



SESAR Solution PJ.07-03: SPR/INTEROP-OSED for V2 - Part V - Performance Assessment Report (PAR)

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PJ07 OAUO

PJ07 OPTIMISED AIRSPACE USERS OPERATIONS

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Abstract

This document provides the Performance Assessment Report as Part V of the SPR-INTEROP/OSED for SESAR Solution PJ.07-03 "Mission Trajectory Driven Processes" and SESAR Solution PJ.18-01 "Mission Trajectories".

The V2 Validation Exercise EXE-07.03-V2-VALP-001 (Initial Mission Trajectory Management in Planning and Execution) confirmed the general feasibility of the updated operating methods in solution SESAR Solution PJ.07-03. By expert judgement it contributes to KPIs CAP2 0-1 % with target 0.5 % and PRD1 about 0.1 % with target 0.155 %. Only for PUN1 no contribution was estimated. Due to the type of exercise (Real-time simulation) it was not possible to collect any data for benefit calculations. The gaps between validation targets and performance assessment result are still 100 %.

As one KPA it summarises the Human Performance (HP) assessment performed for solution PJ07-03 (Mission Trajectory Driven Processes) supported by solution PJ18-01 (Mission Trajectories). It concisely reports the results of the HP activities conducted according to the HP assessment process, the identified issues as well as the HP recommendations & requirements.

Note: The V3 exercise performed in Wave1 was limited to the Planning Phase and did not allow to produce any additional Performance information on-top of what has been documented in the PJ.07-03-V2 PAR. Therefore, it was agreed with PJ.19 and SESAR JU that delivering a V3 PAR would merely be nothing else but a copy and paste of the available V2 version. This is why the PAR refers to V2 but it is equally applicable to V3.



Table of Contents

Abstract	4
1 Executive Summary.....	7
2 Introduction.....	12
2.1 Purpose of the document.....	12
2.2 Intended readership	12
2.3 Inputs from other projects	12
2.4 Glossary of terms.....	12
2.5 Acronyms and Terminology	12
3 Solution Scope	15
3.1 Detailed Description of the Solution.....	15
3.2 Detailed Description of Interactions with other Solutions	15
3.3 Detailed Description and Issues of the OI Steps	16
3.4 List of Enablers	17
4 Solution Performance Assessment.....	20
4.1 Assessment Sources.....	20
4.2 Conditions / Assumptions for Applicability.....	21
4.3 Summary of Validation Exercise Performance Results.....	21
4.4 Environment / Fuel Efficiency.....	23
4.5 Environment / Noise and Local Air Quality	23
4.6 Airspace Capacity (Throughput / Airspace Volume & Time).....	24
4.7 Airport Capacity (Runway Throughput Flights/Hour)	26
4.8 Resilience (% Loss of Airport & Airspace Capacity Avoided).....	26
4.9 Predictability (Flight Duration Variability, against RBT)	27
4.10 Punctuality (% Departures < +/- 3 mins vs. schedule due to ATM causes)	29
4.11 Civil-Military Cooperation and Coordination (Distance and Fuel).....	31
4.12 Flexibility.....	31
4.13 Cost Efficiency	31
4.14 Airspace User Cost Efficiency	31
4.15 Security	32
4.16 Human Performance.....	33
4.17 Other PIs	37

4.18	Gap Analysis.....	37
5	References.....	38
5.1	Applicable Documents.....	38
5.2	Reference Documents.....	40

List of Tables

Table 1:	KPI Assessment Results Summary.....	9
Table 2	Mandatory PIs Assessment Summary.....	11
Table 3:	Acronyms and terminology.....	13
Table 4:	Interactions with other Solutions.....	16
Table 5:	OI Steps allocated to the Solution.....	17
Table 6:	Essential Enablers.....	19
Table 7:	Pre-SESAR2020 Exercises.....	20
Table 8:	SESAR2020 Validation Exercises.....	20
Table 9:	Applicable Operating Environments.....	21
Table 10:	Deployment details.....	21
Table 11:	Influence of Equipage on benefits.....	21
Table 12:	Summary of Validation Results.....	22
Table 13:	Predictability benefit per flight phase, standard deviation improvement.....	28
Table 14:	Punctuality benefit per flight phase.....	30
Table 15:	HP arguments that were addressed and the number of issues in each argument for V2-phase.....	35
Table 16:	Number and types of HP recommendations and requirements identified for V2-phase.....	36
Table 17:	Qualitative assessment of QoS KPIs.....	37

List of Figures

No table of figures entries found.

1 Executive Summary

This document provides the Performance Assessment Report (PAR) for SESAR Solutions PJ.07-03 “Mission Trajectory Driven Processes” and PJ.18-01 “Mission Trajectories”.

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

Description:

SESAR Solution PJ.07-03 “Mission Trajectory Driven Processes” refines the Mission Trajectory concept as part of the ATM CONOPS and focuses on the harmonisation of improved OAT flight plans. Initial mission trajectories are

- developed by the WOC system/functions in close coordination with NM and AMC,
- processed and distributed into the ATM network by NM to all pertaining actors as ATC and AD, and
- revised during mission execution by WOC, ATC and/or the flight crew via ATC.

This is achieved by updating the WOC processes for the management of the shared and reference mission trajectory (SMT/ RMT) through a full integration of the WOC within the ATM system. This responds to the need to accommodate individual military airspace user needs and priorities without compromising optimum ATM system outcome and the performances of all stakeholders.

The scope of PJ.07-03 is performed in close cooperation with PJ.18-01 “Mission Trajectories”. The necessary prototypes (WOC, NM, ATC and AD) and the related documentation were provided by PJ.18-01.

More Information can be found in Chapter 2!

Assessment Results Summary:

The following Table 1 summarises the assessment outcomes per KPI and puts them side-by side to Validation Targets from PJ19 (see [46]). An assessment result of 0 with confidence level N/A, for not applicable, indicates that the Solution is not expected to impact the KPI. An assessment result of 0 with confidence level other than N/A means that the Solution was expected to (possibly) impact the KPI but has been assessed not to do so.

