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PROSA

SEPARATION MANAGEMENT AND CONTROLLER TOOL

This **Performance Assessment Report** is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 874464 under European Union's Horizon 2020 research and innovation programme.



Abstract

Among the expected technological enhancements allocated by SJU to SESAR 2020-W2-PJ10 “**SEPARATION MANAGEMENT AND CONTROLLER TOOL**” are the development of new human machine interface (HMI) interaction modes and technologies for the CWP in the En-Route and TMA Environment, with the aim to minimize the load and mental strain on the ATCOs.

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 Solution 96 ASR, under PJ.10-W2-WP4:

✓ PJ.10-W2-96 ASR ‘*Automatic Speech Recognition*’

The validation activities planned for the Solution comprise 4 Validation Exercise.

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 Technological Solution in *SESAR2020 Wave 2 PJ.10-W2- WP4*, namely:

✓ PJ.10-W2-96 'Automatic Speech Recognition'

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 Solution address the development of new human machine interface (HMI) interaction modes and technologies at the Controller Working Position (CWP) for En-Route and TMA which aim to minimise the load and mental strain on the ATCOs in different Operational situations. The solution is targeting TRL6 maturity level.

The PJ.10-W2-Sol.96 ASR deals with new methods of controller interaction with Human Machine Interface (HMI), integrating an Automatic Speech Recognition tool in a medium complexity environment to bring a positive effect on the controller productivity with no negative impact on human performance, safety and capacity.

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 Solution: namely Cost Efficiency, Human Performance and Safety.

Assessment Results Summary:

The following tables summarises the assessment outcomes per KPI ([Table 1](#)[Table 1](#)) and mandatory PI ([Table 2](#)[Table 2](#)) puts them side-by-side against Validation Targets in case of KPI from PJ19 [\[9\]](#)[\[8\]](#). 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 High, Medium or Low indicates that the Solution is expected to impact in a marginal way the KPI or mandatory PI.
2. An assessment result (positive or negative) different than 0 with confidence level High, Medium or Low indicates that the Solution is expected to impact the KPI or mandatory PI.

3. An assessment result of N/A (Not Applicable) with confidence level N/A indicates that the Solution is not expected to impact at all the KPI or mandatory PI consistently with the Benefit Mechanism.

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits at Network Level (ECAC Wide or Local depending on the KPI) ¹	Confidence in Results ²
SAF1: Safety - Total number of estimated accidents with ATM Contribution per year	<i>ISI</i>		<i>Medium</i>
FEFF1: Fuel Efficiency - Actual average fuel burn per flight	<i>N/A</i>	<i>N/A</i>	<i>N/A</i>
CAP1: TMA Airspace Capacity - TMA throughput, in challenging airspace, per unit time.	<i>N/A</i>	<i>N/A</i>	<i>N/A</i>
CAP2: En-Route Airspace Capacity - En-route throughput, in challenging	<i>N/A</i>	<i>N/A</i>	<i>N/A</i>

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

airspace, per unit time			
CAP3: Airport Capacity – Peak Runway Throughput (Mixed mode).	<i>N/A</i>	<i>N/A</i>	<i>N/A</i>
TEFF1: Gate-to-gate flight time	<i>N/A</i>	<i>N/A</i>	<i>N/A</i>
PRD1: Predictability – Average of Difference in actual & Flight Plan or RBT durations	<i>N/A</i>	<i>N/A</i>	<i>N/A</i>
PUN1: Punctuality – Average departure delay per flight	<i>N/A</i>	<i>N/A</i>	<i>N/A</i>
CEF2: ATCO Productivity – Flights per ATCO - Hour on duty	1,71	<i>Between 6 and 10% WL reduction (Local)</i>	<i>Medium</i>
CEF3: Technology Cost – Cost per flight	<i>N/A</i>	<i>N/A</i>	<i>N/A</i>

Table 1: KPI Assessment Results Summary

Mandatory PI	Performance Expectations at Network Level (ECAC Wide or Local depending on the KPI) ³	Benefits at Network	Confidence Results ⁴	in
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	YES		N/A	
SEC2: Risk Treatment has been carried out	YES		N/A	
SEC3: Residual risk after treatment meets security objective.	YES		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

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.	N/A	N/A
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

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	N/A	N/A
HP2: Suitability of technical system in supporting the tasks of human actors	N/A	N/A
HP3: Adequacy of team structure and team communication in supporting the human actors	N/A	N/A
HP4: Feasibility with regard to HP-related transition factors	N/A	N/A
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

2 Introduction

2.1 Purpose of the document

The Performance Assessment covers the Key Performance Areas (KPA) 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, 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], [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.

- 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] [8][6] for a comprehensive glossary of terms.

Term	Definition	Source of the definition
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. For example: 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 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
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 controllers’ HMI.	PJ.16-04

⁵ Go to “Advanced Portfolio Manager” on the left navigation menu, and select “Coordination Group – ATM Performance Assessment (APA)” in STELLAR:

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) 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
Functional Block	A logical and cohesive grouping of automated Functions in a Technical System	EATMA Guidance Material [1]

Table 3: Glossary

2.5 Acronyms and Terminology

Term	Definition
ABSR	Assistant Based Speech Recognition
AI	Artificial Intelligence
ANSP	Air Navigation Service Provider
ATCO	Air Traffic Controller
APP	Approach
ASR	Automatic Speech Recognition
ASW	Air Situation Window
ATC	Air Traffic Control
ATM	Air Traffic Management
CHMI	Controller HMI
CR	Change Request
CV	Clearance Verification
CWP	Controller Working Position

