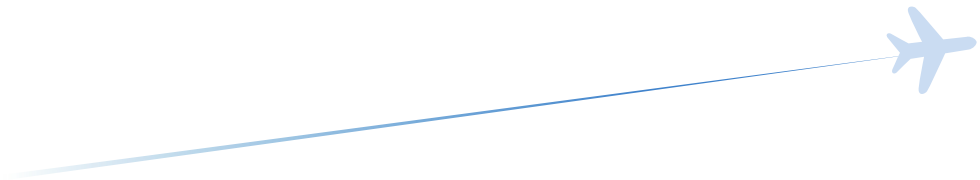

SESAR Solution 97.1 and 97.2 SPR/INTEROP-OSED Template for TRL4 - Part V - Performance Assessment Report (PAR)

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DTT

DIGITAL TECHNOLOGIES FOR TOWER

This ***Performance Assessment Report*** is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 874470 under European Union's Horizon 2020 research and innovation programme.

Abstract

Among the expected technological enhancements allocated by SJU to SESAR 2020-W2-PJ05 "***DIGITAL TECHNOLOGIES FOR TOWER***" are the development of new human machine interface (HMI) interaction modes and technologies for the CWP in the Control Tower, with the aim to minimize the load and mental strain on the Tower ATCOs, in several sub-operating Environments.

The high-level improvements addressed in the scope, defined above, may be applicable in current operations as well as in future operational concepts.

The Operational Improvements identified have been allocated to 2 Solutions, under PJ.05-W2-WP3:

- ✓ PJ.05-W2-97.1 '*Virtual/Augmented reality applications for tower*'
- ✓ PJ.05-W2-97.2 '*ASR at the TWR CWP supported by AI and Machine Learning'*

The validation activities planned for the Solutions comprise ***6*** Validation Exercises.

In line with the Performance Management Process, that regulates the post analysis phase at the end of the Validation Exercises, the Performance Assessment Report documents the benefits calculated from the KPAs' assessment, as reported into the VALR Deliverable, and to allow an assessment of performances, in comparison with expectations of the SESAR ATM Master Plan.

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1 Executive Summary

This document provides the Performance Assessment Report (PAR) for the two Technological Solutions in *SESAR2020 Wave 2 PJ.05-W2-* WP3, namely:

- ✓ PJ.05-W2-97.1 '*Virtual/Augmented reality applications for tower*'
- ✓ PJ.05-W2-97.2 '*ASR at the TWR CWP supported by AI and Machine Learning'*

The PAR is consolidating Solution performance validation results addressing KPIs/PIs and metrics in line with the SESAR2020 Performance Framework [3], which defines the official performance indicators.

- ✓ **Description:**

These Solutions address the development of new human machine interface (HMI) interaction modes and technologies at the Controller Working Position (CWP) for Tower, that aim to minimise the load and mental strain on the ATCOs in different Operational situations and in several airport sub-operating Environments. Both solutions are targeting V2 (TRL4) maturity level.

Solution 97.1 investigates the use of Augmented Reality devices in real or remote tower, in order to provide situational information to controllers in head up position, so to enhance the Situation Awareness.

Solution 97.2 investigates the use of Speech Recognition, supported by AI and ML algorithms, that enables the recognition and translation of spoken language (e.g., ATCO commands) into the system thus reducing human error and improving HMI usability.

The TVALP [10] includes the BIM (Benefits Impact Mechanism), which identifies and allocates the set of relevant KPAs and KPIs, defined in the SESAR2020 Performance Framework [3], to the two Solutions: namely Cost Efficiency, Human Performance and (indirectly) Safety. It also allocates Capacity (Resilience Focus Area) to Solution 97.1.

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 [8]. The impact of a Solution on the performances are described in Benefit Impact Mechanism. All the KPI and mandatory PI from the Benefit Mechanism identified for the Solution have to be assessed by means of 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.

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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)[1]	Confidence in Results[2]
SAF1: Safety - Total number of estimated accidents with ATM Contribution per year	***N/A***	***N/A***	***Medium***
FEFF1: Fuel Efficiency - Actual average fuel burn per flight	***N/A***	***N/A***	***N/A***
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	***N/A***	***N/A***	***N/A***

[1] Negative impacts are indicated in red.

[2] 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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throughput, in challenging airspace, per unit time			
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	***97.1: 0,35%*** ***97.2: 0,35%***	***1,63%***	***Medium***
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)[3]	Confidence in Results[4]
SAF1.X: Mid-air collision - En-Route	***N/A***	***N/A***
SAF2.X: Mid-air collision - TMA	***N/A***	***N/A***
SAF3.X: RWY-collision accident	***N/A***	***N/A***
SAF4.X: TWY-collision accident	***N/A***	***N/A***
SAF5.X: CFIT accident	***N/A***	***N/A***
SAF6.X: Wake related accident	***N/A***	***N/A***
SAF7.X: RWY-excursion accident	***N/A***	***N/A***
SAF8.X ...: Other SAF Risks	***N/A***	***N/A***
SEC1: A security risk assessment has been carried out	***N/A***	***N/A***
SEC2: Risk Treatment has been carried out	***N/A***	***N/A***
SEC3: Residual risk after treatment meets security objective.	***N/A***	***N/A***
ENV1: Actual Average CO2 Emission per flight	***N/A***	***N/A***
NOI1: Relative noise scale	***N/A***	***N/A***
NOI2: Size and location of noise contours	***N/A***	***N/A***
NOI4: Number of people exposed to noise levels exceeding a given threshold	***N/A***	***N/A***
LAQ1: Geographic distribution of pollutant concentrations	***N/A***	***N/A***

[3] Negative impacts are indicated in red.

[4] 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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CAP3.1: Peak Departure throughput per hour (Segregated mode)	***N/A***	***N/A***
CAP3.2: Peak Arrival throughput per hour (segregated mode)	***N/A***	***N/A***
CAP4: Un-accommodated traffic reduction	***N/A***	***N/A***
RES1: Loss of Airport Capacity Avoided	***N/A***	***N/A***
RES1.1: Airport time to recover from non-nominal to nominal condition	***N/A***	***N/A***
RES2: Loss of Airspace Capacity Avoided.	***27,68%***	***Medium***
RES2.1: Airspace time to recover from non-nominal to nominal condition.	***N/A***	***N/A***
RES4: Minutes of delays.	***N/A***	***N/A***
RES5: Number of cancellations.	***N/A***	***N/A***
TEFF2: Taxi in time	***N/A***	***N/A***
TEFF3: Taxi out time	***N/A***	***N/A***
TEFF4: TMA arrival time	***N/A***	***N/A***
TEFF5: TMA departure time	***N/A***	***N/A***
TEFF6: En-Route time	***N/A***	***N/A***
PRD2: Variance of Difference in actual & Flight Plan or RBT durations	***N/A***	***N/A***
PUN2: % Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather-related delay causes	***N/A***	***N/A***
CEF1: Direct ANS Gate-to-gate cost per flight	***N/A***	***N/A***
AUC3: Direct operating costs for an airspace user	***N/A***	***N/A***
AUC4: Indirect operating costs for an airspace user	***N/A***	***N/A***
AUC5: Overhead costs for an airspace user	***N/A***	***N/A***

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CMC1.1: Allocated vs. Requested ARES duration	***N/A***	***N/A***
CMC1.2: Allocated vs. Requested ARES dimension	***N/A***	***N/A***
CMC1.3: Deviation of Transit Time to/from airbase to ARES	***N/A***	***N/A***
CMC 1.3.1: Allocated ARES duration vs. total mission duration	***N/A***	***N/A***
CMC 1.3.2: Deviation of total mission duration by iOAT FPL validation	***N/A***	***N/A***
CMC 1.4.1: Rate of iOAT FPLs acceptance by NM systems	***N/A***	***N/A***
CMC 1.4.2: Rate of iOAT FPLs acceptance by ATC systems	***N/A***	***N/A***
CMC2.1: Fuel and Distance saved by GAT	***N/A***	***N/A***
HP1: Consistency of human role with respect to human capabilities and limitations	***Open***	***Medium***
HP2: Suitability of technical system in supporting the tasks of human actors	***Open***	***Medium***
HP3: Adequacy of team structure and team communication in supporting the human actors	***Open***	***Medium***
HP4: Feasibility with regard to HP-related transition factors	***Open***	***Medium***
FLX1: Average delay for scheduled civil/military flights with change request and non-scheduled or late flight plan request	***N/A***	***N/A***

Table 2 Mandatory PIs Assessment Summary

Additional Comments and Notes:

N/A

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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 SESAR Joint Undertaking (SJU) 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.

2.2 Intended readership

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

Produced by the Solution project, the main recipient in the SESAR performance management process is PJ19, which will aggregate all the performance assessment results from the SESAR2020 solution projects PJ1-18 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 [4]: Performance Assessment and Gap Analysis Report (2019), where are 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[6], 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)[5] within STELLAR, gathering experts and providing best practices.

