PJ PROSA

SESAR Solution 10.02a SPR/INTEROP-OSED for V3 - Part V - Performance Assessment Report (PAR)

D04-02-010	PU/CO/CL
PROSA	
Grant:	734143
Call:	H2020-SESAR-2015-2
Topic:	Separation Management
Consortium coordinator:	DFS
Edition date:	16 September 2019
Edition:	00.01.02
Template Edition	02.00.02

Founding Members
EUROPEAN UNION EUROCONTROL

SESAR JOINT UNDERTAKING

PROSA

IMPROVED PERFORMANCE IN THE PROVISION OF SEPARATION

This deliverable is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 734143 under European Union's Horizon 2020 research and innovation programme.

Abstract

This document provides the Performance Assessment Report (PAR) for Solution Pj.10-02a Improved Performance in the Provision of Separation. The PAR consolidates the Solution performance validation results addressing KPIs/PIs and metrics from the SESAR2020 Performance Framework [3].

Table of Contents

List of Tables

List of Figures

Aucune entrée de table d'illustration n'a été trouvée.

1 Executive Summary

This document provides the Performance Assessment Report (PAR) for Solution Pj.10-02a Improved Performance in the Provision of Separation.

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

Description:

The SESAR Solution PJ.10-02a aims at improving the provision of separation (tactical layer) in TMA and En-Route environments through the use of improved services and aircraft data which allow prediction, with better uncertainty, the future aircraft positions.

These enhanced services comprise:

- Conflict detection and resolution set, based on improved ground trajectory prediction and enhanced resolution features.
- Conformance monitoring service based on improved ground trajectory prediction and enriched with additional alerts, such as vertical rate monitoring.

More Information can be found in Chapter 2!

Assessment Results Summary:

The following tables summarises the assessment outcomes per KPI (Table 1) and mandatory PI (Table 2) puts them side-by side against Validation Targets in case of KPI from PJ19 [18]. The impact of a Solution on the performances are described in Benefit Impact Mechanism. All the KPI and mandatory PI from the Benefit Mechanism were the Solution potentially impact have to be assessed via validation results, expert judgment etc.

There are three cases:

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

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits Expectations at Network Level (ECAC Wide or Local depending on the KPI)[1]	Confidence in Results[2]
FEFF1: Fuel Efficiency – Fuel burn per flight	None	0.5% Improvement (25kg per flight)	Medium
CAP1: TMA Airspace Capacity – TMA throughput, in challenging airspace, per unit time.	4.475% 4.475% (VHC) 4.475% (HC) 4.475% (MC)	1.82%	Medium
CAP2: En-Route Airspace Capacity – En-route throughput, in challenging airspace, per unit time	**3.141%** 3.141% (VHC) 3.141% (HC) 3.141% (MC)	5% to 18%	Medium
CAP3: Airport Capacity – Peak Runway Throughput (Mixed mode).	N/A	N/A	N/A
PRD1: Predictability – Variance of Difference in actual & Flight Plan or RBT durations	**0.415%** 0.251% (TMA VHC) 0.053% (TMA HC) 0.050% (TMA MC) 0.035% (ER VHC) 0.010% (ER HC) 0.017% (ER MC)[3]	No value measured, but indications are that predictability is maintained or, with FRA, improved.	

[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

[3] In Validation Targets [18] the unit for PRD1 is % Reduction in variance of block-to-block flight time.

PUN1: Punctuality – % Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather related delay causes	N/A	N/A	N/A
CEF2: ATCO Productivity – Flights per ATCO -Hour on duty	**3.333%** 0.474% (TMA VHC) 0.100% (TMA HC) 0.093% (TMA MC) 1.493% (ER VHC) 0.427% (ER HC) 0.747% (ER MC)	**ENR-VH: 1.6% - 5.6%** **ENR-H: 1.4% - 5.0%** **ENR-M: 1.9% - 6.8%** **TMA-VHC: 0.8%** **TMA-HC: 0.5%** **TMA-MC: 0.8%**	Medium
CEF3: Technology Cost – Cost per flight	N/A	N/A	N/A
SAF1: Safety - Total number of fatal accidents and incidents with ATM Contribution per year	-0.89% (TMA VHC) -0.89% (TMA HC) -0.89% (TMA MC) -7.2% (ER VHC) -7.2% (ER HC) -7.2% (ER MC)[5]	Safety maintained or improved	

Table 1: KPI Assessment Results Summary

[4] In Validation Targets [18] the unit for CEF2 is % increase in ATCO productivity.

[5] In Validation Targets [18] the unit for SAF1 is % reduction in the total number of fatal accidents per year.

Mandatory PI	Performance Benefits Expectations at Network Level (ECAC Wide or Local depending on the KPI)[6]	Confidence in Results[7]
SAF1.X: Mid-air collision – En-Route		
SAF2.X: Mid-air collision – TMA		
SAF3.X: RWY-collision accident		
SAF4.X: RWY-excursion accident		
SAF5.X: TWY-collision accident		
SAF6.X: CFIT accident		
SAF7.X: Wake related accident		
SEC1: A security risk assessment has been carried out		
SEC2: Risk Treatment has been carried out		
SEC3: Residual risk after treatment meets security objective.		
SEC7: Personnel (safety) risk after mitigation		
SEC8: Capacity risk after mitigation		
SEC9: Economic risk after mitigation		
FEFF2: CO2 Emissions.		
FEFF3: Reduction in average flight duration.		
NOI1: Relative noise scale		
NOI2: Size and location of noise contours		

[6] Negative impacts are indicated in red.

[7] 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

NOI4: Number of people exposed to noise levels exceeding a given threshold		
LAQ1: Geographic distribution of pollutant concentrations		
CAP3.1: Peak Departure throughput per hour (Segregated mode)		
CAP3.2: Peak Arrival throughput per hour (segregated mode)		
CAP4: Un-accommodated traffic reduction		
RES1: Loss of Airport Capacity Avoided		
RES1.1: Airport time to recover from non-nominal to nominal condition		
RES2: Loss of Airspace Capacity Avoided.		
RES2.1: Airspace time to recover from non-nominal to nominal condition.		
RES4: Minutes of delays.		
RE5: Number of cancellations.		
CEF1: Direct ANS Gate-to-gate cost per flight		
AUC3: Direct operating costs for an airspace user		
AUC4: Indirect operating costs for an airspace user		
AUC5: Overhead costs for an airspace user		
CMC1.1: Available/Required training Duration within ARES		
CMC1.2: Allocated/ Optimum ARES dimension		
CMC1.3: Transit Time to/from airbase to ARES		
CMC2.1: Fuel and Distance saved (for GAT operations)		
CMC2.2: GAT planning efficiency of Available ARES		

HP1: Consistency of human role with respect to human capabilities and limitations		
HP2: Suitability of technical system in supporting the tasks of human actors		
HP3: Adequacy of team structure and team communication in supporting the human actors		
HP4: Feasibility with regard to HP-related transition factors		
FLX1: Average delay for scheduled civil/military flights with change request and non-scheduled or late flight plan request		

Table 2 Mandatory PIs Assessment Summary

Additional Comments and Notes:

At the time of the previous release of the PAR, results were only available from the V2 exercises that comprised SESAR Release 8. This release of the PAR provides the results from exercises performed as part of SESAR Release 9.

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

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

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

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

In accordance with an SJU dictate, this document only consolidates results concerning the V3 part of the solution; V2 results are documented in section 5.

2.2 Intended readership

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

Produced by the Solution project, the main recipient in the SESAR performance management process is PJ19, which will aggregate all the performance assessment results from the SESAR2020 solution projects PJ1-18, and provide the data to PJ20 for considering the performance data for the European ATM Master Plan. The aggregation will be done at higher levels suitable for use at Master Planning Level, such as deployment scenarios. Additionally, the consolidation process will be carried out annually, based on the SESAR Solution's available inputs.

2.3 Inputs from other projects

The document includes information from the following SESAR 1 projects:

- B.05 D72 [5]: SESAR 1 Final Performance Assessment, where are described the principles used in SESAR1 for producing the performance assessment report.

PJ19 will manage and provide:

- PJ19.04.01 D4.1 [3]: Performance Framework (2018), guidance on KPIs and Data collection supports.
- PJ19.04.03 D4.0.1: 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)[8] within STELLAR, gathering experts and providing best practices.

2.4 Glossary of terms

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

2.5 Acronyms and Terminology

Term	Definition
ADD	Aircraft-Derived Data
ADS-C	Automatic Dependent Surveillance - Contract
ANS	Air Navigation Service
ANSP	Air Navigation Service Provider
AOI	Area of Interest
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
BAD	Benefits Assessment Date
BAER	Benefit Assessment Equipment Rate
BIM	Benefit and Input Mechanism

8 https://stellar.sesarju.eu/?link=true&domainName=saas&redirectUrl=%2Fjsp%2Fproject%2Fproject.jsp%3FobjId%3Dxrn%3Aview%3Axrn%3Adatabase%3Aondb%2Ftable%2F59_anonymous%402333834.13%403834139.13

CBA	Cost Benefit Analysis
CD/R	Conflict Detection / Resolution
DB	Deployment Baseline
DOD	Detailed Operational Description
E-ATMS	European Air Traffic Management System
ECAC	European Civil Aviation Conference
EPP	Extended Projected Profile
FRA	Free Route Airspace
KPA	Key Performance Area
KPI	Key Performance Indicator
MONA	Monitoring Aids
N/A	Not Applicable
OI	Operational Improvement
OSED	Operational Service and Environment Description
PAR	Performance Assessment Report
PI	Performance Indicator
PRU	Performance Review Unit
QoS	Quality of Service
RBT	Reference Business / Mission Trajectory
RTE VIA	Route Via (Clearance)
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

3 Solution Scope

3.1 Detailed Description of the Solution

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

The SESAR Solution "Improved Performance in the Provision of Separation" aims at improving the provision of separation (tactical layer) in TMA and En-Route environments through the use of improved services and aircraft derived data which allows predicting, with better uncertainty, the present and future aircraft positions.

This SESAR Solution is in the continuity of SESAR1 projects. Initial maturity at the end of SESAR1 is V2-started. V2 and V3 maturity phases are expected to be completed in Wave 1.

Outstanding R&D needs to improve trajectory prediction are:

- The use of downlinked aircraft data when available:
    - *Aircraft position reporting data* : Mode S enhanced data set, ADS-B data as defined in ED-102-A/DO260B,
    - *Aircraft predictive data* : ADS-C reports as defined in ED-229A, including ADS-C EPP data
- Addition of improved MET services, such as the calculation of wind data,
- Available information from the ground e.g. specific areas (military areas, adverse weather,..)

For a complete description, see the OSED.

3.2 Detailed Description of relationship with other Solutions

Solution Number	Solution Title	Relationship	Rational for the relationship
PJ.06-01	Optimized traffic management to enabler free routing in high and very high complexity environments	Dependent	Advanced support services in free route airspace.
PJ.10-01a	High Productivity Controller Team Organisation	Preferable	Support adapted to new controller roles.
PJ.10-01b	Flight Centric ATC	Preferable	Support adapted to new controller roles.

PJ.10-01c	Collaborative Control	Preferable	Support adapted to new controller roles.
PJ.18-06	Performance Based Trajectory Prediction	Dependent	Improvement to separation services enabled by more reliable trajectory information.

Table 4: Relationships with other Solutions

For a complete description of the solution interactions, see the OSED [43].

4 Solution Performance Assessment – V3

4.1 Assessment Sources and Summary of Validation Exercise Performance Results

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

Organisation	Document Title	Publishing Date
SESAR	P04 07 02 D09 "Validation Report_3 (M9 of VP 175 & 499)", edition 00.01.02	17/12/2015
SESAR	P04.07.02 D21 "Validation Report_4" (EXE-04.07.02-VP-501), edition 00.01.00	15/06/2016
SESAR	P05 07 02 D75 "MD MC Multi Airport TMA-V2b Validation Report VP738-VP741", edition 00.01.01	07/07/2016
SESAR	P05 07 02 D76 "HD HC Multi Airport TMA V2b Validation Report VP740-VP743", edition 00.01.01	07/07/2016

Table 5: Pre-SESAR2020 Exercises

SESAR Validation Exercises of this Solution (completed ones and planned ones) are listed below. This version of the PAR reports on the results obtained from the V3 exercises (rows 7 to 11).

