

D1.4 - SESAR 2020-VLD3-W2-SORT DEMO Report - Part V - Performance Assessment Report (PAR) - WP5

Deliverable ID:	D1.4
Dissemination Level:	PU
Project Acronym:	SORT
Grant:	874520
Call:	H2020-SESAR-2019-1
Topic:	SESAR-IR-VLD-WAVE2-16-2019
Consortium Coordinator:	NLR (AT-One)
Edition Date:	24 May 2023
Edition:	00.03.00
Template Edition:	01.00.09

Authoring & Approval

Authors of the document

Beneficiary	Date
LFV (COOPANS)	03/03/2023

Reviewers internal to the project

Beneficiary	Date
LFV (COOPANS)	31/08/2022
SINTEF (NATMIG)	16/09/2022
SWEDAVIA	16/09/2022
NLR (AT-One)	23/02/2023

Reviewers external to the project

Beneficiary	Date
None	03/03/2023

Approved for submission to the S3JU By - Representatives of all beneficiaries involved in the project

Beneficiary	Date
NLR (AT-One)	03/03/2023
LFV (COOPANS)	03/03/2023
SINTEF (NATMIG)	03/03/2023
SWEDAVIA	03/03/2023
ACG (COOPANS)	03/03/2023
DLR (AT-One)	03/03/2023
EUROCONTROL	03/03/2023
NATS	03/03/2023
HAL (SEAC2020)	03/03/2023

Rejected By - Representatives of beneficiaries involved in the project

Beneficiary	Date
None	03/03/2023

Document History

Edition	Date	Status	Beneficiary	Justification
00.00.00	26/04/2022	Initial draft	NLR (AT-One)	Distribution of first draft
00.00.01	31/08/2022	Final Draft	LFV (COOPANS)	Update of result with focus on WP5
00.00.01	20/02/2023	Updated, final draft	LFV-COOPANS	Few corrections and updates
00.00.02	24/02/2023	Reviewed draft	NLR (AT-One)	Final draft for review/approval
00.00.03	28/02/2023	Corrected draft	NLR (AT-One)	Final draft for approval
00.01.00	03/03/2023	Partners Approved first edition	NLR (AT-One)	Submitted first D1.4 version to SJU (as D1.4.02)
00.02.00	17/04/2023	Issue approved for submission	NLR (AT-One)	Submitted second D1.4 version to SJU
00.03.00	24/05/2023	Final SJU approved issue	NLR (AT-One)	Version approved by all project partners and SJU.

Copyright Statement © 2023 – VLD3-W2-SORT beneficiaries. All rights reserved. Licensed to SESAR3 Joint Undertaking under conditions.

SORT

SAFELY OPTIMISED RUNWAY THROUGHPUT

This VLD3-W2-SORT DEMO report – Part V Performance Assessment Report (PAR) for WP5 is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874520 under European Union’s Horizon 2020 research and innovation programme.



Abstract

This document is the fifth part of the DEMO Report document for WP5 of the SESAR 2020 VLD3-W2-SORT project that addresses traffic optimisation on single and multiple runway airports by integrating multiple concepts operating in both Execution and Planning Phases and supporting both Tower Controllers and Supervisors in monitoring and optimising runway usage.

The present document contains the demonstration Performance Assessment Report (PAR) related to the concept. The contents are based on the results of the demonstration and validation of the solution.

Table of Contents

Abstract	4
1 Executive Summary.....	8
2 Introduction.....	13
2.1 Purpose of the document.....	13
2.2 Intended readership	13
2.3 Inputs from other projects	13
2.4 Glossary of terms.....	14
2.5 Acronyms and Terminology	14
3 Demo Scope	21
3.1 Detailed Description of the Demo	21
3.2 Detailed Description of relationship with other Solutions	21
4 Demo Performance Assessment	22
4.1 Assessment Sources and Summary of Validation Exercise Performance Results.....	22
4.2 Conditions / Assumptions for Applicability.....	23
4.3 Safety.....	25
4.3.1 Safety Design drivers and Performance Mechanism	25
4.3.2 Data collection and Assessment.....	25
4.3.3 Extrapolation to ECAC wide.....	25
4.3.4 Discussion of Assessment Result.....	25
4.3.5 Additional Comments and Notes	25
4.4 Environment: Fuel Efficiency / CO2 emissions.....	26
4.4.1 Performance Mechanism	26
4.4.2 Assessment Data (Exercises and Expectations).....	26
4.4.3 Extrapolation to ECAC wide.....	26
4.4.4 Discussion of Assessment Result.....	27
4.4.5 Additional Comments and Notes	27
4.5 4.5 Environment / Emissions, Noise and Local Air Quality	28
4.5.1 Performance Mechanism	28
4.5.2 Assessment Data (Exercises and Expectations).....	28
4.5.3 Extrapolation to ECAC wide.....	29
4.5.4 Discussion of Assessment Result.....	29
4.5.5 Additional Comments and Notes	29
4.6 Airspace Capacity (Throughput / Airspace Volume & Time).....	30
4.7 Airport Capacity (Runway Throughput Flights/Hour)	31
4.7.1 Performance Mechanism	31
4.7.2 Assessment Data (Exercises and Expectations).....	31
4.7.3 Extrapolation to ECAC wide.....	32
4.7.4 Discussion of Assessment Result.....	32
4.7.5 Additional Comments and Notes	32