[…]

2.4 Glossary of terms

See the AIRM Glossary [1] [7] for a comprehensive 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*
Air Gesture	Gesture recognition is a type of perceptual computing user interface that allows computers to capture and interpret human gestures as commands via mathematical algorithms. Gestures can originate from any bodily motion or state but commonly originate from the face or hand. Users can use simple gestures to control or interact with devices without physically touching them.	SOL 97.1
Attention Guidance	The Attention Guidance function uses perceptual cues to direct the attention of air traffic controllers towards an	SOL 97.1

[5] 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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	event. The function is triggered by relevant events determined by an Attention Guidance Logic that receives input from external sources, such as a particular safety net, an overall alerting system prioritization logic, or a particular sensor at the airport. The Attention Guidance Logic determines how the attention of the controller will be guided.	
Automatic Speech Recognition	An Automatic Speech Recognition (ASR) system gets an audio signal as input and transforms it into a sequence of words, i.e., "speech-to-text" following the recognition process. The sequence of words is transcribed into a sequence of ATC concepts ("text-to-concepts") using an ontology. E.g.: The word sequence "Lufthansa two alpha altitude four thousand feet on QNH one zero one four reduce one eight zero knots or less turn left heading two six zero" is transcribed into "DLH2A ALTITUDE 4000 ft, DLH2A INFORMATION QNH 1014, DLH2A REDUCE 180 OR_LESS, DLH2A HEADING 260 LEFT". The resulting concepts can be used for further applications such as visualization on an HMI.	PJ.16-04
Command (Recognition) Error Rate	The number of controller commands which are wrongly recognized by ASR, and which are not rejected divided by number of total given commands; in other words: the percentage of given commands wrongly shown on the	PJ.16-04

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	controllers' HMI.	
Command (Recognition) Rejection Rate	The number of recognized controller commands which are correctly or wrongly rejected (plus number of given controller commands which are not recognized at all) divided by number of total given commands.	PJ.16-04
Command Hypotheses Predictor	Components needed for Assistant Based Speech Recognition which predicts a set of possible commands.	PJ.16-04
Command Prediction Error Rate	The number of controller commands which are not predicted by the Command Hypotheses Predictor divided by number of total given commands.	PJ.16-04
Command Recognition Rate	The number of controller commands which are correctly recognized by ASR and are not rejected before divided by number of total given commands; in other words: the percentage of given commands correctly shown on the controllers' HMI.	PJ.16-04
Conventional Input devices	This sentence is used to identify the current, legacy devices as keyboard, mouse and trackball. It is used as the reference system.	PJ.16-04
Direct Interaction	When touching the object directly	PJ.16-04
Functional Block	A logical and cohesive grouping of automated Functions in a Technical System	EATMA Guidance Material
Gesture	Movement or posture, of the whole body or parts of the body	ISO/IEC 30113-1, 3.1

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Indirect Interaction	When not touching the object directly	PJ.16-04
Interaction	Variety of ways users interact with an app, including touch, keyboard, mouse, and so on	PJ.16-04
Net Present Value	Net Present Value (NPV) is the sum of all discounted cash inflows and outflows during the time horizon period	Investopedia
Technical System	A collection of Functional Blocks or Functions.	EATMA Guidance Material
Virtual/Augmented Reality	V/AR in ATC Tower environment supports the Air Traffic Controllers by blending real world images with computer-generated data (augmented reality) in real-time, so that visual information can be enhanced to improve identification and tracking of aircraft (or vehicles) on the airport surface. Moreover, in low visibility conditions, the lack of visual information provided by the out-of-the-tower windows view can be compensated by the massive use of synthetic vision to show digital georeferenced data that supplement the missing real vision (virtual reality). Airport operations can benefit from this kind of advanced technologies, capable to provide beneficial automation support under low visibility conditions, but also, in good visibility situations, to present additional information in the labels to the controllers so to help in case of physical obstacles that obstruct vision or by reducing head-down time.	SOL 97.1 TVALP

Table 3: Glossary

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2.5 Acronyms and Terminology

Term	Definition
AG	Attention Guidance
Air G	Air Gestures
AI	Artificial Intelligence
ANSP	Air Navigation Service Provider
AR	Augmented Reality
ASR	Automatic Speech Recognition
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATM	Air Traffic Management
BIM	Benefit Impact Mechanism
CATC	Conflicting ATC Clearances
CBAT	Cost Benefit Analysis tailored for the Technological Solution
CC	Capability Configuration
CMAC	Conformance Monitoring Alerts for Controllers
CWP	Controller Working Position
EATMA	European ATM Architecture
E-ATMS	European Air Traffic Management System
EN	Enabler
E-OCVM	European Operational Concept Validation Methodology
ER	En-Route
FAA	Federal Aviation Administration
HMI	Human Machine Interface
HPAP	Human Performance Assessment Plan
IER	Information Exchange Requirement

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INTEROP	Interoperability Requirements
IRS	Interface Requirements Specification
ISRM	Information Services Reference Model
ML	Machine Learning
NAF	NATO Architecture Framework
NFR	Non- Functional Requirements
NOV	NAF Operational View
NPV	Net Present Value
NSOV	NAF Service Oriented View
NSV	NAF System View
OE	Operating Environment
PAR	Performance Assessment Report
QoS	Quality of Service
RMCA	Runway Monitoring and Conflict Alerting
SDD	Service Description Document
SecAP	Security Assessment Plan
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SoaML	Service Oriented Architecture Modelling Language
SPR	Safety and Performance Requirements
SUT	System Under Test
TRL	Technology Readiness Level
TS	Technical Specification
TS/IRS	Technical Specification/Interface Requirements Specification
TSAP	Technical Safety Assessment Plan
TVALP	Technological Validation Plan
TVALR	Technological Validation Report

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TWR	Tower
V&V	Validation and Verification
VALS	Validation Strategy
VCS	Voice Communication System
V/AR	Virtual/Augmented Reality

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
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)) whereas 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

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Term	Definition	Source
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 SJU 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
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

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Term	Definition	Source
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
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

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Term	Definition	Source
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
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

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Term	Definition	Source
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
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

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Term	Definition	Source
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
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 SJU.	EUROCONTROL ATM Lexicon
SESAR Solution	A term used when referring to both SESAR ATM Solution and SESAR Technological 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.	SESAR2020 Project Handbook
SESAR Technological Solution	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

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3 Solution Scope

3.1 Detailed Description of the Solution

Solutions 97.1 and 97.2 deal with operational and technical objectives of the Controller Working Position in Tower environment.

Both Solutions consider the work already performed during Wave 1, continuing to provide significant improvements thanks to advanced interaction methods with the airport Control Tower *human machine interface* (HMI).

***Solutions 97.x** address the development of new HMI interaction modes and technologies to minimise the load and mental strain on the Tower controllers (especially under high traffic density situations, low visibility conditions, etc.). These improvements may be applicable in current operations and/or in future operational concepts still in development under the scope of other SESAR Solutions.*

SOL 97.1 investigates the use of Virtual and Augmented Reality technology enabled by applications such as head-on displays, to enable tower ATCOs safe operations supervision under any meteorological conditions while maintaining a high taxiway and runway throughput. Within this specific area other technologies such as Tracking labels and air gestures and attention guidance were investigated.

SOL 97.2 investigates the use of Automatic Speech Recognition (ASR) supported with AI/ML techniques, which enables the recognition and translation of spoken language into the system with the aim to reduce ATCO workload and hence improving safety.

3.2 Detailed Description of relationship with other Solutions

Concerning the Solution 97.1, the possible relationships of the solution have been analysed looking at the W2 solutions in airport operational environment and all the relationships have been judged as “Compatible/Independent/No cross effect”. Thus, these relationships are not mentioned except for the following, being part of the same project:

Solution Number	Solution Title	Relationship	Rational for the relationship
W2.PJ5.97.1 with W2.PJ5.97.2	ASR at the TWR CWP supported by AI and Machine Learning	Compatible/Independent / No Cross Effect	Automatic speech recognition tool has no effect neither is affected by the Virtual/ augmented reality device in tower environment

Table 6: Relationships of Sol 97.1 with other Solutions

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Concerning the Solution 97.2, the possible relationships of the solution have been analysed looking at the W2 solutions in airport operational environment and all the relationships have been judged as "Compatible/Independent/No cross effect".

Also, the relationships with Solution PJ.10-W2.96.x have been considered due to the similarities of the technology addressed; although from a R&D development perspective there might be dependencies, we have been not able to identify any relationship considering that the technologies will be deployed in different operational environments by PJ 10.96 and PJ.05-97 and no influence between these ones is expected. So even in that case, the relationship would be "Compatible/Independent/No cross effect".

Thus, these relationships are not mentioned except for the following, being part of the same project:

Solution Number	Solution Title	Relationship	Rational for Justification
W2.PJ5.97.2 with W2.PJ5.35	Multi Remote Tower Module	Compatible/Independent / No Cross Effect	W2.PJ5.35 could be compatible with W2.PJ5.97.2 ASR solution as speech recognition functionality might support ATCOs responsible of the MRTMs

Table 7: Relationships of Sol 97.2 with other Solutions

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4 Solution Performance Assessment

4.1 Assessment Sources and Summary of Validation Exercise Performance Results

4.1.1 Solution 97.1

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

Organisation	Document Title	Publishing Date
RETINA	D4.3 RETINA Validation Report	26 March 2018

Table 8: Pre-SESAR2020 Exercises

SESAR Validation Exercises of this Solution (completed ones and planned ones) are listed below.

Exercise ID	Exercise Title	Release	Maturity	Status
EXE-05.97.1-TRL4-TVALP-VAR-001	Validation of AR Interaction Modes for Schiphol Tower with a Focus on Attention Guidance	R22	TRL4	completed
EXE-05.97.1-TRL4-TVALP-VAR-002	Augmented Reality Multimodal Control Tower Interaction	R22	TRL4	completed
EXE-05.97.1-TRL4-TVALP-VAR-005	V2 Augmented Reality in the Tower Environment	R22	TRL4	completed

Table 9: SESAR2020 Validation Exercises

[…]

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

Exercise	OI Step	Exercise scenario & scope	Performance Results	Notes
EXE-05.97.1-TRL4-TVALP-VAR-001	POI-0039-SDM	Augmented Reality and Attention Guidance technology for tower controllers, performed on NARSIM Tower platform, within an environment for Amsterdam	**44,44%**	***EXE 1*** – Confidence in Result: ***Medium***

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		Airport Schiphol.		
EXE-05.97.1-TRL4-TVALP-VAR-002	POI-0039-SDM	Virtual/Augmented Reality Tower Tools, Tracking Labels and Air Gesture Interaction, carried out at UNIBO CAVE simulator in the Bologna Airport scenario.	**5,38%**	***EXE 2*** – Confidence in Result: ***Medium***
EXE-05.97.1-TRL4-TVALP-VAR-005	POI-0039-SDM	Shadow Mode validation regarding Virtual and augmented reality as well as Tracking Label and Air Gestures executed at Vitoria airport.	**28,57%**	***EXE 5*** – Confidence in Result: ***Medium***

Table 10: Summary of Validation Results.

4.1.2 Solution 97.2

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

Organisation	Document Title	Publishing Date
16.04.02	D3_2_020-SESAR 2020 PJ_16-04 TRL4 TVALR-ASR_v02_00_00	30 September 2019

Table 11: Pre-SESAR2020 Exercises

SESAR Validation Exercises of this Solution (completed ones and planned ones) are listed below.