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Expectations at Network Level (ECAC Wide) ¹	Confidence in Results ²
FEFF1: Fuel Efficiency – Fuel burn per flight		N/A	N/A
CAP1: TMA Airspace Capacity – Throughput / airspace volume & time		0 %	Low
CAP2: En-Route Airspace Capacity – Throughput / airspace volume & time	0,505 %	0-1 %	Low
CAP3: Airport Capacity – Peak runway throughput (mixed mode) flights/hour		N/A	N/A
PRD1: Predictability – Flight duration variability, against RBT	0,155 %	0.1 %	Low
PUN1: Punctuality – % AOBT within +/- 3 minutes of SOBT	0,210 %	0 %	Low
RES1: Airport Resilience – % avoided loss of capacity		N/A	N/A
RES2: Airspace Resilience – % Avoided loss of capacity		N/A	N/A

¹ Negative impacts are indicated in red.

² High – the results might change by +/-10%
 Medium – the results might change by +/-25%
 Low – the results might change by +/-50% or greater
 N/A – not applicable, i.e., the KPI cannot be influenced by the Solution

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Expectations at Network Level (ECAC Wide) ¹	Benefits at Network Level (ECAC Wide)	Confidence in Results ²
CEF2: ATCO Productivity – Flights per ATCO hour			N/A	N/A
CEF3: Technology Cost – Cost per flight				N/A

Table 1: KPI Assessment Results Summary

Mandatory PI	Performance Expectations at Network Level (ECAC Wide) ³ – Metric and Value	Benefits at Network Level (ECAC Wide) ³ – Metric and Value	Confidence in Results ⁴
CAP1.1: TMA Airspace Capacity – Increased throughput	0 %		N/A
CAP1.2: En-Route Airspace Capacity – Increased throughput	0 %		Low
CAP3.1: Airport Capacity – Peak departure throughput per hour, segregated mode	0 %		N/A
CAP3.2: Airport Capacity – Peak arrival throughput per hour, segregated mode	0 %		N/A
RES3.1: Airport Resilience – Time to recover from non-nominal to nominal condition	0 %		N/A
RES3.2: Airspace Resilience – Time to recover from non-nominal to nominal condition	0 %		N/A
RES4.1: Resilience – Minutes of delay	0 %		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

Mandatory PI	Performance Expectations at Network Level (ECAC Wide) ³ – Metric and Value	Benefits Confidence in Results ⁴
RES4.2: Resilience – Number of cancellations	0 %	N/A
AUC3: Airspace User Cost Efficiency – Direct operating costs for an airspace user	0 %	N/A
AUC4: Airspace User Cost Efficiency – Indirect costs for an airspace user	0 %	N/A
AUC5: Airspace User Cost Efficiency – Overhead costs for an airspace user	0 %	N/A
FEFF2: Fuel Efficiency – CO2 emissions	0 %	N/A
FEFF3: Fuel Efficiency – Reduction in average flight duration	0 %	N/A
NOI1: Noise – Relative noise scale	0 %	N/A
NOI2: Noise – Size and location of noise contours	0 %	N/A
LAQ1: Local Air Quality – Geographic distribution of pollutant concentrations	0 %	N/A
HP1: Human Performance – Role consistency	0 %	N/A
HP2: Human Performance – User interface usability	0 %	N/A
HP3: Human Performance – Support team structure	0 %	N/A
HP4: Human Performance – Transition feasibility	0 %	N/A
SEC1: Security – Personnel (safety) risk after mitigation	0 %	N/A
SEC2: Security – Capacity risk after mitigation	0 %	N/A
CMC1.1: Civil-Military Cooperation and Coordination – Available training duration within ARES	0 %	N/A
CMC1.2: Civil-Military Cooperation and Coordination – Allocated ARES dimension	0 %	N/A
CMC1.3: Civil-Military Cooperation and	0 %	N/A

Mandatory PI	Performance Expectations at Network Level (ECAC Wide) ³ – Metric and Value	Benefits at Network –	Confidence in Results ⁴
Coordination – Distance to/from airbase to ARES			
CMC2.1: Civil-Military Cooperation and Coordination – Offered fuel and distance saving (for GAT operations)	0 %		N/A
CMC2.2: Civil-Military Cooperation and Coordination – %GAT flights using ARES / GAT flights for which ARES is available	0 %		N/A
FLX1: Flexibility – Average delay for scheduled civil/military flights with change request and non-scheduled / late flight plan request	0 %		N/A

Table 2 Mandatory PIs Assessment Summary

Additional Comments and Notes:

Please refer to Section 4.18 for the performance gap analysis.

This is the first PAR release in the context of SESAR Solution PJ.07-03.

The V2 Validation Exercise EXE-07.03-V2-VALP-001 (Initial Mission Trajectory Management in Planning and Execution) confirmed the general feasibility of the updated operating methods in solution SESAR Solution PJ.07-03. It did not contribute to KPIs CAP2, PRD1 and PUN1 as expected. Due to the type of exercise (Real-time simulation) it was not possible to collect any data for benefit calculations. The gaps between validation targets and performance assessment result are still 100 %.

In the Area of Human Performance 7 recommendations and 4 requirements could be defined. They will be re-validated in the next V3-phase.

2 Introduction

2.1 Purpose of the document

The following text is not supposed to be changed!

The Performance Assessment covers the Key Performance Areas (KPA) defined in the SESAR2020 Transition Performance Framework [7], with the exception of Safety, which is discussed in a dedicated assessment report. 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.

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

2.2 Intended readership

In general, this document provides the ATM stakeholders (e.g. airspace users, ANSPs, airports, airspace industry) and 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 collect and combine KPI results at network level, and provide the data to PJ20 for considering the performance data for the European ATM Master Plan.