4.8	Resilience (% Loss of Airport & Airspace Capacity Avoided)	33
4.9	Flight Times	34
4.9.1	Assessment Data (Exercises and Expectations)	34
4.9.2	Extrapolation to ECAC wide	34
4.9.3	Discussion of Assessment Result	35
4.9.4	Additional Comments and Notes	35
4.10	Predictability	37
4.10.1	Performance Mechanism	37
4.10.2	Assessment Data (Exercises and Expectations)	37
4.10.3	Extrapolation to ECAC wide	37
4.10.4	Discussion of Assessment Result	37
4.10.5	Additional Comments and Notes	38
4.11	Punctuality	38
4.11.1	Assessment Data (Exercises and Expectations)	38
4.11.2	Extrapolation to ECAC wide	38
4.11.3	Discussion of Assessment Result	39
4.11.4	Additional Comments and Notes	39
4.12	Civil-Military Cooperation and Coordination (Distance and Fuel)	40
4.13	Flexibility	40
4.14	Cost Efficiency	41
4.15	Security	41
4.16	Human Performance	41
4.16.1	HP arguments, activities and metrics	41
4.16.2	Extrapolation to ECAC wide	42
4.16.3	Open HP issues/ recommendations and requirements	42
4.16.4	Concept interaction	43
4.16.5	Most important HP issues	43
4.16.6	Additional Comments and Notes	43
4.17	Other PIs	44
4.18	Gap Analysis	44
5	References	46
5.1	Reference Documents	48
Appendix A	Detailed Description and Issues of the OI Steps	49

List of Tables

Table 1: KPI Assessment Results Summary	9
Table 2: Mandatory PIs Assessment Summary	12
Table 3: Acronyms and terminology	15
Table 4: Terminology	20
Table 6: Pre-SESAR2020 Exercises	22

Table 7: SESAR2020 Validation Exercises	22
Table 8: Summary of Validation Results.....	23
Table 9: Applicable Operating Environments.....	24
Table 10: Fuel burn and CO2 emissions saving for Mandatory KPIs /PIs	27
Table 11: Fuel burn and CO2 emissions saving per flight phase.	27
Table 12: Noise and Local Air Quality benefit for Mandatory PIs	29
Table 18: Airport Capacity for Mandatory KPIs /PIs.....	32
Table 22: Flight Times benefits per Exercise	34
Table 24: Flight Times benefits for Mandatory KPIs /PIs	35
Table 25: Flight times benefit per flight phase.....	35
Table 28: Predictability benefits for Mandatory KPIs /PIs	37
Table 29: Predictability benefit per flight phase	37
Table 32: Punctuality benefit for Mandatory KPIs /PIs	38
Table 33: Punctuality benefit per flight phase.	39
Table 49: HP arguments, activities and metrics	42
Table 50: Open HP issues/ recommendations and requirements	43
Table 53: Gap analysis Summary.....	45
Table 54: OI Steps allocated to the Demo.....	49

List of Figures

No table of figures entries found.

1 Executive Summary

This document constitutes the Environment Assessment Report (PAR) for WP5, hence is part of the contractual deliverable D1.4 (DEMOR). It consists of Part V of the DEMOR for the VLD-03-004 Exercise held under WP5 of the SESAR 2020 VLD3-W2-SORT project.

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

Description:

The demonstration was performed with shadow-mode technique in localities separate from the operations room and no Air Traffic Controller was asked to act on the information provided by the shadow-mode system and no aircraft was given instructions based on it.

The purpose of this demonstration was to give ground ATM actors and stakeholders a live demonstration of the concept, and provide participants with useful insight in the benefits to capacity, safety, predictability and environmental impacts of the solution. It also gave the opportunity for further feedback from ATCOs, airport users and ANS users. The demonstration has thereby not focused on gathering data from the system as this has already been performed during earlier V3 Real Time Simulations in PJ02-08.

Assessment Results Summary:

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

There are three cases:

1. An assessment result of 0 with confidence level other level High, Medium or Low indicates that the Demo 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 Demo 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 Demo 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
FEFF1: Fuel Efficiency - Actual average fuel burn per flight	8,5 kg/flight in fuel savings	3,8 kg/flight in fuel savings	High
CAP1: TMA Airspace Capacity - TMA throughput, in challenging airspace, per unit time.	N/A	0	N/A
CAP2: En-Route Airspace Capacity - En-route throughput, in challenging airspace, per unit time	N/A	0	N/A
CAP3: Airport Capacity – Peak Runway Throughput (Mixed mode).	1,341%	Airport capacity can be improved with 6,25%	High
PRD1: Predictability – Average of Difference in actual & Flight Plan or RBT durations	N/A	No data from demonstration	N/A
PUN1: Punctuality – Average departure delay per flight	N/A	No data from demonstration	N/A

Table 1: KPI Assessment Results Summary

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

Mandatory PI	Performance Expectations at Network Level (ECAC Wide or Local depending on the KPI) ³	Benefits at Network	Confidence in Results ⁴
SAF1.X: Mid-air collision - En-Route	0		N/A
SAF2.X: Mid-air collision - TMA	0		N/A
SAF3.X: RWY-collision accident	0		N/A
SAF4.X: TWY-collision accident	0		N/A
SAF5.X: CFIT accident	0		N/A
SAF6.X: Wake related accident	0		N/A
SAF7.X: RWY-excursion accident	0		N/A
SAF8.X ...: Other SAF Risks	0		N/A
SEC1: A security risk assessment has been carried out	0		N/A
SEC2: Risk Treatment has been carried out	0		N/A
SEC3: Residual risk after treatment meets security objective.	0		N/A
ENV1: Actual Average CO2 Emission per flight	11.8 kg CO2/flight saving		Medium
NOI1: Relative noise scale	Not measured		Not measured
NOI2: Size and location of noise contours	Not measured		Not measured
NOI4: Number of people exposed to noise levels exceeding a given threshold	Not measured		Not measured
LAQ1: Geographic distribution of pollutant concentrations	0		N/A
CAP3.1: Peak Departure throughput per hour	Not measured		Not measured