Exercise ID	Exercise Title	Release	Maturity	Status
EXE-05.97.2-TRL4-TVALP-ASR-004	Improved controller productivity by using speech recognition in a multiple remote tower environment	R22	TRL4	completed
EXE-05.97.2-TRL4-TVALP-ASR-006	Assistant Based Speech Recognition in Multiple Remote Tower Environment	R22	TRL4	completed
EXE-05.97.2-TRL4-TVALP-ASR-007	Assistant Based Speech Recognition as support to ATCOs	R22	TRL4	completed

Table 12: SESAR2020 Validation Exercises

[…]

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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
EXE-05.97.2-TRL4-TVALP-ASR-004	POI-0040-SDM	Real-time simulation addressing Speech Recognition in a multiple remote tower environment, at Asker platform.	***N/A***	***N/A***
EXE-05.97.2-TRL4-TVALP-ASR-006	POI-0040-SDM	Assistant Based Speech Recognition realized at Braunschweig, simulating three generic (multiple remote) airports adapted from existing airports.	**20,00%**	***EXE 6*** – Confidence in Result: ***Medium***
EXE-05.97.2-TRL4-TVALP-ASR-007	POI-0040-SDM	Speech Recognition validation performed in Rome, simulating Sofia airport.	**40,00%**	***EXE 7*** – Confidence in Result: ***Medium***

Table 13: Summary of Validation Results.

4.2 Conditions / Assumptions for Applicability

4.2.1 Solution 97.1

The following Table 14 summarises the applicable operating environments.

OE	Applicable sub-OE	Special characteristics
Airport	Very Large / Large / Medium / Small /Other airports	The solution has been validated in: • Schiphol (Very Large Airport) • Bologna (Medium Airport) • Vitoria Gasteiz (Other/small)

Table 14: Applicable Operating Environments.

4.2.2 Solution 97.2

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The following Table 14 summarises the applicable operating environments.

OE	Applicable sub-OE	Special characteristics
Airport	Very Large / Large / Medium / Small / Other Airports	The solution has been validated in single runway airports as well as multiple tower centres. Namely: • RTC in Bodø control on Røst, Haugesund, Vardø (other airports) • RTC in Braunschweig control on Vilnius (medium), Kaunas, Palanga (other) • Sofia (Medium Airport)

Table 15: Applicable Operating Environments.

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4.3 Safety

The scope of technological safety assessment is equivalent to the scope of the PJ05-W2-97.1 and PJ05-W2-97.2 solution: therefore, it covers the operational environment conditions, OI steps/Enablers, Use Cases and Scenarios (in the Solution scope as per the TS/IRS) which will be covered by solution validation exercises.

4.3.1 Safety Design drivers and Performance Mechanism

According to SRM [11], the design safety driver for a Technological solution is the specification of the technical system limited to the potential safety implication on the side of the operational users (e.g., ATS service provider). For this reason, the current safety assessment was initiated by a preliminary safety impact assessment, including initial hazard identification, involving operational experts which are relevant for the use of the technological concept. This approach allowed to understand the potential safety implication of the solution. Additional safety drivers considered in this safety assessment are coming from operational and technical standards and codes of practice (e.g., PANS-ATM, ICAO Annexes, equipment standards, interoperability requirements) that apply to the Technological solution and could have a bearing on the overall safety of the functional system concerned. […]

4.3.2 Data collection and Assessment

The safety assessment was conducted according to SRM. The Technical Specification Safety Requirements (TSSRs) identified refer to the functionalities & performance characteristics derived from the (potential) operational uses envisaged for the technological solution limited to the potential safety implication on the side of the operational users (i.e., ATS service provider).

For this reason, the safety assessment was initiated by a preliminary safety impact assessment, including initial hazard identification, involving operational experts which are relevant for the use of the technological concept. This approach allowed to understand the potential safety implication of the solution.

The scope and change assessment workshop, metrics and indicators and HAZID workshop were performed with the participation of PJ05-W2-97 solution partners including air traffic controllers, concept designers, ATM engineers, human factors and safety experts.

In order to identify Initial set of Technical Safety Requirements at Design Level (TSRD) a dedicated workshop with subject matters experts (including air traffic controllers, concept designers, ATM engineers, human factors, and safety experts) was conducted addressing both success approach (defining at the level of each component what it is required to fulfil in terms of functionality and performance) and failure approach (defining at the level of each component what it is required to fulfil in terms of integrity and additional functionalities). During the workshop the potential HP and safety issues were discussed and accordingly the mitigation actions were identified.

The safety relevant metrics and indicators to be applied in validation exercises were identified and agreed on among different exercises' partners during a dedicated online workshop with participation of validation exercises' safety, human factors, operational and technical experts. The safety validation objective and associated criteria, benefits and impacts, as well as initially identified

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hazards were analysed to derive metrics and techniques adequate to generate the evidence to be obtained from the safety assessment.

[…]

4.3.3 Extrapolation to ECAC wide

We are currently limited only to the operational environments in which the solution tools and functions were tested taking into consideration the characteristics of the airports, traffic load and traffic patterns, operating methods and procedures applied at these airports. These results could be extrapolated to similar airports in ECAC, meaning that the level of safety would not be degraded when providing ATC service with the support of the V/AR and ASR.

[…]

4.3.4 Discussion of Assessment Result

The safety impact of the solution is driven by the impact of the solution on the human performance and consequently on safety. Therefore, as it has been concluded for the HP assessment (see section**Fehler! Verweisquelle konnte nicht gefunden werden.**), the solution PJ05.W2.97 have achieved TRL4 level of maturity but need to be further validated for TRL6 level of maturity.

[…]

4.3.5 Additional Comments and Notes

No additional comments and notes.

[…]

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4.4 Environment: Fuel Efficiency / CO2 emissions

Does the Solution impact this KPA? ***NO***

4.4.1 Performance Mechanism

N/A

4.4.2 Assessment Data (Exercises and Expectations)

N/A

4.4.3 Extrapolation to ECAC wide

N/A

KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
FEFF1 Actual Average fuel burn per flight	Kg fuel per movement	Total amount of actual fuel burn divided by the number of movements	N/A	***N/A***	***N/A***
ENV1 Actual Average CO2 Emission per flight	Kg CO2 per flight	Amount of fuel burnt x 3.15 (CO2 emission index) divided by the number of flights	***N/A***	***N/A***	***N/A***

Table 16: Fuel burn and CO2 emissions saving for Mandatory KPIs /PIs

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
FEFF1 Actual Average fuel burn per flight	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
ENV1 Actual Average CO2 Emission per flight	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***

Table 17: Fuel burn and CO2 emissions saving per flight phase.

Were there any benefits obtained in SESAR2020 Wave1 for this Solution? ***N/A***.

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4.4.4 Discussion of Assessment Result

N/A

4.4.5 Additional Comments and Notes

N/A

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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)

PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
NOI1 Relative noise scale	-2 to +2	It is a qualitative scale based on expert judgment. -2 very negative effect or benefit, 0 neutral and +2 very positive effects or benefit. The objective of this metric is to provide a global assessment of the noise impact. This metric is built upon the other quantitative noise PIs (NOI2, NOI3, NOI4, NOI5)	***N/A***	***N/A***	***N/A***
NOI2 Size and location of noise contours	Contours of noise level thresholds (e.g. LDEN 55 see ERM document for the list of recommended PIs). Surface of these contours(Km^2)	Noise contours to be calculated according to the ECAC Doc.29 methodology. Surface of the noise contours calculated using a GIS tool or modules. Suggest the use of IMPACT tool.	***N/A***	***N/A***	***N/A***
(NOI4) Number of people exposed to noise levels exceeding a given threshold	Number of people inside noise contours.	Population count inside the contours calculated above. Need the availability of population census data. Calculated using a GIS tool or modules. IMPACT tool includes this functionality, using the EEA population database.	***N/A***	***N/A***	***N/A***

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PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
LAQ1 Geographic distribution of pollutant concentrations	Airport Local Air Quality Studies (ALAQS) inventory method generally uses mg/m^3 for each pollutant	Measurement to be performed within LTO cycle. • NOx: Nitrogen oxides, including nitrogen dioxide (NO2) and nitrogen oxide (NO); • VOC: Volatile organic compounds (including non-methane hydrocarbons (NMHC)); • CO: Carbon monoxide; • PM: Particulate matter (fraction size PM2.5 and PM10); • SOx: Sulphur oxides. • Recommended tools: Open-ALAQS	***N/A***	***N/A***	***N/A***

Table 18: Noise and Local Air Quality benefit for Mandatory PIs

Were there any benefits obtained in SESAR2020 Wave1 for this Solution? ***NO***

4.5.3 Extrapolation to ECAC wide

N/A

4.5.4 Discussion of Assessment Result

N/A

4.5.5 Additional Comments and Notes

N/A

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4.6 Airspace Capacity (Throughput / Airspace Volume & Time)

Does the Solution impact this KPA? ***NO***

4.6.1 Performance Mechanism

Is there a Benefit Mechanism available? ***NO***

4.6.2 Assessment Data (Exercises and Expectations)

Exercise ID or Expert judgement	Benefits contribution to CAP1	Benefits contribution to CAP2
EXE-xx	***N/A***	***N/A***

Table 19: Airspace Capacity benefits per Exercise

OI step	Relative benefits contribution to CAP1	Relative benefits contribution to CAP2
XX-XXXX	***N/A***	***N/A***
TOTAL	***N/A***	***N/A***

Table 20: Airspace Capacity relative benefits per OI step

KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
CAP1 TMA throughput, in challenging airspace, per unit time	Relative change of movements (% and number of movement)	% and also total number of movements per volume of TMA airspace per hour for specific traffic mix and density, for High and Medium Complexity TMAs. TMA at peak demand hours.	YES	***N/A***	***N/A***
CAP2 En-route throughput, in challenging	Relative change of movements (% and number of	% and also total number of movements, per volume of En-Route airspace per hour for specific traffic mix and density, for High and	YES	***N/A***	***N/A***

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KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
airspace, per unit time	movement)	Medium Complexity TMAs. airspace at peak demand hours.			

Table 21: Airspace benefits for Mandatory KPIs /PIs

Were there any benefits obtained in SESAR2020 Wave1 for this Solution? **NO**.