EATMA	European Air Traffic Management Architecture
E-ATMS	European Air Traffic Management System
EN	Enabler
ER	En-Route
FB	Functional Block
FRD	Functional Requirements Document
HMI	Human Machine Interface
HP	Human Performance
HPAP	Human Performance Assessment Plan
ID	Identifier
IRS	Interface Requirements Specification
KHZ	Kilohertz
NFR	Non- Functional Requirements
NSV	NATO Systems View
POI	Performance Operational Improvement
PMP	Project Management Plan
SeAP	Security Assessment Plan
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SPR-INTEROP/OSED	Safety and Performance Requirements – Interoperability Requirements / Operational Service and Environment Definition
SUT	System Under Test
TLA	Target Location Assistance
TRL	Technology Readiness Level
TS/IRS	Technical Specification/Interface Requirements Specification
TVALP	Technological Validation Plan
TVALR	Technological Validation Report

VALS	Validation Strategy
VCS	Voice Communication System
VP	Validation Plan
VR	Validation Report
V&V	Validation & Verification

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

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

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

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

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

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

3 Solution Scope

3.1 Detailed Description of the Solution

ASR in ATM domain matured in Wave 1 up to TRL-4 and enabled the definition of rules for transformation of a sequence of ATC words into ATC concepts (so called ontology). This ontology has been developed further and maybe prepared for standardization in the future.

In Wave 2 ASR has operated also on real life data and the objective is to reach TRL-6. As most input comes from the ATCO-pilot spoken dialog, ASR is the appropriate technology to reduce ATCO's workload by directly filling the command masks and radar labels using the spoken commands instead of manually inputting them into the system. This requires integration of artificial intelligence (AI) and machine learning algorithms. Highlighting of targets, user-friendly and intuitive operation is expected to increase controller productivity.

The solution operates in a medium complexity TMA and En-Route environment and ATCOs are the end users. HMI prototypes will be developed in order to present the results of the speech recognition (highlighting of targets, user-friendly and intuitive operation etc.) in the optimal way to the controllers.

ASR in the ATC environment can still be enhanced. The solution aims to reach a commands recognition rate better than 85%, which was aimed in Wave1, which is quite ambitious. Therefore, comparison algorithms will be developed avoiding that erroneous recognitions are missed by the controller and used by subsequent systems. This requires integration of artificial intelligence (AI) and machine learning algorithms for the intelligent data provision to the controllers. In addition, the solution will also investigate how ASR may be used to enable faster and more predictable navigation in 3D visualizations of the air space sectorisation when using dynamic air space configuration (DAC). One of the challenges that will be addressed is how to combine using speech to communicate with pilots and other ATCOs with using speech to control the CWP.

The improvements in the HMI interaction modes and technologies aim to minimise the workload of the TMA and En-Route Controllers and may be applicable in current operations and/or in future operational concepts still under development and scope of other SESAR Solutions.

PJ.10-W2-96 ASR deals with both the current operating TMA and En-Route environment and future environments and is aligned to the current evolution happening within the SESAR 2020 Programme.

The enabler used for the validation is represented in EATMA DS22 and the architecture proposed for the validation exercises is described in the deliverable TS/IRS.

3.2 Detailed Description of relationship with other Solutions

Solution Number	Solution Title	Relation ship	Rational for Justification	Impacted KPA; Relationship coefficient ⁶
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⁶ For any question on how to fulfil this section please contact us through "STELLAR - Slideboard ()" or directly by email: Irisa Chiu irisa.chiu.ext@eurocontrol.int and Didier Dohy didier.dohy.ext@eurocontrol.int ⁷ Reactionary delay out of the scope since

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PJ.08-01	Management of Dynamic Airspace configurations	Cross Effect	PJ.16-04-CWPV perspective: Other Solutions are potentially candidates as the Solution is linked to the definition of a new architecture of the CWP HMI. These Solutions might be identified using the link to CHMI functional block in EATMA/MEGA. Interaction magnitude should be low.	CEF 2 (Cost Efficiency optimization for ANSP due to technological Enablers that will increase the efficiency in ATC.); CAP 2 increased (Medium impact) due to general expectation to improve complexity management through new algorithm that allow to manage less critical flight.
PJ.10-01b	Flight-Centric ATC	Cross Effect	PJ.16-04-CWPV perspective: Other Solutions are potentially candidates as the Solution is linked to the definition of a new architecture of the CWP HMI. These Solutions might be identified using the link to CHMI functional block in EATMA/MEGA. Interaction magnitude should be medium.	
PJ.10-01c	Collaborative Control	Cross Effect	PJ.16-04-CWPV perspective: Other Solutions are potentially candidates as the Solution is linked to the definition of a new architecture of the CWP HMI.	

they could be due to many different reasons other than capacity degradation, in addition the cause of reactionary delay are not recorded in detail.

			These Solutions might be identified using the link to CHMI functional block in EATMA/MEGA. Interaction magnitude should be medium.	
PJ.10-05	IFR RPAS Integration	Cross Effect	PJ.16-04-CWPV perspective: Other Solutions are potentially candidates as the Solution is linked to the definition of a new architecture of the CWP HMI. These Solutions might be identified using the link to CHMI functional block in EATMA/MEGA. Interaction magnitude should be high. PJ.10-05 perspective: Confirm a potential interaction that has to be confirmed and evaluated in Wave 2. Positive effect on HP.	
PJ.11-G1	Enhanced Short Term Conflict Alert (STCA) and Non Transgression Zone (NTZ) Ground Based Safety Nets making use of DAPs information.	Cross Effect	PJ.16-04-CWPV perspective: Other Solutions are potentially candidates as the Solution is linked to the definition of a new architecture of the CWP HMI. These Solutions might be identified using the link to CHMI functional block in EATMA/MEGA. Interaction magnitude should be low.	
PJ.15-02	E-AMAN Service	Cross Effect	PJ.16-04-CWPV perspective: Other Solutions are potentially candidates as the Solution is linked	

			to the definition of a new architecture of the CWP HMI. These Solutions might be identified using the link to CHMI functional block in EATMA/MEGA. Interaction magnitude should be low.	
W2. PJ10.96 AG with W2.PJ10 .96 ASR	Improving ATCO productivity by ASR in EnRoute OE (improving Situation awareness and ATCO workload)	Compati ble / Indepen tent / No Cross Effect	W2. PJ10.96 AG prefers / is compatible with W2.PJ10.96.ASR as the Speech Recognition module might support ATCOs on duty and both SOLs are compatible in the same OE	
W2. PJ10.96 ASR with W2.PJ10 .96 AG	Improving ATCO productivity by AG in EnRoute OE (improving Situation awareness and ATCO workload)	Compati ble / Indepen tent / No Cross Effect	W2. PJ10.96 ASR prefers / is compatible with W2.PJ10.96.AG as the Attention Guidance module might support ATCOs on duty and both SOLs are compatible in the same OE	