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

(Segregated mode)		
CAP3.2: Peak Arrival throughput per hour (segregated mode)	6.25% improvement	High
CAP4: Un-accommodated traffic reduction	0	N/A
RES1: Loss of Airport Capacity Avoided	0	N/A
RES1.1: Airport time to recover from non-nominal to nominal condition	0	N/A
RES2: Loss of Airspace Capacity Avoided.	0	N/A
RES2.1: Airspace time to recover from non-nominal to nominal condition.	0	N/A
RES4: Minutes of delays.	0	N/A
RES5: Number of cancellations.	0	N/A
TEFF2: Taxi in time	Same as reference scenario	High
TEFF3: Taxi out time	Same as reference scenario	High
TEFF4: TMA arrival time	0.45 min/flight	Medium
TEFF5: TMA departure time	Same as reference scenario	High
TEFF6: En-Route time	Not measured	Not measured
PRD2: Variance of Difference in actual & Flight Plan or RBT durations	Not measured	Not measured
PUN2: % Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather related delay causes	0	N/A
CEF1: Direct ANS Gate-to-gate cost per flight	0	N/A
AUC3: Direct operating costs for an airspace user	0	N/A
AUC4: Indirect operating costs for an airspace user	0	N/A
AUC5: Overhead costs for an airspace user	0	N/A
CMC1.1: Allocated vs. Requested ARES duration	0	N/A
CMC1.2: Allocated vs. Requested ARES dimension	0	N/A
CMC1.3: Deviation of Transit Time to/from airbase to ARES	0	N/A

CMC 1.3.1: Allocated ARES duration vs. total mission duration	0	N/A
CMC 1.3.2: Deviation of total mission duration by iOAT FPL validation	0	N/A
CMC 1.4.1: Rate of iOAT FPLs acceptance by NM systems	0	N/A
CMC 1.4.2: Rate of iOAT FPLs acceptance by ATC systems	0	N/A
CMC2.1: Fuel and Distance saved by GAT	0	N/A
HP1: Consistency of human role with respect to human capabilities and limitations	0	N/A
HP2: Suitability of technical system in supporting the tasks of human actors	0	N/A
HP3: Adequacy of team structure and team communication in supporting the human actors	0	N/A
HP4: Feasibility with regard to HP-related transition factors	0	N/A
FLX1: Average delay for scheduled civil/military flights with change request and non-scheduled or late flight plan request	0	N/A

Table 2: Mandatory PIs Assessment Summary

Additional Comments and Notes:

The VLD-03-004 exercise of WP5 has not been focusing on gathering data in the same way as a validation would have. The reason for this is that the focus off the demonstration has been to show how the solution works with live data for persons of interest.

The results where quantitative figures can be provided are for the environmental result such as fuel burn, CO2 emissions and flight/taxi time. Other results are based on observation from the demonstration or results from earlier validations.

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 Demo. 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 Demo level. The KPA performance results are used for the performance assessment at strategy level and provide inputs to the SESAR3 Joint Undertaking (S3JU) for decisions on the SESAR2020 Programme.

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

2.2 Intended readership

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

Produced by the SESAR 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, 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, 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] [6] for a comprehensive glossary of terms.

2.5 Acronyms and Terminology

Term	Definition
ANS	Air Navigation Service
ANSP	Air Navigation Service Provider
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
BAD	Benefits Assessment Date
BAER	Benefit Assessment Equipment Rate
CBA	Cost Benefit Analysis
DOD	Detailed Operational Description
E-ATMS	European Air Traffic Management System
ECAC	European Civil Aviation Conference
DB	Deployment Baseline
KPA	Key Performance Area
KPI	Key Performance Indicator
N/A	Not Applicable
OI	Operational Improvement

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

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

PAR	Performance Assessment Report
PI	Performance Indicator
PRU	Performance Review Unit
PU	PUBlic
QoS	Quality of Service
RBT	Reference Business / Mission Trajectory
SESAR	Single European Sky ATM Research Programme
S3JU	SESAR3 Joint Undertaking (Agency of the European Commission)
SESAR2020 Programme	The programme which defines the Research and Development activities and Projects for the S3JU.

Table 3: 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

Term	Definition	Source
ARES Capacity	The ability of an ATM system to accommodate specific training events which require airspace reservations and/or restrictions during a specific period of time, taking into account the duration of the training events, ATM inefficiency, planning inefficiency and weather impact on training and operations.	Performance Framework 2017
ATM Master Plan	The European ATM Master Plan is the agreed roadmap to bring ATM R&I to the deployment phase, introducing the agreed vision for the future European ATM system. It provides the main direction and principles for SESAR R&I, as well as the deployment planning and an implementation view with agreed deployment objectives. Through the SESAR Key Features, the ATM Master Plan identifies the Essential Operational Changes (both Essential Operational Changes featured in the Pilot Common Project and New Essential Operational Changes) and key R&I activities that support the identified performance ambition. The ATM Master Plan is updated on a regular basis in collaboration and consultation with the entire ATM community. Amendments are submitted to the S3JU Administrative Board for adoption. The content of the European ATM Master Plan is structured in three levels (Level 1 – Executive View, Level 2 – Planning and Architecture View, and Level 3 – Implementation View) to allow stakeholders to access the information at the level of detail that is most relevant to their area of interest. The intended readership for Level 1 is executive-level stakeholders. Levels 2 and 3 of the ATM Master Plan provide more detail on the operational changes and related elements and therefore the target audience is expert-level stakeholders.	SESAR2020 Project Handbook, European ATM Master Plan (9 Edition)
Civil-military coordination and cooperation	The coordination between the civil and military parties authorised to make decisions and agree a course of action.	Performance Framework 2017
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
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