4.6.3 Extrapolation to ECAC wide

N/A

4.6.4 Discussion of Assessment Result

N/A

4.6.5 Additional Comments and Notes

N/A

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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)

Exercise ID or Expert judgement	Benefits contribution to CAP3	Benefits contribution to CAP3.1	Benefits contribution to CAP3.2	Benefits contribution to CAP4
EXE-xx	***N/A***	***N/A***	***N/A***	***N/A***

Table 22: Airport Capacity benefits per Exercise

OI step	Relative benefits contribution to CAP3	Relative benefits contribution to CAP3.1	Relative benefits contribution to CAP3.2	Relative benefits contribution to CAP4
XX-XXXX	***N/A***	***N/A***	***N/A***	***N/A***
TOTAL	***N/A***	***N/A***	***N/A***	***N/A***

Table 23: Airport Capacity relative benefits per OI step

KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
CAP3 Peak Runway Throughput (Mixed mode)	% and Flight per hour	% and also total number of movements per one runway per one hour for specific traffic mix and density (in mixed mode RWY operations). The percentage change is measured against the maximum observed throughput during peak demand hours in the mixed-mode RWY operations airports group.	YES	***N/A***	***N/A***

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KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
CAP3.1 Peak Departure throughput per hour (Segregated mode)	% and Flight per hour	% and also total number of departures per one runway per one hour for specific traffic mix and density (in segregated mode of operations). The percentage change is measured against the maximum observed throughput during peak demand hours in the segregated-mode RWY operations airports group.	YES	***N/A***	***N/A***
CAP3.2 Peak Arrival throughput per hour (Segregated mode)	% and Flight per hour	% and also total number of arrivals per one runway per one hour for specific traffic mix and density (in segregated mode of operations). The percentage change is measured against the maximum observed throughput during peak demand hours in the segregated-mode RWY operations airports group.	YES	***N/A***	***N/A***
CAP4 Un-accommodated traffic reduction	Flights/year	Reduction in the number of un-accommodated flights i.e. a flight that would have been scheduled if there were available slots at the origin/destination airports. NB: Supports CBA Inputs. NB: Relates to Airport Capacity because this is STATFOR computation. CBA calculate this based on the assessment of the runway throughput we provide with and without the solutions and STATFOR data.	YES For CBA.	***N/A***	***N/A***

Table 24: Airport Capacity for Mandatory KPIs /PIs

Were there any benefits obtained in SESAR2020 Wave1 for this Solution? ***NO***

4.7.3 Extrapolation to ECAC wide

N/A

4.7.4 Discussion of Assessment Result

N/A

4.7.5 Additional Comments and Notes

N/A

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

4.8.1 Performance Mechanism

4.8.1.1 Solution 97.1

Does the Solution impact this KPA? ***YES***

Is there a Benefit Mechanism available? ***YES***

See paragraph 4.14

4.8.1.2 Solution 97.2

Does the Solution impact this KPA? ***No***

4.8.2 Assessment Data (Exercises and Expectations)

Exercise ID or Expert judgement	Benefits contribution to RES1	Benefits contribution to RES1.1	Benefits contribution to RES2	Benefits contribution to RES2.1	Benefits contribution to RES4	Benefits contribution to RES5
EXE-001	N/A	N/A	***44,44%***	N/A	N/A	N/A
EXE-002	N/A	N/A	***5,38%***	N/A	N/A	N/A
EXE-004	N/A	N/A	***N/A***	N/A	N/A	N/A
EXE-005	N/A	N/A	***28,57%***	N/A	N/A	N/A
EXE-006	N/A	N/A	***20,00%***	N/A	N/A	N/A
EXE-007	N/A	N/A	***40,00%***	N/A	N/A	N/A

Table 25: Resilience benefits per Exercise

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
POI-0039	**N/A**	**N/A**	***50%***	N/A	N/A	N/A
POI-0040	**N/A**	**N/A**	***50%***	N/A	N/A	N/A
TOTAL			***100%***			

Table 26: Resilience relative benefits per OI step

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PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
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	***N/A***	***N/A***
RES 1.1 Airport time to recover from non-nominal to nominal condition	Minutes	Duration of Airport lost capacity from non-nominal to nominal condition.	YES for Airport OE Solutions	***N/A***	***N/A***
RES2 Loss of Airspace Capacity Avoided	% and Movements per hour	Loss of Airspace Capacity with the concept divided by the loss of Airspace Capacity without the concept	YES	***27,68%***	***SOL 97.1: 26,13%*** ***SOL 97.2: 30,00%*** ***SOL 97.X: 27,68% (at Local Level only)***
RES2.1 Airspace time to recover from non-nominal to nominal condition	Minutes	Duration of Airspace lost capacity compared to non-nominal to nominal condition.	YES for Airspace OE Solutions	***N/A***	***N/A***
RES4 Minutes of delays	Minutes	Impact on AUs measured through delays resulting from capacity degradation[6]. 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	***N/A***	***N/A***

[6] 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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PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
RES5 Number of cancellations	No flights	Impact on AUs measured through Cancellations resulting from capacity degradation[7]. 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	***N/A***	***N/A***

Table 27: Resilience for Mandatory PIs

Were there any benefits obtained in SESAR2020 Wave1 for this Solution? ***NO***

4.8.3 Extrapolation to ECAC wide

The output value of RES PI, obtained by analyzing the HP results, is not possible to be extrapolated at ECAC level due to the particular operational Scenario/situation that has determined the characteristic of the Validation Exercise.

So, the output results will remain valid, for the RES PI, at local level only (see details at the *PJ19.4 – Performance Framework*).

4.8.4 Discussion of Assessment Result

N/A

4.8.5 Additional Comments and Notes

N/A

[7] 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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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)

Exercise ID or Expert judgement	Benefits contribution to TEFF1	Benefits contribution to TEFF2	Benefits contribution to TEFF3	Benefits contribution to TEFF4	Benefits contribution to TEFF5	Benefits contribution to TEFF6
EXE-xx	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***

Table 28: Flight Times benefits per Exercise

OI step	Relative benefits contribution to TEFF1	Relative benefits contribution to TEFF2	Relative benefits contribution to TEFF3	Relative benefits contribution to TEFF4	Relative benefits contribution to TEFF5	Relative benefits contribution to TEFF6
XX-XXXX	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
TOTAL	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***

Table 29: Flight Times relative benefits per OI step

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4.9.3 Extrapolation to ECAC wide

KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
TEFF1 Gate-to gate flight time	Min/flight	Average of the distribution of actual gate-to-gate flight durations	YES	*N/A*	*N/A*
TEFF2 Taxi in time	Min/flight	Average of the distribution of actual taxi-in (including ground queuing during taxi-in) durations	When relevant	*N/A*	*N/A*
TEFF3 Taxi out time	Min/flight	Average of the distribution of actual taxi-out (including ground queuing during taxi-out) durations	When relevant	*N/A*	*N/A*
TEFF4 TMA arrival time	Min/flight	Average of the distribution of actual TMA arrival (including holdings) durations	When relevant	*N/A*	*N/A*
TEFF5[8] TMA departure time	Min/flight	Average of the distribution of actual TMA departure durations	When relevant	*N/A*	*N/A*
TEFF6 En-Route time	Min/flight	Average of the distribution of actual en-route durations	When relevant	*N/A*	*N/A*

Table 30: Flight Times benefits for Mandatory KPIs /PIs

[8] Although no major time inefficiencies occur during climb, this phase has been included for consistency.

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Table 31 is showing the impact on flight phases (provided when it is possible).

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
TEFF1 Gate-to gate flight time	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
TEFF2 Taxi in time	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
TEFF3 Taxi out time	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
TEFF4 TMA arrival time	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
TEFF5 TMA departure time	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
TEFF6 En-Route time	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***

Table 31: Flight times benefit per flight phase.

Were there any benefits obtained in SESAR2020 Wave1 for this Solution? ***NO***

4.9.4 Discussion of Assessment Result

N/A

4.9.5 Additional Comments and Notes

N/A

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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)

Exercise ID or Expert judgement	Benefits contribution to PRD1	Benefits contribution to PRD2
EXE-xx	***N/A***	***N/A***

Table 32: Predictability benefits per Exercise

OI step	Relative benefits contribution to PRD1	Relative benefits contribution to PRD2
XX-XXXX	***N/A***	***N/A***
TOTAL	***N/A***	***N/A***

Table 33: Predictability relative benefits per OI step

4.10.3Extrapolation to ECAC wide

KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
PRD1 Average of Difference in actual & Flight Plan or RBT durations	Minutes	Average of the distribution of the differences between flown trajectories & Flight Plans or RBT durations	YES	***N/A***	***N/A***

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KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
PRD2 Variance[9] of Difference in actual & Flight Plan or RBT durations	Minutes[2]	Variance of the distribution of the differences between flown trajectories & Flight Plans or RBT durations	YES	*N/A*	*N/A*

Table 34: Predictability benefits for Mandatory KPIs /PIs

Table 35 is showing the impact on flight phases (provided when it is possible).

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
PRD1 Average of Difference in actual & Flight Plan or RBT durations	N/A	N/A	N/A	N/A	N/A
PRD2 Variance of Difference in actual & Flight Plan or RBT durations	N/A	N/A	N/A	N/A	N/A

Table 35: Predictability benefit per flight phase

Were there any benefits obtained in SESAR2020 Wave1 for this Solution? ***NO***

4.10.4Discussion of Assessment Result

N/A

4.10.5Additional Comments and Notes

N/A

[9] Standard Deviation is also accepted (in minutes).

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4.11 Punctuality (% Departures < +/- 3 mins vs. schedule due to ATM causes)

Does the Solution impact this KPA? ***NO***

4.11.1 Performance Mechanism

Is there a Benefit Mechanism available? ***NO***

4.11.2 Assessment Data (Exercises and Expectations)

Exercise ID or Expert judgement	Benefits contribution to PUN1	Benefits contribution to PUN2
EXE-xx	***N/A***	***N/A***

Table 36: Punctuality benefit per Exercise

OI step	Relative benefits contribution to PUN1	Relative benefits contribution to PUN2
XX-XXXX	***N/A***	***N/A***
TOTAL	***N/A***	***N/A***

Table 37: Punctuality relative benefit per OI step

4.11.3 Extrapolation to ECAC wide

KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
PUN1 Average departure delay per flight	min/flight	Average delay (AOBT – SOBT) per flight due to reactionary delays, ATM and weather related delay causes.	YES	***N/A***	***N/A***
PUN2 % Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather related delay causes	%	% Departures so that |AOBT – SOBT| < +/- 3 min. Difference in Actual Departure Time vs. Scheduled Time due to ATM and weather-related delay causes.	YES	***N/A***	***N/A***

Table 38: Punctuality benefit for Mandatory KPIs /PIs

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Table 39 is showing the impact on flight phases (provided when it is possible).

