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SESAR Solution PJ.09-W2-44 SPR/INTEROP-OSED for V3 - Part V - Performance Assessment Report (PAR)

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DNMS

PJ.09-W2-44 DYNAMIC AIRSPACE CONFIGURATION

This Performance Assessment Report (PAR) is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874463 under European Union's Horizon 2020 research and innovation programme.

Abstract

This document is presenting the Performance Assessment Report for the SESAR 2020 Wave 2 PJ09 Solution 44 "Dynamic Airspace Configuration", consolidating the performance validation results addressing KPIs/PIs and metrics from the SESAR2020 Performance Framework [3].

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1 Executive Summary

This document provides the Performance Assessment Report (PAR) for SESAR Solution PJ.09-W2-44 "Dynamic Airspace Configuration"

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

Description:

The focus of Solution PJ.09-W2-44 is the use of the DAC concept in the DCB process (including the INAP concept) in an integrated way, and not as two different steps. Emphasis is put on the INAP timeframe where the two overlap. This timeframe is established between a few hours to a few minutes before a spot occurs, e.g.: from ~-6 hours to ~-15 min, being these thresholds adjusted according to local specificities.

Former Solutions in SESAR Programme: Solution PJ.08-01 (Management of Dynamic Airspace configurations), Solution PJ.09-01 (Network Prediction and Performance), Solution PJ.09-02 (Integrated Local DCB Processes)

Assessment Results Summary:

The following tables summarise the assessment outcomes per KPI (Table 1) and mandatory PI (Table 2) puts them side-by-side against Validation Targets in case of KPI from PJ19 [8]. The impact of a Solution on the performance is described in Benefit Impact Mechanism. All the KPI and mandatory PI from the Benefit Mechanism where the Solution potentially impacts must be assessed via validation results, expert judgment etc.

There are three cases:

1. An assessment result of 0 with a confidence level other than 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 a confidence level of 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 a confidence level of N/A indicates that the Solution is not expected to impact at all the KPI or mandatory PI, consistently with the Benefit Mechanism.

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits at Network Level (ECAC Wide or Local depending on the KPI)[1]	Confidence in Results[2]
SAF1: Safety - Total number of estimated accidents with ATM Contribution per year	YES	Please see section 4.3 Safety	N/A
FEFF1: Fuel Efficiency - Actual average fuel burn per flight	Impact Level 3	4.75 kg/flight Positive impact (i.e., fuel savings)	High
CAP1: TMA Airspace Capacity - TMA throughput, in challenging airspace, per unit time.	N/A	N/A	N/A
CAP2: En-Route Airspace Capacity - En-route throughput, in challenging airspace, per unit time	Impact Level 3	3% Positive impact (i.e., capacity increase)	High
CAP3: Airport Capacity – Peak Runway Throughput (Mixed mode).	N/A	N/A	N/A
TEFF1: Gate-to-gate flight time	Impact Level 2	0.16 min/flight Positive impact (i.e., reduction of flight time)	High
PRD1: Predictability – Average of Difference in actual & Flight Plan or RBT durations	Impact Level 2	0.32 min Positive impact (i.e., better adherence to flight plan)	High
PUN1: Punctuality – Average departure delay per flight	Impact Level 3	0.25 min/flight Positive impact (i.e., average delay decreases)	High

[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

CEF2: ATCO Productivity – Flights per ATCO - Hour on duty	Impact Level 3	1.14% Positive impact (i.e., ATCo productivity increases)	High
CEF3: Technology Cost – Cost per flight	N/A	N/A	N/A

Table 1: KPI Assessment Results Summary

Mandatory PI	Performance Benefits Expectations at Network Level (ECAC Wide or Local depending on the KPI)[3]	Confidence in Results[4]
SAF1.X: Mid-air collision - En-Route	N/A	N/A
SAF2.X: Mid-air collision - TMA	N/A	N/A
SAF3.X: RWY-collision accident	N/A	N/A
SAF4.X: TWY-collision accident	N/A	N/A
SAF5.X: CFIT accident	N/A	N/A
SAF6.X: Wake related accident	N/A	N/A
SAF7.X: RWY-excursion accident	N/A	N/A
SAF8.X ...: Other SAF Risks	N/A	N/A
SEC1: A security risk assessment has been carried out	See Section 4.11 Security	Medium
SEC2: Risk Treatment has been carried out	See Section 4.11 Security	Medium
SEC3: Residual risk after treatment meets security objective.	See Section 4.11 Security	Medium
PRD2: Variance of Difference in actual & Flight Plan or RBT durations	0.92 min^2 (≈1.88%) Negative impact (i.e., increase of variance	High
PUN2: % Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather related delay causes	Not measured	N/A
AUC3: Direct operating costs for an airspace user	N/A	N/A

[3] Negative impacts are indicated in red.

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

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AUC4: Indirect operating costs for an airspace user	N/A	N/A
AUC5: Overhead costs for an airspace user	N/A	N/A
CMC2.1: Fuel and Distance saved by GAT	N/A	N/A
HP1: Consistency of human role with respect to human capabilities and limitations	See Section 4.12 Human Performance	Medium
HP2: Suitability of technical system in supporting the tasks of human actors	See Section 4.12 Human Performance	Medium
HP3: Adequacy of team structure and team communication in supporting the human actors	See Section 4.12 Human Performance	Medium
HP4: Feasibility with regard to HP-related transition factors	See Section 4.12 Human Performance	Medium

Table 2 Mandatory PIs Assessment Summary

Additional Comments and Notes:

Please, consider that the figures shown throughout the whole document are round to two decimals. However, the significant figures used in the calculus might be greater in some cases, what may result in minor discrepancies between the final figures and those that one may calculate from the initial results reported by the exercises.

2 Introduction

2.1 Purpose of the document

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

The purpose of this document is to present the performance assessment results from the validation exercises at the SESAR Solution level. The KPA performance results are used for the performance assessment at strategic level and provide inputs to the SESAR3 Joint Undertaking (S3JU) for decisions on the SESAR2020 Programme.

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

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

2.2 Intended readership

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

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

2.3 Inputs from other projects

The document includes information from the following SESAR 2020 Wave1 projects:

- PAGAR 2019: Performance Assessment and Gap Analysis Report (2019), where are collected the final benefits from SESAR 2020 Wave1.

PJ19 will manage and provide:

- SESAR Performance Framework (2019) [3], guidance on KPIs and Data collection supports.
- S2020 Common Assumptions used to aggregate results obtained during validation exercises (and captured into validation reports) into KPIs at the ECAC level, which will in turn be captured in Performance Assessment Reports and used as inputs to the CBAs produced by the Solution projects. There are also included performance aggregation assumptions, with traffic data items.

- For guidance and support, PJ19 has put in place the Community of Practice (CoP)[5] within STELLAR, gathering experts and providing best practices.

2.4 Glossary of terms

See the AIRM Glossary [1] [7] for a comprehensive glossary of terms.

2.5 Acronyms and Terminology

Term	Definition
ACC	Air Control Centre
AEM	Advanced Emission Model
ANS	Air Navigation Service
ANSP	Air Navigation Service Provider
ARES	Airspace Reservation
ASM	Airspace Management
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATFCM	Air Traffic Flow Capacity Management
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ATS	Air Traffic Service
ATSU	Air Traffic Service Unit
AU	Airspace User
BAD	Benefits Assessment Date

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

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

BAER	Benefit Assessment Equipment Rate
CBA	Cost Benefit Analysis
CDM	Collaborative Decision Making
DAC	Dynamic Airspace Configuration
DCB	Demand Capacity Balancing
DES	Digital European Sky
DMA	Dynamic Mobile Area
DOD	Detailed Operational Description
EAP	Extended ATC Planning
eAUP	European Airspace Use Plan
E-ATMS	European Air Traffic Management System
ECAC	European Civil Aviation Conference
ENR	En-Route
ER	En-Route
DB	Deployment Baseline
FCA	Flight Centric Air Traffic Control
FMP	Flow Management Position
FTS	Fast Time Simulation
HC	High Complexity
INAP	Integrated Network Management and Extended ATC Planning
KPA	Key Performance Area
KPI	Key Performance Indicator
LTM	Local Traffic Manager
N/A	Not Applicable
NM	Network Manager
NOP	Network Operation Plan
OE	Operating Environment

OI	Operational Improvement
PAR	Performance Assessment Report
PI	Performance Indicator
PRU	Performance Review Unit
QoS	Quality of Service
RBT	Reference Business / Mission Trajectory
RTS	Real Time Simulation
SD	Safety Driver
SESAR	Single European Sky ATM Research Programme
S3JU	SESAR3 Joint Undertaking (Agency of the European Commission)
SESAR2020 Programme	The programme which defines the Research and Development activities and Projects for the S3JU.
SUP	Supervisor
TMA	Terminal Manoeuvring Area
VALR	Validation Report
VHC	Very High Complexity
WOC	Wing Operations Centre

Table 3: Acronyms and terminology

The following is a list of the concepts, terms or definitions introduced or commonly referred to in this document.