Table 6: Relationships of Sol 97.1 with other Solutions

The possible relationships that PJ10-W2 -SOL 96 ASR might have, looking at the other W2 Solutions in EnRoute and TMA Operational Environment, is with SOL 96 AG and vice versa, judged as **“Compatible/Independent/No cross effect”**. Thus, these relationships are not mentioned except for the above, due to being part of the same project.

4 Solution Performance Assessment

4.1 Assessment Sources and Summary of Validation Exercise Performance Results

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

Exercise ID	Exercise Title	Release	Maturity	Status
EXE-PJ.10-96-ASR-TRL6-01	Assessment of efficiency improvements in datalink communications by means of the use of Automatic Speech Recognition	Q2 2022	TRL6	Completed
EXE-PJ.10-96-ASR-TRL6-02	Assessment of Recognition Performance and ATM Efficiency Improvements	Q4 2022	TRL6	Completed
EXE-PJ.10-96-ASR-TRL6-03	Assessment of improvements in situational awareness thanks to the use of Automatic Speech Recognition.	Q4 2021	TRL6	Completed
EXE-PJ.10-96-ASR-TRL6-05	Assessment of how ASR may be used to enhance the ATCOs management of changes when using dynamic air space configuration (DAC).	Q3 2022	TRL6	Completed

Table 7: 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-PJ.10-96-ASR-TRL6-01	POI-0055-SDM	Real-time simulation addressing the improvement of controller productivity by ASR at the ER CWP/HMI	Workload within acceptable limits	
EXE-PJ.10-96-ASR-TRL6-02	POI-0055-SDM	Real-time simulation addressing the improvement of controller productivity by ASR at the ER CWP/HMI	10% reduction of WL	
EXE-PJ.10-96-	POI-0055-SDM	Real-time simulation addressing the improvement of controller	6% reduction of WL	

ASR-TRL6-03		productivity by ASR at the ER CWP/HMI		
EXE-PJ.10-96-ASR-TRL6-05	POI-0055-SDM	Real-time simulation addressing the improvement of controller productivity by ASR at the ER CWP/HMI	Workload within acceptable limits	

Table 8: Summary of Validation Results.

4.2 Conditions / Assumptions for Applicability

The following [Error! Reference source not found.](#)Table 5 summarises the applicable operating environments.

OE	Applicable sub-OE	Special characteristics
En-Route and TMA	Medium/high complexity	

Table 9: Applicable Operating Environments.

4.3 Safety

The scope of technological safety assessment is equivalent to the scope of the PJ.10-W2-96 ASR 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 [Error! Reference source not found.\[11\]](#), 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 [Error! Reference source not found.\[12\]](#). 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 PJ10-W2-96 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, 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 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 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 4.17 Error! Reference source not found.), the solution PJ10-W2-96 have achieved TRL6 level of maturity.

4.3.5 Additional Comments and Notes

N/A

4.4 Environment: Fuel Efficiency / CO2 emissions

Does the Solution impact this KPA?

The Solution has not detect any impact. The flight trajectory were not impacted by the use of ASR and therefore the fuel consumption didn't change.

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

<i>KPIs / Pls</i>	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	YES	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 10: Fuel burn and CO2 emissions saving for Mandatory KPIs /Pls

	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 11: Fuel burn and CO2 emissions saving per flight phase.

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

4.4.4 Discussion of Assessment Result

N/A

4.4.5 Additional Comments and Notes

N/A

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

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 PM_{2.5} and PM₁₀); • SOx: Sulphur oxides. • Recommended tools: Open-ALAQS	N/A	N/A	N/A

Table 12: 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

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 13: Airspace Capacity benefits per Exercise

OI step	Relative benefits contribution to CAP1	Relative benefits contribution to CAP2
XX-XXXX	N/A	N/A
TOTAL	100%	100%

Table 14: Airspace Capacity relative benefits per OI step

KPIs / Pls	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	% and also total number of movements, per volume of En-Route airspace per hour for specific traffic mix and	YES	N/A	N/A

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

Table 15: 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

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 16: 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	100%	100%	100%	100%

Table 17: 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

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 18: 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

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

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

4.8.1 Performance Mechanism

Is there a Benefit Mechanism available? **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-xx	N/A	N/A	N/A	N/A	N/A	N/A

Table 19: 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-0055	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL			100%			

Table 20: Resilience relative benefits per OI step

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.	NO	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.	NO	N/A	N/A

PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
RES2 Loss of Airspace Capacity Avoided	% and Movement s per hour	Loss of Airspace Capacity with the concept divided by the loss of Airspace Capacity without the concept	YES		
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.		N/A	N/A
RES4 Minutes of delays	Minutes	Impact on AUs measured through delays 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).		N/A	N/A
RES5 Number of cancellations	No flights	Impact on AUs measured through Cancellations resulting from capacity degradation ⁸ . 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).		N/A	N/A

Table 21: Resilience for Mandatory PIs

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

4.8.3 Extrapolation to ECAC wide

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.

⁸ 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.