Exercise ID	Exercise Title	Release	Maturity	Status
EXE-10.02a-V2-VALP-001	Enhancement of the MTCD with detection of conflict between Aircraft-Volume & Improvement of TP allowing refining MTCD thresholds accuracy	R8	V2	Completed
EXE-10.02a-V2-VALP-002	Improved Separation Management through CD/R aid to TC (TCT)	R8	V2	Completed
EXE-10.02a-V2-VALP-003	Fast-time study of CD&R Tool Performance	R8	V2	Completed
EXE-10.02a-V2-VALP-004	Improved Separation Management through CD/R aid to TC and MONA	R8	V2	Completed
EXE-10.02a-V2-VALP-005	Subtle Navigational Factors - DSS	R8	V2	Completed
EXE-10.02a-V2-VALP-006	Tactical Encounter Solver Assistant (TESLA)	R8	V2	Completed

EXE-10.02a-V3-VALP-001	CD&R Aids in En-Route upper sectors Focus on MTCD in En-Route	R9	V3	Completed
EXE-10.02a-V3-VALP-002b	COOPANS/Thales Tactical Controller Tool (TCT) for conflict detection and resolution optimization in TMA	R9	V3	Completed
EXE-10.02a-V3-VALP-003	Conflict Tools optimization in Free-route airspace	R9	V3	Completed
EXE-10.02a-V3-VALP-004	CD&R and conformance monitoring tools adapted for Free Route Airspace (above FL245) in very high complex environment	R9	V3	Completed
EXE-10.02a-V3-VALP-005	Early Conflict Resolution Using Enhanced CD&R Tools	R9	V3	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
EXE-10.02a-V3-VALP-001	CM-0211	The exercise focused on the assessment of an enhanced MTCD with detection of conflict between Aircraft-Volume in French En-Route airspace with high traffic complexity. The exercise validated the extent to which the results from DSNA validations in SESAR 1 P04.07.02 & WP04.03 could be achieved in a different operational environment, thereby addressing the overarching attempt of SESAR to obtain comparable and representative results. It was also the continuation of EXE-10.02a-V2-VALP-001.	**SAF**: Indications that the PC is able to resolve conflicts early so the number of tactical conflicts is reduced. **PRD1**: **CAP2:** +1.2% to 15.6% (fixed route) +2.4% (free route) **CEF2:** +0.5 to 5.7%.	V3
EXE-10.02a-V3-VALP-002b	CM-0206	The exercise focussed on understanding the extent to which the new TCT tools positively impact the controller's task performance in conflict detection and resolution in TMA and extended TMA airspace with high traffic density including a	**SAF:** Indications are that safety is maintained or improved. **FEFF1:** +0.51%	V3

		high percentage of vertical movements.	**CAP1:** +1.82% **CEF2:** +1.36%	
EXE-10.02a-V3-VALP-003	CM-0209	The exercise focused on enhanced separation tools (TCT and MTCD with what-if) and HMI improvements to support controllers in their tasks for separation assurance: • Conflict detection and resolution tools based on improved ground trajectory prediction and enhanced resolution features • Enhanced FDP developed in order to be able to integrate Mode-S data in the trajectory calculation, then distributed to the CD/R tools (TCT and MTCD featured by what-if function). The operational environment is related to Rome ACC En-Route airspace with high traffic density/complexity and Free Routing configuration.	SAF Based on available results, no specific conclusion can be derived (see section 4.4.2) PRD1 -1,1% CEF2 Based on available results, no conclusions can be derived on the actual value related to the CEF2 assessment and further investigation are recommended FEFF1 +0,71%	V3
EXE-10.02a-V3-VALP-004	CM-0211 CM-0210A	The objective was to assess the Controller Support Tools and Monitoring Aids adapted to a Free Routing environment on Predictability, Capacity, Safety and Human Performance. The Skyguide validation platform (skysim) was used. The platform was equipped with advanced ATC support tools (e.g. flight data processing, trajectory management, Conflict Detection and Resolution, monitoring tools, electronic coordination) adapted	**SAF** Indications are that safety is maintained or improved. **FEFF1** 1.06% to 1.18% **CAP2** +18% **CEF2** +18%	V3

		to Free Routing cross-border environment.		
EXE-10.02a-V3-VALP-005	CM-0209A CM-0210A	The exercise addressed an enhanced working method, enabled by more reliable CD&R tools (achieved by more accurate trajectory prediction), that was expected to reduce executive controller workload. The exercise built on the V2 FTS EXE-10.02a-V2-VALP-003, which evaluated the potential reduction in executive controller workload that might be achieved if the sector planner resolves certain, high probability conflicts.	**SAF** Indications are that safety is maintained or improved. **FEFF1** 0% **CAP2** +3.9% **CEF2** +2.9%	V3

Table 7: Summary of Validation Results.

4.2 Conditions / Assumptions for Applicability

The following Table 8 summarises the applicable operating environments. In principle, the solution is applicable in ER and TMA operational environments of all complexity levels, though performance targets have been set only for VHC, HC and MC sub-OEs.

OE	Applicable sub-OE	Special characteristics
TMA	VHC, HC, MC	No special characteristics are relevant.
ER	VHC, HC, MC	No special characteristics are relevant.

Table 8: Applicable Operating Environments.

The following Table 9 summarises the essential deployment details.

BAD	Specific geographical and/or stakeholder deployment
31/12/2025	TMA airspace (Low to High Complexity)
31/12/2029	En-Route airspace (Low to High Complexity)

Table 9: Deployment details.

No equipage rates have been assessed for this version of the PAR.

4.3 Important Contextual Information Influencing The Performance Results and Their Extrapolation

The evolution of controller support tools, of which Sol.10-02a is a part, is partially described in the Pj10.02a Contextual Note [46]. As this has important implications on the interpretation of the performance results and any attempt at their extrapolation, it is reiterated here with additional information.

Sol.10-02a follows the development of controller tools in SESAR1 and, prior to that, the FASTI programme; thus FASTI can be considered to represent the baseline of the first generation of controller tools. The SESAR1 programme started the development of the second generation of controller tools, aiming to adapt them for use in the TMA, which was not addressed by FASTI, and to refine them for use in complex ER airspace by improving support to the tactical controller (Tactical Control Tool [TCT]) and improving filtering and resolution support (e.g. “what-else” trajectories).

As only the tactical support in ER achieved V3 in SESAR1, Sol.10-02a was tasked with progressing the development of the remaining aspects to achieve full V3 of the second generation controller tools. In addition, Sol.10-02a is also developing the third generation of controller tools which comprises the improvement of the tools with enriched trajectory information (e.g. use of ADS-C, Extended Flight Plan, better weather prediction, etc.), with the aim of completing V2.

Therefore, this PAR, which collates performance results up to Release 9, addresses the second generation controller tools at V3, and the third generation tools at V2. Due to the relative immaturity of the V2 results, they are included in the report (in section 5) for each KPI, but no extrapolation is performed.

This uneven evolution of the tools leads to a complicated reference against which performance benefits are reported. For the second generation tools, the reference in the TMA OE is a system without controller tools, whereas the reference in ER is the first generation tools (FASTI)[9]. The reference for the third generation tools in ER and TMA would most properly be the second generation tools in the respective OE.

Unfortunately, the complexity does not end there. Controller support tools are hugely sensitive to very detailed aspects of system functionality and operational environment (e.g. traffic characteristics, sector sizes, etc.). This can be seen in the wide variety of results obtained by the same system when operated in different sectors.

The reference systems for the ER V3 exercises, which might be considered first generation systems as represented by FASTI, are all conceptually similar, but vary at the detailed level as a result of the specific operational requirements of the environment in which they are operated. Furthermore, each exercise, although forming part of the same initiative of improving the performance of the controller

[9] This is not the case in exercise -004, where the reference using existing operating methods and route network, but improved controller tools.

tools, has made its own detailed changes specific to the operational requirements of its target environment.

Although the improvements made in each exercise are to a large extent complementary, it is not justified to expect that the aggregated solution benefit is simply the sum of the benefits determined by each exercise.

With all this in mind, it would not be useful to attempt a precise extrapolation of the solution benefit. Instead, extrapolation, where performed, will be based on a figure, or a range, that is considered representative of the results obtained in the exercises.

4.4 Safety

Information presented hereunder on the safety criteria has been collected from the Safety Plan [45].

When available, assessment results will be obtained from the Safety Assessment Report and Validation Report.

4.4.1 Safety Criteria and Performance Mechanism

The table below lists the SACs defined for the V3 phase in Solution 10-02a:

SAC ID	Description	Barrier / Precursor
SAC-10.02a-ER-001 Basis SESAR1: SAC21 ER	**There shall be no increase in ATC induced pre-tactical conflicts-non plan predicted per flight arising from knock-on pre-tactical conflicts from previous sector (due to FPL not being updated) taking into consideration a 16 % increase in traffic.** *Due to the use of conflict resolution aid to PC (What-if probing) and through the use of new data for improved TP*	MF11 Pre-tactical Conflict non plan predicted – ENR*
SAC-10.02a-TMA-ER-002 Basis SESAR 1: SAC5 TMA; SAC22 ER	**There shall be no increase in the number of planning conflicts per flight arising from Inadequate Planning Tasks (Identifying Conflicts and Judging Conflict Resolution) taking into consideration a 13.4/16 % increase in traffic.** *Due to the use of PC-aid (MTCD and What-if probing), potential "strategic" clearances (conflict-free clearances given further in advance due to the use of what-if and by CPDLC), improved TP.*	B10 Tactical Planning Barrier / MF5.1 Planning Conflicts
SAC-10.02a-TMA-ER-003 Basis SESAR 1: SAC4 TMA; SAC23 ER	**There shall be no increase in crew or aircraft induced conflicts per flight due to crew or aircraft speed or lateral deviation, taking into consideration a 13.4/16 % increase in traffic.** *Due to the use of MONA for PC or TC including new data (Mode-S, EPP, improved algorithms)*	MF6.1.2
SAC-10.02a-TMA-ER-004 Basis SESAR 1: SAC3 TMA; SAC13 ER	**There shall be no increase in ATC-induced tactical conflicts arising from inadequate Instructions given to pilot taking into consideration a 13.4/16 % increase in traffic.** *Due to the use of resolution aid to TC (What-else probing) and new data for improved TP (Mode-S, EPP, improved algorithms)*	MF7.1

SAC ID	Description	Barrier / Precursor
SAC-10.02a-TMA-ER-005 Basis SESAR 1: SAC2 TMA; SAC11 ER; (SAC12 ER)	**There shall be no increase in imminent infringements taking into consideration a 13.4/16 % increase in traffic.** *Due to the use of TC- aid (including What-else probing) and improvement in the Trajectory prediction capabilities.*	B5-9** / MF5-9
SAC-10.02a-TMA-ER-006 Basis SESAR 1: SAC1 TMA; (SAC11 ER); SAC15 ER	**There shall be no increase in the number of imminent collisions.** *Unchanged, used to ensure that CD/R aid to PC and TC and STCA work together in a coherent manner (if this SAC is not met positive effects induced by CD/R aid to PC and TC combined with STCA lead to an overall negative effect of the precursor MF4)*	B3, B4* / MF4
SAC-10.02a-TMA-ER-007	**There shall be no increase in the number of Airspace Infringements in own airspace arising due to conflict resolutions taking into consideration a 13.4/16 % increase in traffic.** *mainly due to the geo-fencing capability of the What-else probing incorporating danger or prohibited zones in the conflict resolution options.*	

The table below expresses the link between the SACs and the tools/functionalities and new concept elements:

Controller Tools	SACs addressed (TMA / En-Route)	OI Steps
conflict detection aid to PC (MTCD)	SAC 10.02a-TMA-ER-002	CM-0211, CM-0206, CM-0209
conflict resolution aid to PC (What-if & What-else probing)	SAC 10.02a-TMA-ER-001	CM-0211, CM-0206, CM-0209
MONA to PC and TC	SAC 10.02a-TMA-ER-003	CM-0208-A, CM-0210
conflict detection aid to TC	SAC 10.02a-TMA-ER-005	CM-0206, CM-0209
conflict resolution aid to TC (What-if & What-else probing)	SAC 10.02a-TMA-ER-004	CM-0206, CM-0209
Concept elements	**SACs addressed (TMA / En-Route)**	

User preferred trajectories	All	CM-0206, CM-0209
PC “strategic clearances“	SAC 10.02a-TMA-ER-002	CM-0209
TC / PC interaction	SAC 10.02a-TMA-ER-005 SAC 10.02a-TMA-ER-002	CM-0211, CM-0209

The table below maps the SACs to exercises in which they are validated.