Term	Definition	Source
Airport Capacity Focus Area	Capture the peak runway throughput in the most challenging (or constrained) environments at busy hours, i.e. the capacity at a “maximum observed throughput” airport.	PAGAR
Airspace Capacity Focus Area	Capture the capability of a challenging volume of airspace to handle an increasing number of movements per unit time – through changes to the operational concept and technology.	PAGAR
Airspace Reservation/ Restriction (ARES)	Airspace Reservation means a defined volume of airspace temporarily reserved for exclusive or specific use by categories of users (Temporary Segregated Area (TSA), Temporary Reserved Area (TRA), and Cross-Border Area (CBA)) whereas Airspace Restriction designates Danger, Restricted and Prohibited Areas.	EC Regulation No 2150/2005

Term	Definition	Source
Airspace User Cost-Efficiency Focus Area	Cost-Efficiency obtained by Airspace Users other than direct gate-to-gate ATS costs (CEF1) or AU cost improvements assessed through other KPIs: Fuel Efficiency, Punctuality, etc. Note: Benefits assessed through other KPIs should not be included in this focus area to avoid double counting of benefits. AU Cost-Efficiency includes reduction of direct (AUC3) and indirect (AUC4) operational costs of the AU, as well as overhead costs (AUC5). In addition there are two specific PIs, Strategic Delay (AUC1) and Sequence Optimisation Benefit (AUC2).	PAGAR
ARES Capacity	The ability of an ATM system to accommodate specific training events which require airspace reservations and/or restrictions during a specific period of time, taking into account the duration of the training events, ATM inefficiency, planning inefficiency and weather impact on training and operations.	Performance Framework 2017
ATM Master Plan	The European ATM Master Plan is the agreed roadmap to bring ATM R&I to the deployment phase, introducing the agreed vision for the future European ATM system. It provides the main direction and principles for SESAR R&I, as well as the deployment planning and an implementation view with agreed deployment objectives. Through the SESAR Key Features, the ATM Master Plan identifies the Essential Operational Changes (both Essential Operational Changes featured in the Pilot Common Project and New Essential Operational Changes) and key R&I activities that support the identified performance ambition. The ATM Master Plan is updated on a regular basis in collaboration and consultation with the entire ATM community. Amendments are submitted to the S3JU Administrative Board for adoption. The content of the European ATM Master Plan is structured in three levels (Level 1 – Executive View, Level 2 – Planning and Architecture View, and Level 3 – Implementation View) to allow stakeholders to access the information at the level of detail that is most relevant to their area of interest. The intended readership for Level 1 is executive-level stakeholders. Levels 2 and 3 of the ATM Master Plan provide more detail on the operational changes and related elements and therefore the target audience is expert-level stakeholders.	SESAR2020 Project Handbook, European ATM Master Plan (9 Edition)
Civil-military coordination and cooperation	The coordination between the civil and military parties authorised to make decisions and agree a course of action.	Performance Framework 2017

Term	Definition	Source
Cost-Benefit Analysis	A Cost-Benefit Analysis is a process for quantifying in economic terms the costs and benefits of a project or a programme over a certain period, and those of its alternatives (within the same period), in order to have a single scale of comparison for unbiased evaluation. This process helps decision-makers to compare an investment with other possible investments and/or to make a choice between different options / scenarios and to select the one that offers the best value for money while considering all the key criteria affecting the decision.	PAGAR
Deployment Scenario	Set of SESAR Solutions selected to satisfy the specific Performance Needs of operating environments in the European ATM System and based on the timescales in which their performance contribution is needed in the respective operating environments.	PAGAR
Flexibility KPA	The ability of the ATM System and airports to respond to changes in planned flights and missions. It covers late trajectory modification requests as well as ATFCM measures and departure slot swapping and it is applicable to military and civil airspace users covering both scheduled and unscheduled flights. In terms of specific military requirements, it also covers the ability of the ATM System to address military requirements related to the use of airspace and reaction to short-notice changes.	Performance Framework 2017
Focus Area	Within each KPA, a number of more specific "Focus Areas" are identified in which there are potential intentions to establish performance management. Focus Areas are typically needed where performance issues have been identified.	ICAO Doc 9883
Fuel Efficiency Focus Area	The SESAR performance Focus Area concerned with fuel efficiency. How much fuel is used by aviation or by extension "Fuel efficiency" (how much fuel can be saved?) is one of the performance aspects. Note: Policy places considerable focus on this. Fuel efficiency contributes to 3 of the 11 KPAs defined by ICAO: Cost-efficiency, Efficiency, and Environment.	PAGAR
Gap Analysis	Difference between the validation targets and the performance assessment. It is used to: 1. Anticipate any deviation from the design performance targets; 2. Identify the underlying reasons; 3. Derive the appropriate recommendations to be taken on board to redirect the R&D activities within the Programme towards the ultimate achievement of SESAR2020's performance ambitions.	PAGAR

Term	Definition	Source
G2G ANS Cost-Efficiency Focus Area	One of the SESAR performance Focus Areas concerned with Cost Efficiency. Direct G2G ANS costs are those costs that are charged to Airspace Users via unit rates, including ATM/CNS costs, regulatory costs, Met costs and EUROCONTROL Agency costs.	Performance Framework new
Human Performance (HP)	Human capabilities and limitations which have an impact on the safety, security and efficiency of aeronautical operations.	EUROCONTROL ATM Lexicon
Key Performance Area	A way of categorising performance subjects related to high level ambitions and expectations. ICAO Global ATM Concept sets out these expectations in general terms for each of the 11 ICAO defined KPAs.	EUROCONTROL ATM Lexicon
Key Performance Indicator	Current/past performance expected future performance (estimated as part of forecasting and performance modelling), as well as actual progress in achieving performance objectives is quantitatively expressed by means of indicators (sometimes called Key Performance Indicators, or KPIs). To be relevant, indicators need to correctly express the intention of the associated performance objective. Since indicators support objectives, they should not be defined without having a specific performance objective in mind. Indicators are not often directly measured. They are calculated from supporting metrics according to clearly defined formulas, e.g., cost-per-flight-indicator = Sum (cost)/Sum (flights). Performance measurement is therefore carried out through the collection of data for the supporting metrics." In SESAR2020 Performance Framework, Key Performance Indicators are those that have a validation target associated derived from the corresponding Performance Ambition.	ICAO Doc 9883 Performance Framework
Local Air Quality Focus Area	One of the SESAR performance Focus Areas concerned with Environment. Local air quality is a term commonly used to designate the state of the ambient air to which humans and the ecosystem are typically exposed at a specific location. In the case of aviation, local air quality studies are generally conducted near airports.	PAGAR
Noise Focus Area	One of the SESAR performance Focus Areas concerned with Environment. The term Noise is used in this document to designate noise pollution, which is defined as unwanted sound. The impact of unwanted sounds on the recipients (in this case, people living around airports) causes adverse effects.	PAGAR
Operational Environment (OE)	An environment with a consistent type of flight operations.	EUROCONTROL ATM Lexicon