4.8.4 Discussion of Assessment Result

N/A

4.8.5 Additional Comments and Notes

N/A

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 22: 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	100%	100%	100%	100%	100%	100%

Table 23: Flight Times relative benefits per OI step

4.9.3 Extrapolation to ECAC wide

KPIs / Pls	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
TEFF59 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 24: Flight Times benefits for Mandatory KPIs /Pls

⁹ Although no major time inefficiencies occur during climb, this phase has been included for consistency.

Table 25Table 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 25: 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

4.10 Predictability

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

4.10.1 Performance Mechanism

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

4.10.2 Assessment Data (Exercises and Expectations)

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

Table 26: Predictability benefits per Exercise

OI step	Relative benefits contribution to PRD1	Relative benefits contribution to PRD2
XX-XXXX	N/A	N/A
TOTAL	100%	100%

Table 27: Predictability relative benefits per OI step

4.10.3 Extrapolation to ECAC wide

KPIs / Pls	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

KPIs / Pls	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
PRD2 Variance ¹⁰ 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 28: Predictability benefits for Mandatory KPIs /Pls

Table 29Table 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 29: Predictability benefit per flight phase

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

4.10.4 Discussion of Assessment Result

N/A

4.10.5 Additional Comments and Notes

N/A

¹⁰ Standard Deviation is also accepted (in minutes).

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 30: Punctuality benefit per Exercise

OI step	Relative benefits contribution to PUN1	Relative benefits contribution to PUN2
XX-XXXX	N/A	N/A
TOTAL	100%	100%

Table 31: 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 32: Punctuality benefit for Mandatory KPIs /PIs

Table 33Table 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 33: 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

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

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

4.12.1 Performance Mechanism

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

4.12.2 Assessment 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 34: 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	100%	100%	100%	100%	100%	100%	100%	100%

Table 35: Civil-Military Cooperation and Coordination relative benefit per OI step

4.12.3 Extrapolation 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

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

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

Table 37Table 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

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 37: 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

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 38: 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	100%

Table 39: Flexibility relative benefit per OI step

4.13.3 Extrapolation 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 40: Flexibility benefit for Mandatory KPIs /PIs

Table 41 ~~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 41: Flexibility benefit per flight phase.

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

4.13.4 Discussion of Assessment Result

N/A

4.13.5 Additional Comments and Notes

N/A

4.14 Cost Efficiency

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

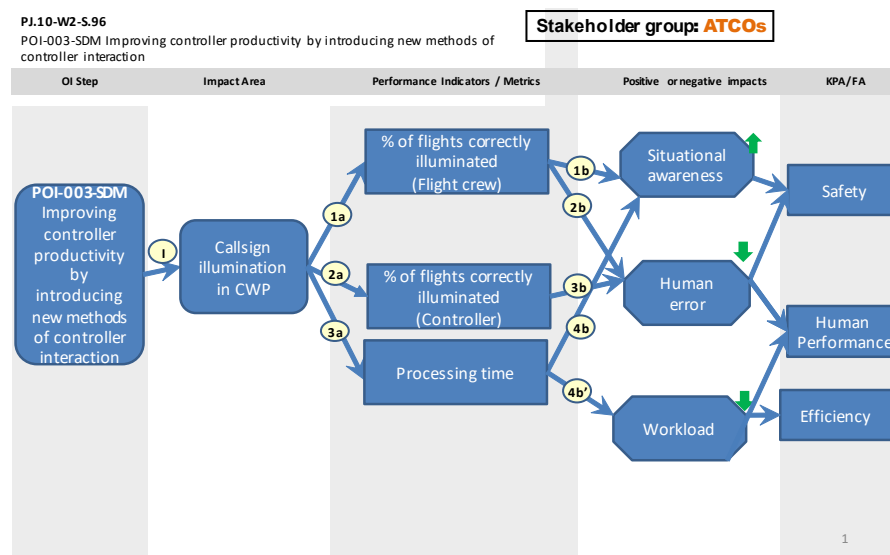
The Cost Efficiency performance metric is the direct gate-to-gate ANS cost per flight. It is being assessed by means of the following two KPIs:

- ATCO Productivity improvement (%) – En-Route or TMA, 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).

4.14.1.1 Performance Mechanism

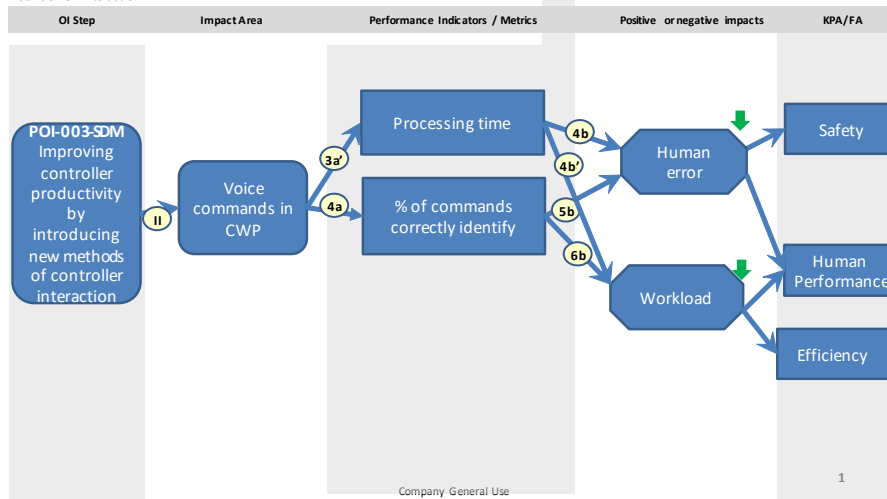
Is there a Benefit Mechanism available? **YES**

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



PJ.10-W2-S.96

POI-003-SDM Improving controller productivity by introducing new methods of controller interaction

