Solutions and therefore is not contributing a direct benefit). **Please contact your PJ19.04 Solution Champion to clarify when the Gap Rational is needed.**

in actual & Flight Plan or RBT durations			
PUN1: Punctuality – Average departure delay per flight			
CEF2: ATCO Productivity – Flights per ATCO -Hour on duty			
CEF3: Technology Cost – Cost per flight			

Table 37: Gap analysis Summary

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5 References

[1] 08.01.03 D47: AIRM v4.1.0

[2] B05 Performance Assessment Methodology for Step 1 PJ19.04.01 Methodology for Performance Assessment Results Consolidation (2020)[17]

[3] SESAR Performance Framework (2019), Edition 01.00.01, Dec 2019

https://stellar.sesarju.eu/?link=true&domainName=saas&redirectUrl=%2Fjsp%2Fproject%2Fproject.jsp%3FobjId%3Dxrn%3Adatabase%3Aondb%2Frecord%2F16414675

[4] Performance Assessment and Gap Analysis Report (2019), Edition 00.01.02, Dec 2019

[5] Methodology for the Performance Planning and Master Plan Maintenance, Edition 0.13, Dec 2017

Content Integration

[6] SESAR ATM Lexicon

Performance Management

[7] PJ19.04 D4.1 Validation Targets - Wave 2 (2020)[18]

[8] PJ19.04 D4.0.30 SESAR2020 Common Assumptions 2019-Edition 01.00.00 , Sept 2019

Validation

[9] European Operational Concept Validation Methodology (E-OCVM) - 3.0 [February 2010]

Safety

[10] SESAR, Safety Reference Material, Edition 4.0, April 2016

https://stellar.sesarju.eu/jsp/project/qproject.jsp?objId=1795089.13&resetHistory=true&statInfo=Ogp&domainName=saas

[11] SESAR, Guidance to Apply the Safety Reference Material, Edition 3.0, April 2016

https://stellar.sesarju.eu/jsp/project/qproject.jsp?objId=1795102.13&resetHistory=true&statInfo=Ogp&domainName=saas

[12] SESAR, Final Guidance Material to Execute Proof of Concept, Ed00.04.00, August 2015

[17] At the time of the creation of the PAR template, the Methodology (PJ19.04 Internal Document) is foreseen to be update in 2020.

[18] At the time of the creation of the PAR template the Validation Target is foreseen to be delivered in June 2020

[13]Accident Incident Models – AIM, release 2017

https://stellar.sesarju.eu/servlet/dl/ShowDocumentContent?doc_id=3658775.13&att=attachment&statEvent=Download

Human Performance

[14]16.06.05 D 27 HP Reference Material D27

[15]16.04.02 D04 e-HP Repository - Release note

Environment Assessment

[16]SESAR, Environment Assessment Process (2019), PJ19.4.2, Deliverable D4.0.080, Sep 2019.

https://stellar.sesarju.eu/servlet/dl/DownloadServlet?downloadKey=xrn%3Adatabase%3Aondb%2Frecord%2F14665451&resuming=true&zip=true&disposition=attachment&domainName=saas&domainName=saas

[17]ICAO CAEP – "Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes" document, Doc 10031.

https://www.icao.int/publications/pages/publication.aspx?docnum=10031

Security

[18]16.06.02 D103 SESAR Security Ref Material Level

[19]16.06.02 D137 Minimum Set of Security Controls (MSSCs).

[20]16.06.02 D131 Security Database Application (CTRL_S)

Others

[21]SESAR Solution PJ.03b-01 - D2.1.120 SPR-INTEROP/OSED for V2. Edition 01.00.00, 31 July 2019.

[22]SESAR Solution PJ.03b-01 - D2.1.090 - Validation Report (VALR) for V2, edition 01.00.00, 31/07/2019

[23]SESAR D32 P06.07.01 Final OSED for Conflicting ATC Clearances and Conformance Monitoring Alerts for Controllers, V00.01.01 Dated 10/11/2016.

[24]SESAR Solution PJ.02-W2-21.1 – D6.1.006 - Validation Report (VALR) for V3, edition 00.01.02, 24 May 2023.

[25]SESAR Solution PJ.02-W2-21.1- D6.1.010 – CBA for V3, Edition 00.01.03, 24 May 2023.

[26]SESAR Solution PJ.02-W2-21.1 – D6.1.002 - SPR/INTEROP OSED for V3 – Part I, Edition 00.02.02, 24 May 2023.

[27]EUROCONTROL Specification for Advanced-Surface Movement Guidance and Control System (A-SMGCS) Services – Specification, V2.0, Dated 22 April 2020, EUROCONTROL-SPEC-171.

[28]ICAO (Doc. 9830) A-SMGCS Manual First Edition, ICAO Montreal, Canada 2004.

[29]ICAO (Doc. 9883) Manual on Global Performance of the Air Navigation System

[30]ICAO Doc 4444 Procedures for Air Navigation Services -Air Traffic Management 16th Edition, 2016.

[31]SESAR Solution PJ.02-W2-21.1 – D6.1.002 - SPR/INTEROP OSED for V3 – Part IV-HPAR, Edition 00.02.02, 24 May 2023.

[32]SESAR Solution PJ.02-W2-21.1 – D6.1.002 - SPR/INTEROP OSED for V3 –Part II-SAR, Edition 00.02.02, 24 May 2023.

[33]SESAR WP06.03.01 - D149 - Consolidated DEL Release 5 Validation Report (with 06.09.02 T1031), Edition 00.01.01, 14/10/2016

Beneficiaries contributing to Solution PJ.02-W2-21.1

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