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Term	Definition	Source
Performance Ambitions	Performance capability that may be achieved if SESAR Solutions are made available through R&D activities, deployed in a timely and, when needed, synchronised way and used to their full potential.	EUROCONTROL ATM Lexicon
Performance assessment	This term relates to the quantitative estimate of the potential performance benefit of an operational improvement based on outputs from validation projects, collected and analysed by PJ19.04.02	ICAO Doc 9883 updated in PAGAR
Performance Framework	1) The overall performance-driven development approach that is applied within the SESAR development programme to ensure that the programme develops the operational concept and technology needed to meet long-term performance expectations. 2) The set of definitions and terminology describing the building blocks used by a group of ATM community members to collaborate on performance management activities. This set of definitions includes the levels in the global ATM performance hierarchy, the eleven Key Performance Areas, a set of process capability areas, focus areas, performance objectives, indicators, targets, supporting metrics, lists of dimension objects, their aggregation hierarchies and classification schemes.	EUROCONTROL ATM Lexicon
Performance Indicator	PIs are defined in the SESAR performance framework and relate to performance benefits in specific KPAs. However, no validation targets are assigned to PIs. SESAR Solutions projects use the results of validation exercises to report performance assessment in terms of the PIs, reporting the expected positive and negative impacts. Certain PIs are mandatory for measurement and reporting by Solution projects.	SESAR2020 Project Handbook
Performance metrics	Sometimes proxies may be used in a validation exercise when it is not possible to measure an impact directly using the specified KPIs and PIs. In these cases, other metrics may be used provided the solution project later converts the results into the reporting KPIs and PIs.	SESAR2020 Project Handbook
Predictability Focus Area	Predictability is focused on in-flight (i.e. off-block to on-block) variability of flight duration compared to the planned duration. It is expected that this area will be extended in the future to reflect the improvement derived from better planning in pre-tactical phase.	Performance Framework 2019
Punctuality Focus Area	Refers to "ATM Punctuality". It captures ATM issues as well as events related to ATM that cause a temporal perturbation to airspace user schedules.	PAGAR
Resilience Focus Area	Resilience focuses on the ability to withstand and recover from planned and unplanned events and conditions which cause a loss of nominal performance.	Performance Framework updated
Safety	The state to which the possibility of harm to persons or damage to property is reduced, and maintained at or below, an acceptable level through a continuing process of hazard identification and risk management.	EUROCONTROL ATM Lexicon

Term	Definition	Source
Security	(aviation) Safeguarding civil aviation against acts of unlawful interference. This objective is achieved by a combination of measures and human and material resources. Note: ATM Security is concerned with those threats that are aimed at the ATM System directly, such as attacks on ATM assets, or where ATM plays a key role in the prevention of or response to threats aimed at other parts of the aviation system (or national and international assets of high value). ATM security aims to limit the effects of a threats on the overall ATM Network. ATM Security is a subset of Aviation Security (as defined by ICAO in Annex 17).	EUROCONTROL ATM Lexicon, Note are from PAGAR
SESAR2020	The Programme for SESAR2020 was created with a clear and agreed need for continuing research and innovation in ATM beyond the SESAR 1 development phase. SESAR2020 is structured into three main research phases, starting with Exploratory Research, which is then further expanded within a Public-Private-Partnership (PPP) to conduct Industrial Research and Validation. Finally, it further exploits the benefits of the PPP in Demonstrating at Large Scale the concepts and technologies in representative environments to firmly establish the performance benefits and risks.	Performance Framework 2017
SESAR Programme	The programme which defines the Research and Development activities and Projects for the S3JU.	EUROCONTROL ATM Lexicon
SESAR Solution	A term used when referring to both SESAR ATM Solution and SESAR Technological Solution.	SESAR2020 Project Handbook
SESAR ATM Solution	SESAR Solutions relate to either an Operational Improvement (OI) step or a group of OI steps with associated Enablers (technical system, procedure or human), which have been designed, developed and validated in response to specific Validation Targets and that are expected deliver operational and/or performance improvements to European ATM, when translated into their effective realisation. SESAR Technological Solutions relate to verified technologies proven to be feasible and profitable, which may therefore be considered to enable future SESAR Solutions.	SESAR2020 Project Handbook
Single European Sky High Level Goals	The SES High Level Goals are political targets set by the European Commission. Their scope is the full ATM performance outcome resulting from the combined implementation of the SES pillars and instruments, as well as industry developments not driven directly by the EU.	SESAR2020 Project Handbook
Sub-OE	A subcategory of an Operating environment, classified according to its complexity (e.g. high complexity TMA, medium complexity TMA, low complexity TMA).	EUROCONTROL ATM Lexicon
Validation targets	Validation targets are the targets that focus on the development of enhanced capabilities by the SESAR Solutions. They aim to secure from R&D the required performance capability to contribute to the achievement of the Performance Ambitions and, thus, to the SES high-level goals. In SESAR2020 validation targets are associated with a KPI.	EUROCONTROL ATM Lexicon

Table 4: Terminology

3 Solution Scope

3.1 Detailed Description of the Solution

The focus of Solution PJ.09-W2-44 is the use of the DAC concept in the DCB process (including the INAP concept) in an integrated way, and not as two different steps. Emphasis is put on the INAP timeframe where the two overlap. The INAP timeframe is established between a few hours to a few minutes before a spot occurs, e.g.: from ~-6 hours to ~-15 min, being the thresholds adjusted according to local specificities.

To manage a seamless integration, the solution investigates:

- Further development of the DAC concept for DCB integration, notably the implementation of the optimised configurations and the seamless integration of DAC at pre-tactical and tactical phases.
- Adequate automatic support for spot detection, traffic analysis and measures monitoring.
- Development of new features to support the analysis and resolution of hotspots, namely what-if and what-else.
- Development of new indicators to fine-tune analysis and ease monitoring, namely the complexity and the uncertainty.
- Alignment of processes, roles, and measures, based on the above-mentioned features, ensuring the right level of coordination and shared situation awareness at local, sub-regional and regional network levels.

Further development of the DAC concept includes:

- Development of optimised functions for hotspots resolution based on both capacity and demand measures.
- A Sector Configuration Performance Based Approach defined according to a set of DAC KPA/KPI Assessment Criteria and linked to adequate What-if functions
- Establishment of guidelines for the design of DAC airspace basic structures: i.e., Airspace Building Blocks and Controlling Building Blocks.
- Identification of proper criteria to set the Airspace Block Attributes, which optimise Sector Configuration.
- Integration of the use of complexity, ATCO workload and ATCO availability within the sector configuration optimisation process.
- Reinforcement of a seamless DCB process (ASM-ATFM-ATC CDM processes).
- Inclusion of Cross Border Dynamic Airspace Configurations.
- Full concept Integration within the Network Operations Plan (NOP).

Former Solutions in SESAR Programme: Solution PJ.08-01, Solution PJ.09-01, Solution PJ.09-02. Regarding the results reported by these projects in Wave 1, due to the nature and the main objective of PJ.09-W2-44 - i.e., integration of DAC into the whole DCB process – the figures hereafter shown might be regarded as the natural evolution of the previous concepts and therefore, may substituted the benefits declared by them.