2.3 Inputs from other projects

PJ19 will manage and provide common assumptions and aggregation assumptions which are needed for producing this report.

2.4 Glossary of terms

See the AIRM Glossary [1] 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
AU	Airspace User
BAD	Benefits Assessment Date
BAER	Benefit Assessment Equipment Rate
CBA	Cost Benefit Analysis
DOD	Detailed Operational Description
DB	Deployment Baseline
E-ATMS	European Air Traffic Management System
ECAC	European Civil Aviation Conference
FMP	Flow Management Position
KPA	Key Performance Area
KPI	Key Performance Indicator
N/A	Not Applicable
OI	Operational Improvement
PAR	Performance Assessment Report
PI	Performance Indicator
PRU	Performance Review Unit
QoS	Quality of Service
RBT	Reference Business / Mission Trajectory
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SESAR2020 Programme	The programme which defines the Research and Development activities and Projects for the SJU.

Table 3: Acronyms and terminology

Founding Members





PJ07
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3 Solution Scope

3.1 Detailed Description of the Solution

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

Trajectory Based Operation, or more specifically 4D Trajectory Management, facilitates a fundamental shift away from the management of flights through tactical intervention towards a more strategic focus on planning and intervention by exception. This enables the effective dynamic adjustment of airspace characteristics in order to meet predicted demand, whilst aiming to keep any distortions to the Business/Mission Trajectories to the absolute minimum, as well as providing sufficient flexibility for optimization purposes.

The concept does not question those tactical actions necessary for safety reasons or those needed to handle non-nominal situations.

The use of a single reference trajectory through a common data set, shared between all actors from the planning phase onwards, represents the backbone for its subsequent management. The management through time and the sharing of flight relevant data amongst all involved actors improves the reactivity, the interoperability and the performance of the network as a whole, facilitating an improved environment within which Airspace Users specific needs can be better accommodated.

The trajectory is shared in the planning phase as the SBT/SMT, based on the preferred trajectory developed internally by the AU. The SBT/SMT is progressively refined through a collaborative iterative process as the planning phase progresses, to take account of, and reflect, the most up-to-date data, ATM 4D constraints and targets.

When specific conditions are met, the SBT/SMT becomes the RBT/RMT. This transition between the two states represents the conclusion of the planning phase and the start of the execution phase.

The RBT/RMT describes the trajectory the Airspace User has agreed to fly and that the ANSPs and Airports agree to facilitate. Such data need to be amended through a revision process in order to reflect the current trajectory to be flown by the aircraft. Indeed, this RBT/RMT “reference trajectory” is the fundamental element, i.e. the heart, of the Flight Relevant Data Set, which contains all the data necessary to support all actors’ needs for the preparation and execution of the flight.

SESAR Solution PJ.07-03 is concentrating on the Mission Trajectory Driven Processes. They refer, through a full integration of the Wing Operations Centre (WOC) within the ATM system, to the updating of WOC processes for the management of the shared and reference mission trajectory (SMT/RMT). These processes respond to the need to accommodate individual military airspace user needs and priorities without compromising optimum ATM system outcome and the performances of all stakeholders.

3.2 Detailed Description of Interactions with other Solutions

Table 4 contains other solutions with interactions to SESAR Solution PJ.07-03.

Solution Number	Solution Title	Interaction
#31	Variable profile military reserved areas and enhanced (further automated) civil-military collaboration	Solution PJ.07-03 is successor of this SESAR 1 solution #31 in SESAR 2020 for enhanced (further automated) civil-military collaboration
PJ.08-01	Management of Dynamic Airspace configurations	PJ.07-03 is not needed by PJ08.01 DAC, MTs can be used or not by the States anyway DMA & DAC can be deployed. The 2 Solutions might be used together in 90% of the cases. So, it is more a Prefers link (Compatible - dependant – interdependent)
PJ.09-03	Collaborative Network Management Functions	<p>The DCB process should take the opportunity to use the TTO information (ATM constraint management) to improve its processes and performance in the context of advanced management of airspace: OAT flights not totally taken into account, i.e. 98.7% of flight are for consideration by NM. Therefore, it can be considered an increase of the scope of flight by 1.3%.</p> <p>Due to increasing airspace volume, 1.3 % may increase further due to additional NM functional.</p> <p>Current situation do not allow to really quantifying impact. Nevertheless, it can be assumed (i.e. expert judgment) that impact might be low on the KPAs. Link is Compatible - preferable</p>
PJ.18-01	Mission Trajectories	Enabling solution for Solution PJ.07-03 with same context

Table 4: Interactions with other Solutions

SESAR Solution PJ.07-03 is the successor of SESAR 1 WP11.1 WOC which represented the military aspects of ATM in solution #31.

SESAR Solution PJ.07-03 is supported by solution PJ18-01 (Mission Trajectories).which is part of Enabling project PJ18 (4D Trajectory Management).

3.3 Detailed Description and Issues of the OI Steps

Table 5 provides the OI Steps considered in SESAR Solution PJ.07-03. All mentioned OI Steps refer to Dataset 18a (see EATMA V10.0 Draft) as described in the EATMA portal (see <https://www.eatmportal.eu/working/>).

According to the initial S2020 Grant Agreement the OI Steps AOM-0304-A, AUO-0215 and AUO-0228 belonged to SESAR Solution PJ.18-01 Mission Trajectories. In an update of the S2020 Grant Agreement these OI Steps have been switched to SESAR Solution PJ.07-03 whereas the related Enablers were moved to SESAR Solution PJ.18-01. This switch of the related solution for OI Steps AOM-0304-A, AUO-0215 and AUO-0228 has been requested by change requests but is not yet implemented in the current Dataset 18a.