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

Term	Definition	Source
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 .	EUROCONTR OL ATM Lexicon
Security	(aviation) Safeguarding civil aviation against acts of unlawful interference . This objective is achieved by a combination of measures and human and material resources. Note: ATM Security is concerned with those threats that are aimed at the ATM System directly, such as attacks on ATM assets, or where ATM plays a key role in the prevention of or response to threats aimed at other parts of the aviation system (or national and international assets of high value). ATM security aims to limit the effects of a threats on the overall ATM Network. ATM Security is a subset of Aviation Security (as defined by ICAO in Annex 17).	EUROCONTR OL 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 S3JU.	EUROCONTR OL ATM Lexicon
SESAR Solution	A term used when referring to both SESAR ATM Solution and SESAR Technological Solution.	SESAR2020 Project Handbook

Term	Definition	Source
SESAR ATM Solution	SESAR Solutions relate to either an Operational Improvement (OI) step or a group of OI steps with associated Enablers (technical system, procedure or human), which have been designed, developed and validated in response to specific Validation Targets and that are expected deliver operational and/or performance improvements to European ATM, when translated into their effective realisation. SESAR Technological Solutions relate to verified technologies proven to be feasible and profitable, which may therefore be considered to enable future SESAR Solutions.	SESAR2020 Project Handbook
Single European Sky High Level Goals	The SES High Level Goals are political targets set by the European Commission. Their scope is the full ATM performance outcome resulting from the combined implementation of the SES pillars and instruments, as well as industry developments not driven directly by the EU.	SESAR2020 Project Handbook
Sub-OE	A subcategory of an Operating environment, classified according to its complexity (e.g. high complexity TMA, medium complexity TMA, low complexity TMA).	EUROCONTR OL 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.	EUROCONTR OL ATM Lexicon

Table 4: Terminology

3 Demo Scope

3.1 Detailed Description of the Demo

The VLD covers technologies which aim to safely optimise the airport runway throughput. The focus of the demonstration was to show how the solution works with live data for persons of interest.

Based on solution PJ.02-08 "Traffic optimisation on single and multiple runway airports", which reached V3 at the end of 2019, a demonstration in WP5 was set up to show the use of the Integrated Runway Sequence Function (IRSF) working with mixed mode operations at parallel runways (solutions PJ.02-08-01 and PJ.02-08-02), as well as some runway configurations that are frequently used in real operations at Stockholm-Arlanda. The following KPAs was addressed: capacity, environment, predictability and punctuality.

3.2 Detailed Description of relationship with other Solutions

The VLD3-04 demonstration is based on earlier PJ.02-08 V3 activities. See section above and the D1.4 (DEMOR) Part I report for more information.

4 Demo Performance Assessment

4.1 Assessment Sources and Summary of Validation Exercise Performance Results

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

Organisation	Document Title	Publishing Date
PJ02-08 members	PJ02-08 V2 validation exercises (refer to PJ02-08 V2 PAR [20])	12.10.2018
PJ02-08 members	PJ02-08 V3 validation exercises (refer to PJ02-08 V3 PAR [21])	31.01.2020

Table 5: Pre-SESAR2020 Exercises

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

Exercise ID	Exercise Title	Release	Maturity	Status
EXE.02-08.V2.003	Integrated Runway Sequence function to integrate arrivals and departures on mixed mode parallel runways at Stockholm-Arlanda airport and TMA environment (COOPANS RTS)	R7	V2	Completed
EXE.02-08.V3.002	Integrated Runway Sequence function to integrate arrivals and departures on mixed mode parallel runways at Stockholm-Arlanda airport and TMA environment (COOPANS RTS)	R8	V3	Completed
EXE-VLD-03-004	Demonstration for integrated Runway Sequence function to integrate arrivals and departures on mixed mode parallel runways at Stockholm-Arlanda airport and TMA environment.	R9	4	Completed

Table 6: 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
V2 exercises	Refer to [21].	Refer to [20].	Refer to [20].	Refer to [20].
V3 exercise	Refer to [21].	Refer to [21].	Refer to [21].	Refer to [21].
VLD-03-004 exercise	TS-0301	Real Time Demonstration of Stockholm-Arlanda Airport and TMA environment with focus on Tower and Approach. The objective is to mainly demonstrate the improvements in predictability and punctuality as well as environmental benefits that the solution has.	FEFF1 increased CAP3 increased	Demonstration results are based on observations and debriefs and not on data from the system.
VLD-03-004 exercise	TS-0313	Optimised use of RWY capacity for multiple runway airports. Improving predictability on airport operations.	FEFF1 increased CAP3 increased	Demonstration results are based on observations and debriefs and not on data from the system.

Table 7: Summary of Validation Results.

4.2 Conditions / Assumptions for Applicability

The solution is expected to be applied in Medium to Very Large Airports with runways operated in mixed mode or having other dependencies between arrivals and departures between the runways. The solution is expected to provide benefits in all conditions but especially when runways are used in mixed mode operations.

The following Table 9 summarises the applicable operating environments in accordance with 2019 SESAR 2020 airports classification provided by PJ20 sWP2.2 WG.