3.2 Detailed Description of relationship with other Solutions

Solution Number	Solution Title	Relationship	Rational for the relationship
PJ.04-W2-28.3	Connected large airports	**Is Preferable To**	DAC prefers that flight plan information is updated according to airports' planning.
PJ.07-W2-38	Enhanced integration of AU trajectory definition and network management processes	**Is Preferable To**	Dynamic Airspace Configuration is built upon Network Management process and it will aim at accommodating AU trajectories. Therefore, the enhanced integration of AU trajectory is preferable from DAC perspective.
PJ.07-W2-39	Collaborative framework managing delay constraints on arrivals	**Is Preferable To**	Dynamic Airspace Configuration propose the integration of demand and capacity measures in the INAP timeframe, where a collaborative framework managing delay constraints on arrivals is preferable.
PJ.07-W2-40	Mission trajectories management with integrated Dynamic Mobile Areas Type 1 and Type 2	**Is Preferable To**	DAC airspace design rules and CDM processes prefers that military areas are dynamically designed and coordinated according to Dynamic Mobile Areas concept
PJ.10-W2-73 FCA	Flight-centric ATC	**Mutually Exclusive**	In the same geographical area, either FCA or sector-based controller mode can be implemented. Therefore, benefits cannot come from both at the same time.
PJ.10-W2-93	Delegation of ATM services amongst ATSUs	**Is Preferable To**	DAC benefits might be greater because sectorisation could be dynamic over different ATSUs
PJ.14-W2-100	SWIM TI Purple Profile for Air/Ground Safety-Critical Information Sharing	**Depends On Pre-requisite**	SWIM Air/Ground information sharing will be needed to implement DAC
PJ.14-W2-101	SWIM TI Green profile for G/G Civil Military Information Sharing	**Depends On Pre-requisite**	SWIM Ground/Ground information sharing will be needed to implement DAC
PJ.32-W3-02	Virtual Centres - Operational Thread	**Is Preferable To**	DAC benefits might be greater because sectorisation could be dynamic over different ATSUs

Table 5: Relationships with other Solutions

There is No Cross Effect with the rest of SESAR2020 W2 and W3 Solutions.

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4 Solution Performance Assessment

4.1 Assessment Sources and Summary of Validation Exercise Performance Results

No previous Validation Exercises (pre-SESAR2020 Wave 2, etc.) have been considered as relevant for the performance assessment of PJ.09-W2-44 results.

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

Exercise ID	Exercise Title	Release	Maturity	Status
EXE-PJ.09-W2-44-V3-VALP-001	Demand and capacity measures for tactical imbalance resolution based on complexity	Q4 2021	V3	Completed
EXE-PJ.09-W2-44-V3-VALP-002	Full DAC Management process from Strategic to Execution phase	Q4 2022	V3	Completed
EXE-PJ.09-W2-44-V3-VALP-003	Swim INAP Services 2020	Q2 2022	V3	Completed
EXE-PJ.09-W2-44-V3-VALP-004	Integrated DCB/DAC Planning within INAP timeframe using iACM (NATS/Indra)	Q1 2022	V3	Completed
EXE-PJ.09-W2-44-V3-VALP-005	DAC integration into DCB and ATC processes	Q3 2022	V3	Completed
EXE-PJ.09-W2-44-V3-VALP-006	Demand measures for tactical DCB imbalance resolution based on complexity assessment	Q3 2022	V3	Completed
EXE-PJ.09-W2-44-V3-VALP-007	Tactical optimization of traffic demand/complexity accommodation	Q3 2022	V3	Completed

Table 6: SESAR2020 Validation Exercises

Table 7 provides a summary of information collected from available performance outcomes.

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Exercise	OI Step	Exercise scenario & scope	Performance Results	Notes
EXE-PJ.09-W2-44-V3-VALP-001	CM-0103-B CM-0103-C DCB-0210	Airspace: Madrid ACC from FL245 – Sectors of study: TLU, TLL, ZMU, ZMM, ZML, DGU, DGL, BLU, BLL, PAU and PAL. Traffic: 2019 FRA traffic sample as forecasted traffic for 2024. Reference scenario: Actual sector Configuration in place on the simulated day from 2019. Solution scenario: DAC sector configuration provided by Sector Configurations optimiser. Use Cases addressed: UC02, UC03, UC04 and UC05.	Qualitative results in terms of Process and Procedures, Role, and Responsibilities (i.e., Human Performance) and Safety as well. The analysed PIs results in the following figures regarding the reference scenario: Capacity increase ≈8%. Cost Efficiency increase ≈8%. Flight duration decrease ≈3%. Fuel burn decrease ≈3%. Adherence to the flight plan decreases.	RTS in both LTM/EAP and ATC timeframe.
EXE-PJ.09-W2-44-V3-VALP-002	AOM-0805 AOM-0809-A DCB-0210	The scenarios tackle Pre-tactical DAC phase on D-1 and D-Ops. Airspace: EPWWCTA ACC Traffic: AIRAC 1907 environment data. Reference scenario: Assessment of the current ASM organization. Solution scenario: Extension of the DAC process with inclusion of the new airspace definition, the CDM processes, the new airspace structure, configurations and DMAs, and improved tool functionalities Use Cases addressed: UC00, UC01, UC02, UC04, UC05, UC06, UC07, UC09, UC10 and UC11.	Qualitative results in terms of Process and Procedures, Roles, and Responsibilities (i.e., Human Performance). The analysed PIs results in the following figures regarding the reference scenario: Capacity is measured in minutes of delay and shows no benefit with respect to the reference scenario. Cost Efficiency seems to improve because of the lowered overload sum for the same number of control position hours due to the opening scheme proposed by DAC algorithm. Both Fuel and Time Efficiency improve ≈15%. Punctuality remains the same.	Real-Time Gaming Simulation in the LTM/EAP timeframe.

EXE-PJ.09-W2-44-V3-VALP-003	AOM-0805 CM-0102-B CM-0104-C DCB-0210	The exercises investigate the optimisation of DAC operational concept into DCB cross border within pre-tact and INAP timeframe. Two validation techniques are considered: A Fast Time Simulation and A Passive Shadow Mode. Airspace: Bordeaux and Brest ACCs from FL255. Traffic: FTS traffic samples recorded in 2019; Passive Mode considers real traffic. Reference scenario: Regulations in place due to ATC Capacity in LFBB and LFRR. Solution scenario: Usage of regulation and optimisation algorithms. Use Cases addressed: UC02, UC03, UC04, UC05, UC06, UC07 and UC09.	Qualitative results in terms of Process and Procedures, Roles, and Responsibilities (i.e., Human Performance). On the other hand, Safety is assessed from workload distribution and situation awareness. Capacity is measured through the minutes of delays imposed by the regulations in place. Even though, Punctuality is not directly addressed, it might be analysed from the latter results.	FTS and Passive Shadow Mode with real traffic in the INAP timeframe.
EXE-PJ.09-W2-44-V3-VALP-004	CM-0102-B CM-0103-B CM-0104-C DCB-0210	Exercises validate the application of DAC functionalities and concepts at local level within the early-mid INAP phase of the day of operation. Airspace: Swanwick ACC WEST and CENTRAL sector. Traffic: 2019 Traffic samples. Reference scenario: Current operating method: FMP identifies and solves emerging DCB hotspots using the standard Network Manager capabilities to solve network congestion. Solution scenario: New operational environment is introduced using vertical	Regarding the measurement of performance indicators, exercise was not able to take quantitative measures. Qualitative assessment about capacity, fuel efficiency predictability and cost efficiency. Usability, level of situational awareness and the support of the LTM tool is assessed through questionnaires.	RTS in the INAP phases pre-ATC.

		stratification of sectors and new rules to allow cross-sector family combinations Use Cases addressed: UC02, UC04, UC05, UC06, UC10 and UC11.		
EXE-PJ.09-W2-44-V3-VALP-005	AOM-0809-A CM-0102-B CM-0104-C DCB-0210	Scenarios aim at the validation of the operational feasibility of the concept solution and demonstrate its benefit. Airspace: Milan ACC Traffic: AIRAC 1908. Reference scenario: Current operations using NM Tools. Solution scenario: Local DAC, DCB and ATC integrated processes into the Validation Platform and the related collaboration with operations at Network level in both pre-tactical and tactical phases. Use Cases addressed: UC01, UC02, UC03, UC04, UC05, UC06 and UC08a.	Qualitative results in terms of Process and Procedures, Roles, and Responsibilities (i.e., Human Performance). The analysed PIs results in the following figures regarding the reference scenario: Capacity and Cost Efficiency slightly improve. Flight duration decrease ≈0.5% Fuel burn decrease ≈0.5% Adherence to the flight plan increases.	RTS in in both LTM/INAP and ATC timeframe.
EXE-PJ.09-W2-44-V3-VALP-006	CM-0103-B CM-0104-C	Airspace: COOPANS ACC airspace - Vienna and Zagreb ACCs. Traffic: Real traffic data 2022. Reference scenario: No reference scenario because of the nature of the shadow mode. Anyway, FMPs had the possibility to refer to current operational tools at any time. Solution scenario: Usage of specific TopSky Flow Manager features aligned with DAC. Use Cases addressed: UC05 and UC07.	Qualitative results in terms of Process and Procedures, Roles, and Responsibilities (i.e., Human Performance).	Shadow mode in the LTM/EAP timeframe.