OI Step ID	Title	Step	Consistency with latest Dataset
AOM-0303	Pan-European OAT Transit Service	1	Yes
AUO-0210	Participation in CDM through iSMT and Target Time (TTO) negotiation	1	Yes
AUO-0211	WOC Management of iRMT via improved OAT FPL	1	Yes
AOM-0304-A	Mission Trajectories in Step 1	1	Yes
AUO-0215	Sharing iSMT through improved OAT flight plan	1	Yes
AUO-0228	Agreed iRMT	1	Yes

Table 5: OI Steps allocated to the Solution

3.4 List of Enablers

The enablers considered essential by the Solution project are provided Table 6. All mentioned OI Steps and Enablers refer to Dataset 18a (see EATMA V10.1 Draft) as described in the EATMA portal (see <https://www.eatmportal.eu/working/>).

Enabler ID	Title	Related OI Step ID	Consistency with latest Dataset
AAMS-10a	Initial airspace management system enhanced with commonly applied GAT/OAT handling	AOM-0303	Yes
AIMS-19b	Aeronautical Information system is interfaced to receive and distribute aeronautical information electronically to military systems.	AOM-0303 AOM-0304-A	Yes
AOC-ATM-14	Upgrade of WOC system to handle improved OAT flight plans	AOM-0303 AOM-0304-A	Yes

Enabler ID	Title	Related OI Step ID	Consistency with latest Dataset
		AUO-0210	
AOC-ATM-15	Upgrade of Wing Ops System Technical Architecture to provide Military Mission Trajectory Services	AOM-0304-A	Yes
AOC-ATM-20	Sharing of trajectory data between AOC/WOC and the ATM world using B2B web services	AUO-0210 AUO-0211 AUO-0228	Yes
ER APP ATC 82b	Enhance FDP to process iSMT/iRMT	AUO-0215	Yes
ER APP ATC 143	Upgrade of ATC System to handle Improved OAT Flight Plan	AOM-0303 AOM-0304-A AUO-0215	Yes
ER APP ATC 168	Enable ATC System to manage improved OAT flight plans with inherent ARES information (reservation restrictions) in accordance with VPA design principle.	AOM-0304-A	Yes
MIL-0103	Wing Operations Centre Mission Support System (including update/revision) of iMT	AUO-0211	Yes
MIL-0106	Wing Operations Centre Mission Support System enhanced to support the CDM process	AUO-0210	Yes
MIL-0501	Specifications for the interoperability of military ground systems with SWIM	AUO-0215	Yes
MIL-0502	Upgrade of military ground systems to allow bi-directional exchanges with non-military IP networks	AOM-0303 AOM-0304-A AUO-0215	Yes
MIL-STD-03	Update of IFPS User Manual to include OAT Specificities in the Flight Plan (Improved OAT flight plan)	AOM-0303 AOM-0304-A AUO-0215	Yes
MIL-STD-04	Procedure to implement EUROAT rules.	AOM-0303	Yes

Enabler ID	Title	Related OI Step ID	Consistency with latest Dataset
NIMS-21b	Flight Planning management enhanced to support 4D	AUO-0228	Yes
NIMS-35	Flight Planning management sub-system enhanced to process improved OAT flight plans	AOM-0303 AOM-0304-A AUO-0210 AUO-0215	Yes
NIMS-45	Initial Flight Planning management enhanced to support initial Mission Trajectory	AUO-0210 AUO-0211 AUO-0215	Yes
PRO-014	Procedures harmonised at pan-European level for the management of the Improved OAT FPL (flight plan filing, validation, acceptance and distribution)	AOM-0303 AOM-0304-A AUO-0215	Yes
PRO-015	Harmonised ATC Procedures for providing a standardized service to OAT flights at pan-European level	AOM-0303 AOM-0304-A	Yes
PRO-076	Procedures for the iSMT in the CDM process	AUO-0210	Yes
PRO-077	Procedures facilitating iRMT management	AUO-0211	Yes
SWIM-INFR-05a	General SWIM Services infrastructure Support and Connectivity	AOM-0304-A	Yes
SWIM-NET-01a	SWIM Network Point of Presence	AOM-0304-A	Yes

Table 6: Essential Enablers

4 Solution Performance Assessment

4.1 Assessment Sources

Previous Validation Exercises (pre-SESAR2020, etc.) relevant for this assessment are listed in Table 7.

Organisation	Document Title	Publishing Date
EUROCONTROL	Step 1 Advanced Flexible Use of Airspace Validation Report (VALR) (VP-710)	27/04/2016
EUROCONTROL	Validation Report (VALR) for STEP1 Operational Air Traffic (OAT) Flight Plan Management (VP-716)	21/01/2016
Airbus	Update Validation report for stand-alone WOC validation for Step 1 (BMT, AFUA, iOATFPL) (VP-789)	08/04/2016
Airbus	Update Validation report for stand-alone WOC validation for Step1 (BMT, AFUA, iOATFPL) (VP-790)	24/10/2016

Table 7: Pre-SESAR2020 Exercises

SESAR Validation Exercises of this Solution (completed ones and planned ones) are listed in Table 8.

Exercise ID	Exercise Title	Release	Maturity	Status
EXE-07.03-V2-VALP-001	Initial Mission Trajectory Management in Planning and Execution		V2	completed

Table 8: SESAR2020 Validation Exercises

SESAR 1 exercise VP-710 addressed the Human Performance and several KPAs. The HP assessment provided several HP issues and recommendations. Clear benefits in terms of SESAR KPAs, mainly fuel savings (environment efficiency) have been proven through this exercise. It also contributed to civil and military cooperation & coordination with more oriented AUs (see [42]).

SESAR 1 exercise VP-716 was a V2 validation exercise and didn't address any KPAs (see [43]).

SESAR 1 exercise VP-789 addressed the Human Performance and the Civil Military Cooperation and Coordination KPAs. The HP assessment produced 5 issues and 5 recommendations for future validations. In the Civil Military Cooperation and Coordination KPA this exercise confirmed that it is possible to ensure an acceptable transit time to ARES (CMC1) and to ensure the required training time within ARES (CMC2). The contribution to the performance of civil ATM was not validated in VP-789 as it was a Real-Time simulation exercise (see [44]).