OE	Applicable sub-OE	Special characteristics
Airport	Very Large	<u>Multiple runways:</u> EDDF Flughafen Frankfurt/Main EDDM Munich Airport EGKK Gatwick Airport EGLL Heathrow Airport EHAM Amsterdam Airport EKCH Copenhagen Airport LEBL Aeropuerto de Barcelona-El Prat LEMD Aeropuerto de Adolfo Suárez Madrid-Barajas LFPG Aéroport de Paris-Charles de Gaulle LIRF Aeroporto di Roma-Fiumicino LSZH Flughafen Zürich ENGM Oslo-Gardermoen Airport LOWW Vienna International Airport LTBA Atatürk International Airport
	Large	<u>Single runways:</u> EGSS Stansted Airport LSGG Genève Aéroport <u>Multiple runways:</u> LFPO Aéroport de Paris-Orly ESSA Stockholm-Arlanda Airport EBBR Brussels Airport EDDL Düsseldorf International Airport EIDW Dublin Airport LEPA Aeropuerto de Palma de Mallorca EGCC Manchester Airport LIMC Milano Malpensa LPPT Lisbon Airport EFHK Helsinki-Vantaa Airport EPWA Warsaw Frederic Chopin Airport LKPR Prague Airport
	Medium	<u>Single runways:</u> EVRA Riga International Airport <u>Multiple runways:</u> LFMN Aéroport Nice Côte d'Azur EDDB Schönefeld Airport LROP Henri Coanda International Airport UKBB Boryspil State International Airport

Table 8: Applicable Operating Environments.

4.3 Safety

4.3.1 Safety Design drivers and Performance Mechanism

See SESAR Solution 02-08 SPR/INTEROP-OSED for V3 for safety criteria and performance mechanism. [21].

4.3.2 Data collection and Assessment

Observations and debriefings from the demonstration showed the potential of the solution being able to lower ATCOs workload and stress while improving the Situational Awareness. These results are consistent with earlier validations results. See SESAR Solution 02-08 SPR/INTEROP-OSED for V3 for further information regarding data collection and assessment for V3 validations [21].

4.3.3 Extrapolation to ECAC wide

Results from both earlier PJ02-08 validations and the demonstration shows that a maintained safety levels can be achieved, there will be no ECAC wide extrapolation of airport data.

4.3.4 Discussion of Assessment Result

Results on safety are based on earlier validations results from PJ02-08 and observations from demonstration which shows that the solution ensure a maintained level of safety.

4.3.5 Additional Comments and Notes

No additional comments.

4.4 Environment: Fuel Efficiency / CO2 emissions

Often fuel efficiency and CO2 emissions are improved through a reduction of flight and/or taxi time. The reduction in time that are used for fuel efficiency and CO2 emission calculations can be found in section 4.9 in this document.

4.4.1 Performance Mechanism

Fuel efficiency benefits due to the application of operational concepts addressed by the solution have been indirectly identified taking into account:

- Reduction in arrival time
- Reduction in departure time

Taxi in time and departure time after take-off are seen to be the same for both reference and solution scenario. It is thereby the arrival flight time and taxi out time where the solution are seen to be able to lower fuel burn and CO2 emissions the most.

4.4.2 Assessment Data (Exercises and Expectations)

Fuel efficiency and CO2 emission benefits of the solution are analysed using results from demonstration and compared with earlier results from validations.

4.4.2.1 Assumptions

Assumptions are the same as in V3 validations, see list below:

- Fuel burn rate Departure/Taxi (see [Ref – Assumptions for Performance Aggregation – CPA 2018]) = 900 kg/h = 15 kg/min
- Fuel burn rate Arrival (see [Ref – Assumptions for Performance Aggregation – CPA 2018]) = 500 kg/h = 8.3 kg/min
- CO2/Fuel ratio = 3.15
- Average fuel burn per flight = 4800 kg
- Share of ECAC traffic to which the Integrated Runway Sequence function (TS-0301) applies: 45.3%.

4.4.3 Extrapolation to ECAC wide

Values seen in table 10 are only based on savings with focus on arrival time.

KPIs / Pls	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	3.8 kg/flight	0.078%
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	YES	11.8 kg/flight	0.078%

Table 9: 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	No data from demonstration	Same as reference scenario	Not to be covered	8.5 kg/flight	Same as reference scenario
ENV1 Actual Average CO2 Emission per flight	No data from demonstration	Same as reference scenario	Not to be covered	26.15 kg/flight	Same as reference scenario

Table 10: Fuel burn and CO2 emissions saving per flight phase.

4.4.4 Discussion of Assessment Result

Results for fuel burn and CO2 emissions are based on the time improvements. It is important to notice that the system has not been logging data during demonstration, the values are based on limited number of observations as the system was never run in Fast Time Simulation. Fuel efficiency and CO2 emissions for taxi out could not be gathered as no taxi-out times could be gathered, see section 4.9 in this document. However, observations shows that the solution held flights at gate compared to the real data where flights instead were put on hold during taxi. This shows that the solution would lower the fuel burn and CO2 emissions for taxi out as engines was not started until needed for taxi with as little stops as possible. The taxi in and departure fuel burn and CO2 emissions are seen as the same as the reference scenario.

The overall results from the demonstration are in line with the results from the V3 validation. This indicates that the results from the V3 validation can be trusted.

4.4.5 Additional Comments and Notes

No additional comments.

4.5 Environment / Emissions, Noise and Local Air Quality

4.5.1 Performance Mechanism

No benefit mechanism for lowering number of flights flying over noise sensitive areas.

4.5.2 Assessment Data (Exercises and Expectations)

Observations during the demonstrations has been performed in order to understand if the number of flights can be lowered over noise sensitive areas. No data from demonstration has been collected and no calculations such as noise contour has been performed. The observations mainly focus on understanding if ATCOs can lower number of flights over noise sensitive areas with the help of the solution. This is mainly done by ATCOs choosing to land arrival flights on the departure runway or using an RNP AR approach. This makes it ideal to use observations in order to collect information regarding lowering number of flights over noise sensitive areas.