Stakeholder group: **ATCOs**


Distribution to ATC	Stakeholder group: AUs
OI:	
(I)	The Automatic Speech Recognition as new controller interaction method will allow the automatic illumination of callsigns in the CWP
(II)	The Automatic Speech Recognition as new controller interaction method will allow the transcription and identification of controllers commands and support ATCOs in visualization navigation.
(1a)	The percentage of callsigns correctly illuminated coming from flight crew utterances will determine if this new controller interaction method is useful
(2a)	The percentage of callsigns correctly illuminated coming from controller utterances will determine if this new controller interaction method is useful
(3a)	The information should be produced in a timely manner to effectively support the controller
(3a')	
(1b)	A high percentage of callsigns (from flight crew utterances) correctly identify will increase the controller's situational awareness increasing safety. Situational awareness will increase specially when the flight crew performs the first contact.
(2b)	A high percentage of callsigns (from flight crew utterances) correctly identify will decrease human error increasing safety. It confirms the controller the callsign from the aircraft contacting or performing the readback.
(3b)	A high percentage of callsigns (from controller utterances) correctly identify will decrease human error increasing safety. It will help the controller to identify if the command spoke and entered in the CWP have different callsigns
(4b)	Low processing time is necessary to support controllers in their task.

(4b')	
(6b)	A high number of commands correctly identified will reduce human error by allowing the controller to check the last commands provided. This will increase safety and human performance.

4.14.2 Assessment Data (Exercises and Expectations)

Exercise ID or Expert judgement	Benefits contribution to CEF2	Benefits contribution to CEF3	Benefits contribution to CEF1
EXE-PJ.10-96-ASR-TRL-01	Workload within acceptable limits	N/A	N/A
EXE-PJ.10-96-ASR-TRL-02	10% workload reduction	N/A	N/A
EXE-PJ.10-96-ASR-TRL-03	6% workload reduction	N/A	N/A
EXE-PJ.10-96-ASR-TRL-05	Workload within acceptable limits	N/A	N/A

Table 42: Cost Efficiency benefit per Exercise

OI step	Relative benefits contribution to CEF2	Relative benefits contribution to CEF3	Relative benefits contribution to CEF1
POI-0055-SDM	100%	N/A	N/A
TOTAL	100%	N/A	N/A

Table 43: Cost Efficiency relative benefit per OI step

Next subsections gather the information from the TVALR from where the numbers have been obtained.

4.14.2.1 EXE-PJ.10-96-ASR-TRL-01

Exercise 001 used the Bedford questionnaire to gather the controller's workload. The average level of workload reported for the solution scenarios (4.1 out of 10) was below the maximum tolerable WL level (6), however it was higher to the average workload level calculated for the reference scenario (2) which indicates that ATCOs perceived a higher level of workload during the scenarios with ASR. The scoring was motivated by the low system recognition rates and current ASR activation means which require mental effort.

Controllers indicated that a more mature prototype with higher recognition rates would probably improve the perceived workload scoring.

4.14.2.2 EXE-PJ.10-96-ASR-TRL-02

The NASA TLX was used to assess different dimensions of workload in exercise 002 of DLR and Austro Control for benefits of ASRU for radar label maintenance. The outcome of the normalized answer when normalized to a scale were all the answers range from (1) Low to (10) High is presented in [Table 44](#) [Table 42](#).

The table shows the average mean values with and without using ASRU support and for the medium and heavy traffic scenario. The third row (Delta) is the difference. It is not always the difference between the means, because here already sequence compensation was performed. Negative values correspond to an improvement, when ASRU support was provided (solution runs).

The row "relative" shows the average improvement, i.e. we divided delta by the average value of without and with ASRU support. We show a deviation for question 4. Maybe the participants did not carefully read the questions, not recognizing that high values correspond here to low workload (before normalizing it).

		1	2	3	4	5	6	Summary
Medium	without ASRU	4.30	3.50	3.53	2.27	4.96	2.89	3.57
Medium	with ASRU	3.94	2.94	3.26	2.66	4.00	2.37	3.20
	Delta	-0.35	-0.54	-0.26	0.38	-0.93	-0.50	-0.37
	Relative	-8%	-17%	-8%	15%	-21%	-19%	-11%
Heavy	without ASRU	7.08	6.00	6.08	3.25	7.25	4.17	5.64
Heavy	with ASRU	6.58	4.92	5.75	3.17	6.50	4.25	5.19
	Delta	-0.50	-1.08	-0.33	-0.08	-0.75	0.08	-0.44
	Relative	-7%	-20%	-6%	-3%	-11%	2%	-8%
Both	without ASRU	5.69	4.75	4.81	2.76	6.10	3.53	4.61
	with ASRU	5.26	3.93	4.50	2.91	5.25	3.31	4.19
	Delta	-0.42	-0.81	-0.30	0.15	-0.84	-0.21	-0.41
	Relative	-8%	-19%	-6%	5%	-15%	-6%	-9%

Table 4442: EXE-002 normalized answers

The column "Summary" just takes the average of the corresponding rows. We can conclude that the workload (with respect to NASA TLX) is reduced by 11% for medium traffic and by 8% for the heavy traffic scenario. If we combine both we can a workload improvement by 9%.

If we are ignoring question 4, we would get

		1	2	3	5	6	Summary
Medium	without ASRU	4.30	3.50	3.53	4.96	2.89	3.83
Medium	with ASRU	3.94	2.94	3.26	4.00	2.37	3.30

Delta seq compensation		-0.35	-0.54	-0.26	-0.93	-0.50	-0.52
Relative		-8%	-17%	-8%	-21%	-19%	-14%
Heavy	without ASRU	7.08	6.00	6.08	7.25	4.17	6.12
	with ASRU	6.58	4.92	5.75	6.50	4.25	5.60
	Delta	-0.50	-1.08	-0.33	-0.75	0.08	-0.52
	Relative	-7%	-20%	-6%	-11%	2%	-9%
Both	without ASRU	5.69	4.75	4.81	6.10	3.53	4.98
	with ASRU	5.26	3.93	4.50	5.25	3.31	4.45
	Delta	-0.42	-0.81	-0.30	-0.84	-0.21	-0.52
	Relative	-8%	-19%	-6%	-15%	-6%	-11%

Table 4542: EXE-002 normalized answers without outliers

We can conclude that the workload (with respect to NASA TLX) is reduced by 14% for medium traffic and by 9% for the heavy traffic scenario. If we combine both we can a workload improvement by 11%.