SESAR 1 exercise VP-790 was a V2 validation exercise and didn't address any KPAs (see [45]).

The results of SESAR 2020 exercise EXE-07.03-V2-VALP-001 are described in [49].

4.2 Conditions / Assumptions for Applicability

The following Table 9 summarises the applicable operating environments.

OE	Applicable sub-OE	Special characteristics
En-Route	All level of complexity	Cross-border
TMA	All level of complexity	
Airport	All level	Military airports
Network	-	

Table 9: Applicable Operating Environments.

The following Table 10 summarises the essential deployment details.

BAD	Specific geographical and/or stakeholder deployment
31.12.2027	Deployment at NM, all State AUs WOC and all ATC ECAC wide

Table 10: Deployment details.

Equipage details and how equipage influences benefits in the ramp-up phase is given in Table 11. Table 11 is empty as there are no single benefits in the ramp up phase.

Min flight equipage rate	Opt flight equipage rate	BAER	AUs that need to equip	Start of flight equipage	End of flight equipage

Table 11: Influence of Equipage on benefits.

4.3 Summary of Validation Exercise Performance Results

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

Exercise	OI Step	Exercise scenario & scope	Performance Results	Notes
EXE-07.03-V2-VALP-001	AOM-0303	En-Route	None	
	AUO-0210			
	AUO-0211			
	AOM-0304-A			



Exercise	OI Step	Exercise scenario & scope	Performance Results	Notes
	AUO-0215			
	AUO-0228			

Table 12: Summary of Validation Results.



4.4 Environment / Fuel Efficiency

No specific benefit is expected from SESAR Solution PJ.07-03 for this KPI.

In SESAR 1 validation exercise VP-710 fuel savings have already been proven (see [42]).

4.5 Environment / Noise and Local Air Quality

No specific benefit is expected from SESAR Solution PJ.07-03 for this KPI.

4.6 Airspace Capacity (Throughput / Airspace Volume & Time)

Airspace capacity, in the context of the SESAR Performance Framework, focuses on 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.

According to the validation targets (see [46]) only En-Route capacity benefits are expected from SESAR Solution PJ.07-03 but no TMA capacity benefits.

4.6.1 Performance Mechanism

Solution PJ.07-03 is related to military flights only. Therefore it may improve the performance of this KPI direct for these state AUs flights and additionally indirect for all other flights.

The usage of iOAT FPL allows the state AU to provide specific points and times for entering and leaving airspace volumes which are activated and deactivated for these specific times for the related mission. Today about 1.3 % of all flights in controlled airspace are OAT by state AUs including military, all other flights are GAT by civil AUs. Therefore the direct contribution of state AUs can only be marginal.

The benefit in solution PJ.07-03 for state AUs is that by using these mechanisms of detailed ARES reservation the state AU gets the needed airspace for the required time. The ARES is blocked only for the shorter time as needed. In all other times the airspace is available for all AUs which is the greater contribution to this KPI.

4.6.2 Assessment Data (Exercises and Expectations)

The PJ.07-03 real-time simulation exercise with about 30 military missions was not suitable to collect detailed performance values as the other GAT flights which could benefit from the usage of a better detailed iOAT FPL and the longer availability of the airspace volumes were not considered. This can only be measured in the context of Shadow Mode or Live Trial exercises.

Expert judgements: In the flight plans the solution provides more precise information on the OAT flights to the FMP.

KPIs / PIs	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	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	YES	No benefits in SESAR1	0 %	0 %

KPIs / Pls	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
		Complexity TMA at peak demand hours.				
CAP2 En-route throughput, in challenging airspace, per unit time	Relative change of movements (% and number of movement)	% and also total number of movements, per volume of En-Route airspace per hour for specific traffic mix and density, for High and Medium Complexity TMA's airspace at peak demand hours.	YES	No benefits in SESAR1	0 - 1 %	0 -1 %

4.6.3 Aggregation

In the V2 exercise EXE-07.03-V2-VALP-001 (Initial Mission Trajectory Management in Planning and Execution) no measurements were taken for KPA Airspace Capacity CAP2.

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)

No specific benefit is expected from SESAR Solution PJ.07-03 for this KPI.

Not applicable as only military airports were involved in the exercise.

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

No specific benefit is expected from SESAR Solution PJ.07-03 for this KPI.

4.9 Predictability (Flight Duration Variability, against RBT)

Predictability is focused on in-flight (i.e. off-block to on-block) variability of flight duration compared to the planned duration. The KPI is the variance of differences between actual and flight plan of Reference Business Trajectory (RBT) durations. It does not cover pre-departure variability or aspects related to geographical position, i.e. latitude/longitude/altitude at any point in time.

4.9.1 Performance Mechanism

Solution PJ.07-03 contributes to Focus Area Predictability by enabling the state AUs to refine the MT before and after departure. Additionally due to the direct access to AMC for ARES reservation and/or release it is also possible to allocate unused airspace and/or to provide additional airspace for other flights.

Due to the enhanced possibilities of the WOC Mission Support System to prepare the detailed MT and FPL with a more precise calculated planned duration the variability of the flight duration will reduce.

As the possibility exists that an ARES reservation is cancelled on last minute, then several other most probably civil flights might benefit and use this airspace for their purposes (see section 4.6).

4.9.2 Assessment Data (Exercises and Expectations)

Solution PJ.07-03 is related to Mission Trajectories (MT) of state AU only. During the planning phase they are referred to as Shared MT (SMT) and during the execution phase as Reference MT (RMT). Business Trajectories refer to GAT flights of civil AUs. Today less than 1.3 % of all flights in controlled airspace refer to Reference Mission Trajectories (RMT).