EXE-PJ.09-W2-44-V3-VALP-007	CM-0102-B DCB-0210	Scenarios aim at testing the full efficiency of tactical ATFCM systems through an optimized tactical ATCO shift/break plan in response to DAC needs. Both pre-tactical on D-Ops and tactical phases are considered. Airspace: Geneva and Zurich ACC over FL245. Traffic: Real traffic data. Reference scenario: Current operating methods. Solution scenario: Two solution scenarios that tackles tackle the illustration of a sector opening scheme optimization within (a) one ATSU and (b) two ATSUs. Use Cases addressed: UC02.	Safety is analysed through workload and situation awareness in a qualitative manner.	Live-shadow mode configuration and RTS in the LTM timeframe.

Table 7: Summary of Validation Results.

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4.2 Conditions / Assumptions for Applicability

Table 8 summarises the applicable operating environments.

OE	Applicable sub-OE	Special characteristics
ER	ER Very High Complexity ER High Complexity	N/A
Terminal	Terminal Very High Complexity Terminal High Complexity	Marginal impact in some KPIs (there will be no VAL EXE in TERMINAL)

Table 8: Applicable Operating Environments.

4.3 Safety

4.3.1 Safety Design drivers and Performance Mechanism

No changes to ATC are brought in by this Solution because, regarding the only two solution use cases addressing ATC:

- DCB-UC-08a: Air Traffic Control in an integrated DAC-DCB environment – hotspot
  - The only change compared to reference (i.e., Wave 1 PJ08) is in relation to the LTM-ATSU SUP coordination and Collaborative Decision-Making process (possibility of interlacing DAC with DCB measures when approaching the DCB measures cut-off time). All the ATC use case activities, information flows and requirements remain unchanged compared to Wave 1 PJ 08.
- DCB-UC-08b: Air Traffic Control in an integrated DAC-DCB environment - optispot
  - Not relevant for the safety assessment (optispot have no safety implication).

In conclusion, as the change is focused on DAC and DCB, is a **"Other-than-ATS" operational solution** which does not have direct ATS safety impact but an indirect impact via the potential safety implications of the DAC and DCB services delivered to ATS. Consequently, no Safety Criteria but Safety drivers were defined.

Safety Drivers (SD) were defined only on the services where it was identified that Sol 44 is introducing a change with safety impact.

Safety Drivers:

- The following SD was derived in order to express in a high-level manner the impact on the Short Term DCB service:

SD 000: The change introduced by Sol44 to the Short Term DCB service shall not increase the number of overloads, despite the increased airspace throughput (CAP2).

This high-level SD has been further fragmented according to the components of the Short Term DCB service:

- In order to account for the impact on the "Load and Capacity Monitoring" service (this service includes provision of traffic demand and capacity data to LTM, as well as monitoring of these data to ensure demand does not exceed the declared capacity; it contains two service components: *Demand Data Provision* and *ATC sector load and capacity monitoring*):

SD 001: The Load and Capacity Monitoring service delivered to ATS, service which is enhanced with complexity at local level by Sol44, shall not increase the number of overloads, despite the increased airspace throughput (CAP2).

Note for SD 001: The share of local complexity to regional NM in order to build a consolidated view of complexity will be brought in from Sol 45. Until that is the case, complexity remains local in Sol 44.

- In order to account for the impact on the *ATFCM measure design* function inside the "Demand and Capacity Balancing" service (purpose of this service is to react when the predicted traffic demand is higher than the available capacity by considering, assessing and implementing adequate solutions - ATFCM measures; it contains the following functions: *ATFCM measure* *design*, *ATFCM measure promulgation*, *ATFCM measure implementation* and *Network cherry-pick regulations*):

SD 002: The ATFCM measure design service delivered to ATS, service which is enhanced by Sol 44 with new KPIs (such as fuel burn/distance flown and environment impact), new types of demand and capacity measures (e.g. Targeted CASA regulation, dynamic sector configuration, etc.) and new functionalities (e.g. What-if/What-else) shall not increase the number of overloads, despite the increased airspace throughput (CAP2).

SD 003: The ATFCM measure implementation service delivered to ATS, service which is enhanced by Sol 44 through digital coordination and information sharing with regional NM and ATC, shall not increase the number of overloads, despite the increased airspace throughput (CAP2).

- In order to account for the impact on the Airspace and capacity data provision service (basic service component that includes collection, analysis, validation, upload into and maintenance of airspace, capacity and aeronautical (environment) data in the CACD; it contains the following functions: *ENV dossier, Static and dynamic NM environment data updates, Provision of AIXM airspace data files and Environment data query*):

SD 004: The Airspace and capacity data provision service delivered by regional NM shall maintain the same level of safety-related performance as per NM AIRSPACE DATA SERVICE SPECIFICATION NM AIRSPACE DATA SERVICE SPECIFICATION, accounting for the following Sol 44 updates:

- The ENV dossier function updated with dynamic sector configurations and DMAs;

- The Static and Dynamic NM environment data update function with CACD consideration of sector capacity for the dynamic sector configuration;

- The Provision of AIXM airspace data files function enabling the exchange of the dynamic sector configurations and DMAs.

- In order to account for the impact on the Consolidated European Airspace Use Plan (eAUP) service (delivered by the Central Airspace Data Function (CADF), includes preparation and release of a consolidated daily European Airspace Use Plan (EAUP) and European Updated Airspace Use Plans (EUUPs)):

SD 005: The Consolidated European Airspace Use Plan (eAUP) service delivered to ATS, service which is merged by Sol 44 with the ATFCM daily plan (ADP) to form the EDAC plan, shall maintain the same level of safety-related performance as per NM AIRSPACE DATA SERVICE SPECIFICATION [reference].

Note: The manner of considering the conservation of same safety level despite the increased airspace throughput (CAP2) enabled by the Solution (due to a better airspace configuration and best DCB measures optimising the use of available airspace i.e., optimally adapt airspace capacity to the demand) **needs to be carefully considered when performing the overall PAGAR Safety computation**.

4.3.2 Data collection and Assessment

The level of safety with the Solution has been assessed qualitatively in validation exercises (RTS) via debriefing with participating LTMs (and EAPs where applicable) and/or assessment of LTM & EAP situation awareness. A negative safety feeling or a degraded situation awareness of the LTM and/or EAP are interpreted as an increased potential for occurrence of sector overloads.

The next table summarizes the safety-relevant results from Solution VAL EXE as documented in SAR §6 (Demonstration of service specification achievability). For each safety specification item (at service level, SRS) are indicated the related safety drivers (SD) and the VAL EXE that addressed that particular SRS.