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
PUN1 Average departure delay per flight	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
PUN2 % Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather related delay causes	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***

Table 39: Punctuality benefit per flight phase.

Were there any benefits obtained in SESAR2020 Wave1 for this Solution? ***No***.

4.11.4Discussion of Assessment Result

N/A

4.11.5Additional Comments and Notes

N/A

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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)

Exercise ID or Expert judgement	Benefits contribution to CMC1.1	Benefits contribution to CMC1.2	Benefits contribution to CMC1.3	Benefits contribution to CMC1.3.1	Benefits contribution to CMC1.3.2	Benefits contribution to CMC1.4.1	Benefits contribution to CMC1.4.2	Benefits contribution to CMC2.1
EXE-xx	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***

Table 40: Civil-Military Cooperation and Coordination benefit per Exercise

OI step	Relative benefits contribution to CMC1.1	Relative benefits contribution to CMC1.2	Relative benefits contribution to CMC1.3	Relative benefits contribution to CMC1.3.1	Relative benefits contribution to CMC1.3.2	Relative benefits contribution to CMC1.4.1	Relative benefits contribution to CMC1.4.2	Relative benefits contribution to CMC2.1
XX-XXXX	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
TOTAL	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***

Table 41: Civil-Military Cooperation and Coordination relative benefit per OI step

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4.12.3Extrapolation to ECAC wide

Category	PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
Impact of ATM Solutions on the effectiveness of military mission	**CMC1.1** Allocated vs. Requested ARES duration	%	It is calculated as proportion between the time allocated for ARES after completing the ASM planning phase (including the civil-military CDM process for airspace configuration) and the time initially requested by the user: Time allocated / time requested for airspace reservation/restriction. It could be calculated for an individual ARES or for a group of ARES depending on the validation scenario objectives and specifications. It is applicable to Variable Profile Area (VPA), Dynamic Mobile Area (DMA), and modular types of design for ARES. The indicator supports the assessment of the impact of ASM planning and civil-military decision-making processes on the training time for military mission inside ARES.	When relevant	***N/A***	***N/A***
	CMC1.2 Allocated vs. Requested ARES dimension	%	It is calculated as the proportion between the volume of the ARES allocated after completing the ASM planning phase (including the civil-military CDM process for airspace configuration) and the volume initially requested by the user: (Allocated ARES surface/ Requested ARES Surface) x (Allocated FL band/Requested FL band). It could be calculated for an individual ARES or for a group of ARES depending on the validation scenario objectives and specifications. It is applicable to VPA, DMA, and modular types of design for ARES. It provides an indication on how closely the allocated ARES conforms to the required airspace dimensions for the execution of the training inside ARES.	When relevant	***N/A***	***N/A***

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Category	PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
	CMC1.3 Deviation of Transit Time to/from airbase to ARES	+/- Minutes	It represents the difference between the transit time in the initial request of the military Airspace User and the transit time resulting from the airspace configuration processes (including the civil-military CDM for ASM). Transit time is defined as the time to be flown from the airbase of departure to the entry point in ARES or from a reference point specified by the military user to the entry point in ARES. It is applicable in situations where a time/distance constraint is defined by the military airspace user for the location of ARES. It could be calculated for individual ARES and then the results could be summed up to provide a global figure for the entire military airspace use plan. It is applicable to VPA, DMA type 1, and modular types of design for ARES. It provides an indication on the effectiveness of ARES location.	When relevant	***N/A***	***N/A***
	CMC 1.3.1 Allocated ARES duration vs. total mission duration	%	It is calculated as the difference in mean values of the ratios between time spent in DMA(s) versus total mission time (based on mid-speed) before (initial military request) and after the completion of airspace configuration (ARES allocation throughout civil-military CDM) processes. It could be calculated for individual ARES or a group of ARES depending on the missions defined in the exercise scenarios. It is applicable to VPA, DMA, and modular types of design for ARES. It supports the assessment of the achievement of military training objectives inside ARES.	When relevant	***N/A***	***N/A***
	CMC 1.3.2 Deviation of total mission duration by iOAT FPL validation	+/- Minutes	It is calculated as the difference between the duration of the mission in the validated iOAT FPL (Reference Mission Trajectory RMT) and the duration of the mission in the submitted iOAT FPL (Shared Mission Trajectory SMT). It could be calculated for a single or the total FPLs submitted by WOC to the Network Manager (NM). It supports the assessment of the impact of NM flight plan validation processes on the effectiveness of military Mission Trajectory planning, especially for cross border flights.	When relevant	***N/A***	***N/A***

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Category	PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
	CMC 1.4.1 Rate of iOAT FPLs acceptance by NM systems	%	The indicator it is calculated as a proportion between the number of FPLs submitted by WOC to NM and the number of FPLs validated by NM systems against the flight planning and ATM route network rules. The measurements could include both of the validation and tactical flow management systems of NM or could be limited to one of them. It supports the assessment of the acceptability of military requirements and exemptions by NM systems.	When relevant	***N/A***	***N/A***
	CMC 1.4.2 Rate of iOAT FPLs acceptance by ATC systems	%	The indicator is calculated as a proportion between the number of FPLs distributed after processing by NM to ATC systems and the number of FPLs accepted by the ATC systems. It supports the assessment of the viability of IOAT FPL to ATC as well as of the ability of ATC systems to provide services to OAT flights.	When relevant	***N/A***	***N/A***
Contribution of CMCC to ATM performance gains	**CMC2.1** Fuel and Distance saved by GAT	Kg and NM	Kg of fuel and distance saved by GAT due optimisation of the ATM network through Demand Capacity balancing and to the new ARES design and management	When relevant	***N/A***	***N/A***

Table 42: Civil-Military cooperation and coordination benefit for Mandatory KPIs /PIs

Table 43 is showing the impact on flight phases (provided when it is possible).

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
CMC1.1 Allocated vs. Requested ARES duration	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
CMC1.2 Allocated vs. Requested ARES dimension	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
CMC1.3 Deviation of Transit Time to/from airbase to ARES	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
CMC 1.3.1 Allocated ARES duration vs. total mission duration	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
CMC 1.3.2 Deviation of total mission duration by iOAT FPL validation	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***

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CMC 1.4.1 Rate of iOAT FPLs acceptance by NM systems	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
CMC 1.4.2 Rate of iOAT FPLs acceptance by ATC systems	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
CMC2.1 Fuel and Distance saved by GAT	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***

Table 43: Civil-Military cooperation and coordination benefit per flight phase.

Were there any benefits obtained in SESAR2020 Wave1 for this Solution? ***NO***

4.12.4Discussion of Assessment Result

N/A

4.12.5Additional Comments and Notes

N/A

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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)

Exercise ID or Expert judgement	Benefits contribution to FLX1
EXE-xx	***N/A***
Add additional rows for all the Exercises from your Solution	

Table 44: Flexibility benefit per Exercise

OI step	Relative benefits contribution to FLX1
XX-XXXX	***N/A***
Add additional rows for all the OIs from your Solution	
TOTAL	***N/A***

Table 45: Flexibility relative benefit per OI step

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4.13.3Extrapolation to ECAC wide

PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
FLX1 Average delay for scheduled civil/military flights with change request and non-scheduled or late flight plan request	Minutes	Total delay for scheduled flights with change request and non-scheduled or late filling flights |AOBT – SOBT|, divided by number of movements	YES	**N/A**	**N/A**

Table 46: Flexibility benefit for Mandatory KPIs /PIs

Table 47 is showing the impact on flight phases (provided when it is possible).

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
FLX1 Average delay for scheduled civil/military flights with change request and non-scheduled or late flight plan request	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***

Table 47: Flexibility benefit per flight phase.

Were there any benefits obtained in SESAR2020 Wave1 for this Solution? ***NO***

4.13.4Discussion of Assessment Result

N/A

4.13.5Additional Comments and Notes

N/A

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4.14Cost Efficiency

Solution 97.1

Does the Solution impact this KPA? ***YES***

The Cost Efficiency performance metric is the direct gate-to-gate ANS cost per flight. It is being assessed by means of the following two KPIs:

- ATCO Productivity improvement (%) – En-Route or TWR/APP, assessing the reduction of workload per controlled flight hour.
- Technology Related Cost-Efficiency Improvement (%) – by assessing the contributions of the technology enablers to a change in asset costs and/or operating costs (maintenance, etc), including support costs improvements (support personnel productivity).

Solution 97.2

Does the Solution impact this KPA? ***YES***

The Cost Efficiency performance metric is the direct gate-to-gate ANS cost per flight. It is being assessed by means of the following two KPIs:

- ATCO Productivity improvement (%) – En-Route or TWR/APP, assessing the reduction of workload per controlled flight hour.
- Technology Related Cost-Efficiency Improvement (%) – by assessing the contributions of the technology enablers to a change in asset costs and/or operating costs (maintenance, etc), including support costs improvements (support personnel productivity).

4.14.1Performance Mechanism

4.14.1.1Solution 97.1

Is there a Benefit Mechanism available? ***YES***

The Benefit and Impact Mechanisms (BIMs) for each operational improvement are presented here below, following.