The concept of the PJ.07-03 exercise was to plan typical missions for state AUs in the real airspaces of the FIRs Praha and Munich. The execution of these missions was simulated according to the submitted flight plan including its updates. This simulation didn't contain perturbation by ATM related events. The simulated flight duration equalled the planned duration. Therefore it is not possible to calculate flight duration variability with data from a real-time simulation exercise of solution PJ.07-03.

4.9.3 Aggregation

By its definition solution PJ.07-03 could only impact the En-route flight phase.

1.3% of the flights represent about 500 OAT flights compared with 37839 GAT flights.

1% of Predictability would represent 42 second for all ECAC flights. The Experts consider that this would be a too high contribution for such a low number of military flights. It was discussed that the contribution is about 0.1%. This figure includes the influence of the 500 OAT flights on the other flights but not the ARES benefits from the flight plan on the other flights which was already addressed in SESAR 1. This has to be confirmed by further validation exercises.

KPIs / Pls	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
PRD1 Variance ⁵ of Difference in actual & Flight Plan or RBT durations	Minutes ²	Variance of Difference in actual & Flight Plan or RBT durations	YES	No benefits in SESAR1	0 %	0.1 %

Table 13 is showing the impact on flight phases.

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
Flight duration variability improvement	N/A	N/A	0.1 %	N/A	N/A

Table 13: Predictability benefit per flight phase, standard deviation improvement

The V2 exercise EXE-07.03-V2-VALP-001 (Initial Mission Trajectory Management in Planning and Execution) did not contribute to KPA Predictability PRD1.

4.9.4 Discussion of Assessment Result

N/A

4.9.5 Additional Comments and Notes

N/A

⁵ Standard Deviation is also accepted.

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

The approach for Departure Punctuality is to focus specifically on airspace user punctuality issues that are considered within the scope of SESAR 2020 projects to address. This is referred to here as “ATM Punctuality”. It captures ATM issues as well as events related to ATM that cause a temporal perturbation to airspace user schedules.

4.10.1 Performance Mechanism

Punctuality is related to weather and ATM causes on airports or in the airspace. In the current European ATM system these issues and events manifest in terms of delays which are captured against standard industry (IATA) cause codes. According to the SESAR Performance Framework (see [48]) this KPI PUN1 refers to IATA delay cause codes 81 (ATFM due to ATC En-Route Demand / Capacity) and 82 (ATFM due to ATC Staff / Equipment En-Route). Weather and Airport related causes are out of the scope of solution PJ.07-03.

Solution PJ.07-03 is related to the planning and execution of Mission Trajectories (MT) of state AU only. In the planning phase Solution PJ.07-03 may contribute to Focus Area Punctuality by calculating a realistic and precise departure time. After successful validation the filed Flight plans are subject to Demand Capacity Balancing (DCB) in Network Manager and/or ATC areas. Optimized DCB routines contribute to the punctuality as they will allow the departure according to the filed FPL.

4.10.2 Assessment Data (Exercises and Expectations)

Solution PJ.07-03 is related to Mission Trajectories (MT) of state AU only. The concept of the PJ.07-03 exercise was to plan typical missions for state AUs in the real airspaces of the FIRs Praha and Munich. As there is only 1.3 % OAT flights amongst all flights in controlled airspace the expected benefit couldn't be high.

In this real-time simulation exercise the execution of the missions was simulated according to the submitted flight plan including its updates. The simulation didn't contain ATM issues. There were no airspace user punctuality issues addressed in the scope of solution PJ.07-03.

4.10.3 Aggregation

By its definition solution PJ.07-03 could only impact the En-route flight phase.

1.3% of the flights represent 500 OAT flights compare with 37839 flights.

The overall PUN1 target is an increase of 7% of flights departing on time (within +/- 3 minutes of scheduled departure time). The Experts consider the contribution of military flights tend to be marginal.

KPIs / PIs	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
PUN1 % Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather related delay causes	%	% Departures so that $ AOBT - SOBT < +/- 3 \text{ min.}$ Difference in Actual Departure Time vs. Scheduled Time due to ATM and weather related delay causes.	YES	No benefits in SESAR1	0 %	0 %

Table 14 is showing the impact on flight phases.

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
% Departures so that $ AOBT - SOBT < +/- 3 \text{ min.}$)	N/A	N/A	0 %	N/A	N/A

Table 14: Punctuality benefit per flight phase

The V2 exercise EXE-07.03-V2-VALP-001 (Initial Mission Trajectory Management in Planning and Execution) did not contribute to KPA Punctuality PUN1.

4.10.4 Discussion of Assessment Result

N/A

4.10.5 Additional Comments and Notes

N/A

⁶ Taking into account those SESAR concepts working on the planning phase, it is possible for different Stakeholders to request departure changes (outside the tolerance window of +/- 3 minutes) subject to approval by all actors involved before the flight execution. If accepted by all concerned actors, the reference plan against which the departure punctuality is measured will be this updated RBT instead of SBT.

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

No specific benefit is expected from SESAR Solution PJ.07-03 for this KPI.

4.12 Flexibility

No specific benefit is expected from SESAR Solution PJ.07-03 for this KPI.

4.13 Cost Efficiency

No specific benefit is expected from SESAR Solution PJ.07-03 for this KPI.

CEF2: Operating statistics of military systems are not available for the public. For the civil ATC part an evaluation will be part of the next (V3) validation exercise in this solution.

CEF3: Technology costs of military systems are not available for the public.

KPIs / PIs	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
CEF2⁷ Flights per ATCO-Hour on duty	Nb	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		Unable to make an estimation.	Unable to make an estimation.

4.14 Airspace User Cost Efficiency

No specific benefit is expected from SESAR Solution PJ.07-03 for this KPI.

⁷ 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 Security

No specific benefit is expected from SESAR Solution PJ.07-03 for this KPI.