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)	YES for Airport OE Solutions	No data from demonstrations	No data from demonstrations
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.	YES for Airport OE Solutions	No data from demonstrations	No data from demonstrations
(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.	YES for Airport OE Solutions	No data from demonstrations	No data from demonstrations

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 (ALAQS) Studies 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	YES for Airport OE Solutions relative to LTO (=>below 3000ft)	No data from demonstrations	No data from demonstrations

Table 11: Noise and Local Air Quality benefit for Mandatory PIs

4.5.3 Extrapolation to ECAC wide

There is no ECAC wide extrapolation required for this KPI.

4.5.4 Discussion of Assessment Result

The main result from demonstrations is that the solution allows ATCOs to, in an easier way, reduce flights over noise sensitive areas. No data from the simulator has been gathered, instead observations has been performed in order to see the potential of reducing noise with the help of the solution. The observations shows that the solution is able to lower number of flights over noise sensitive areas and reduce the size of the noise contour as less vectorization is needed.

4.5.5 Additional Comments and Notes

No additional comments.

4.6 Airspace Capacity (Throughput / Airspace Volume & Time)

N/A

4.7 Airport Capacity (Runway Throughput Flights/Hour)

4.7.1 Performance Mechanism

Airport arrival capacity for the demonstration is based on calculated values. The reason for this is that the demonstration is based on live data that never reached the high level of traffic needed to show the improvements the solution has on the airport capacity. Instead, a calculation, with respect to the active environmental permit at Stockholm-Arlanda, has been performed in order to obtain the potential increase of airport arrival capacity.

4.7.2 Assessment Data (Exercises and Expectations)

See SESAR Solution 02-08 SPR/INTEROP-OSED for V3 for further information regarding assessment of data for V3 validation [21].

The data from the demonstration with focus on airport arrival capacity are based on calculation and observations. The results are that the airport arrival capacity can be improved with 12,5% based on the active environmental permit at Stockholm-Arlanda that limits the number of arrival flight allowed to land on departure runway to five flights every hour.

KPIs / Pls	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	85 movements per hour	Increased throughput with 6,25%
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	No data from demonstrations	No data from demonstrations
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	Increase arrival throughput with 5 landings per hour	Increase arrival throughput with 12,5%

KPIs / Pls	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
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.	No data from demonstrations	No data from demonstrations

Table 12: Airport Capacity for Mandatory KPIs /Pls

4.7.3 Extrapolation to ECAC wide

There is no ECAC wide extrapolation required for this KPI.

4.7.4 Discussion of Assessment Result

The results from the demonstration are based on calculations and not data from the system. It is however seen as helpful for the system to propose five landing on the departure runway if there are high amount of arriving traffic and lower amount of departing traffic without the ATCO having to search for potential arrival gaps at all time.

The increase of capacity when introducing an Integrated Runway Sequence Function are depending on the airport complexity, runway layout and linked operating procedures at each airport. Airport priorities for balancing of different KPA's will also have an impact.

4.7.5 Additional Comments and Notes

No additional comments.

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

N/A

4.9 Flight Times

4.9.1 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
VLD3-04	No data from demonstration as TEFF6 are not to be covered.	Reference and solution scenario seen as same	Lowering taxi-out times by improving the overall sequence and minimizing taxi-holding	Lowering arrival flight time by improving the overall sequence and making it easier for ATCOs to use RNP AR or give clearance to land on departure runway.	Reference and solution scenario seen as same	No to be covered.

Table 13: Flight Times benefits per Exercise

4.9.2 Extrapolation to ECAC wide

Values seen in table 24 are only based on savings with focus on arrival time.

Pls / 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	Not to be covered	Not to be covered
TEFF2 Taxi in time	Min/flight	Average of the distribution of actual taxi-in (including ground queuing during taxi-in) durations	When relevant	Reference and solution scenario seen as same	Reference and solution scenario seen as same
TEFF3 Taxi out time	Min/flight	Average of the distribution of actual taxi-out (including ground queuing during taxi-out) durations	When relevant	No data from demonstration	No data from demonstration
TEFF4 TMA arrival time	Min/flight	Average of the distribution of actual TMA arrival (including holdings) durations	When relevant	0.45 Min/flight	Limited data from demonstration

TEFF5 TMA departure time	Min/flight	Average of the distribution of actual TMA departure durations	When relevant	Reference and solution scenario seen as same	Reference and solution scenario seen as same
TEFF6 En-Route time	Min/flight	Average of the distribution of actual en-route durations	When relevant	Not to be covered	Not to be covered

Table 14: Flight Times benefits for Mandatory KPIs /PIs

Table 25 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	Not to be covered	Not to be covered	Not to be covered	Not to be covered	Not to be covered
TEFF2 Taxi in time	N/A	N/A	N/A	N/A	Reference and solution seen as same
TEFF3 Taxi out time	No data from demonstration.	N/A	N/A	N/A	N/A
TEFF4 TMA arrival time	N/A	N/A	N/A	1 min/flight	N/A
TEFF5 TMA departure time	N/A	Reference and solution seen as same	N/A	N/A	N/A
TEFF6 En-Route time	Not to be covered	Not to be covered	Not to be covered	Not to be covered	Not to be covered

Table 15: Flight times benefit per flight phase.