Exercise	Associated SACs
EXE-10.02a-V3-VALP-001	SAC-10.02a-ER-001 SAC-10.02a-TMA-ER-002 SAC-10.02a-TMA-ER-005
EXE-10.02a-V3-VALP-002b	SAC-10.02a-TMA-ER-004 SAC-10.02a-TMA-ER-005
EXE-10.02a-V3-VALP-003	SAC-10.02a-ER-001 SAC-10.02a-TMA-ER-002 SAC-10.02a-TMA-ER-003 SAC-10.02a-TMA-ER-004 SAC-10.02a-TMA-ER-005
EXE-10.02a-V3-VALP-004	SAC-10.02a-TMA-ER-002 SAC-10.02a-TMA-ER-004 SAC-10.02a-TMA-ER-005
EXE-10.02a-V3-VALP-005	SAC-10.02a-ER-001 SAC-10.02a-TMA-ER-002 SAC-10.02a-TMA-ER-005
EXE-10.02a-V3-VALP-006	SAC-10.02a-ER-001 SAC-10.02a-TMA-ER-002 SAC-10.02a-TMA-ER-005
EXE-10.02a-V3-VALP-007	SAC-10.02a-TMA-ER-002 SAC-10.02a-TMA-ER-003 SAC-10.02a-TMA-ER-004 SAC-10.02a-TMA-ER-005

Table 10 SAC mapping to each exercise

4.4.2 Data collection and Assessment

From the Safety Criteria listed in the previous section and following the SRM process, Safety Objectives (SO) and Operational Hazards have been developed and identified. Therefore, the Safety Criteria are implicitly achieved through the demonstration of the aforementioned and through the definition of Safety Validation Objectives, which are documented in the Safety Assessment Report.

The full results for the exercises can be found in the corresponding appendices of the VALR. The table below summarizes the quantitative results of each exercise against the safety criteria.

SAC-10.02a-ER-001 ATC induced pre-tactical conflicts			
Exercise	OI Steps	OE	Results
001	CM-0211	ER HC	The solution MTCD allowed reducing the number of planned conflict and allowed avoiding ATC induced pre-tactical conflicts
003	CM-0209	ER HC	With the available simulation setting it was not possible to record data useful to compare the number of Induced pre-tactical conflicts in the Reference and Solution simulation runs. Therefore, no accurate conclusion can be derived for what specifically concerns this criterion.
005	CM-0209A CM-0210A	ER MC	No ATC-induced pre-tactical conflicts were observed to last for any significant duration (the resolution was immediately corrected). Aircraft leaving a sector whilst still on an assigned heading was only observed in the reference runs. These can be taken as indicators that ATC-induced pre-tactical conflicts are not increased.
SAC-10.02a-TMA-ER-002 Planning conflicts per flight			
Exercise	OI Steps	OE	Results
001	CM-0211	ER HC	The solution MTCD allowed reducing the number of planned conflict and allowed avoiding ATC induced pre-tactical conflicts
003	CM-0209	ER HC	With the available simulation setting, it was not possible to record data useful to compare the number of Induced pre-tactical conflicts in the Reference and Solution simulation runs. Therefore, no accurate conclusion can be derived for what specifically concerns this criterion.
004	CM-0211 CM-0210A	ER VHC	An effect of cross-border FRA seemed to be an overall increase in the number and geographical spread of potential conflicts. However, the controllers reported no negative impact on safety. Advanced Controller Support Tools (CD&R Tools (MTCD, Exit Conflict Detection & Resolution tool, What-if, MONA, Electronic Coordination…) are deemed necessary to manage high traffic load and complexity in FRA.
005	CM-0209A CM-0210A	ER MC	Most conflicts were solved well in advance by the PC, leaving few to be resolved by EC. Conflicts were generally resolved slightly earlier (1 to 2 minutes) in the solution runs than in the reference runs. The actual horizontal miss distance (i.e. the closest point of approach) was generally slightly larger in the solution runs than the reference runs.

			These can be taken as indicators that planning conflicts are not increased.
SAC-10.02a-TMA-ER-003 Crew or aircraft induced conflicts			
Exercise	OI Steps	OE	Results
003	CM-0209	ER HC	With the available simulation setting it was not possible to clearly distinguish crew or aircraft induced conflicts from ATC induced conflicts. A precise distinction between ATC factors (e.g. delayed clearance or avoiding instruction, error in issuing them, call-sign error, etc.) and crew induced factors (e.g. deviation from planned trajectory, delayed response, etc.) is very difficult without very detailed information on each individual conflict. It was therefore assumed that all tactical conflicts were ATC-induced when occurring in both the Reference and Solution scenarios (see following criterion). No specific conclusion can be derived for what concerns this criterion.
SAC-10.02a-TMA-ER-004 ATC-induced tactical conflicts			
Exercise	OI Steps	OE	Results
001	CM-0211	ER HC	There is a trend toward reduction of the number of tactical conflicts, when comparing the reference logs to the solution logs, thanks to the What-if
002b	CM-0206	TMA VHC	As part of the data analysis, STCAs logs were used as a metric for tactical conflicts. The total count of alerts across the REF and SOL 2 (including both TCT functions) scenarios, there was no considerable difference. Furthermore, the count for SOL 1 runs (TCT CD only) showed a 43% reduction compared to the other scenarios. Causality was established via recorded alerts in the observations log. Of the 29 events described, 86% were not specifically attributed to pilot error and can therefore be designated as 'ATC-induced'. Through this analysis, no increase in ATC-induced tactical conflicts has been found.
003	CM-0209	ER HC	The comparison between the Reference simulation runs and the Solution simulation runs shows a reduction of the number of ATC induced tactical conflicts only when the MTCD and TCT are configured with the optimized alerting thresholds introduced starting from the second day of the exercise. Still, in one case, the Reference scenario showed less tactical conflicts than the Solution, also when the optimized alerting

			thresholds were adopted. However, the result may have been biased by the tendency of some ACTOs to test the tools in order to better familiarize with them, thus inducing some conflicts that did not derive from real operational constraints. Based on these results, no conclusions can be derived on the actual impact of MTCD and TCT in reducing the number of tactical conflicts.
004	CM-0211 CM-0210A	ER VHC	The conflict resolution rate in the solution scenario was the same as that in the reference scenario in spite of increased traffic. Therefore it can be deduced that there was no increase in the number of ATC-induced tactical conflicts.
SAC-10.02a-TMA-ER-005 Imminent infringements			
Exercise	OI Steps	OE	Results
001	CM-0211	ER HC	The number of STCA conflicts tends to show a diminution of imminent infringements with the solution system.
002b	CM-0206	TMA VHC	Participants were asked to report any imminent infringements at the end of each measured run. These events were reported to have occurred on five occasions, the majority of which occurred under reference conditions. Although this could be taken as an indicator that the number of imminent infringement events did not increase under solution conditions, the low number of total events recorded limits the value of this finding. ATCO feedback on the impact of the TCT on the likelihood of imminent infringements occurring, 75% stated that they believed the TCT CD function would reduce this probability. No impact was reported from the TCT WEP function.
003	CM-0209	ER HC	The comparison between the Reference simulation runs and the Solution simulation runs shows a reduction of the number of imminent infringements only when the MTCD and TCD are configured with the optimized alerting thresholds introduced starting from the second day of the exercise. Still, in one case, the Reference scenario showed less imminent infringements than the Solution, also when the optimized alerting thresholds were adopted. However, the result may have been biased by the tendency of some ACTOs to test the tools in order to better familiarize with them, thus inducing some conflicts that did not derive from real operational constraints.

			Based on these results, no conclusions can be derived on the actual impact of MTCD and TCT in reducing the number of tactical conflicts.
004	CM-0211 CM-0210A	ER VHC	An analysis of recorded data revealed no increase in the number of infringements in spite of the increase of traffic.
005	CM-0209A CM-0210A	ER MC	No imminent infringements were observed as a result of the RTE VIA. In the final questionnaire, 80% of the participants felt that safety was the same or improved. Therefore, no increase in imminent infringements has been found.
SAC-10.02a-TMA-ER-006 Imminent collisions			
Exercise	OI Steps	OE	Results
002b	CM-0206	TMA VHC	The separation log data was analysed to investigate the conflict pairs with the smallest minimum vertical and lateral separations. Investigation involved the replay of these separation losses and revealed no cases in which aircraft pairs were at risk of imminent collision. Of the four losses of separation recorded during the exercise, all involved either a catch-up scenario for departing aircraft where one is planned to turn behind, or aircraft pairs of opposite parallel approaches. In either case, the event cannot be interpreted as an imminent collision. Therefore, it can be concluded that the TCT does not increase the number of imminent collision events, under the conditions simulated in EXE-002b.
003	CM-0209	ER HC	This safety criterion was not considered relevant when defining the validation objectives of EXE003. Therefore, no data about Imminent Collisions are available in relation to this exercise.
004	CM-0211 CM-0210A	ER VHC	No imminent collisions were observed.
005	CM-0209A CM-0210A	ER MC	No imminent collisions were observed. In the final questionnaire, 80% of the participants felt that safety was the same or improved. Therefore, no increase in imminent collisions has been found.

SAC-10.02a-TMA-ER-007 Airspace Infringements			
Exercise	OI Steps	OE	Results
003	CM-0209	ER HC	This safety criterion was not considered relevant when defining the validation objectives of EXE003. Therefore, no data about Airspace Infringements are available in relation to this exercise.

Table 11 Exercise Validation Results - Safety

4.4.3 Extrapolation to ECAC wide

An extrapolation is not possible based on the nature of the results, but it can be concluded that subjective feedback and objective measures indicate that safety is somewhat improved.

4.4.4 Discussion of Assessment Result

It was not possible to provide a measurement of safety improvement using real-time simulation. However, quantifiable indicators such as numbers of ATC-induced conflicts, numbers of imminent conflicts, and the timeliness of conflict resolution, show a trend of increasing safety which corroborates the subjective feedback given by controllers.

4.4.5 Additional Comments and Notes

None.

4.5 Environment / Fuel Efficiency

Often fuel efficiency is improved through a reduction of flight or taxi time. This time benefit is also assessed, in this section, as it is additional input for the business case.

4.5.1 Performance Mechanism

The improvement in trajectory prediction tools provides a more accurate and stable prediction of potential conflicts, which allows the controller a longer look-ahead time and consequently greater flexibility in optimizing the resolution clearances. This is expected to impact positively environmental and fuel efficiency.[10]

For more information, see OSED [43] Appendix A, section A.2.3 ANSP Benefits Mechanism.

4.5.2 Assessment Data (Exercises and Expectations)

In the table below, the exercises report a value of FEFF1 (average fuel burn saving per flight).

<table>
<tr><th>Exercise

EXE-10.02a-V3-VALP-</th><th>OI Steps</th><th>Sub-OE</th><th>Results</th></tr>
<tr><td>002b</td><td>CM-0206</td><td>TMA VHC</td><td>FEFF1 (fuel benefit per flight):

To quantify any impact from the TCT on fuel efficiency, the industry-standard tool AEM was used to process the platform log data. Although no KPA target was apportioned to this solution, it is important that the impact of earlier detection of conflicts and improved resolution advisories on environmental efficiency is not damaging.

The AEM outputs were then used to determine the impact of the TCT functions, as shown in the table below.
<table>
<tr><th>Scenario</th><th>Mean Fuel Burn per A/C (Kg)</th><th>Mean Fuel Burn Change</th></tr>
<tr><td>REF</td><td>1458.7</td><td rowspan="2">+0.51%</td></tr>
<tr><td>SOL 2 (CD and WEP)</td><td>1466.1</td></tr>
</table>
</td></tr>
</table>

[10] Source: BIM, see [43].