4.16 Human Performance

4.16.1 HP arguments, activities and metrics

The general operating principle is that the current ATM environment based on static flight plans is evolving through SESAR towards Trajectory Based Operations (TBO) in order to improve Airports and ATM Network performance. Better performance of ATM operations depends on a better knowledge of the true demand of Airspace Users during planning and on better adherence to the plan during operations. Improved Collaborative Decision Making (CDM) incorporating Airspace Users evolving business needs will be key to improve operations.

Irregular operations impose unplanned/additional cost on airlines and have a huge impact on airlines' annual costs and revenue. A better support to AU operations' recovery process that includes more flexibility i.e. the ability of the ATM system to incorporate AUs' decision processes and accommodate AUs' changing business priorities, could result in substantial reductions of these impacts. Flexibility and equity in the ATM system are key.

In addition, Military (OAT) flight plans are not harmonized at European level and information is not disseminated into the Network. This induces a lack of awareness about military traffic intentions that can impact ATM Network performance (including safety), and a lack of flexibility in the definition of cross borders mission trajectories and limitations in terms of interoperability.

The validation activity addressed a better integration of processes from the military Wing Operations Centre (WOC), local ATC and the Network, based on shared military flight plan and trajectory information taking into account different scenarios such as En-Route and TMA with the corresponding sub-operating environments Very High, High, Medium and Low.

Level of maturity of the concept at the start of the HP assessment was considered to be V2. Therefore the argument structure for V2 was applied on the project and it is concluded that eleven of the twelve V2 second level HP arguments needed to be considered and satisfied in the HP assessment, namely:

1. Roles & Responsibilities

- *Argument 1.1:* The roles and responsibilities of the human are clear & exhaustive
- *Argument 1.2:* The operating methods are clear, exhaustive and support human performance
- *Argument 1.3:* Human actors can achieve their tasks in normal, abnormal and degraded modes of operation

2. Human & System

- *Argument 2.1:* There is appropriate allocation of tasks between the human and the machine
- *Argument 2.2:* The performance of the technical system supports the human in carrying out their tasks

- *Argument 2.3:* The design of the HMI supports the human in carrying out their tasks

3. Teams & Communication

- *Argument 3.1:* The effects on team composition
- *Argument 3.2:* The allocation on tasks between human actors support human performance
- *Argument 3.3:* The communication between team members supports human performance

4. HP related transition factors

- *Argument 4.2:* Changes in competence requirements are analysed
- *Argument 4.5:* Training needs are identified for affected human actors

According to the identified HP issues/benefits, three activities were identified and successfully carried out for the “improved Airspace Users’ participation - through their Flight/Wing Operations Centre (WOC) - into ATM Network Collaborative Processes” concept:

1. Task Analysis and HP issue analysis (through focus groups and ad-hoc WebExs)
2. Validation exercises (through Real Time Simulations)
3. Joint HP & Safety Workshop (with relevant experts- ATCOs & concept developers)

More information is available in OSED Part IV the HP assessment report (see [47]).

Consolidated results from the validation exercises show that this may be considered one of the major steps towards enhanced civil – military coordination and is expected to contribute to a more complete view of the pan-European air traffic situation, civil as well as military, at ATM network level. Indeed, from the completion of the HP assessment and, in particular from the HP maturity criteria checklist for transition from V2 to V3 which is based on the ‘evidence’ obtained from the HP related validation activities conducted within SESAR PJ07.03, it can be concluded that the operational concept tested in the validation exercises has reached the V2 level of HP maturity and **satisfies the V2 transition criteria to start V3 validation.**

4.16.2 Open HP issues

Specific HP issues and benefits relating to the “improved Airspace Users’ participation - through their Flight/Wing Operations Centre (WOC) - into ATM Network Collaborative Processes” concept for each of the relevant arguments were identified by performing a review of existing literature, work performed in SESAR 1, focus groups and ad-hoc WebExs with various subject matter experts, and a Joint HP & Safety Workshop with all the impacted actors involved in V2 validation exercise. Mitigation means to those issues were identified and validated in either Real Time Simulations or a workshop.

The table outlines the arguments that were addressed and the number of issues in each argument.

HP Argument	No of issues	Open issues	Closed issues	Not addressed
Argument 1.1 Roles and responsibilities of	3	0	3	

human actors are clear and exhaustive				
Argument 2.1 There is an appropriate allocation of tasks between the human and machine (i.e. level of automation)	1	0	1	
Argument 2.2 The performance of the technical system supports the human in carrying out their tasks	1	1	0	
Argument 2.3 The design of the human-machine interface supports the human in carrying out their tasks	1	1	0	
Argument 3.1 Effects on team composition	1	0	1	
Argument 3.2 The allocation on tasks between human actors support human performance	1	0	1	
Argument 3.3 The communication between team members supports human performance	1	1	0	
Argument 4.2 Changes in competence requirements are analysed	1	1	0	
Argument 4.5 Training needs are identified for affected human actors.	1	1	0	

Table 15: HP arguments that were addressed and the number of issues in each argument for V2-phase

Some of the issues are open, which is a completely normal status in V2, as most of the issues will be refined and further addressed in V3. The majority of issues were addressed. Those that were not addressed will be addressed in V3.

4.16.3 Requirements and recommendations

The description of the HP requirements and recommendations can be found in the Part IV of the OSED - Human Performance Assessment Report (Appendix A and B).

Number of Recommendation	Category	Number of Requirement	Category
7	1 system design 6 Training	4	4 system design

Table 16: Number and types of HP recommendations and requirements identified for V2-phase

Most of the requirements and recommendations relate to system design as the project is in V2 and therefore still under development. The line with the number of issues related the operator tasks and the needed training to properly accomplish them.

The identified HP recommendations and requirements will be taken into account and validated in the next V3-phase.