ID	Safety Requirement at Service level (SRS) *(success approach)*	Related Safety Driver	VAL EXE	Safety conclusion
SRS 001	In addition to Traffic Counts (Hourly Entry Counts and Occupancy Counts), Complexity and ATCO Workload shall be displayed to the LTM/EAP actor through the Imbalance Prediction and Monitoring Service HMI in order to enable them to analyse traffic volume imbalances	SD 001 SD 004	EXE 01 EXE 03 EXE 04 EXE 05 EXE 06 EXE 07	Ok* Ok Ok Ok Ok** Ok
SRS 002	The hotspot resolution monitoring alert, encompassing the monitoring values (MV) revision, provided to the LTM/EAP actor shall account for complexity and workload, in addition to entry and occupancy counts	SD 001 SD 004	EXE 01 EXE 03 EXE 04 EXE 05 EXE 06 EXE 07	Ok Ok Ok*** Ok Ok Ok
SRS 003	The LTM-ATSU SUP coordination shall account for the possibility of interlacing DAC with DCB measures when approaching the DCB measures cut-off time	SD 001 SD 004	EXE 01 EXE 03 EXE 05 EXE 07	Ok Ok Ok**** Ok
SRS 004	The LTM coordination with WOC in view of agreeing on the tactical ARES/DMA (re)allocation and subsequent EDAC publication, shall account for the possibility of	SD 005	EXE 04	Ok

ID	Safety Requirement at Service level (SRS) *(success approach)*	Related Safety Driver	VAL EXE	Safety conclusion
	interlacing DAC with DCB measures when approaching the DCB measures cut-off time			
SRS 005	The What-if exclusion tool shall propose to the LTM the flights to be excluded from the regulation whilst still allowing LTM to resolve the hotspot	SD 002 SD 003	EXE 03	Ok
SRS 006	The Targeted CASA flow regulation measure shall be proposed to LTM as a potential alternative to the baseline CASA flow regulation in view of NM impact assessment and comparative evaluation of performance against the baseline regulation	SD 002 SD 003	EXE 03	Ok

** EXE 01: Meanwhile, it is worth mentioning that there is room for visualization improvements that allows the LTM to get the best solution efficiently and in a timely manner (to avoid confusion with all the possible sector combinations)*

***EXE 06: Note (imputable to the prototype used): There were no issues related to safety, but the system was not mature enough and sometimes it hindered the LTMs to have the correct information*

****EXE 04: There are some comments about the amount of data shown on one of the screens, related to too many sectors to monitor, this is something that is planned to be addressed in a later stage of research. Moreover, the tool support needs to be made more efficient to reduce workload in performing tasks. Some thought needs to be made as to how situational awareness of the user can be improved.*

*****EXE 05: The participant FMPs recommended to enhance the LTLM tool by including other demand measures (Level capping, Rerouting) in addition to the Ground Delay measures and by enhancing the "What-if" with new functionalities to acquire and manage additional airspace and ATC constraints impacting the user workspace and taking into account the actual airspace availability*

Based on the outcome of VAL EXE, the analysis of the results regarding the impact on operational safety allows to conclude that the Solution allows to maintain the same level of safety as per the Reference.

Meanwhile note that EXE 02 did not provide safety evidence as the scope was downsized to the day of operation planning phase: Dops-3 Hrs.

4.3.3 Extrapolation to ECAC wide

When performing the **overall PAGAR Safety computation decision will be taken** whether this "Other than ATS" solution should be considered. The reason for the doubt is that for such solution the contribution to the overall safety performance is achieved via the ATS operational solutions (or other ATS operational usages outside SESAR).

4.3.4 Discussion of Assessment Result

Not necessary.

4.3.5 Additional Comments and Notes

No additional comments or notes.

4.4 Environment: Fuel Efficiency / CO2 emissions

PJ.09-W2-44 analyses the benefits that might be drawn from the integration of DAC into the whole DCB process. Therefore, the operational concept behind mainly focuses in the short-term/pre-tactical phases and on the work performed by the ANSP systems and human resources, with special attention on the process and procedures related to the work performed by the LTMs and their supporting systems.

As a result of the better usage of the airspace capacity and the adoption of capacity measures for imbalance resolution, Fuel Efficiency might be improved, as depicted in Appendix A through the Performance Mechanisms. The objective of this section is to provide evidence, based on exercises' results, about the benefits in terms of both Fuel consumption and emissions.

4.4.1 Performance Mechanism

Performance Benefit Impact Mechanisms for Fuel Efficiency can be checked in Appendix A. The better identification of hotspots and imbalances based on complexity and considering both network performances and ANSP Performance Targets allows the reduction of reactive Airspace Users action.

4.4.2 Assessment Data (Exercises and Expectations)

According to DES Performance Framework, Fuel Efficiency is a component of Operational Efficiency and is assessed through ***FEFF1*** KPI, defined as the actual average fuel burnt per flight. Therefore, the calculus is based on the total amount of actual fuel burnt divided by the number of flights and is measured in Kg fuel per flight.

On the other hand, CO2 emissions are considered within the Environment area and is measured by ***ENV1***: actual average CO2 Emission per flight. The calculus is based on the amount of fuel burnt although, some dedicated software provides the emissions as an output. Hereafter, even though EXE-PJ.09-W2-44-V3-VALP-001 provides the actual output of the AEM Kernel model, CO2 emissions will be assessed as 3.15 times the amount of fuel burnt.

Results are drawn from the assessment of OBJ-PJ09W2S44-V3-VALP.022 validation objective. Contributing to the latter objective, three exercise success criteria are defined and evaluated: EXE1-CRT-PJ09W2S44-V3-VALP-013-001, EXE2-CRT-PJ09W2S44-V3-VALP.022 and EXE5-CRT-PJ09W2S44-V3-VALP.021.

- In *EXE-PJ.09-W2-44-V3-VALP-001*, both FEFF1 and ENV1 are analysed in the four high complexity scenarios. The results are collected through Real Time Simulations in the ATC service provision timeframe. The main considerations about the results shown in Table 9, which are already available in [25], are: (a) EUROCONTROL tool Advanced Emission Model (AEM) was used for the calculus of both Fuel Efficiency and emissions; (b) reference and solution traffic samples do not match perfectly because the scenarios include different demand measures applied (mainly ground delays) and hence, a fairer comparison would be to pick those flights that appear in both scenarios; and (c) 0001 ID refers to Reference scenarios; meanwhile 1001 belongs to solution ones.

Scenario	Nb. Flights	$FEFF1$ [kg fuel/flight]	ENV [kg CO_2/flight]
SCN-PJ09W2S44-V3-VALP-0001-TS2	89	657.03	2069.64
SCN-PJ09W2S44-V3-VALP-1001-TS2		628.42	1979.52
SCN-PJ09W2S44-V3-VALP-0001-TS5	119	613.66	1933.03
SCN-PJ09W2S44-V3-VALP-1001-TS5		633.38	1996.71
SCN-PJ09W2S44-V3-VALP-0001-TS4	72	470.42	1481.84
SCN-PJ09W2S44-V3-VALP-1001-TS4		449.90	1417.17
SCN-PJ09W2S44-V3-VALP-0001-TS2**	71	548.77	1728.64
SCN-PJ09W2S44-V3-VALP-1001-TS2**		499.39	1573.07

Table 9: Fuel Efficiency results for EXE-PJ.09-W2-44-V3-VALP-001.

- *EXE-PJ.09-W2-44-V3-VALP-002* ran four scenarios within the ENR High Complexity operating environment classifying them according to two criteria: the day of operation (i.e., D-1 and D-OPS) and the military scenario. Having in mind that the objective of the simulation is to assess the impact of the exchange of DAC and DMA updates on the key actors, the main considerations for the Fuel Efficiency assessment are: (a) since D-1 and D-OPS refers to the same traffic scenario, only D-OPS values are considered for the metric calculus; (b) validation exercise provides the route extension and the delay caused by the DMA/ARES allocation; (c) the translation mechanism to obtain FEFF1 in Kg fuel per flight is based on Common Assumption F-0011: 56.8 kg/min of fuel burn rate; and (d) the exercise consists of a real-time gaming simulation. The results of the exercise, which are available in Stellar, and the final figures in the proper units (i.e., kg fuel/per flight) are collected in Table 10.

Scenario	Nb. Flights	Delay [Δmin]	Extra fuel [Δkg fuel]	Extra fuel per flight [Δkg fuel/flight]
MScen2 D - OPS Reference	150	51.70	2936.56	19.58
MScen2 D - OPS Solution	148	74.40	4225.92	28.55
MScen3 D – OPS Reference	150	78.10	4436.08	29.57
MScen3 D – OPS Solution	150	33.40	1897.12	12.65

Table 10: Fuel Efficiency results for EXE-PJ.09-W2-44-V3-VALP-002.