<table>
<tr><td></td><td></td><td></td><td>As these figures demonstrate, a mean of 12.6Kg additional fuel is burnt per aircraft when operating with the TCT functions. This represents a small negative impact to environmental efficiency due to the use of the TCT functions.</td></tr>
<tr><td>003</td><td>CM-0209</td><td>ER HC</td><td>FEFF1 (fuel benefit per flight):

FEFF1 associated to the fuel consumption is related to flight time within the measured area. The slight increase in the recorded fuel consumption is due to a greater occupancy time of the flights within the measured area (slight increase in the flight time for each aircraft). However, this negative impact can be considered to be not significant.

<table>
<tr><th>Scenario</th><th>Avg Fuel burn per a/c (Kg)</th><th>Δ % per a/c</th></tr>
<tr><td>REFERENCE</td><td>1264</td><td rowspan="2">0,71%</td></tr>
<tr><td>SOLUTION</td><td>1273</td></tr>
</table>
</td></tr>
<tr><td>004</td><td>CM-0211
CM-0210A</td><td>ER VHC</td><td>FEFF1 (fuel benefit per flight):

The exercise measured the flight routing inefficiency in terms of the additional length compared to the great-circle from departure to destination. KPIs record the inefficiency as regards the last filed flight plan (KEP) and the actual flown route (KEA). The results are expressed in the following table:

<table>
<tr><th>Validations</th><th>KEP (planned)</th><th>KEA (flown)</th><th>KEP improvement REF > SOL</th><th>KEA improvement REF > SOL</th></tr>
<tr><td>Reference Scenario FRN</td><td>7.81%</td><td>5.55%</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Solution 1 - XFRA 2 cells</td><td>5.42%</td><td>4.49%</td><td>2.39%</td><td>1.06%</td></tr>
<tr><td>Solution 2 - XFRA 1 cell</td><td>5.26%</td><td>4.37%</td><td>2.55%</td><td>1.18%</td></tr>
</table>

This is converted to a fuel saving per flight as given in the table below:

<table>
<tr><th>Validations</th><th>Planned fuel consumption reduction SOL vs REF</th><th>Planned fuel consumption reduction in flight execution phase SOL vs REF</th></tr>
<tr><td>Solution 1 - XFRA 2 cells</td><td>19.91 kg</td><td>8.63 kg</td></tr>
<tr><td>Solution 1 - XFRA 1 cell</td><td>21.56 kg</td><td>9.62 kg</td></tr>
</table>
</td></tr>
</table>

005	CM-0209A CM-0210A	ER MC	FEFF1 (fuel benefit per flight): An analysis of recorded flight data revealed that when RTE VIA was used in a tactical manner, similar to radar vectoring, the path lengths were often slightly longer than in the reference runs. However, as the controller became more familiar with the system they were able to give more strategic clearances that resulted in significant reductions in path length. Thus it can be considered that the use of RTE VIA didn't have a measurable effect on flight efficiency.

Table 12 Exercise Validation Results – Fuel Efficiency

4.5.3 Extrapolation to ECAC wide

As reasoned in section 4.3, above, extrapolation will be performed according to a figure, applicable to all complexity levels, that is representative of the results obtained in the exercises. The TMA was only addressed in a single exercise at V3 and therefore its result of will be used directly. In the ER environment, the only V3 result comes from exercise 004, with values corresponding to the number of FRA cells configured; an average of the two figures is used for the purpose of the extrapolation.

The extrapolation makes use of the following common assumptions and aggregation assumptions from [42]:

- F-0001: Ave fuel burn per flight, all domains = 5280kg
- F-0005: ER fuel consumption contribution = 66%
- F-0006: TMA arrival fuel consumption contribution = 5%
- F-0007: TMA departure fuel consumption contribution = 25%
- TMA-VHC-2035: contribution to total TMA traffic from TMA VHC = 57.49%
- TMA-HC-2035: contribution to total TMA traffic from TMA HC = 37.44%
- TMA-MC-2035: contribution to total TMA traffic from TMA MC = 61.16%
- ER-VHC-2035: contribution to total ER traffic from ER VHC = 31.33%
- ER-HC-2035: contribution to total ER traffic from ER HC = 27.98%
- ER-MC-2035: contribution to total ER traffic from ER MC 37.89%

The extrapolation is detailed in the table below.

	ER VHC	ER HC	ER MC	TMA VHC	TMA HC	TMA MC
Fuel % benefit per flight	1.12%			-0.51%		

Contribution of Traffic	31.33%	27.98%	37.89%	57.49%	37.44%	61.16%
Average fuel burn per flight	5280kg					
Fuel consumption contribution	66%			30%		
FEFF1 (Kg fuel saved per flight)	**12kg**	**11kg**	**15kg**	**-5kg**	**-3kg**	**-5kg**

This result in each sub-OE is summed to produce the table below. FEFF2 has also been provided as, although it was not measured, it is derived from the value of FEFF1.

KPIs / PIs	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
FEFF1 Actual Average fuel burn per flight	Kg fuel per movement	Total amount of actual fuel burn divided by the number of movements	YES	n/a	25kg	0.5%
FEFF2 Actual Average CO2 Emission per flight	Kg CO2 per flight	Amount of fuel burn x 3.15 (CO2 emission index) divided by the number of flights	YES	n/a	79kg	0.5%

Table 13 Consolidated Results - FEFF

4.5.4 Discussion of Assessment Result

Regarding second-generation controller tools (V3), measurable differences in fuel consumption were only reported in two exercises; one, due to the use of free-route airspace, reported a benefit, and the other, using TCT in the TMA reported a slight dis-benefit. One exercise reported no measurable difference in fuel consumption. On this basis it can be concluded that the tools enable a flight efficiency benefits thanks to FRA, which might be slightly negated in the TMA.

Note that, although validation was performed with high traffic loads, similar results might be expected with lower loads on the basis that efficiency benefits are enabled essentially through reducing controller workload, which will also be the case at lower traffic levels when sectors are combined.

The confidence in the results should be treated as “medium” due to the specific environment in which the results were measured and the relative inexperience of the controllers with the system under test.

V2 results of the third generation tools indicate a larger benefit.

4.5.5 Additional Comments and Notes

None.

4.6 Environment / Noise and Local Air Quality

4.6.1 Performance Mechanism

N/A

4.6.2 Assessment Data (Exercises and Expectations)

N/A

4.6.3 Extrapolation to ECAC wide

N/A

4.6.4 Discussion of Assessment Result

N/A

4.6.5 Additional Comments and Notes

N/A

4.7 Airspace Capacity (Throughput / Airspace Volume & Time)

4.7.1 Performance Mechanism

The improved MTCD on-demand services such as filtering and what-if are expected to decrease controller workload in delivering vertical clearances (CFL/rate). Furthermore, as there are expected to be fewer intermediate clearances, workload should be further reduced. The on-demand nature of the MTCD services avoids the generation of "nuisance warning" and therefore reduces the workload associated with analyzing non pertinent encounters.[11]

With improved TP accuracy there is a better delineation between high-probability and low-probability conflicts, which leads to two types of benefits:

1. Actual Potential Conflicts (aircraft pairs and/or situations where loss of separation is predicted as likely to occur – and where control action for resolution is required) will be detected earlier thanks to improved TP accuracy, giving the controller more time to assess the conflicts and to issue a clearance if necessary.

2. Unlikely Conflicts / Risks (aircraft pairs and/or situations where loss of separation is predicted as unlikely to occur – and where control action for resolution would not be needed) will be more reliably classified and therefore the number of required EXE control clearances related to these situations will decrease accordingly and the time spent on monitoring by ATCOs (PLN and EXE) related to these situations will also decrease.

These factors are expected to lead to a reduction of ATCO workload and to provide a consequent increase in capacity.[12]

For more information, see the Appendix A, section A.2.3 ANSP Benefits Mechanism of [43].

4.7.2 Assessment Data (Exercises and Expectations)

In the table below, the exercises report a value of CAP1/CAP2 for TMA/ER.

Exercise EXE-10.02a-V3-VALP-	OI Steps	Sub-OE	Results
001	CM-0211	ER HC	CAP2:

[11] Source: BIM – CM-0211, see [43]

[12] Source: BIM – CM-0206/CM-0209, see [43]

<table>
<tr><td></td><td></td><td></td><td>In fixed-route airspace, overall workload reduction show a potential 1,2% capacity increase, while efficiency is increased by 14% (7,8% capacity increase). Controllers perceived that capacity was improved by 15,6%.

In Free/Direct Route Airspace, capacity is improved by 2,4% according to workload reduction scores.</td></tr>
<tr><td>002b</td><td>CM-0206</td><td>TMA VHC</td><td>CAP1:

One of the expected performance benefits of introducing improved CD&R functions to the TMA environment is an increase in airspace capacity. The apportioned target for this solution is a 4.475% increase in VHC TMA environments. When using an RTS exercise technique, this benefit can be expressed through the change in mean ATCO workload; as a reduction in effort for the controller will enable them to handle a greater number of aircraft. The TMA capacity benefit through reduced controller workload can be calculated by using the following equation:

$$Increase\ in\ TMA\ Airspace\ Capacity\ (\%) = \left(\frac{1}{\left(1-\frac{Workload\ Reduction}{2}\right)}-1\right)\times 100$$

The ‘workload reduction’ referred to in the equation can be generated from a chosen metric for mean workload. In the case of this exercise, the Bedford scale ratings submitted following each run were selected. For the purposes of the TMA capacity change calculation, only the 2024 traffic sample data was used. Mean ‘average’ workload ratings across all 2024 matched pairs were averaged to produce a workload score for that scenario. These figures are presented in the table below.

<table>
<tr><th>Scenario</th><th>Mean Workload Score</th><th>Workload Reduction</th><th>TMA Capacity Increase</th></tr>
<tr><td>REF</td><td>3.11</td><td colspan="2">N/A</td></tr>
<tr><td>SOL 2 (CD and WEP)</td><td>3.00</td><td>0.04</td><td>+1.82%</td></tr>
</table>

As per the Performance Framework definition of the TMA Airspace Capacity KPA, the TCT function would deliver a 1.82% benefit. This falls below the 4.475% target for a very-</td></tr>
</table>

			high complexity TMA sub-operating environment but is a positive contribution to the greater solution-level result.
004	CM-0211 CM-0209A	ER VHC	CAP2: Traffic was performed at 2022 levels in both reference and solution runs, representing a 18% increase from 2017 (an extra load of 5% was also added to compensate for simulation effect). The same improved conflict management tools were used in both reference and solution runs. There was no measurable difference between workload in the reference and solution runs. It can therefore be deduced: • A capacity increase in the order of ***18%*** is likely due to the use of the improved tools, when compared to 2017 operations; • There is no measurable difference in capacity between FRA and FRN environments.
005	CM-0209A	ER MC	CAP2: For the controllers involved in the exercise, as they are not currently using MTCD, it was very difficult for them to distinguish between workload caused by MTCD and that caused by RTE VIA. It is consequently impossible to conclude any trends from ISA reports or the questionnaire feedback. Indications of reduced workload can be inferred from the number of instructions given, that was reduced in the solution runs. This, and the positive qualitative feedback from the controllers, and on the assumption that the requirements identified in the exercise are fulfilled, are considered as consistent with the findings of the V2 FTS. Thus it can be concluded that with “current” TP accuracy, the planner resolving conflicts whose probability is at least 50%, and on the assumption that conflict management represents 50% of the workload, the impact on workload is as follows: Overall sector workload: -2.5% Executive controller workload: -7.5%

			Planner controller workload: 2.5% Converting EC workload reduction to capacity increase gives a benefit of ***3.9%.***

Table 14 Exercise Validation Results - Capacity

For TMA, only a single exercise has contributed a result and therefore this is used directly. For ER, two values, representing a minimum likely value and maximum likely value, are chosen.

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 Complexity TMAs. TMA at peak demand hours.	YES	n/a	n/a	1.82%
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 TMAs.airspace at peak demand hours.	YES	n/a	n/a	5% to 18%

Table 15 Consolidated Results - Capacity

4.7.3 Extrapolation to ECAC wide

There is no ECAC wide extrapolation required for this KPI.