4.14.2.3 EXE-PJ.10-96-ASR-TRL-03

The workload was measured using different approaches in the questionnaires. [Figure 1](#) ~~Figure 10~~ presents the answers to the Nasa TLX.

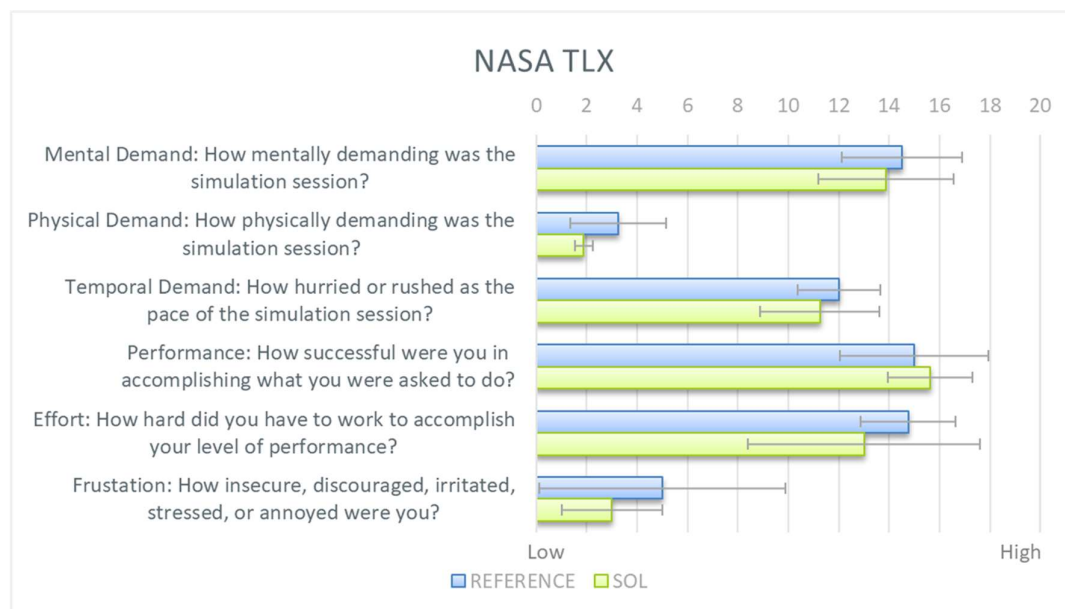


Figure 123 Questionnaire – Workload – NASA TLX

The scoring of the Nasa TLX is 9.1 for the reference questionnaire and 7.9 for the solution questionnaire. **The workload is reduced a 6% in the solution scenario**, but the outcomes need further confirmation from other exercises as the sample and difference between both scenarios are not high.

In the tailor-made questionnaires, workload slightly improves when compared to the reference scenario. When questioned regarding the support of the new tools the answers indicates that ASR slightly supported them although mismatch of information (no recognition from the ASR) introduced some workload.

The feedback during debriefings indicated that controllers consider that ASR slightly decreased the workload which is in line with the previous answers.

4.14.2.4 EXE-PJ.10-96-ASR-TRL-05

Exe-005 collected workload feedback using two complementary means, one during each run in a scale from 1 to 10 and then through fill-in questionnaires. **Error! Reference source not found.** Table 1 shows the collected workload data for the two sessions.

	Ordinary session 1		Ordinary session 2	
	Average WL trad UI	Average WL ASR	Average WL trad UI	Average WL ASR
20 min.	1.666666667	1.75	1	1.666666667
35 min.	1.333333333	1	1	1.666666667

Table 4654: Workload data (1=low, 2=medium, 3=high)

In the first session, the WL is slightly higher for ATCOs using ASR after 20 minutes, and slightly lower after 35 minutes. In the second session, WL is higher for ATCOs using ASR than for the ones not using it. All average data represent low workload.

The underlying data shows that the workload is unevenly distributed, i.e., it is rather low for four of the sectors, and quite high for the fifth one. This is mainly due to a weakness in the DAC solution for used for these sessions. Furthermore, the workload data are also influenced by the dispatch work done by the master controller before and during the sessions. The WL data for all sectors indicate that the traffic distribution between the sectors were different in the two sessions, giving the ATCO in the sector with most traffic more traffic in the second than in the first session. As the ATCO in this sector used ASR in the second run, this is probably more important for the WL data than the use of ASR. **During the debriefings controllers gave no indication of increased workload due to use of ASR.**

4.14.3 Extrapolation to ECAC wide

KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
CEF2¹¹ Flights per ATCO-Hour on duty	No	Count of Flights handled divided by the number of ATCO-Hours applied by ATCOs on duty.	YES		
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 4744: Cost Efficiency benefit for Mandatory KPIs /PIs

Were there any benefits obtained in SESAR2020 Wave1 for this Solution? No analysis was performed during Wave 1 as it was a technological solution.

Extrapolation has been performed in the PJ.10-W2-S96 Final CBA [7].

4.14.4 Discussion of Assessment Result

By analyzing the assessment of the post analysis reported within the TVALR, following the conclusion of the Validation EXEs planned and executed for the scope of the SoLution 96 ASR 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**, as some of the exercises reported that improved prototype may provide higher workload reduction.