- *EXE-PJ.09-W2-44-V3-VALP-005* does not directly measure the fuel burnt per flight but, from TEFF6 indicator, which gathers the average of the distribution of the actual En-Route durations and using the Common Assumption F-0011: 56.8 kg/min of fuel burn rate in En-Route; it is possible to analyse the impact on Fuel Efficiency. Besides, the main considerations to take into account are: (a) different solution scenarios are considered for the same traffic sample and all of them are included in the Fuel Efficiency analysis; (b) since the Common Assumption F-0011 sets a fix fuel burn rate, the Fuel Efficiency analysis will be consistent with the Time Efficiency results; and (c) the figures are obtained from an ATC Real Time Simulation. Table 11 summarizes both the exercise results from the [25] and the FEFF1 translation.

Scenario	TEFF6 [min/flight]	FEFF1 [kg fuel/flight]
Reference TS1 RUN1/1	18.03	1024.16
Solution TS1 RUN3/1	18.04	1024.62
Solution TS1 RUN4/1	17.97	1020.58
Solution TS1 RUN5/1	18.04	1024.45
Reference TS2 RUN1/2	18.22	1034.84
Solution TS2 RUN3/2	18.06	1025.81
Solution TS2 RUN5/2	18.06	1025.64

Table 11: Fuel Efficiency results for EXE-PJ.09-W2-44-V3-VALP-005.

Before extrapolating the results to ECAC, the aggregation of the latter by reference and solution scenarios is deem necessary, since all exercises are framed in High Complexity ENR. For *EXE-PJ.09-W2-44-V3-VALP-001*, the consolidation of the metric considers the level of significance of the result (i.e., both the fuel burn and the CO2 emissions are weighted considering the number of flights). On the other hand, the results from *EXE-PJ.09-W2-44-V3-VALP-005* are calculated as the mean value of both scenarios. Finally, because of *EXE-PJ.09-W2-44-V3-VALP-002* measures the extra fuel burn due to the DMA/ARES allocation, the difference among reference and solution scenarios is directly considered.

Besides, Table 12 includes the difference between solution and reference scenario, $\Delta FEFF1$, and the non-dimensional value of the fuel consumption reduction.

$$\Delta FEFF1\ [kg\ fuel/flight] = FEFF1_{solution} - FEFF1_{reference}$$

$$\Delta FEFF1\,[\%] = \frac{FEFF1_{solution} - FEFF1_{reference}}{FEFF1_{reference}} = \frac{\Delta FEFF1[kg\ fuel/flight]}{FEFF1_{reference}}$$

According to the definition of the latest variables, a negative value means greater consumptions in reference scenario and then, a fuel reduction because of the operational concept.

Validation Exercise	Ref. scenario FEFF1 [kg fuel/flight]	Sol. scenario FEFF1 [kg fuel/flight]	$\Delta FEFF1$ [kg fuel/flight]	$\Delta FEFF1$ [%]
EXE-PJ.09-W2-44-V3-VALP-001	582.15	567.38	-14.77	-2.54%
EXE-PJ.09-W2-44-V3-VALP-002	-	-	-3.97	-
EXE-PJ.09-W2-44-V3-VALP-005	1029.50	1024.22	-5.28	-0.51%

Table 12: Summary of FEFF1 KPI per validation exercise.

The average of the fuel burn reduction is 8.01 kg/flight (positive impact).

Getting back to the definition of the validation activities, the three exercises examined under the scope of the environment area contribute to the OIs showed in Table 13

	EXE-PJ.09-W2-44-V3-VALP-001	EXE-PJ.09-W2-44-V3-VALP-002	EXE-PJ.09-W2-44-V3-VALP-005
CM-0102-B			X
CM-0103-B	X		
CM-0104-C	X		X
DCB-0210	X	X	X
AOM-0805		X	
AOM-0809-A		X	X

Table 13: OIs addressed by the exercises contributing to FEFF.

Therefore, the six OIs addressed by PJ.09-W2-44 contribute to the benefits drawn in terms of Fuel Efficiency and their relative contribution to the KPIs is shown in Table 14.

OI step	Relative benefits contribution to FEFF1
CM-0102-B	10%
CM-0103-B	10%
CM-0104-C	10%

DCB-0210	40%
AOM-0805	15%
AOM-0809-A	15%
TOTAL	100%

Table 14: Relative benefits contribution to FEFF1 by OI.

4.4.3 Extrapolation to ECAC wide

From the Common assumptions 2019 F-0001, the average fuel burn per flight is 5280 kg. Additionally, from the aggregation assumptions for 2035, the contribution to total ENR traffic from the Sub-Operating Environments affected by the operational concept are shown in Table 15.

ID	Sub-OE	Year	Value	Comment
ER-VHC-2035	Very High Complexity ER	2035	31,33%	Contribution to total En-Route traffic from the specific sub-OE
ER-HC-2035	High Complexity ER	2035	27,98%	Contribution to total En-Route traffic from the specific sub-OE

Table 15: Values for extrapolation at ECAC level

The fuel reduction measured by the validation activities is ***8.01 kg/flight*** (positive impact) in very high and high complexity airspace, which represent 59.31% of the ECAC traffic and therefore, the ***saving in fuel consumption at ECAC leve***l is:

$$\Delta FEFF1_{ECAC} = \Delta FEFF1_{local} \cdot Traffic_{SubOE} = 8.01\ kg/flight \cdot 59.31\% = 4.75 \frac{\text{kg}}{\text{flight}}$$

Finally, considering the average fuel burn per flight from the Common Assumptions, the ***average reduction of fuel per ECAC as a percentage of the total flight consumption*** is:

$$\Delta FEFF1_{ECAC_{flight}} = \frac{4.75\ kg/flight}{5280\ kg/flight} = 0.09\%$$

KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
FEFF1 Actual Average fuel burn per flight	Kg fuel per movement	Total amount of actual fuel burn divided by the number of movements	YES	*-4.75 kg/flight* *Positive impact (i.e., savings in fuel consumption)*	*-0.09%* *Positive impact (i.e., savings in fuel consumption)*
ENV1 Actual Average CO2 Emission per flight	Kg CO2 per flight	Amount of fuel burnt x 3.15 (CO2 emission index) divided by the number of flights	NO	*-14.96 kg CO2/flight* *Positive impact (i.e., savings in CO2 emissions)*	*-0.09%* *Positive impact (i.e., savings in CO2 emissions)*

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

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	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
FEFF1 Actual Average fuel burn per flight	N/A	N/A	100%	N/A	N/A
ENV1 Actual Average CO2 Emission per flight	N/A	N/A	100%	N/A	N/A

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

4.4.4 Discussion of Assessment Result

Validation techniques designed for the measurement of PJ.09-W2-44 in terms of Fuel Efficiency are Real Time Simulations of both INAP and ATC timeframe. On top of that, the six OIs addressed by the solution are analysed under the scope of the environment impact. Therefore, the ***confidence level of the results is high***.

On the other hand, from the qualitative scale published by PJ.19 in 'PJ19_04 – D4_7 Validation Targets – SESAR2020 Wave 2 & Wave 3', the expected impact of PJ.09-W2-44 on Fuel Efficiency is *level 3*. In quantitative and absolute values, that level 3 means the solution should bring in fuel savings between 14.87 and 54.96 kg/flight (i.e., percentile 70 and max value, respectively). Table 18: Percentiles for the translation of qualitative into quantitative values. depicts the correspondence between qualitative ranges (i.e., impact levels) and quantitative values.

KPI		P10	P70	MAX
Fuel Efficiency	**FEEF1**	4.19	14.87	54.96

Table 18: Percentiles for the translation of qualitative into quantitative values.

As the results reported by PJ.09-W2-44 are 4.75 kg fuel/flight, there is a misalignment (i.e., gap) with regards to the expected benefits reported by PJ19.04 in [8]. From the solution perspective, the results are consistent with the experts' opinion involved in the solution.