4.7.4 Discussion of Assessment Result

As reasoned in section 4.3, the performance benefit of controller tools is hugely sensitive to the environment in which it is operated. In addition, the full benefit of the tools is only realized once the controllers have gained sufficient familiarity and trust in the tools, which is often difficult to achieve fully in the context of a V3 exercise. Furthermore, controller workload, which has been used as the basis for calculating capacity impact in the exercises, is also an imprecise measure. These factors can be observed in the large range of reported capacity results. Whereas the upper figures might be considered optimistic, an actual performance benefit somewhat higher than the lower figures might

be expected once the controllers are sufficiently familiar with the operation of the tools. For these reasons, the confidence in the results should be considered as “medium”.

To a certain extent, the improvements validated by each exercise are complimentary (e.g. filtering in 001, FRA in 004, RTE VIA in 005), and this has influenced the choice of the lower bound of the ER benefit range.

4.7.5 Additional Comments and Notes

None.

4.8 Airport Capacity (Runway Throughput Flights/Hour)

4.8.1 Performance Mechanism

N/A

4.8.2 Assessment Data (Exercises and Expectations)

N/A

4.8.3 Extrapolation to ECAC wide

N/A

4.8.4 Discussion of Assessment Result

N/A

4.8.5 Additional Comments and Notes

N/A

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

4.9.1 Performance Mechanism

N/A

4.9.2 Assessment Data (Exercises and Expectations)

N/A

4.9.3 Extrapolation to ECAC wide

N/A

4.9.4 Discussion of Assessment Result

N/A

4.9.5 Additional Comments and Notes

N/A

4.10Predictability (Flight Duration Variability, against RBT)

4.10.1Performance Mechanism

The improvement in trajectory prediction tools provides a more accurate and stable prediction of potential conflicts and improves the reliability of conflict resolution clearances, thereby decreasing the total number of corrective conflict resolution instructions and open-loop clearances. This improves the flight profile predictability.[13]

For more information, see OSED Appendix A, section a.2.3 ANSP Benefits Mechanism.

4.10.2Assessment Data (Exercises and Expectations)

Although none of the exercises have produced predictability results, some indications can be gleaned from their analysis of flight efficiency.

Exercise 002b, looking at TMA operations, found no significant difference between path lengths in reference and solution runs; flight efficiency was only impacted by the handling of the vertical profile. Therefore it can be concluded that the predictability (i.e. the difference between actual & flight Plan or RBT durations) was not impacted.

Exercise 003 recorded a reduction of flight's total route length and even an improvement of vertical profile. Comparing reference and solution runs, the recorded improvement related to PRD1 is -1,1% per a/c.

Similarly, exercise 005, looking at early resolution using a RTE-VIA clearance in ER airspace, found no measurable difference in path lengths between reference and solution runs.

Conversely, exercise 004, which addressed the use of FRA enabled by advanced controller tools, found that the difference between the actual route flown and the planned route was 1.5% less in the solution runs (FRA) as compared to the reference (fixed route network). This was found by comparing the inefficiency of the route in the flight plan (KEP) with the inefficiency of the actual flown route (KEA); in the reference run the difference was 2.26% (7.81 – 5.55) and in the solution runs it was 0.93% and 0.49% - see section 4.6.2 for details. Thus a corresponding 1.5% reduction in the flying time error would also be expected.

Although this result can't be used to provide a figure for PRD1, as the units are not compatible, it gives an indication that the use of FRA, enabled by advanced controller tools, will increase predictability.

4.10.3Extrapolation to ECAC wide

As there is no directly usable value from an exercise, no extrapolation is performed.

[13] Source: BIM, see [43]. Predictability not explicitly shown in the figure.

4.10.4Discussion of Assessment Result

None

4.10.5Additional Comments and Notes

None

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

4.11.1 Performance Mechanism

N/A

4.11.2 Assessment Data (Exercises and Expectations)

N/A

4.11.3 Extrapolation to ECAC wide

N/A

4.11.4 Discussion of Assessment Result

N/A

4.11.5 Additional Comments and Notes

N/A

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

4.12.1Performance Mechanism

N/A

4.12.2Assessment Data (Exercises and Expectations)

N/A

4.12.3Extrapolation to ECAC wide

N/A

4.12.4Discussion of Assessment Result

N/A

4.12.5Additional Comments and Notes

N/A

4.13Flexibility

Flexibility means the ability to react to late flight plan changes and requests. The main PI / metric, FLX1, is “Average delay for scheduled civil/military flights with change request and non-scheduled / late flight plan request.”

4.13.1Performance Mechanism

N/A

4.13.2Assessment Data (Exercises and Expectations)

N/A

4.13.3Extrapolation to ECAC wide

N/A

4.13.4Discussion of Assessment Result

N/A

4.13.5Additional Comments and Notes

N/A

4.14Cost Efficiency

4.14.1Performance Mechanism

Cost efficiency benefits derive from increased controller productivity, which are an effect of reducing controller workload. The benefit mechanism is therefore as described under section 4.7, Airspace Capacity (Throughput / Airspace Volume & Time).

4.14.2Assessment Data (Exercises and Expectations)

In the table below, the exercises report a value of CEF2. It is typical for an exercise to measure productivity benefits in terms of a workload reduction. In such cases a productivity factor can be derived using the formula:

*Productivity factor = 1 / (1 – (0.375 * WKL)),*

where WKL is the workload reduction (e.g. 10% reduction = 0.1).

A productivity benefit as a % change can be achieved by subtracting 1 from the factor.

Exercise EXE-10.02a-V3-VALP-	OI Steps	OE	Results
001	CM-0211	ER HC	CEF2*(Flights per ATCO-Hour on duty)*: Workload and efficiency data show a potential cost-efficiency increases between ***0.5%*** and ***5.7%***.
002b	CM-0206	TMA HC	CEF2*(Flights per ATCO-Hour on duty)*: Through the same approach used to determine the change in airspace capacity, potential savings in the cost efficiency of ANSP operations can be identified by first calculating the change in mean controller workload. This benefit mechanism is built on the model that if a controller has more capacity due to reduced workload, they can safely handle a greater number of flights per hour. This represents a cost efficiency in staffing cost for the ANSP as a higher volume of traffic can be operated by the same staff when compared to reference conditions. Once again, the Bedford scale metric for workload has been used in the standard equation for this KPA (Bedford results are discussed above, in relation to TMA Airspace Capacity). This equation (shown below) uses a decimal reduction in workload to produce a percentage increase in ATCO productivity. For this

<table>
<tr>
<td></td>
<td></td>
<td></td>
<td>solution, the relevant target is a 0.474% increase in VHC TMA environments.

$$Increase\ in\ productivity\ (\%) = \left(\frac{1}{\left(1 - 0.75 \times \frac{Workload\ reduction}{2}\right)} - 1 \right) \times 100$$

The table below shows that, by calculating the difference between SOL 2 and REF workload scores and using the equation above, a 1.36% improvement in ATCO productivity (which is an indicator of ANSP cost efficiency) is yielded via the introduction of the TCT functions. This exceeds the 0.474% apportioned to this environment within the KPA targets for this solution.
<table>
<tr><th>Scenario</th><th>Mean Workload Score</th><th>Workload Reduction</th><th>ATCO Productivity Increase</th></tr>
<tr><td>REF</td><td>3.11</td><td colspan="2">N/A</td></tr>
<tr><td>SOL 2 (CD and WEP)</td><td>3.00</td><td>0.04</td><td>+1.36%</td></tr>
</table>
</td>
</tr>
<tr>
<td>003</td>
<td>CM-0209</td>
<td>ER HC</td>
<td>CEF2(Flights per ATCO-Hour on duty):

The number of assumed flights across the different scenarios has shown a not univocal trend across scenarios comparison. Moreover, although ATCOs working with the advanced C/DR tools support were able to assume a higher number of flight, it is worth to note that these values are not corroborated by a decrease of workload in the solution scenarios.

Therefore, no conclusions can be derived on the actual value related to the CEF2 assessment and further investigation are recommended.</td>
</tr>
<tr>
<td>004</td>
<td>CM-0209A</td>
<td>ER HC</td>
<td>CEF2(Flights per ATCO-Hour on duty):

Traffic was performed at 2022 levels in both reference and solution runs, representing an 18% increase from 2017 (an extra load of 5% was also added to compensate for simulation effect).

The same improved conflict management tools were used in both reference and solution runs.

It can therefore be deduced that an ATCO productivity increase in the order of 18% due to the improved tools might be expected when compared to 2017 operations.</td>
</tr>
</table>

005	CM-0209A	ER MC	CEF2*(Flights per ATCO-Hour on duty)*: For the controllers involved in the exercise, as they are not currently using MTCD, it was very difficult for them to distinguish between workload caused by MTCD and that caused by RTE VIA. It is consequently impossible to conclude any trends from ISA reports or the questionnaire feedback. Indications of reduced workload can be inferred from the number of instructions given, that was reduced in the solution runs. This, and the positive qualitative feedback from the controllers, and on the assumption that the requirements identified in the exercise are fulfilled, are considered as consistent with the findings of the V2 FTS. Thus it can be concluded that with "current" TP accuracy, the planner resolving conflicts whose probability is at least 50%, and on the assumption that conflict management represents 50% of the workload, the impact on workload is as follows: Overall sector workload: -2.5% Executive controller workload: -7.5% Planner controller workload: 2.5% Converting EC workload reduction to productivity gives a benefit of ***2.9%.***

Table 16 Exercise Validation Results – Cost Efficiency

4.14.3Extrapolation to ECAC wide

As reasoned in section 4.3, extrapolation is performed only on the V3 results. For TMA, only a single exercise has contributed a result and therefore this is used directly. For ER, two values, representing a minimum likely value and maximum likely value, are chosen.

The extrapolation makes use of the following common assumptions and aggregation assumptions from [42]:

- TMA-VHC-2035: contribution to total TMA traffic from TMA VHC = 57.49%
- TMA-HC-2035: contribution to total TMA traffic from TMA HC = 37.44%
- TMA-MC-2035: contribution to total TMA traffic from TMA MC = 61.16%
- ER-VHC-2035: contribution to total ER traffic from ER VHC = 31.33%
- ER-HC-2035: contribution to total ER traffic from ER HC = 27.98%

- ER-MC-2035: contribution to total ER traffic from ER MC 37.89%

This extrapolation is detailed in the table below. For the purpose of the extrapolation, a likely benefits range has been estimated on the basis of the measured results. Note that, although each exercise was performed in a specific sub-OE, the results obtained are likely to be applicable to all complexity levels, and therefore a common range is used for all ER sub-OEs and for all TMA sub-OEs.

	ER VHC	ER HC	ER MC	TMA VHC	TMA HC	TMA MC
CEF2*(Flights per ATCO-Hour on duty)*	5% - 18%			1.36%		
Contribution of traffic	31.33%	27.98%	37.89%	57.49%	37.44%	61.16%
CEF2 (Flights per ATCO-Hour on duty)	**1.6% - 5.6%**	**1.4% - 5.0%**	**1.9% - 6.8%**	**0.8%**	**0.5%**	**0.8%**

KPIs / PIs	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
CEF2[14] Flights per ATCO-Hour on duty	Nb	Count of Flights handled divided by the number of ATCO-Hours applied by ATCOs on duty.	YES	n/a	n/a	ENR-VH: 1.6% - 5.6% ENR-H: 1.4% - 5.0% ENR-M: 1.9% - 6.8% TMA-VHC: 0.8% TMA-HC: 0.5% TMA-MC: 0.8%

Table 17 Consolidated Results – Cost Efficiency

4.14.4Discussion of Assessment Result

The discussion of the results for productivity follow very much the same reasoning as that for capacity in section 4.7.4, i.e. the sensitivity of the benefit to the environment, the need for controller familiarity and the imprecision in the measurement of controller workload.

To a certain extent, the improvements validated by each exercise are complimentary (e.g. filtering in 001, FRA in 004, RTE VIA in 005), and this has influenced the choice of the lower bound of the ER benefit range.

[14] 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).

Note that, although validation was performed with high traffic loads, similar results might be expected with lower loads on the basis that sectors are combined as necessary to ensure that the controllers are efficiently loaded.

The confidence in the results should be treated as “medium” due to the specific environment in which the results were measured and the relative inexperience of the controllers with the system under test.