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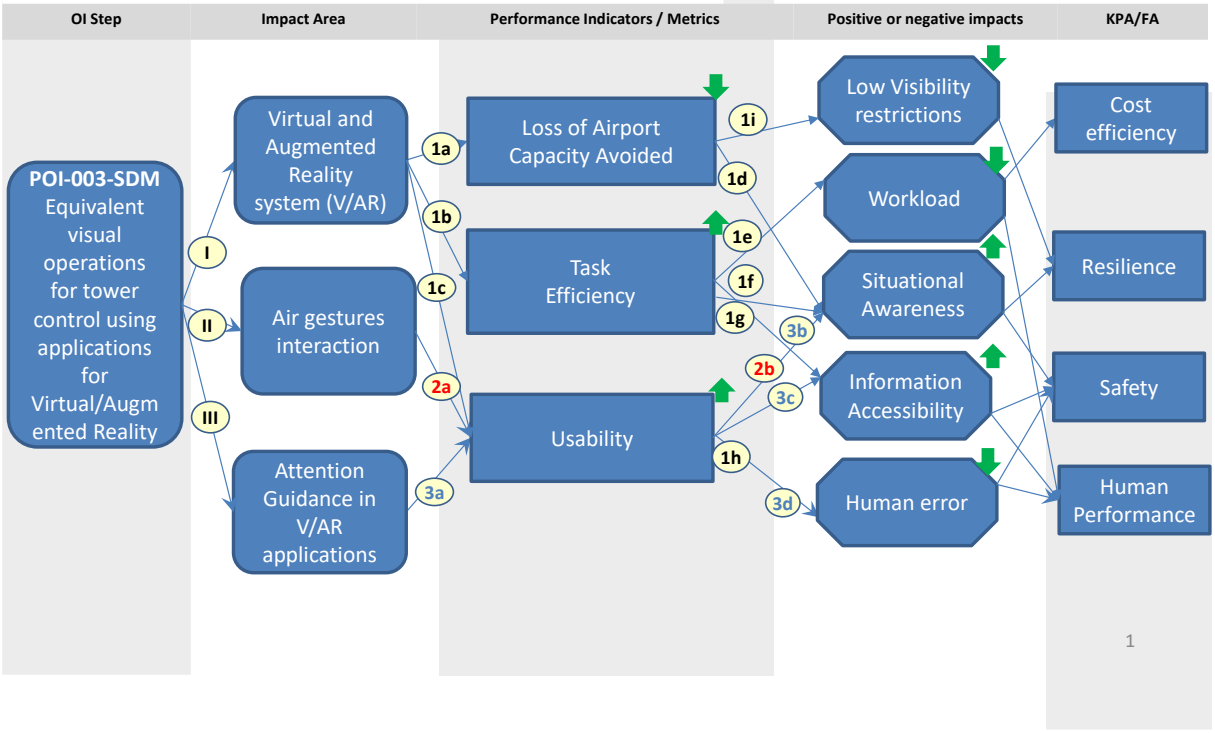
PJ.5-W2-S.97
POI-0039-SDM: Equivalent visual operations for tower control using applications for Virtual/Augmented Reality

Stakeholder group: ATCOs



Distribution to ATC	Stakeholder group: ATCOs
OI: POI-0039-SDM	
(1a)	V/AR is expected to provide ATCOs information regarding the status of the aircraft and aerodrome obstacles in low visibility conditions. This will generate that, in some airports, LVC procedures can remove some restrictions currently in place, minimizing the **capacity loss** in LVC
(1b)	V/AR is expected to improve **task efficiency** by decreasing head-down time as, the introduction of overlays superimposed onto the out of the tower view stimulate the ATCO to work in head-up position more than in head-down position.
(1c)	V/AR is expected to improve **usability** as it enables a more intuitive display of safety nets, and it can guide the ATCO in spotting safety hazard quickly.
(1d)	The updated information provided by V/AR will improve **situational awareness** in LVC producing an improvement in the resilience and safety of airports.
(1e)	V/AR is expected to decrease cognitive **workload** as the expected decrease in head-down time reduces the cognitive load needed to switch from head-down 2D visualization to head-up perspective view. V/AR can be also used to guide ATCOs through hazardous situation or checklists thereby reducing WL even further. The reduced workload will have an impact on cost efficiency and human performance.

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(1f)	V/AR is expected to increase **situational awareness** as the expected decrease in head-down time reduces the disorientation caused by the repetitive refocus from perspective out of the tower view to 2D CWP visualization. This will improve safety.
(1g)	V/AR is expected to improve **information accessibility** as the ATCOs will now have information available while they have their head-up that it was only accessible on the CWP before. This will impact human performance and safety.
(1h)	The improved usability from V/AR is expected to decrease **human error** due to a more intuitive display of safety nets, improving safety and human performance.
(1i)	There might be the possibility of improving airport resilience by changing or removing some **LVP restrictions** at the airports thanks to the equivalent to good weather visibility conditions provided by the V/AR devices.
(2a)	Air Gestures interaction is expected to improve **usability** as ATCO are able to retrieve relevant information more efficiently without switching from Head-up to Head-down.
(2b)	Air Gestures interaction is expected to increase **situational awareness** because the expected increase in information accessibility will contribute to clearer perception and projection of the situation. This will improve safety and human performance.
(3a)	Attention guidance is expected to increase **usability** because it will enable ATCO to retrieve relevant information more efficiently especially in stressed conditions.
(3b)	Attention guidance is expected to increase **situational awareness** by improving increase hazard detection as it highlights the display of safety nets.
(3c)	Workload will be reduced as the **access to information** will be easier and less effort from controller will be required to process it.
(3f)	The highlight of safety nets to the controller will reduce the possibility of a **human error** of overseeing/missing them, increasing safety

4.14.1.2Solution 97.2

Is there a Benefit Mechanism available? ***YES***

The Benefit and Impact Mechanisms (BIMs) for each operational improvement are presented here below, following.

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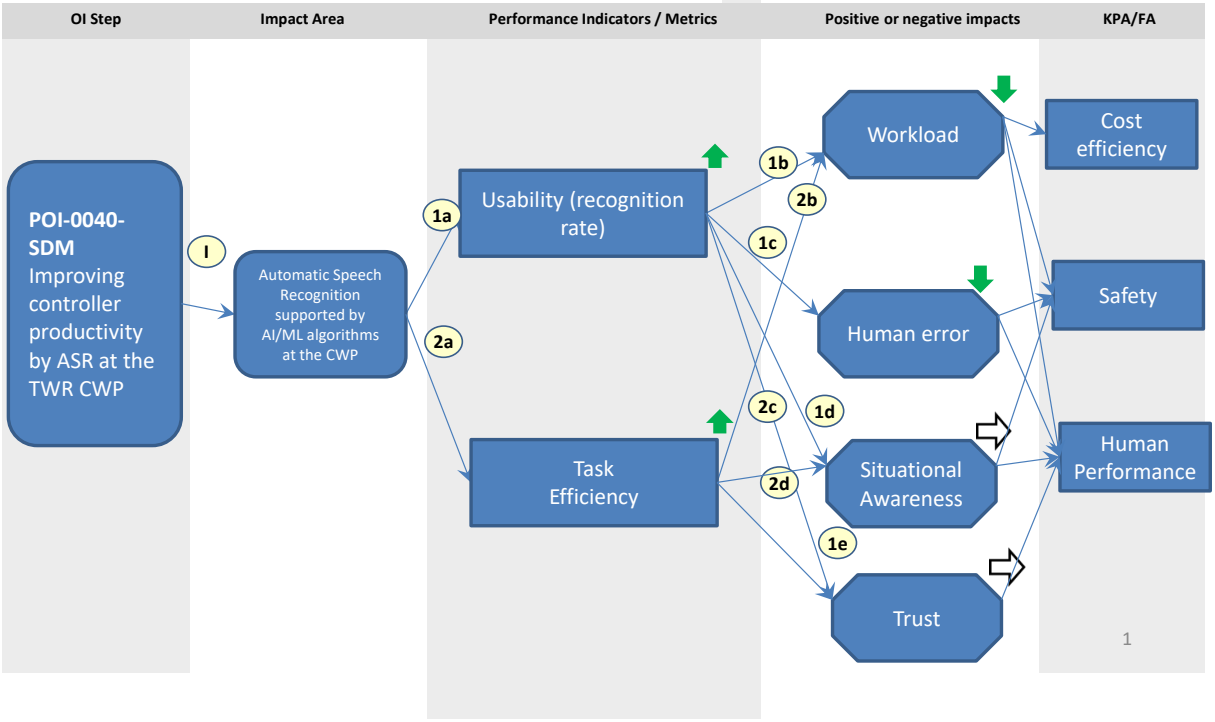
PJ.5-W2-S.97
POI-0040-SDM Improving controller productivity by ASR at the TWR CWP

Stakeholder group: ATCOs



Distribution to ATC	Stakeholder group: ATCOs
OI: POI-0040-SDM	
(1a)	Automatic Speech Recognition is expected to improve usability, by, for example prefilling CWP inputs ATCOs need to perform. To confirm the usability of the technology a show **high recognition rate is needed**, as the basis for further benefits.
(1b)	The improved usability (ASR technology with high recognition rate) would decrease the **workload** in general, which relates to Cost Efficiency, Safety and Human Performance KPA.
(1c)	**Human error** would also be reduced if the system recognizes well that the ATCO made a mistake with the callsign (and even notifies the user). This is linked to Human Performance and Safety KPA.
(1d)	ASR with its innovative technology is expected to have an impact on **situational awareness**, but the exact direction is yet to be seen (see 2c). This is linked to Human Performance and Safety KPA.
(1e)	**Trust** in an ASR technology is expected to be affected, but its exact direction is unclear at the moment. This has a link to Human Performance KPA.
(2a)	ASR could improve efficiency with the **automatic update of the clearances** in the HMI, **the label highlight** on the Visual Panorama and thus would facilitate **less heads-down time** in the TWR environment, increasing thus ATCO's task efficiency.

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(2b)	ASR is expected to decrease **workload** by supporting the Tower ATCO in executing his/her tasks smoothly with the advanced features described in 2a. This is linked to Cost Efficiency, Safety and Human Performance KPA.
(2c)	ASR with its new functionalities described in 2a is expected to impact **situational awareness**. On one hand, the label highlight on the Visual Panorama could direct the attention and enhance situational awareness. On the other hand, if something unexpected happens, the ATCO may not be aware of the exact clearances because s/he did not provide the manual system input and hasn't built up the mental picture of the traffic as well as before this technology. This is linked to Human Performance and Safety KPA.
(2d)	ASR with its new functionalities described in 2a is expected to impact **trust** in the system. This is line with the current trend in high automation- as long as the system is working well, it has a beneficial influence on efficiency. However, in case of an unexpected situation or a system malfunction, due to the potential overreliance the ATCO will have a more difficult time to pick up the pieces and work without the system's assistance. This has a link to Human Performance KPA.