4.14.5 Additional Comments and Notes

N/A

¹¹ 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).

4.15 Airspace 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.

4.15.1 Performance Mechanism

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

4.15.2 Assessment 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 4845: 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	100%	100%	100%

Table 4946: Airspace User Cost Efficiency relative benefit per OI step

4.15.3 Extrapolation 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

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 5047: Airspace User Cost Efficiency benefit for Mandatory KPIs /PIs

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

4.15.4 Discussion of Assessment Result

N/A

4.15.5 Additional Comments and Notes

N/A

4.16 Security

4.16.1 The SecRAM 2.0 methodology and the Security Performance Mechanism

The main cyber-security objective of Solution 96 ASR 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 that no further recommended security controls need to be implemented and applied to reduce the impact of a successful attack to the ones already performed by the system also without the integration of the ASR.

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.

4.16.2 Security 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	The operational environments considered are en-route, terminal and aerodrome environments in which air traffic control service is provided.
SC#2	ICAO PANS-ATM (Doc 4444) provides the following definitions related to air traffic control service, instructions and clearances that are relevant for PJ.10-W2 Sol.96 ASR. Air Traffic Control Service. A service provided for the purpose of: a) preventing collisions: 1) between aircraft, and 2) on the manoeuvring area between aircraft and obstructions; and b) expediting and maintaining an orderly flow of air traffic. Air traffic control instruction. Directives issued by air traffic control for the purpose of requiring a pilot to take a specific action. Air traffic control clearance. Authorization for an aircraft to proceed under conditions specified by an air traffic control unit.

SC#3	Automatic Speech Recognition is used by the ANSP to support its units and controllers in providing air traffic control service to controlled flights in control areas under its jurisdiction. Therefore, the related business objective of the ANSP is to provide air traffic control service. Air traffic control service is provided directly by means/elements such as: • Executive and planning controllers • Supervisors • ATC systems • Technical support
------	--

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

PA#1	Air Traffic Control Service
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The resulting list of supporting assets was then generated:

SA#1	Executive Controller
SA#2	Planning Controller
SA#3	Supervisor
SA#4	ATC systems (e.g. FDPS, CWP, ASR)
SA#5	Technical support

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

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.	SA4-5	PA1	B	L	Reduction in access to data limiting opportunities for tampering
C2	Network protection/segregation policies	SA4-5	PA1	B	L	Reduction of risk associated with network use and unauthorized network access
C3	Secure information transfer through formal exchange policies and authentication	SA4-5	PA1	B	I	Security enhancement via reduction of entry points for tampering
C4	Extensive logging and monitoring of ATM, application and network traffic	SA4-5	PA1	B	I	Online/offline automated log checks to detect anomalies
C5	Encryption of commands and orders, of packets on network to/from other applications	SA4-5	PA1	B	I	Security enhancement reducing entry points hardening data transfer
C6	Controlled and verified change management to configuration, OS, application	SA4-5	PA1	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	SA1-3, SA5	PA1	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.

PIs	Unit	Calculation	Mandatory	Current value
SEC1 A security risk assessment has been carried out	Binary Vector – with maximum 7 components with Y/N (according to the prioritization and maturity level of the solution)	A security risk assessment has been carried out applying SecRAM 2.0, and the following steps have each been carried out : The identification of Primary Assets, Supporting Assets, Threat Scenarios and Vulnerabilities; The evaluation of Impacts, Likelihoods and Risks.	YES (different steps are strongly recommended for different maturity levels)	Y, Y, Y, Y, Y, Y, Y
SEC2 Risk Treatment has been carried out	Binary Vector – 2 components with Y/N	Following SecRAM 2.0, Security controls have been identified by Security Experts and implemented in the Solution.	YES (implementation just at higher maturity levels – V4)	Y, Y <i>but in actual fact no extra measures were found to be necessary other than usual ATM systems security already in place</i>
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 ($H \rightarrow M$, $M \rightarrow L$, $H \rightarrow L$). It is important to notice that according to SecRAM the Risk Level achieved should be “Low” otherwise justifications must be provided.	YES	<i>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</i>

Table 5148 Security benefit for Mandatory PIs

In terms of security the validation exercises are situated within the ATM system, 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

4.16.3 Extrapolation to ECAC wide

N.A.

4.16.4 Discussion of Assessment Result

The resulting requirements apply to the exercises in the solution, since they are applicable equally to ICT systems, as per the following list:

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

The 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

4.16.5 Additional Comments and Notes

None

4.17 Human Performance

4.17.1 HP arguments, activities and metrics

PIs	Activities & Metrics	Second level indicators	Covered
HP1 Consistency of human role with respect to human capabilities and limitations	Real Time Simulation SUS, NASA TLX, SASHA Tailor-Made Questionnaires, Trust questionnaire, Standardised workload questionnaire	HP1.1 Clarity and completeness of role and responsibilities of human actors	N/A
		HP1.2 Adequacy of operating methods (procedures) in supporting human performance	Closed
		HP1.3 Capability of human actors to achieve their tasks in a timely manner, with limited error rate and acceptable workload level	Closed
HP2 Suitability of technical system in supporting the tasks of human actors	Real Time Simulation Tailor-Made Questionnaires, SASHA, SATI, Bedford, Observations, Debriefing, Logs	HP2.1 Adequacy of allocation of tasks between the human and the machine (i.e. level of automation).	Closed
		HP2.2 Adequacy of technical systems in supporting Human Performance with respect to timeliness of system responses and accuracy of information provided	Closed
		HP2.3 Adequacy of the human machine interface in supporting the human in carrying out their tasks.	Closed
HP3 Adequacy of team structure and team communication in supporting the human actors		HP3.1 Adequacy of team composition in terms of identified roles	N/A
		HP3.2 Adequacy of task allocation among human actors	N/A
		HP3.3 Adequacy of team communication with regard to information type, technical enablers and impact on situation awareness/workload	N/A

PIs	Activities & Metrics	Second level indicators	Covered
HP4 Feasibility with regard to HP-related transition factors	Real Time Simulation	HP4.1 User acceptability of the proposed solution	Closed
		HP4.2 Feasibility in relation to changes in competence requirements	N/A
		HP4.3 Feasibility in relation to changes in staffing levels, shift organization and workforce relocation.	N/A
	Tailor-Made Questionnaires, Debriefing, Observations	HP4.4 Feasibility in relation to changes in recruitment and selection requirements .	N/A
		HP4.5 Feasibility in terms of changes in training needs with regard to its contents, duration and modality.	Closed

Table 5249: HP arguments, activities and metrics

[...]