4.14.5Additional Comments and Notes

None

4.15Airspace User Cost Efficiency

4.15.1Performance Mechanism

N/A

4.15.2Assessment Data (Exercises and Expectations)

N/A

4.15.3Extrapolation to ECAC wide

N/A

4.15.4Discussion of Assessment Result

N/A

4.15.5Additional Comments and Notes

N/A

4.16Security

4.16.1The SecRAM 2.0 methodology and the Security Performance Mechanism

N/A

4.16.2Security Assessment Data Collection

N/A

4.16.3Extrapolation to ECAC wide

N/A

4.16.4Discussion of Assessment Result

N/A

4.16.5Additional Comments and Notes

N/A

4.17Human Performance

4.17.1HP arguments, activities and metrics

As described in the HPAR, HP related validation activities conducted include:

1. Interviews through WebEx with operational experts,
2. Joint HP & Safety Workshop with all the HF and safety experts involved in the validation exercises,
3. Real Time Simulation including observations during the validation exercises as well as dedicated brainstorming sessions with relevant stakeholders.

The output or 'evidence' collected from each of these activities that are relevant to the HP assessment are summarised in the HPAR together with recommendations and/or requirements that have been proposed to help prevent or mitigate each of the potential HP issues identified. The recommendations and requirements relate to: the operational concept, the technical system, HMI and the training of the end user. In addition, HP recommendations for future validation activities that need to be conducted in the next V-phase(s) in order to investigate the HP issues and benefits in more detail, as well as, potential mitigation are also provided.

PIs	Activities & Metrics	Second level indicators	Covered
HP1 Consistency of human role with respect to human capabilities and limitations	**Debriefs, questionnaires, recordings.** **Workload, user acceptance, alerts, errors, late actions**	**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	
		HP1.3 Capability of human actors to achieve their tasks in a timely manner, with limited error rate and acceptable workload level	
HP2 Suitability of technical system in supporting the tasks of human actors	**Debriefs, questionnaires, recordings.** **Trust, workload, situational awareness, user acceptance, alerts, flights per sector, heart-rate variability, number of clearances**	**HP2.1** Adequacy of allocation of tasks between the human and the machine (i.e. level of automation).	
		HP2.2 Adequacy of technical systems in supporting Human Performance with respect to timeliness of system responses and accuracy of information provided	
		HP2.3 Adequacy of the human machine interface in supporting the human in carrying out their tasks.	
		HP3.1 Adequacy of team composition in terms of identified roles	N/A

PIs	Activities & Metrics	Second level indicators	Covered
HP3 Adequacy of team structure and team communication in supporting the human actors	**Debriefs, questionnaires, recordings.** **Workload, situational awareness, task sharing, alerts, flights per sector, number of clearances, errors**	**HP3.2** Adequacy of task allocation among human actors	
		HP3.3 Adequacy of team communication with regard to information type, technical enablers and impact on situation awareness/workload	
HP4 Feasibility with regard to HP-related transition factors	**Debriefs, questionnaires.** **Subjective feedback / expert opinion.**	**HP4.1** User acceptability of the proposed solution	
		HP4.2 Feasibility in relation to changes in competence requirements	
		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.	

4.17.2Extrapolation to ECAC wide

N/A.

4.17.3Open HP issues/ recommendations and requirements

An indication of the number of HP issues that are still open and HP benefits identified following the Solution validation exercises, as well as the number of recommendations and requirements defined. For the detailed description, please consult the HP Plan/ HP Log and the HP Assessment Report.

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

4.17.4Concept interaction

An enumeration/ description of possible interactions with other SESAR2020 solutions. Where interactions are identified, please specify the level of concept interaction and enumerate below the issues that are considered to have a relevant impact on other solutions as well.

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

4.17.5 Most important HP issues

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

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

PIs	Most important issue of the solution	Most important issues due to solution interdependencies
HP1 Consistency of human role with respect to human capabilities and limitations		
HP2		

PIs	Most important issue of the solution	Most important issues due to solution interdependencies
Suitability of technical system in supporting the tasks of human actors		
HP3 Adequacy of team structure and team communication in supporting the human actors		
HP4 Feasibility with regard to HP-related transition factors		

4.17.6Additional Comments and Notes

If needed, add comments and notes as free text and structure.

[...]

4.18Other PIs

Further PIs from the Performance Framework update are assessed qualitatively, or, if possible, quantitatively, in Table 18

KPA	PIs	Benefit mechanism (text only)	Qualitative Impact[15]

Table 18: Qualitative assessment of QoS KPIs

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

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

4.18.1Performance Mechanism

4.18.2Assessment Data (Exercises and Expectations)

4.18.3Additional Comments and Notes

[15] --, -, 0, +, ++

4.19Gap Analysis

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits Expectations at Network Level (ECAC Wide or Local depending on the KPI)[16]	Rationale[17]
FEFF1: Fuel Efficiency – Fuel burn per flight	None	0.5% Improvement (25kg per flight)	
CAP1: TMA Airspace Capacity – TMA throughput, in challenging airspace, per unit time.	4.475% 4.475% (VHC) 4.475% (HC) 4.475% (MC)	1.82%	
CAP2: En-Route Airspace Capacity – En-route throughput, in challenging airspace, per unit time	**3.141%** 3.141% (VHC) 3.141% (HC) 3.141% (MC)	5% to 18%	
CEF2: ATCO Productivity – Flights per ATCO -Hour on duty	**3.333%** 0.474% (TMA VHC) 0.100% (TMA HC) 0.093% (TMA MC) 1.493% (ER VHC) 0.427% (ER HC) 0.747% (ER MC)	**ENR-VH: 1.6% - 5.6%** **ENR-H: 1.4% - 5.0%** **ENR-M: 1.9% - 6.8%** **TMA-VHC: 0.8%** **TMA-HC: 0.5%** **TMA-MC: 0.8%**	
SAF1: Safety - Total number of fatal accidents and	-0.89% (TMA VHC) -0.89% (TMA HC)	Safety maintained or improved	

[16] Negative impacts are indicated in red.

[17] Discuss the outcome if, and only 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).

[18] In Validation Targets [18] the unit for CEF2 is % increase in ATCO productivity.

incidents with ATM Contribution per year	-0.89% (TMA MC) -7.2% (ER VHC) -7.2% (ER HC) -7.2% (ER MC)[19]		

Table 19: Gap analysis Summary

[19] In Validation Targets [18] the unit for SAF1 is % reduction in the total number of fatal accidents per year.

5 Solution Performance Assessment – V2

5.1 Assessment Sources and Summary of Validation Exercise Performance Results

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

Organisation	Document Title	Publishing Date
SESAR	P04 07 02 D09 "Validation Report_3 (M9 of VP 175 & 499)", edition 00.01.02	17/12/2015
SESAR	P04.07.02 D21 "Validation Report_4" (EXE-04.07.02-VP-501), edition 00.01.00	15/06/2016
SESAR	P05 07 02 D75 "MD MC Multi Airport TMA-V2b Validation Report VP738-VP741", edition 00.01.01	07/07/2016
SESAR	P05 07 02 D76 "HD HC Multi Airport TMA V2b Validation Report VP740-VP743", edition 00.01.01	07/07/2016

Table 20: Pre-SESAR2020 Exercises

SESAR Validation Exercises of this Solution (completed ones and planned ones) are listed below[20].

Exercise ID	Exercise Title	Release	Maturity	Status
EXE-10.02a-V3-VALP-006	Planner CD&R tools assessment in En-route environment using as input a planned trajectory improved by ADS-C EPP (gross mass and speed schedule).	R9	V2	Completed
EXE-10.02a-V3-VALP-007	CD&R and enhanced conformance monitoring for TC and PC	R9	V2	Completed

Table 21: SESAR2020 Validation Exercises

The following table provides a summary of information collected from available performance outcomes. The exercises are V3 unless otherwise noted.

[20] Only the two subject exercise are listed. For the exercise contributing to V3, see section 4.1.

Exercise	OI Step	Exercise scenario & scope	Performance Results	Notes
EXE-10.02a-V3-VALP-006	CM-0209B CM-0210B	The exercise focussed on assessment of a new planner tool, detecting conflicts relevant to the planner controller responsibilities. The new tool was improved with new TP algorithms, using ADS-C EPP data. The exercise validated the tool that was built around trajectory prediction mechanism. The prototype of the RMK tool was implemented in the iTec validation platform and during the series of test sessions involving ACC controllers from PANSA the tool was validated operationally. In order to do that, the group of controllers was asked to take part in the exercises that will imitate the conditions of FIR EPWW airspace and then assess the new tool.	**SAF** Indications are that conflicts are resolved earlier so the number of tactical conflicts is reduced.	V2
EXE-10.02a-V3-VALP-007	CM-0206 CM-0208a	The exercise addressed the TC-Aid and PC-Aid and conformance monitoring functionalities within TMA and in transition to en-route sectors, based on realistic operational constraints with participation of licenced air traffic controllers. The exercise comprised further V3 development of Tactical Encounter Solver Assistant (TESLA) functionalities, such as: • Conflict detection and resolution (including "what-if" and "what-else" set of functionalities, the new geo-fencing function will be added in which the CD/R tool takes into account activated airspace volumes and terrain specifics) • Conformance monitoring	**SAF** Indications are that the number of conflicts and imminent infringements are reduced. **FEFF1** -4.82% **CAP1** +3.97% to +16.67%. **CEF2** +2.95% to +12%.	V2

		The functions listed above used a combination of system trajectories and aircraft derived data (ADS-C EPP) for enrichment of the trajectory prediction and conflict management.		

Table 22: Summary of Validation Results.

5.2 Conditions / Assumptions for Applicability

The following Table 8 summarises the applicable operating environments. In principle, the solution is applicable in ER and TMA operational environments of all complexity levels, though performance targets have been set only for VHC, HC and MC sub-OEs.

OE	Applicable sub-OE	Special characteristics
TMA	VHC, HC, MC	No special characteristics are relevant.
ER	VHC, HC, MC	No special characteristics are relevant.

Table 23: Applicable Operating Environments.

The following Table 9 summarises the essential deployment details.

BAD	Specific geographical and/or stakeholder deployment
31/12/2025	TMA airspace (Low to High Complexity)
31/12/2029	En-Route airspace (Low to High Complexity)

Table 24: Deployment details.

Aircraft equipage is relevant only as regards ATN-B2 (ADS-C EPP). No equipage rates have been assessed for this version of the PAR.

5.3 Safety

Information presented hereunder on the safety criteria has been collected from the Safety Plan [45].

When available, assessment results will be obtained from the Safety Assessment Report and Validation Report.