4.16.4 Additional Comments and Notes

It is worth noting that, the concept has been mostly elaborated having as reference the ANSPs in which the civil-military integration is achieved with ATCOs responsible for controlling both civil and military aircraft, depending on different operational situations (e.g. ANSPs as DFS and ANS CR). Consequently, the scope of the HP assessment has been limited to similar operational situations with these characteristics. Further studies may be needed in order to extend the HP assessment in case of the application of the concept is envisaged in other types of ANSPs. In addition, other adjustments to rules and regulations may be required for a full implementation of the concept as well as some improvements to the supporting system.

In V3, where possible, validation activities such as stakeholder workshops focus group and WebExs should also be extended in scope to include other than the WOC and ATCOs, namely IFPS and technicians / technical engineer. In addition, technical improvements may be needed to enhance the performance and reliability of the technical components of the system and the V3 validation plan may take into consideration a more systematic assessment of abnormal events and degraded modes.

4.17 Other PIs

No further PIs from the Performance Framework update were assessed qualitatively, nor, if possible, quantitatively. Table 17 is empty.

KPA	PIs ⁸	Benefit (text only)	mechanism	Qualitative Impact ⁹

Table 17: Qualitative assessment of QoS KPIs

Detailed descriptions of these PIs can be found in the Performance Framework [7].

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

4.17.1 Performance Mechanism

N/A

4.17.2 Assessment Data (Exercises and Expectations)

N/A

4.17.3 Additional Comments and Notes

N/A

4.18 Gap Analysis

The gaps between validation targets and performance assessment result for CAP2, PRD1 and PUN1 are still 100 %.

The type of the next validation exercise needs to be discussed and maybe changed to allow further and detailed performance assessment.

⁸ Still under definition by B.04.01



5 References

5.1 Applicable Documents

- [1] 08.01.03 D47: AIRM v4.1.0
- [2] B05 Performance Assessment Methodology for Step 1
- [3] B.05 D86 Guidance on KPIs and Data Collection support to SESAR 2020 transition.
- [4] B.05 Guidance for Performance Assessment Cycle 2013
- [5] B05 Updated Performance Assessment in 2015
- [6] B05 Data Collection and Repository Cycle 2015
- [7] B.04.01 D108 SESAR 2020 Transition Performance Framework

Content Integration

- [8] B.04.01 D138 EATMA Guidance Material
- [9] EATMA Community pages
- [10] SESAR ATM Lexicon

Content Development

- [11] B4.2 D106 Transition Concept of Operations SESAR 2020

System and Service Development

- [12] 08.01.01 D52: SWIM Foundation v2
- [13] 08.01.01 D49: SWIM Compliance Criteria
- [14] 08.03.10 D45: ISRM Foundation v00.08.00
- [15] B.04.03 D102 SESAR Working Method on Services
- [16] B.04.03 D128 ADD SESAR1
- [17] B.04.05 Common Service Foundation Method

Performance Management

- [18] B.04.01 D42 SESAR2020 Transition Validation
- [19] 16.06.06-D68 Part 1 –SESAR Cost Benefit Analysis – Integrated Model
- [20] 16.06.06-D51-SESAR_1 Business Case Consolidated_Deliverable-00.01.00 and CBA

- [21]Method to assess cost of European ATM improvements and technologies, EUROCONTROL (2014)
- [22]ATM Cost Breakdown Structure_ed02_2014
- [23]Standard Inputs for EUROCONTROL Cost Benefit Analyses
- [24]16.06.06_D26-08 ATM CBA Quality Checklist
- [25]16.06.06_D26_04_Guidelines_for_Producing_Benefit_and_Impact_Mechanisms

Validation

- [26]03.00 D16 WP3 Engineering methodology
- [27]Transition VALS SESAR 2020 - Consolidated deliverable with contribution from Operational Federating Projects
- [28]European Operational Concept Validation Methodology (E-OCVM) - 3.0 [February 2010]

System Engineering

- [29]SESAR Requirements and V&V guidelines

Safety

- [30]SESAR, Safety Reference Material, Edition 4.0, April 2016
- [31]SESAR, Guidance to Apply the Safety Reference Material, Edition 3.0, April 2016
- [32]SESAR, Final Guidance Material to Execute Proof of Concept, Ed00.04.00, August 2015
- [33]SESAR, Resilience Engineering Guidance, May 2016

Human Performance

- [34]16.06.05 D 27 HP Reference Material D27
- [35]16.04.02 D04 e-HP Repository - Release note

Environment Assessment

- [36]SESAR, Environment Reference Material, alias, “Environmental impact assessment as part of the global SESAR validation”, Project 16.06.03, Deliverable D26, 2014.
- [37]ICAO CAEP – “Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes” document, Doc 10031.

Security

- [38]16.06.02 D103 SESAR Security Ref Material Level
- [39]16.06.02 D137 Minimum Set of Security Controls (MSSCs).

[40]16.06.02 D131 Security Database Application (CTRL_S)

5.2 Reference Documents

[41]ED-78A GUIDELINES FOR APPROVAL OF THE PROVISION AND USE OF AIR TRAFFIC SERVICES SUPPORTED BY DATA COMMUNICATIONS.

[42]07.05.04 D52 Step 1 Advanced Flexible Use of Airspace Validation Report (VALR)

[43]07.06.02 D50 Validation Report (VALR) for STEP1 Operational Air Traffic (OAT) Flight Plan Management

[44]11.01.05 D26 Update Validation report for stand-alone WOC validation for Step 1 (BMT, AFUA, iOATFPL)

[45]11.01.05 D27 Update Validation report for stand-alone WOC validation for Step1 (BMT, AFUA, iOATFPL)

[46]PJ19: Validation Targets (2018), D4.5, Edition 01.00.00, 26 February 2018

[47]SESAR Solution PJ.07-03 SPR/INTEROP-OSED for V2 - Part IV - Human Performance Assessment Report

[48]PJ19: Performance Framework (2017), D4.1, Edition 00.01.00, 04 July 2017

[49]SESAR Solution PJ.07-03 Validation Report (VALR) for V2, D4.1.030, Edition 00.01.00, 9 July 2018