4.14.2Assessment Data (Exercises and Expectations)

Exercise ID or Expert judgement	Benefits contribution to CEF2	Benefits contribution to CEF3	Benefits contribution to CEF1
EXE-001	***-2,47%***	N/A	N/A
EXE-002	***-0,34%***	***N/A***	N/A
EXE-004	***-1,67%***	N/A	N/A
EXE-005	***-1,21%***	N/A	N/A
EXE-006	***-2,25%***	N/A	N/A
EXE-007	***-2,47%***	N/A	N/A

Table 48: Cost Efficiency benefit per Exercise

OI step	Relative benefits contribution to CEF2	Relative benefits contribution to CEF3	Relative benefits contribution to CEF1
POI-0039	***1,54% - 50%***	N/A	N/A
POI-0040	***1,75% - 50%***	N/A	N/A
TOTAL	***100%***		

Table 49: Cost Efficiency relative benefit per OI step

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4.14.3Extrapolation to ECAC wide

KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
CEF2[10] Flights per ATCO-Hour on duty	No	Count of Flights handled divided by the number of ATCO-Hours applied by ATCOs on duty.	YES	***0.35%***	***1,63%***
CEF3 Technology cost per flight	EUR / flight	G2G ANS cost changes related to technology and equipment.	YES	***N/A***	***N/A***
CEF1 Direct ANS Gate-to-gate cost per flight	EUR / flight	Derived by PJ19, taking into account results for the other two KPIs as contributing factors.	Yes but derived from the other two KPIs below	***N/A***	***N/A***

Table 50: Cost Efficiency benefit for Mandatory KPIs /PIs

Were there any benefits obtained in SESAR2020 Wave1 for this Solution? ***NO***

4.14.4Discussion of Assessment Result

By analyzing the assessment of the post analysis reported within the VALR, following the conclusion of the Validation EXEs planned and executed for the scope of the SOLution 97.x, and

- ✓ Although it was not possible to obtain a direct benefit from the post analysis for the KPA CEF2
- ✓ Thanks to the optimization of traffic management and therefore to the increase in capacity
- ✓ assuming that the reduction was due to the contingent situation at the airport (RESilience PI)
- ✓ taking the benefit of the reverse engineering mechanism,

it was possible to define and then quantify a positive effect in terms of ATCO Workload reduction which made it possible to obtain a benefit for the ATCO Productivity, exportable at ECAC Level (the RES always remains a value not expendable for PAGAR and therefore not "exportable" at a level higher than the scenario where the operating performance was measured).

The *Confidence in the Result* can be considered as ***MEDIUM***, thanks to the solidness of the data collected.

4.14.5Additional Comments and Notes

N/A

[10] The benefits are determined by converting workload reduction to a productivity improvement, and then scale it to peak traffic in the applicable sub-OE category. It has to be peak traffic because there must be demand for the additional capacity (note that in this case the assumption is that the additional capacity is used for additional traffic).

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4.15Airspace User Cost Efficiency

Does the Solution impact this KPA? ***NO***

The Airspace User Cost Efficiency metrics capture monetized operational and non-operational airspace user benefits that are not already assessed through the other KPIs, meaning, benefits other than ANS cost improvements, fuel efficiency improvements, etc.

4.15.1Performance Mechanism

Is there a Benefit Mechanism available? ***NO***

4.15.2Assessment Data (Exercises and Expectations)

Exercise ID or Expert judgement	Benefits contribution to AU3	Benefits contribution to AU4	Benefits contribution to AU5
EXE-xx	***N/A***	***N/A***	***N/A***

Table 51: Airspace User Cost Efficiency benefit per Exercise

OI step	Relative benefits contribution to AU3	Relative benefits contribution to AU4	Relative benefits contribution to AU5
XX-XXXX	***N/A***	***N/A***	***N/A***
TOTAL	***N/A***	***N/A***	***N/A***

Table 52: Airspace User Cost Efficiency relative benefit per OI step

4.15.3Extrapolation to ECAC wide

PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
AUC3 Direct operating costs for an airspace user	EUR	Impact on direct costs related to the aeroplane and passengers. Examples: fuel, staff expenses, passenger service costs, maintenance and repairs, navigation charges, strategic delay, landing fees, catering.	Yes, where an impact is foreseen on AU cost efficiency	***N/A***	***N/A***

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PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
AUC4 Indirect operating costs for an airspace user	EUR	Impact on operating costs that don't relate to a specific flight. Examples: parking charges, crew and cabin salary, handling prices at Base Stations.	Yes, where an impact is foreseen on AU cost efficiency	***N/A***	***N/A***
AUC5 Overhead costs for an airspace user	EUR	Impact on overhead costs. Examples: dispatchers, training, IT infrastructure, sales.	Yes, where an impact is foreseen on AU cost efficiency	***N/A***	***N/A***

Table 53: Airspace User Cost Efficiency benefit for Mandatory KPIs /PIs

Were there any benefits obtained in SESAR2020 Wave1 for this Solution? ***NO***

4.15.4Discussion of Assessment Result

N/A

4.15.5Additional Comments and Notes

N/A

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4.16Security

4.16.1The SecRAM 2.0 methodology and the Security Performance Mechanism

The main cyber-security objective of Solution 97 is to define an acceptable level of residual risk for primary operational assets. Primary ATM operational assets are listed within the foreseen operational scope for all the sub-solutions, also defining supporting assets, which are related to IT and technical infrastructure.

Security risk assessment activities resulted in a list of recommended security controls, implemented and applied to reduce the impact of a successful attack.

After controls are in place, the level of residual risk is finally assessed. Attacks can also be mitigated by means of contingency measures, but the preferred course of action is through security controls, which are aimed at prevention rather than mitigation. According to the SESAR Cyber-security Strategy and the SecRAM 2.0 methodology, Security Objectives for all SESAR Solutions have been set at Programme level, i.e., all the Primary Assets of Solutions should have a “Low” residual risk level, that is 1 on a scale of 5. The EATMA architecture was also utilized throughout security assessment, in order to make use of an enterprise view of ATM.

[…]

4.16.2Security Assessment Data Collection

The collection of data for the security assessment has been mainly of a qualitative nature, with an initial scoping, limited to

SC#1	Controller Working Position
SC#2	ATC Datacenter
SC#3	Information Exchange

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Subsequently Primary assets were identified, based on both SecRAM and EATMA methodologies, resulting in the following list

G/G Voice Communication
Surveillance Infrastructure Airport
Surface Route Management
Communication Management

The resulting list of supporting assets was then generated

SA#1	Aerodrome ATC Surface Guidance Management System
SA#2	Aerodrome ATC Controller Human Machine Interaction Management System (CWP)
SA#3	Aerodrome ATC Flight Data Processing System
SA#4	Aerodrome ATC Runway & Taxiway Usage Management
SA#5	Aerodrome ATC Surface Routing System
SA#6	Airport G/G Communications system
SA#7	Tower Clearance Delivery Controller
SA#8	Tower Ground Controller
SA#9	Tower Runway Controller

Based on the lists of primary and supporting assets, an analysis of the impact on ATM services was carried out, based on scenarios whose result in turn would entail a generalized reduction in terms of the usual parameters such as performance, economics, branding, regulatory and environmental. Such scenarios had previously been designed and assessed.

Impact on supporting assets was analysed, with inherited values never above 3

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Finally, an appraisal of threats and their combinations, vulnerabilities was carried out, followed by risk evaluation and treatment. As it turned out, no special risks were identified and therefore no new risk treatment measures were singled out. A list of control actions is shown in the following table

ID	Control	Supporting asset	Primary asset	Baseline / new	Reduce impact / likelihood	Rationale
C1	Data backup, classification, protection in sw dev., test and dep.	SA1-4	PA4	B	L	Reduction in access to data limiting opportunities for tampering
C2	Network protection/segregation policies	SA1-4	PA2-4	B	L	Reduction of risk associated with network use and unauthorized network access
C3	Secure information transfer through formal exchange policies and authentication	SA1-4	PA3-4	B	I	Security enhancement via reduction of entry points for tampering
C4	Extensive logging and monitoring of ATM, application and network traffic	SA1-9	PA1-4	B	I	Online/offline automated log checks to detect anomalies
C5	Encryption of commands and orders, of packets on network to/from other applications	SA1-4	PA3-4	B	I	Security enhancement reducing entry points hardening data transfer
C6	Controlled and verified change management to configuration, OS, application	SA2,3,4	PA3-4	B	I	Strict version control and test to minimize likelihood of introducing vulnerabilities with new releases or updates
C7	Access control policy for ATM areas, data centre	SA7-9	PA1, PA2	B	L	Physical security enhancement for ATM operational areas

The residual risk values were always very low (1) or low (2) with a low likelihood.

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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 (7)*
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)	*TY but in actual fact no extra measures were found to be necessary other than usual ATM systems security already in place*
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	*Treatment was not specially carried out as a result of a Security Assessment, but ordinary measures put in place in the ATM ICT environment were found to be sufficient*

Table 54: Security benefit for Mandatory PIs

In terms of security there are no significant differences between all the validation exercises, since they are situated within wider ATM systems, and the flow of data always takes place internally, with unlikely exchange of data with the outside world. Other than physical security, which is not within the scope of the current document, there are no special precautions which were the outcome of the Security Assessment Report

[…]

4.16.3Extrapolation to ECAC wide

N/A

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4.16.4Discussion of Assessment Result

[The resulting requirements apply to each exercise in the solution to the same extent, since they are applicable equally to ICT systems, as per the following list:

- Network components segregation
- Backup data saving
- Anti-Malware

All exercises were equally liable to security threats and though no specific extra measures were put in place, residual risk was found to be low, given their setting, within closed ATM environments. Again, EATMA and SecRAM were used extensively, to find that OIs were unlikely to be affected by security threats which would not affect the main ATM infrastructure

[…]

4.16.5Additional Comments and Notes

N/A

[…]