4.17.2 Extrapolation to ECAC wide

There is no ECAC wide extrapolation required for this KPI.

4.17.3 Open 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			
HP2 Suitability of technical system in supporting the tasks of human actors		RECOM_10-96-001_1 RECOM_10-96-001_2 RECOM_10-96-001_3 RECOM_10-96-001_4 RECOM_10-96-001_5 RECOM_10-96-001_6 RECOM_10-96-001_7 RECOM_10-96-001_8	REQ-10.96-01-TS-SF.0060
HP3 Adequacy of team structure and team communication in supporting the human actors			
HP4 Feasibility with regard to HP-related transition factors			

Table 5350: Open HP issues/ recommendations and requirements

4.17.4 Concept interaction

All identified relationships and dependencies with/on other projects/solutions are listed in the PMP section 6.1 [4]. For the HP assessment the following aspects are important:

Progressing the work of PJ.16-04 ASR and PJ.05-W2-Sol.97.2: the outcome of Solution PJ.10-W2-Sol.96 ASR assessment will be the baseline for the further HP work in the subsequent Solutions.

4.17.5 Most 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	Decrease of situation awareness and increase of human error in degraded conditions, e.g. ASR recognizes a wrong clearance/call-sign (applicable for degraded conditions). Task performance: which might increase thanks to the automation support (task performance);	N/A
HP2 Suitability of technical system in supporting the tasks of human actors	Human error might be potentially lessened with automatic highlight and clearance recognition. In case the performance of the technical system is not as expected in terms of recognition rate or time for output, this might increase ATCO frustration and might decrease situation awareness with possible, consequent negative impact on workload and potential negative impact in case of overreliance. This is expected to improve workload, situation awareness and user satisfaction but these HP indicators might also be potentially negatively affected in case the performances of the technical system are not as expected or in case of degraded mode.	N/A
HP3 Adequacy of team structure and team communication in supporting the human actors	No changes are expected in communication, except more strict usage of the standard phraseology in order to have better ASR recognition rate	N/A
HP4 Feasibility with regard to HP-related transition factors	ASR tool might improve job acceptance and satisfaction in case of very good system performance with high recognition rate and in general smooth new technology might attract new ATCOs, but might also negatively affect both job acceptance and satisfaction in case of degraded mode (e.g. ASR recognizes a wrong clearance/call-signs)	N/A

Table 5451: Most important HP issues

4.17.6 Additional Comments and Notes

N/A

4.18Other PIs

Further PIs from the Performance Framework update are assessed qualitatively, or, if possible, quantitatively, in [Table 55](#)~~Table 58~~

KPA	PIs	Benefit (text only)	mechanism	Qualitative Impact ¹²
N/A	N/A	N/A		N/A
N/A	N/A	N/A		N/A

Table ~~55~~**52**: 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

¹² --, -, 0, +, ++

4.19 Gap Analysis

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits at Network Level (ECAC Wide or Local depending on the KPI) ¹³	Rationale ¹⁴
SAF1: Safety - Total number of estimated accidents with ATM Contribution per year			
FEFF1: Fuel Efficiency - Actual average fuel burn per flight	4,19kg	N/A	<i>It was not possible to quantify any quantitative value. (See §</i>
CAP1: TMA Airspace Capacity - TMA throughput, in challenging airspace, per unit time.	2,68	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

¹³ Negative impacts are indicated in red.

¹⁴ 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.**

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	1,71	Between 6 and 10% WL reduction (local)	Medium to High
CEF3: Technology Cost – Cost per flight	0,72	N/A	N/A

Table 5653: Gap analysis Summary

[...]

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)¹⁵

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

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

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

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

[6] D4_0_30-PJ19-SESAR2020_Common_Assumptions_2019 (1.0), ed. 01.00.00, 16 Sep 2019

[7] D4_1_110-PJ_10-W2-96 ASR Final CABT; ed 00.00.05, Feb 2023

Content Integration

[8] SESAR ATM Lexicon

Performance Management

[9] PJ19.04 D4.1 Validation Targets - Wave 2 (2020)¹⁶

Validation

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

[11] SESAR 2020 - PJ05-W2 Sol 97 D3.1.033 - Technical Validation Plan (TVALP) Final version

Safety

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

¹⁵ At the time of the creation of the PAR template, the Methodology (PJ19.04 Internal Document) is foreseen to be update in 2020.

¹⁶ At the time of the creation of the PAR template the Validation Target is foreseen to be delivered in June 2020

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

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

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

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

[15] Accident Incident Models – AIM, release 2017

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

Human Performance

[16] 16.06.05 D 27 HP Reference Material D27

[17] 16.04.02 D04 e-HP Repository - Release note

Environment Assessment

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

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

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

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

Security

[20] 16.06.02 D103 SESAR Security Ref Material Level

[21] 16.06.02 D137 Minimum Set of Security Controls (MSSCs).

[22] 16.06.02 D131 Security Database Application (CTRL_S)

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 5754: OI Steps allocated to the Solution

[...]

Appendix B Title of the appendix

B.1 <Appendix section>

B.1.1 <Appendix sub section>

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