4.9.3 Discussion of Assessment Result

Results for fuel burn and CO2 emissions are based on the time improvements seen above. It is important to notice that the system has not been logging data during demonstration, the values are based on a limited number of observations as the system was never run in Fast Time Simulation. Times for taxi out could not be gathered as no ground radar was used. However, observations show that the solution held flights at gate compared to the real data where flights instead were put on hold during taxi. This shows that the solution would lower the taxi out time. The taxi in and departure time are seen as the same as the reference scenario.

The overall results from the demonstration are in line with the results from the V3 validation. This indicates that the results from the V3 validation can be trusted.

4.9.4 Additional Comments and Notes

No further comments.

4.10 Predictability

4.10.1 Performance Mechanism

No performance mechanism for the demonstration has been developed.

4.10.2 Assessment Data (Exercises and Expectations)

Flight Plans are not updated with focus on the system as the Flight Plans are taken from live data. This results in that the Flight Plans cannot be compared with the times from the system. Thereby could data for the predictability aspect of the solution not be gathered. However, observations were made on ghost flight that followed the solutions sequence planning. This showed the same improvements as during the V3 validations for predictability.

4.10.3 Extrapolation to ECAC wide

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	No data from demonstration	No data from demonstration
PRD2 Variance ⁶ 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	No data from demonstration	No data from demonstration

Table 16: Predictability benefits for Mandatory KPIs /PIs

Table 29 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	No data from demonstration	No data from demonstration	No data from demonstration	No data from demonstration	No data from demonstration
PRD2 Variance of Difference in actual & Flight Plan or RBT durations	No data from demonstration	No data from demonstration	No data from demonstration	No data from demonstration	No data from demonstration

Table 17: Predictability benefit per flight phase

4.10.4 Discussion of Assessment Result

⁶ Standard Deviation is also accepted (in minutes).

Results from the demonstrations are based on observation due to Flight Plans not being updated with focus on the solution. The observations shows that the results are in line seen in V3 validations.

4.10.5 Additional Comments and Notes

No additional comments.

4.11 Punctuality

Performance mechanism used can be seen in “SESAR Solution 02-08 SPR/INTEROP-OSED for V3 – Part I section A.2” [23].

4.11.1 Assessment Data (Exercises and Expectations)

Flight Plans are not updated with focus on the system as the Fight Plans are taken from live data. This results in that the Flight Plans cannot be compared with the times from the system. Thereby could data for the punctuality aspect of the solution not be gathered. However, observations was made on ghost flight that followed the solutions sequence planning. This showed the same improvements as during the V3 validations for punctuality.

4.11.2 Extrapolation to ECAC wide

KPIs / Pls	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	No data from demonstration	No data from demonstration
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	No data from demonstration	No data from demonstration

Table 18: Punctuality benefit for Mandatory KPIs /Pls

Table 33 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	No data from demonstration	No data from demonstration	No data from demonstration	No data from demonstration	No data from demonstration
PUN2 % Flights departing within +/- 3 minutes of scheduled	No data from demonstration	No data from demonstration	No data from demonstration	No data from demonstration	No data from demonstration

departure time due to ATM and weather related delay causes					
--	--	--	--	--	--

Table 19: Punctuality benefit per flight phase.

4.11.3 Discussion of Assessment Result

Results from the demonstrations are based on observation due to Flight Plans not being updated with focus on the solution. The results from the observation confirm the improvements seen in V3 validations.

4.11.4 Additional Comments and Notes

No additional comments.

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

N/A

4.13 Flexibility

N/A

4.14 Cost Efficiency

N/A

4.15 Security

Solution are not expected to impair Security and a security assessment has been performed. See SESAR Solution 02-08 SPR/INTEROP-OSED for V3 - Part V section 4.15 [21] for further information.

4.16 Human Performance

4.16.1 HP arguments, activities and metrics

The demonstration focused on gathering data regarding HP aspects through observations and debriefings. The main focus has been on workload, situational awareness and over all HMI aspects. See D1.4 - SESAR 2020 VLD3 SORT DEMO Report - Part IV - Environment Assessment Report - WP5 for more information regarding HP [22].

PIs	Activities & Metrics	Second level indicators	Covered
HP1 Consistency of human role with respect to human capabilities and limitations	Debriefs and observations shows that the results from earlier validations are still valid.	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	Debriefs and observations shows that the results from earlier validations are still valid.	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	Debriefs and observations	HP3.1 Adequacy of team composition in terms of identified roles	N/A
		HP3.2 Adequacy of task allocation among human actors	N/A

PIs	Activities & Metrics	Second level indicators	Covered
Adequacy of team structure and team communication in supporting the human actors	shows that the results from earlier validations are still valid.	HP3.3 Adequacy of team communication with regard to information type, technical enablers and impact on situation awareness/workload	Closed
HP4 Feasibility with regard to HP-related transition factors	Debriefs and observations shows that the results from earlier validations are still valid.	HP4.1 User acceptability of the proposed Demo	Closed
		HP4.2 Feasibility in relation to changes in competence requirements	Closed
		HP4.3 Feasibility in relation to changes in staffing levels, shift organization and workforce relocation.	N/A
		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 20: HP arguments, activities and metrics

4.16.2 Extrapolation to ECAC wide

There is no ECAC wide extrapolation required for this KPI.

4.16.3 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	No open issues All benefits demonstrated	0	N/A
HP2 Suitability of technical system in supporting the tasks of human actors	No open issues except ISS-02-08-HP.0007 which remains partially open All benefits demonstrated	0	N/A
HP3 Adequacy of team structure and team communication in supporting the human actors	No open issues	0	N/A
HP4 Feasibility with regard to HP-related transition factors	No open issues	0	N/A

Table 21: Open HP issues/ recommendations and requirements

4.16.4 Concept interaction

N/A

4.16.5 Most important HP issues

The most important HP issues from the demonstration are the same as the once that can be found in SESAR Solution 02-08 SPR/INTEROP-OSED for V3 - Part V section 4.16.1.5 [21].