5.3.1 Safety Criteria and Performance Mechanism

The table below lists the SACs defined for the V3 phase in Solution 10-02a:

SAC ID	Description	Barrier / Precursor
SAC-10.02a-ER-001 Basis SESAR1: SAC21 ER	**There shall be no increase in ATC induced pre-tactical conflicts-non plan predicted per flight arising from knock-on pre-tactical conflicts from previous sector (due to FPL not being updated) taking into consideration a 16 % increase in traffic.** *Due to the use of conflict resolution aid to PC (What-if probing) and through the use of new data for improved TP*	MF11 Pre-tactical Conflict non plan predicted – ENR*
SAC-10.02a-TMA-ER-002 Basis SESAR 1: SAC5 TMA; SAC22 ER	**There shall be no increase in the number of planning conflicts per flight arising from Inadequate Planning Tasks (Identifying Conflicts and Judging Conflict Resolution) taking into consideration a 13.4/16 % increase in traffic.** *Due to the use of PC-aid (MTCD and What-if probing), potential "strategic" clearances (conflict-free clearances given further in advance due to the use of what-if and by CPDLC), improved TP.*	B10 Tactical Planning Barrier / MF5.1 Planning Conflicts
SAC-10.02a-TMA-ER-003 Basis SESAR 1: SAC4 TMA; SAC23 ER	**There shall be no increase in crew or aircraft induced conflicts per flight due to crew or aircraft speed or lateral deviation, taking into consideration a 13.4/16 % increase in traffic.** *Due to the use of MONA for PC or TC including new data (Mode-S, EPP, improved algorithms)*	MF6.1.2
SAC-10.02a-TMA-ER-004 Basis SESAR 1: SAC3 TMA; SAC13 ER	**There shall be no increase in ATC-induced tactical conflicts arising from inadequate Instructions given to pilot taking into consideration a 13.4/16 % increase in traffic.** *Due to the use of resolution aid to TC (What-else probing) and new data for improved TP (Mode-S, EPP, improved algorithms)*	MF7.1

SAC ID	Description	Barrier / Precursor
SAC-10.02a-TMA-ER-005 Basis SESAR 1: SAC2 TMA; SAC11 ER; (SAC12 ER)	**There shall be no increase in imminent infringements taking into consideration a 13.4/16 % increase in traffic.** *Due to the use of TC- aid (including What-else probing) and improvement in the Trajectory prediction capabilities.*	B5-9** / MF5-9
SAC-10.02a-TMA-ER-006 Basis SESAR 1: SAC1 TMA; (SAC11 ER); SAC15 ER	**There shall be no increase in the number of imminent collisions.** *Unchanged, used to ensure that CD/R aid to PC and TC and STCA work together in a coherent manner (if this SAC is not met positive effects induced by CD/R aid to PC and TC combined with STCA lead to an overall negative effect of the precursor MF4)*	B3, B4* / MF4
SAC-10.02a-TMA-ER-007	**There shall be no increase in the number of Airspace Infringements in own airspace arising due to conflict resolutions taking into consideration a 13.4/16 % increase in traffic.** *mainly due to the geo-fencing capability of the What-else probing incorporating danger or prohibited zones in the conflict resolution options.*	

The table below expresses the link between the SACs and the tools/functionalities and new concept elements:

Controller Tools	SACs addressed (TMA / En-Route)	OI Steps
new data for TP improvement (ADS-C EPP, weather, subtle nav. factors)	All	CM-0209-B
Concept elements	**SACs addressed (TMA / En-Route)**	
User preferred trajectories	All	CM-0209-B
PC “strategic clearances“	SAC 10.02a-TMA-ER-002	CM-0209-B
TC / PC interaction	SAC 10.02a-TMA-ER-005 SAC 10.02a-TMA-ER-002	CM-0209-B

The table below maps the SACs to exercises in which they are validated.

Exercise	Associated SACs
EXE-10.02a-V3-VALP-001	SAC-10.02a-ER-001 SAC-10.02a-TMA-ER-002 SAC-10.02a-TMA-ER-005 SAC-10.02a-TMA-ER-006
EXE-10.02a-V3-VALP-002b	SAC-10.02a-TMA-ER-004 SAC-10.02a-TMA-ER-005 SAC-10.02a-TMA-ER-006
EXE-10.02a-V3-VALP-003	SAC-10.02a-ER-001 SAC-10.02a-TMA-ER-002 SAC-10.02a-TMA-ER-003 SAC-10.02a-TMA-ER-004 SAC-10.02a-TMA-ER-005 SAC-10.02a-TMA-ER-006 SAC-10.02a-TMA-ER-007
EXE-10.02a-V3-VALP-004	SAC-10.02a-TMA-ER-002 SAC-10.02a-TMA-ER-004 SAC-10.02a-TMA-ER-005 SAC-10.02a-TMA-ER-006
EXE-10.02a-V3-VALP-005	SAC-10.02a-ER-001 SAC-10.02a-TMA-ER-002 SAC-10.02a-TMA-ER-005 SAC-10.02a-TMA-ER-006
EXE-10.02a-V3-VALP-006	SAC-10.02a-ER-001 SAC-10.02a-TMA-ER-002 SAC-10.02a-TMA-ER-005 SAC-10.02a-TMA-ER-006
EXE-10.02a-V3-VALP-007	SAC-10.02a-TMA-ER-002 SAC-10.02a-TMA-ER-003 SAC-10.02a-TMA-ER-004 SAC-10.02a-TMA-ER-005 SAC-10.02a-TMA-ER-006 SAC-10.02a-TMA-ER-007

Table 25 SAC mapping to each exercise

5.3.2 Data collection and Assessment

From the Safety Criteria listed in the previous section and following the SRM process, Safety Objectives (SO) and Operational Hazards have been developed and identified. Therefore, the Safety Criteria are implicitly achieved through the demonstration of the aforementioned and through the definition of Safety Validation Objectives, which are documented in the Safety Assessment Report.

The full results for the exercises can be found in the corresponding appendices of the VALR. The table below summarizes the quantitative results of each exercise against the safety criteria.

SAC-10.02a-ER-001 ATC induced pre-tactical conflicts			
006	CM-0209B CM-0210B	ER MC	When ADS-C EPP was used an increased amount of traffic was deconflicted by the Planning Controller and the Executive Controller had to solve fewer conflicts. Thus, the use of ADS-C EPP led to earlier deconfliction of traffic.
SAC-10.02a-TMA-ER-002 Planning conflicts per flight			
Exercise	OI Steps	OE	Results
006	CM-0209B CM-0210B	ER MC	Actual conflicts were being detected much earlier by MTCD enhanced with ADS-C EPP data, giving PC much more time for pre-tactical deconflicting actions. During the technical validation there were no false positives alarms when MTCD was enhanced with ADS-C EPP.
007	CM-0206 CM-0208a	TMA MC	The results for TMA show reduction in the number of conflicts when the tool and its functionalities are available.
SAC-10.02a-TMA-ER-003 Crew or aircraft induced conflicts			
Exercise	OI Steps	OE	Results
007	CM-0206 CM-0208a	TMA MC	The results for TMA show reduction in the number of crew/aircraft induced conflicts when the tool and its functionalities are available.
SAC-10.02a-TMA-ER-004 ATC-induced tactical conflicts			
Exercise	OI Steps	OE	Results
007	CM-0206 CM-0208a	TMA MC	The results for TMA show reduction in the number of ATCO induced conflicts when the tool and its functionalities are available.
SAC-10.02a-TMA-ER-005 Imminent infringements			
Exercise	OI Steps	OE	Results
006	CM-0209B CM-0210B	ER MC	STCA alarms were anticipated by MTCD warnings between 42 and 87 seconds earlier in the solution scenario, which should reduce the likelihood of imminent infringements.
007	CM-0206 CM-0208a	TMA MC	The results for TMA show reduction in the number of imminent infringements when the tool and its functionalities are available.
SAC-10.02a-TMA-ER-006 Imminent collisions			
Exercise	OI Steps	OE	Results

006	CM-0209B CM-0210B	ER MC	STCA alarms were anticipated by MTCD warnings between 42 and 87 seconds earlier in the solution scenario, which should reduce the likelihood of imminent infringements.
007	CM-0206 CM-0208a	TMA MC	No imminent collisions were observed in any of the runs.

Table 26 Exercise Validation Results - Safety

5.3.3 Extrapolation to ECAC wide

N/A

5.3.4 Discussion of Assessment Result

N/A

5.3.5 Additional Comments and Notes

N/A

5.4 Environment / Fuel Efficiency

Often fuel efficiency is improved through a reduction of flight or taxi time. This time benefit is also assessed, in this section, as it is additional input for the business case.

5.4.1 Performance Mechanism

The improvement in trajectory prediction tools provides a more accurate and stable prediction of potential conflicts, which allows the controller a longer look-ahead time and consequently greater flexibility in optimizing the resolution clearances. This is expected to impact positively environmental and fuel efficiency.[21]

For more information, see OSED [43] Appendix A, section A.2.3 ANSP Benefits Mechanism.

5.4.2 Assessment Data (Exercises and Expectations)

In the table below, the exercises report a value of FEFF1 (average fuel burn saving per flight).

Exercise EXE-10.02a-V3-VALP-	OI Steps	Sub-OE	Results
007	CM-0206, CM-0208-A	TMA MC	The average fuel savings expressed in percentage is ***4.82%*** (88 kg) gain per aircraft. The total average fuel consumption improvement per exercise run is 6050 kg.

Table 27 Exercise Validation Results – Fuel Efficiency

5.4.3 Extrapolation to ECAC wide

N/A

5.4.4 Discussion of Assessment Result

None.

5.4.5 Additional Comments and Notes

None.

[21] Source: BIM, see [43].

5.5 Environment / Noise and Local Air Quality

5.5.1 Performance Mechanism

N/A

5.5.2 Assessment Data (Exercises and Expectations)

N/A

5.5.3 Extrapolation to ECAC wide

N/A

5.5.4 Discussion of Assessment Result

N/A

5.5.5 Additional Comments and Notes

N/A

5.6 Airspace Capacity (Throughput / Airspace Volume & Time)

5.6.1 Performance Mechanism

The improved MTCD on-demand services such as filtering and what-if are expected to decrease controller workload in delivering vertical clearances (CFL/rate). Furthermore, as there are expected to be fewer intermediate clearances, workload should be further reduced. The on-demand nature of the MTCD services avoids the generation of "nuisance warning" and therefore reduces the workload associated with analyzing non pertinent encounters.[22]

With improved TP accuracy there is a better delineation between high-probability and low-probability conflicts, which leads to two types of benefits:

1. Actual Potential Conflicts (aircraft pairs and/or situations where loss of separation is predicted as likely to occur – and where control action for resolution is required) will be detected earlier thanks to improved TP accuracy, giving the controller more time to assess the conflicts and to issue a clearance if necessary.

2. Unlikely Conflicts / Risks (aircraft pairs and/or situations where loss of separation is predicted as unlikely to occur – and where control action for resolution would not be needed) will be more reliably classified and therefore the number of required EXE control clearances related to these situations will decrease accordingly and the time spent on monitoring by ATCOs (PLN and EXE) related to these situations will also decrease.

These factors are expected to lead to a reduction of ATCO workload and to provide a consequent increase in capacity.[23]

For more information, see the Appendix A, section A.2.3 ANSP Benefits Mechanism of [43].

5.6.2 Assessment Data (Exercises and Expectations)

In the table below, the exercises report a value of CAP1/CAP2 for TMA/ER.

Exercise EXE-10.02a-V3-VALP-	OI Steps	Sub-OE	Results
007	CM-0206	TMA MC	CAP1:

[22] Source: BIM – CM-0211, see [43]

[23] Source: BIM – CM-0206/CM-0209, see [43]

			Direct comparison between the number of aircraft in the reference and solution scenarios is not feasible as the number is the same for all runs. The conclusion is based on the results for the workload and situational awareness. The results show improvement in the situational awareness of the TMA ATCOs that varies from 5.88% to 15%. Furthermore, there's reduction in their workload between 7.64% and 28.57% which, when converted by an equation to capacity, corresponds to a capacity increase of between ***3.97%*** and ***16.67%***. In addition, it should be noted that the traffic levels used for the reference and solution scenarios in fact represent 26% increase compared to the busiest day in 2018. All of the above allows us to state with enough confidence that the CAP1 requirement is covered.

Table 28 Exercise Validation Results - Capacity

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 Complexity TMAs. TMA at peak demand hours.	YES	n/a	n/a	**3.97%** *to* **16.67%**.
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 TMAs.airspace at peak demand hours.	YES	n/a	n/a	

5.6.3 Extrapolation to ECAC wide

There is no ECAC wide extrapolation required for this KPI.

5.6.4 Discussion of Assessment Result

None.

5.6.5 Additional Comments and Notes

None.

5.7 Airport Capacity (Runway Throughput Flights/Hour)

5.7.1 Performance Mechanism

N/A

5.7.2 Assessment Data (Exercises and Expectations)

N/A

5.7.3 Extrapolation to ECAC wide

N/A

5.7.4 Discussion of Assessment Result

N/A

5.7.5 Additional Comments and Notes

N/A

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

5.8.1 Performance Mechanism

N/A

5.8.2 Assessment Data (Exercises and Expectations)

N/A

5.8.3 Extrapolation to ECAC wide

N/A

5.8.4 Discussion of Assessment Result

N/A

5.8.5 Additional Comments and Notes

N/A

5.9 Predictability (Flight Duration Variability, against RBT)

5.9.1 Performance Mechanism

The improvement in trajectory prediction tools provides a more accurate and stable prediction of potential conflicts and improves the reliability of conflict resolution clearances, thereby decreasing the total number of corrective conflict resolution instructions and open-loop clearances. This improves the flight profile predictability.[24]

For more information, see OSED Appendix A, section a.2.3 ANSP Benefits Mechanism.