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4.17Human Performance

4.17.1HP arguments, activities and metrics

PIs	Activities & Metrics	Second level indicators	Covered
HP1 Consistency of human role with respect to human capabilities and limitations	**Workshops, RTS& Passive Shadow mode** Workload Situation awareness Acceptability Usability Trust Human Error Operating Methods	**HP1.1** Clarity and completeness of role and responsibilities of human actors	Open: TRL4 identified Req and Rec/Issues & Benefits/Objectives need to be further validated in TRL6
		HP1.2 Adequacy of operating methods (procedures) in supporting human performance	Open: TRL4 identified Req and Rec/Issues & Benefits/Objectives need to be further validated in TRL6
		HP1.3 Capability of human actors to achieve their tasks in a timely manner, with limited error rate and acceptable workload level	Open: TRL4 identified Req and Rec/Issues & Benefits/Objectives need to be further validated in TRL6
HP2 Suitability of technical system in supporting the tasks of human actors		**HP2.1** Adequacy of allocation of tasks between the human and the machine (i.e., level of automation).	Open: TRL4 identified Req and Rec/Issues & Benefits/Objectives need to be further validated in TRL6
		HP2.2 Adequacy of technical systems in supporting Human Performance with respect to timeliness of system responses and accuracy of information provided	Open: TRL4 identified Req and Rec/Issues & Benefits/Objectives need to be further validated in TRL6
		HP2.3 Adequacy of the human machine interface in supporting the human in carrying out their tasks.	Open: TRL4 identified Req and Rec/Issues & Benefits/Objectives need to be further validated in TRL6
HP3 Adequacy of team structure and team communication in supporting the human actors		**HP3.1** Adequacy of team composition in terms of identified roles	Open: TRL4 identified Req and Rec/Issues & Benefits/Objectives need to be further validated in TRL6
		HP3.2 Adequacy of task allocation among human actors	Open: TRL4 identified Req and Rec/Issues & Benefits/Objectives need to be further validated in TRL6
		HP3.3 Adequacy of team communication with regard to information type, technical enablers and impact on situation awareness/workload	Open: TRL4 identified Req and Rec/Issues & Benefits/Objectives need to be further validated in TRL6
		HP4.1	Open: TRL4 identified Req and

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PIs	Activities & Metrics	Second level indicators	Covered
		User acceptability of the proposed solution	Rec/Issues & Benefits/Objectives need to be further validated in TRL6
HP4 Feasibility with regard to HP-related transition factors		**HP4.2** Feasibility in relation to changes in competence requirements	Open: TRL4 identified Req and Rec/Issues & Benefits/Objectives need to be further validated in TRL6
		HP4.3 Feasibility in relation to changes in staffing levels, shift organization and workforce relocation.	Open: TRL4 identified Req and Rec/Issues & Benefits/Objectives need to be further validated in TRL6
		HP4.4 Feasibility in relation to changes in recruitment and selection requirements.	Open: TRL4 identified Req and Rec/Issues & Benefits/Objectives need to be further validated in TRL6
		HP4.5 Feasibility in terms of changes in training needs with regard to its contents, duration and modality.	Open: TRL4 identified Req and Rec/Issues & Benefits/Objectives need to be further validated in TRL6

Table 55: HP arguments, activities and metrics

[…]

4.17.2Extrapolation to ECAC wide

There is no ECAC wide extrapolation required for this KPI.

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4.17.3Open HP issues/ recommendations and requirements

PIs	Number of open issues/ benefits	Nr. of recommendations	Number of requirements
HP1 Consistency of human role with respect to human capabilities and limitations	**PJ05.W2.97.01: 03** **PJ05.W2.97.02: 04**	**PJ05.W2.97.01: 09** **PJ05.W2.97.02: 20**	**PJ05.W2.97.01: 42** **PJ05.W2.97.02: 20**
HP2 Suitability of technical system in supporting the tasks of human actors	**PJ05.W2.97.01: 52** **PJ05.W2.97.02: 22**		
HP3 Adequacy of team structure and team communication in supporting the human actors	**PJ05.W2.97.01: 00** **PJ05.W2.97.02: 01**		
HP4 Feasibility with regard to HP-related transition factors	**PJ05.W2.97.01: 00** **PJ05.W2.97.02: 02**		

Table 56: Open HP issues/ recommendations and requirements

4.17.4Concept interaction

N/A

4.17.5Most important HP issues

Please list here any important issues that might have a major impact on the performance of the solution.

In case issues that impact other solutions are envisaged please list them here to facilitate the aggregation of data into deployment scenarios

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	PJ05.W2.97.01: Failure of V/A-R Tracking label requires ATCO to recover to current operating methods with a consequent decrease in situation awareness and a lack in the operating methods if failure recovery operational procedures are not described. This might negatively affect ATCO productivity	No Intercedences identified

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PIs	Most important issue of the solution	Most important issues due to solution interdependencies
	The issue also affects arguments: Arg. 2.3.8: The user interface supports a sufficient level of individual situation awareness. [V1: AIR only]	
	PJ05.W2.97.02: ASR Can also increase head-down time to check whether the system is registering and executing the right input (versus one-click input in reference situation). O ASR system provides a benefit mostly to a strip-environment and less to a strip less environment. Mainly it will depend on the integration. To achieve the workload benefits and the head-up benefits the integration of the system shall be complete and well performed (the ASR main benefit would be highlighting the callsign from pilot utterance, in EFS environment, the ASR input would have to be integrated into the electronic flight strip)	No Intercedences identified
	PJ05.W2.97.01: V/A-R Tracking label does not provide adequate information (e.g., latest updated information; needed information) and ATCO is not supported by the HMI for the needed information, negatively affecting situation awareness, human error, ability to accomplish tasks and focus on primary tasks. This issue also affects arguments: Arg. 2.3.7: The user interface design reduces human error as far as possible. [V1: AIR only] Arg. 2.3.8: The user interface supports a sufficient level of individual situation awareness. [V1: AIR only]	No Intercedences identified
HP2 Suitability of technical system in supporting the tasks of human actors	**PJ05.W2.97.02:** If the ATCO would have to accept/reject the clearance recognition, workload will not be reduced compared to the reference and waiting time will be	No Intercedences identified

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PIs	Most important issue of the solution	Most important issues due to solution interdependencies
	introduced/increased.	
	PJ05.W2.97.02: BENEFIT: ASR increases situation awareness highlighting callsign based on ATCO-Flight R/T. This might also affect ATCO productivity	No Intercedences identified
	PJ05.W2.97.02: BENEFIT: ATCOs might improve the adherence to the phraseology if they have a good user experience through ASR support	No Intercedences identified
HP3 Adequacy of team structure and team communication in supporting the human actors	**PJ05.W2.97.02:** Job acceptance and satisfaction might be reduced in case of abnormal and degraded mode (malfunction) or low system performance (e.g., need of continuously update wrongly recognised clearance, long time wait before showing the recognised clearance)	No Intercedences identified
	PJ05.W2.97.02: BENEFIT: ASR input device increases job satisfaction by providing an interaction means that is intuitive (adherent to daily life user experience e.g., car speech recognition system, smartphone speech recognition systems). This might also affect argument: Arg. 2.3.6: The usability of the user interface (input devices, visual displays/output devices, alarm& alerts) is acceptable. [V1: AIR only]	No Intercedences identified
	PJ05.W2.97.01: Failure of V/A-R Tracking label requires ATCO to recover to current operating methods with a consequent decrease in situation awareness and a lack in the operating methods if failure recovery operational procedures are not described. This might negatively affect ATCO productivity The issue also affects arguments:	No Intercedences identified

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PIs	Most important issue of the solution	Most important issues due to solution interdependencies
	Arg. 2.3.8: The user interface supports a sufficient level of individual situation awareness. [V1: AIR only]	
HP4 Feasibility with regard to HP-related transition factors	**PJ05.W2.97.02:** ASR Can also increase head-down time to check whether the system is registering and executing the right input (versus one-click input in reference situation). O ASR system provides a benefit mostly to a strip-environment and less to a strip less environment. Mainly it will depend on the integration. To achieve the workload benefits and the head-up benefits the integration of the system shall be complete and well performed (the ASR main benefit would be highlighting the callsign from pilot utterance, in EFS environment, the ASR input would have to be integrated into the electronic flight strip)	No Intercedences identified
	PJ05.W2.97.01: V/A-R Tracking label does not provide adequate information (e.g., latest updated information; needed information) and ATCO is not supported by the HMI for the needed information, negatively affecting situation awareness, human error, ability to accomplish tasks and focus on primary tasks. This issue also affects arguments: Arg. 2.3.7: The user interface design reduces human error as far as possible. [V1: AIR only] Arg. 2.3.8: The user interface supports a sufficient level of individual situation awareness. [V1: AIR only]	No Intercedences identified
	PJ05.W2.97.02: If the ATCO would have to accept/reject the clearance recognition, workload will not be reduced compared to the reference and waiting time will be introduced/increased.	No Intercedences identified

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PIs	Most important issue of the solution	Most important issues due to solution interdependencies
	PJ05.W2.97.02: BENEFIT: ASR increases situation awareness highlighting callsign based on ATCO-Flight R/T. This might also affect ATCO productivity	No Intercedences identified
	PJ05.W2.97.02: BENEFIT: ATCOs might improve the adherence to the phraseology if they have a good user experience through ASR support	No Intercedences identified

Table 57: Most important HP issues

4.17.6Additional Comments and Notes

The solution PJ05.W2.97.01 & PJ05.W2.97.02 are considered to have achieved TRL4 level of maturity but need to be further validated for TRL6 level of maturity.

[…]

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4.18Other PIs

Further PIs from the Performance Framework update are assessed qualitatively, or, if possible, quantitatively, in Table 58

KPA	PIs	Benefit mechanism (text only)	Qualitative Impact[11]
N/A	*N/A*	*N/A*	*N/A*
N/A	*N/A*	*N/A*	*N/A*

Table 58: Qualitative assessment of QoS KPIs

Detailed descriptions of these PIs can be found in the Performance Framework [3].

NOTE: These PIs are preliminary, and the table currently serves as a placeholder!

4.18.1Performance Mechanism

N/A

4.18.2Assessment Data (Exercises and Expectations)

N/A

4.18.3Additional Comments and Notes

N/A

[11] --, -, 0, +, ++

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4.19Gap Analysis

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits at Network Level (ECAC Wide or Local depending on the KPI)[12]	Rationale[13]
SAF1: Safety - Total number of estimated accidents with ATM Contribution per year	***N/A***	***N/A***	***N/A***
FEFF1: Fuel Efficiency - Actual average fuel burn per flight	***N/A***	***N/A***	***N/A***
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***

[12] Negative impacts are indicated in red.

[13] 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.**

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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	***97.x: 0,35%***	***1,63%***	***Medium to High***
CEF3: Technology Cost – Cost per flight	***N/A***	***N/A***	***N/A***

Table 59: 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)[14]

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

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Appendix A Detailed Description and Issues of the OI Steps

OI Step ID	Title	Consistency with latest Dataset
N/A	*N/A*	*N/A*
N/A	*N/A*	*N/A*
N/A	*N/A*	*N/A*

Table 60: OI Steps allocated to the Solution

[…]

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Appendix B Title of the appendix

B.1 <Appendix section>

B.1.1 <Appendix sub section>

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