4.16.6 Additional Comments and Notes

Further explained results for the human performance aspect can be found in SESAR Solution 02-08 SPR/INTEROP-OSED for V3 - Part V section 4.16.1.5 [21].

4.17 Other PIs

N/A

4.18 Gap Analysis

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits at Network Level (ECAC Wide or Local depending on the KPI) ⁷	Rationale ⁸
SAF1: Safety - Total number of estimated accidents with ATM Contribution per year	N/A	N/A	KPI not measured. Safety levels are seen to be maintained.
FEFF1: Fuel Efficiency - Actual average fuel burn per flight	8,5 kg/flight in fuel savings	3,8 kg/flight in fuel savings	Fuel efficiency based only on arrival fuel burn
CAP1: TMA Airspace Capacity - TMA throughput, in challenging airspace, per unit time.	Not to be covered	Not to be covered	KPI not measured. Solution is not to bring benefits in TMA capacity.
CAP2: En-Route Airspace Capacity - En-route throughput, in challenging airspace, per unit time	Not to be covered	Not to be covered	KPI not measured. Solution is not to bring benefits in En-route capacity.
CAP3: Airport Capacity – Peak Runway Throughput (Mixed mode).	1,314%	6,25% and 85 flights per hour	Airport capacity are calculated as the amount of traffic was to low with live data to be able to present the positive impact the solution has on capacity.

⁷ Negative impacts are indicated in red.

⁸ 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 Rationale is needed.**

TEFF1: Gate-to-gate flight time	N/A	Not to be covered	KPI not measured. Solution does not have focus of Gate-to-gate.
PRD1: Predictability – Average of Difference in actual & Flight Plan or RBT durations	5,034%	No data from demonstration	Flight Plan are based on live data and could not be updated with information from the solution. No data was thereby gathered.
PUN1: Punctuality – Average departure delay per flight	0,000%	No data from demonstration	Flight Plan are based on live data and cannot be updated with information from the solution. No data was thereby gathered.
CEF2: ATCO Productivity – Flights per ATCO -Hour on duty	Not covered	Not covered	KPI not measured. Solution is not to bring benefits in Cost Efficiency.
CEF3: Technology Cost – Cost per flight	Not covered	Not covered	KPI not measured. Solution is not to bring benefits in Cost Efficiency.

Table 22: 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)⁹
- [3] SESAR Performance Framework (2019), Edition 01.00.01, Dec 2019
<https://stellar.sesarju.eu/?link=true&domainName=saas&redirectUrl=%2Fjsp%2Fproject%2Fproject.jsp%3FobjId%3Dxrn%3Adatabase%3Aondb%2Frecord%2F16414675>
- [4] Performance Assessment and Gap Analysis Report (2019), Edition 00.01.02, Dec 2019
- [5] Methodology for the Performance Planning and Master Plan Maintenance, Edition 0.13, Dec 2017

Content Integration

- [6] SESAR ATM Lexicon

Performance Management

- [7] PJ19.04 D4.1 Validation Targets - Wave 2 (2020)¹⁰

Validation

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

Safety

- [9] SESAR, Safety Reference Material, Edition 4.0, April 2016
<https://stellar.sesarju.eu/jsp/project/qproject.jsp?objId=1795089.13&resetHistory=true&statInfo=Ogp&domainName=saas>
- [10] SESAR, Guidance to Apply the Safety Reference Material, Edition 3.0, April 2016
<https://stellar.sesarju.eu/jsp/project/qproject.jsp?objId=1795102.13&resetHistory=true&statInfo=Ogp&domainName=saas>
- [11] SESAR, Final Guidance Material to Execute Proof of Concept, Ed00.04.00, August 2015

⁹ At the time of the creation of the PAR template, the Methodology (PJ19.04 Internal Document) is foreseen to be update in 2020.

¹⁰ At the time of the creation of the PAR template the Validation Target is foreseen to be delivered in June 2020

[12]Accident Incident Models – AIM, release 2017

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

Human Performance

[13]16.06.05 D 27 HP Reference Material D27

[14]16.04.02 D04 e-HP Repository - Release note

Environment Assessment

[15]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>

[16]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

[17]16.06.02 D103 SESAR Security Ref Material Level

[18]16.06.02 D137 Minimum Set of Security Controls (MSSCs).

[19]16.06.02 D131 Security Database Application (CTRL_S)

5.1 Reference Documents

- [20] SESAR 2020 – Solution 02-08 OSED SPR INTEROP for V2 Part V Performance Assessment Report, D6.1.10, edition 00.01.01, 12 October 2018.
- [21] SESAR Solution 02-08 SPR/INTEROP-OSED for V3 - Part V - Performance Assessment Report (PAR), edition: 00.04.00, 31 January 2020.
- [22] D1.4 - SESAR 2020 VLD3 D1.1 SORT DEMO Report - Part IV - Environment Assessment Report - WP5, edition 00.02.00, issued as D1.1.01, 29/10/2021.
- [23] SESAR Solution 02-08 SPR/INTEROP-OSED for V3 - Part I.
- [24] SESAR 2020 VLD3-W2-SORT D1.1 Demo Plan - Part I, edition 00.02.00, issued as D1.1.01, 29/10/2021.

Appendix A Detailed Description and Issues of the OI Steps

OI Step ID	Title	Consistency with latest Dataset
TS-0301	Integrated Arrival Departure Management for Full Traffic Optimisation on the Runway	DS20

Table 23: OI Steps allocated to the Demo

- END OF DOCUMENT-