5.9.2 Assessment Data (Exercises and Expectations)

None.

5.9.3 Extrapolation to ECAC wide

None.

5.9.4 Discussion of Assessment Result

None

5.9.5 Additional Comments and Notes

None

[24] Source: BIM, see [43]. Predictability not explicitly shown in the figure.

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

5.10.1 Performance Mechanism

N/A

5.10.2 Assessment Data (Exercises and Expectations)

N/A

5.10.3 Extrapolation to ECAC wide

N/A

5.10.4 Discussion of Assessment Result

N/A

5.10.5 Additional Comments and Notes

N/A

5.11Civil-Military Cooperation and Coordination (Distance and Fuel)

5.11.1Performance Mechanism

N/A

5.11.2Assessment Data (Exercises and Expectations)

N/A

5.11.3Extrapolation to ECAC wide

N/A

5.11.4Discussion of Assessment Result

N/A

5.11.5Additional Comments and Notes

N/A

5.12Flexibility

Flexibility means the ability to react to late flight plan changes and requests. The main PI / metric, FLX1, is “Average delay for scheduled civil/military flights with change request and non-scheduled / late flight plan request.”

5.12.1Performance Mechanism

N/A

5.12.2Assessment Data (Exercises and Expectations)

N/A

5.12.3Extrapolation to ECAC wide

N/A

5.12.4Discussion of Assessment Result

N/A

5.12.5Additional Comments and Notes

N/A

5.13Cost Efficiency

5.13.1Performance Mechanism

Cost efficiency benefits derive from increased controller productivity, which are an effect of reducing controller workload. The benefit mechanism is therefore as described under section 4.7, Airspace Capacity (Throughput / Airspace Volume & Time).

5.13.2Assessment Data (Exercises and Expectations)

In the table below, the exercises report a value of CEF2. It is typical for an exercise to measure productivity benefits in terms of a workload reduction. In such cases a productivity factor can be derived using the formula:

*Productivity factor = 1 / (1 – (0.375 * WKL)),*

where WKL is the workload reduction (e.g. 10% reduction = 0.1).

A productivity benefit as a % change can be achieved by subtracting 1 from the factor.

Exercise EXE-10.02a-V3-VALP-	OI Steps	OE	Results
007	CM-0206	TMA MC	CEF2*(Flights per ATCO-Hour on duty)*: The number of aircraft in the reference and solution scenarios is the same for all runs (29 aircraft per hour). The below conclusion is based on the results for the workload and the provided formula - *Productivity factor = 1 / (1 – (0.375 * WKL))*. The results show reduction between 7.64% and 28.57% in TMA ATCOs' workload. Therefore, the cost efficiency improvement is between ***2.95%*** and ***12%***.

Table 29 Exercise Validation Results – Cost Efficiency

5.13.3Extrapolation to ECAC wide

None.

5.13.4Discussion of Assessment Result

None.

5.13.5Additional Comments and Notes

None

5.14Airspace User Cost Efficiency

5.14.1Performance Mechanism

N/A

5.14.2Assessment Data (Exercises and Expectations)

N/A

5.14.3Extrapolation to ECAC wide

N/A

5.14.4Discussion of Assessment Result

N/A

5.14.5Additional Comments and Notes

N/A

5.15Security

5.15.1The SecRAM 2.0 methodology and the Security Performance Mechanism

N/A

5.15.2Security Assessment Data Collection

N/A

5.15.3Extrapolation to ECAC wide

N/A

5.15.4Discussion of Assessment Result

N/A

5.15.5Additional Comments and Notes

N/A

5.16Human Performance

5.16.1HP arguments, activities and metrics

A summary (max ~20-30 lines) of the Human Performance Assessment Report, containing the description of the HP arguments covered and related activities/ metrics used in the solution. The reader shall be referred to Part IV of the OSED (HP Assessment Report) for a detailed description of the HP results of the validation.

The 4 HP arguments are depicted in the table below in the form of HP performance indicators. In case at least one of the second level indicators have been covered per PI, that PI is considered to have been satisfied at the level of the solution. Please mark the "Covered" section with <<N/A>> in case the PIs were not covered intentionally and with <<open>> or <<closed>> depending on whether the mitigations were found and validated up to date.

Please fill the metrics column with the relevant activities (workshop, interviews etc.) and measurements taken during validation activities (e.g. usability, workload, SA etc.).

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

PIs	Activities & Metrics	Second level indicators	Covered
HP4 Feasibility with regard to HP-related transition factors		**HP4.2** Feasibility in relation to changes in competence requirements	
		HP4.3 Feasibility in relation to changes in staffing levels, shift organization and workforce relocation.	
		HP4.4 Feasibility in relation to changes in recruitment and selection requirements .	
		HP4.5 Feasibility in terms of changes in training needs with regard to its contents, duration and modality.	

[…]

5.16.2Extrapolation to ECAC wide

There is no ECAC wide extrapolation required for this KPI.

5.16.3Open HP issues/ recommendations and requirements

An indication of the number of HP issues that are still open and HP benefits identified following the Solution validation exercises, as well as the number of recommendations and requirements defined. For the detailed description, please consult the HP Plan/ HP Log and the HP Assessment Report.

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

5.16.4Concept interaction

An enumeration/ description of possible interactions with other SESAR2020 solutions. Where interactions are identified, please specify the level of concept interaction and enumerate below the issues that are considered to have a relevant impact on other solutions as well.

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

5.16.5 Most important HP issues

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

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

PIs	Most important issue of the solution	Most important issues due to solution interdependencies
HP1 Consistency of human role with respect to human capabilities and limitations		
HP2 Suitability of technical system in supporting the tasks of human actors		
HP3 Adequacy of team structure and team communication in supporting the human actors		
HP4 Feasibility with regard to HP-related transition factors		

5.16.6Additional Comments and Notes

If needed, add comments and notes as free text and structure.

[…]

5.17Other PIs

Further PIs from the Performance Framework update are assessed qualitatively, or, if possible, quantitatively, in Table 18

KPA	PIs	Benefit mechanism (text only)	Qualitative Impact[25]

Table 30: Qualitative assessment of QoS KPIs

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

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

Other PIs used by the Solution which are not covered in the Performance Framework and the identified or measured performance improvements.

Add any other benefit that has been assessed but has not been covered so far.

[…]

5.17.1Performance Mechanism

A qualitative description (max ~20-30 lines) that explains how the Solution improves performance of this PI.

This section may be supplemented with additional graphs, and models to explain the mechanism, in a similar fashion to the way the benefit mechanisms are described by primary projects in the Validation Plans.

[…]

5.17.2Assessment Data (Exercises and Expectations)

A qualitative explanation as to how the various exercise results contribute to the overall Solution benefit. It should also explain the metrics used, and their expected performance values, based on expert judgement and validations to date (including previous non-SESAR2020 R&D results). Reference to literature and R&D results must be provided. In general the contribution of the Solution is scoped within its validation exercises.

Check:

All OIs within the Solution should be listed and their contributions noted. OIs that are not covered by the Solution should be noted accordingly. It is recommended that when this gap on validation activities occurs, to estimate the OIs benefits with available information (previous non-SESAR2020 R&D results or expert judgement). For subsequent iterations, other means may be taken into consideration to bridge this gap.

[25] --, -, 0, +, ++

In case there are no VALR or other suitable references, a Solution expected performance value should be provided or a statement that no such benefit is expected.

[…]

5.17.3Additional Comments and Notes

If needed, add comments and notes as free text and structure.

[…]

5.18Gap Analysis

The objective of the gap analysis is a comparison between the validation targets and the performance assessment. Resume in next table the comparison done in sections 4.4.4, 4.5.4, 4.7.4, 0, 4.10.4, 0, and 0.

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits Expectations at Network Level (ECAC Wide or Local depending on the KPI)[26]	Rationale[27]
FEFF1: Fuel Efficiency – Fuel burn per flight	*X (kg)*	*X (kg)*	
CAP1: TMA Airspace Capacity – TMA throughput, in challenging airspace, per unit time.	*X% (local)*	*X% (local)*	
CAP2: En-Route Airspace Capacity – En-route throughput, in challenging airspace, per unit time	*X% (local)*	*X% (local)*	

[26] Negative impacts are indicated in red.

[27] Discuss the outcome if, and only 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).

CAP3: Airport Capacity – Peak Runway Throughput (Mixed mode).	*X% (local)*	*X% (local)*	
PRD1: Predictability – Variance of Difference in actual & Flight Plan or RBT durations	*X%* [28]	*X min*[2] *And in addition the % of reduction in variance to compare it with the Validation Targets*	
PUN1: Punctuality – % Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather related delay causes	*X%*	*X%*	
CEF2: ATCO Productivity – Flights per ATCO -Hour on duty	*X%*[29]	*X No.* *And in addition the % increase in ATCO productivity to compare it with the Validation Targets*	
CEF3: Technology Cost – Cost per flight	*X%*[30]	*X EUR/flight* *And in addition the % reduction in technology cost per flight to compare it with the Validation Targets*	
SAF1: Safety - Total number of fatal accidents and incidents with ATM Contribution per year	*X%*[31]	*X No.* *And in addition the % reduction in the total number of fatal accidents per year to compare it with the Validation Targets*	

Table 31: Gap analysis Summary

[28] In Validation Targets [18] the unit for PRD1 is % Reduction in variance of block-to-block flight time.

[29] In Validation Targets [18] the unit for CEF2 is % increase in ATCO productivity.

[30] In Validation Targets [18] the unit for CEF3 is % reduction in technology cost per flight.

[31] In Validation Targets [18] the unit for SAF1 is % reduction in the total number of fatal accidents per year.

6 References

This PAR complies with the requirements set out in the following documents:08.01.03 D47: AIRM v4.1.0

[2] B05 Performance Assessment Methodology for Step 1

[3] PJ19.04 D4.4 Performance Framework (2018), Edition 01.00.00, August 2018

[4] B.05 Guidance for Performance Assessment Cycle 2013

[5] B.05 D72, Updated Performance Assessment in 2016

https://stellar.sesarju.eu/servlet/dl/ShowDocumentContent?doc_id=1669873.13&att=attachment&statEvent=Download

[6] B05 Data Collection and Repository Cycle 2015

[7] Methodology for the Performance Planning and Master Plan Maintenance (edition 0.13)

https://stellar.sesarju.eu/servlet/dl/ShowDocumentContent?doc_id=4731333.13&att=attachment&statEvent=Download

Content Integration

[8] B.04.01 D138 EATMA Guidance Material

[9] EATMA Community pages

[10] SESAR ATM Lexicon

Content Development

[11] PJ19.02.02 D2.1 SESAR 2020 Concept of Operations Edition 2017, Edition 01.00.00, November 2017

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] PJ19.04.01 D4.5 Validation Targets (2018), Edition 01.00.00, April 2018

https://stellar.sesarju.eu/servlet/dl/ShowDocumentContent?doc_id=6784461.13&att=attachment&statEvent=Download

[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

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

[31] 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

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

[33] Accident Incident Models – AIM, release 2017

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

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)

6.1 Reference Documents

The following documents were used to provide input / guidance / further information / other:ED-78A GUIDELINES FOR APPROVAL OF THE PROVISION AND USE OF AIR TRAFFIC SERVICES SUPPORTED BY DATA COMMUNICATIONS.[32]

[42] PJ19 D4.0.1 S2020 Common Assumptions, Edition Date 17 May 2018

[43] PJ10.02a D4-2-010 SPR-INTEROP/OSED for V2 – Part 1

[44] PJ10.02a D4.2.030 Validation Plan Part 1 (VALP) for V3

[45] PJ10.02a D4.2.030 Validation Plan Part 2 (Safety Assessment Plan) for V3

[46] PJ10.02a Contextual Note, Version 0.6

32

Appendix A Detailed Description and Issues of the OI Steps

List the OI Steps, add the estimated performance contribution (reasoning to be provided below) and check against the latest dataset and indicate which dataset this is.

OI Step ID	Title	Consistency with latest Dataset

Table 32: OI Steps allocated to the Solution

Write a detailed description and issues of the OI Steps. Are they aligned with the latest Dataset?

[…]

Appendix B Title of the appendix

B.1 <Appendix section>

B.1.1 <Appendix sub section>

-END OF DOCUMENT-