Finally, *main differences regarding PJ19 estimations are on the Operating environment*: PJ19 expectations include TMA as Operating Environment where PJ.09-W2-44 results may provide benefits regarding Fuel Efficiency. However, PJ.09-W2-44 is focused on En-Route Very High and High complexity sub-operating environments (i.e., En-Route Airspace).

4.4.5 Additional Comments and Notes

No additional comments or notes.

4.5 Airspace Capacity (Throughput / Airspace Volume & Time)

Considering that the operational concept validated in PJ.09-W2-44 has a clear impact in the optimization of airspace capacity and the reduction of the ATCO workload, this concept improves the use of the declared capacity, as it has been expressed in the following sections.

PJ.09-W2-44results on Airspace Capacity covers En-Route Capacity. TMA Capacity is not validated and either addressed in this solution.

4.5.1 Performance Mechanism

Performance Benefit Impact Mechanisms for Airspace Capacity can be checked in Appendix A. The reduction of the controller workload and the balance of the workload impact in the optimisation of the capacity use.

4.5.2 Assessment Data (Exercises and Expectations)

Results for Capacity are extracted from the assessment of OBJ-PJ09W2S44-V3-VALP.019, which comprises one success criteria: CRT-PJ09W2S44-V3-VALP-019-001, the integration of Dynamic Airspace Configuration with INAP shows an improvement in Capacity.

In *EXE-PJ.09-W2-44-V3-VALP-001*, CAP2 is analysed in the four high complexity scenarios. The results are collected through Real Time Simulations in the ATC service provision timeframe and are presented in Table 19.

Traffic Sample	Ref Scenario	Sol Scenario
SCN-PJ09W2S44-V3-VALP-X001-TS2	3.00	3.00
SCN-PJ09W2S44-V3-VALP-X001-TS5	4.80	2.90
SCN-PJ09W2S44-V3-VALP-X001-TS4	2.30	2.80
SCN-PJ09W2S44-V3-VALP-X001-TS2**	3.40	3.60

Table 19: ATCO WL results for EXE-PJ.09-W2-44-V3-VALP-001.

Table 19 shows the average workload per scenario and for the different traffic samples performed during the exercise. With these values, the increase in productivity in terms of workload reduction is shown in Table 20.

Traffic Sample	WL reduction [%]
SCN-PJ09W2S44-V3-VALP-1001-TS2	0
SCN-PJ09W2S44-V3-VALP-1001-TS5	39.58
SCN-PJ09W2S44-V3-VALP-1001-TS4	-21.74
SCN-PJ09W2S44-V3-VALP-1001-TS2**	-5.88

Table 20: WL reduction per Traffic Sample.

Taking into account the values shown in Table 20, and using the definition of increase in productivity provided by PJ19,

$$Increase\ in\ En-route\ Airspace\ Capacity = \frac{1}{1-\frac{Workload\ Reduction}{2}} - 1$$

The values obtained for the increase in En-route Airspace Capacity are the collected in Table 21.

Traffic Sample	Increase in En-route Airspace Capacity [%]
SCN-PJ09W2S44-V3-VALP-1001-TS2	0
SCN-PJ09W2S44-V3-VALP-1001-TS5	24.67
SCN-PJ09W2S44-V3-VALP-1001-TS4	-9.80
SCN-PJ09W2S44-V3-VALP-1001-TS2**	-2.86

Table 21: Increase in Airspace Capacity per Traffic Sample

With this information, the average value for Increase in Airspace Capacity is **3.00%.**

Getting back to the definition of the validation activities, the exercise examined under the scope of the environment area contribute to the OIs as showed in Table 22.

	EXE-PJ.09-W2-44-V3-VALP-001
CM-0102-B	
CM-0103-B	X
CM-0104-C	X
DCB-0210	X
AOM-0805	
AOM-0809-A	

Table 22: OIs addressed by the exercise contributing to CAP2.

Thus, the six OIs addressed by PJ.09-W2-44 contribute to the benefits drawn in terms of Airspace Capacity and their relative contribution to the KPIs is shown in Table 23.

OI step	Relative benefits contribution to CAP2
CM-0102-B	N/A

CM-0103-B	20%
CM-0104-C	20%
DCB-0210	60%
AOM-0805	N/A
AOM-0809-A	N/A
TOTAL	100%

Table 23: Relative contribution to CAP2 per OI

4.5.3 Extrapolation to ECAC wide

No extrapolation is needed for this KPI in the Performance Assessment Report.

4.5.4 Discussion of Assessment Result

The results presented for Airspace Capacity have been calculated with the output of EXE-PJ.09-W2-44-V3-VALP-001, since other exercises did not focus on the measurement of Airspace Capacity. Indeed, in this exercise the increase in Airspace Capacity has been measured by using the ATC workload.

From the qualitative scale published by PJ.19 in 'PJ19_04 – D4_7 Validation Targets – SESAR2020 Wave 2 & Wave 3', the expected impact on Airspace Capacity because of DAC is considered as *level 3*. The results evince the alignment with the expectation.

Finally, *main differences regarding PJ19 estimations are on the Operating environment*: PJ19 expectations include TMA as Operating Environment where PJ.09-W2-44 results may provide benefits regarding TMA Capacity (i.e., CAP1). However, PJ.09-W2-44 is focused on En-Route Very High and High complexity sub-operating environments (i.e., En-Route Airspace).

4.5.5 Additional Comments and Notes

No additional comments or notes

4.6 Flight Times

Flight Time and *Fuel Efficiency* are indicators that share a strong relationship i.e., generally, both verify a *high correlation*. However, it is important to bear in mind that, because of the flight attitude, a minor flight duration does not always mean a lower fuel consumption: climbing phases impact significatively on the fuel burn and hence, even though the flight duration were smaller, the resulting fuel consumption might be greater in those cases that the climb phase lasts longer.

Along with the Fuel Efficiency analysis carried out in 'Environment: Fuel Efficiency / CO2 emissions', the whole Operational Efficiency area is basically, impacted by allowing more flexible airspace structures that lead to a better distribution of the flight complexity. Its integration into the whole DCB process conduct a priori, to a reduction in the flight duration because of the better management of imbalance resolution.

4.6.1 Performance Mechanism

Performance Benefit Impact Mechanisms for Time Efficiency are detailed in Appendix A. The better identification of hotspots and imbalances based on complexity and considering both network performances and ANSP Performance Targets allows the reduction of reactive Airspace Users action and the impact on them due to demand measures (e.g., re-routings).

4.6.2 Assessment Data (Exercises and Expectations)

According to DES Performance Framework, benefits in terms of flight time should be assessed through the mandatory KPI, ***TEFF1***: Gate-to gate flight time. The metric is calculated as the average of the distribution of actual gate-to-gate flight durations and then, the units are [min/flight]. Because of the applicable Operating Environment, the assessed performance indicator is ***TEFF6*** (i.e., En-Route time), which is translated into TEFF1.

Results are drawn from the assessment of OBJ-PJ09W2S44-V3-VALP.021 validation objective. Contributing to the latter objective, three exercise success criteria are defined and evaluated: EXE1-CRT-PJ09W2S44-V3-VALP-012-001, EXE2-CRT-PJ09W2S44-V3-VALP.021 and EXE5-CRT-PJ09W2S44-V3-VALP.021.

- *EXE-PJ.09-W2-44-V3-VALP-001* analyses the flight duration in the four High Complexity scenarios considered in the ATC Real Time Simulation. Table 24 gathers the results for TEFF6 commented in Appendix A of the VALR and the main considerations are: (a) reference and solution traffic samples do not match perfectly because the scenarios include different demand measures applied (mainly ground delays) and hence, a fairer comparison would be to pick those flights that appear in both scenarios; (b) 0001 ID refers to Reference scenarios; meanwhile 1001 belongs to solution ones; and (c) flight duration is calculated from the cancelled flight plans.

Scenario	Nb. Flights	$TEFF6$ [min/flight]	$\Delta TEFF6$ [%]
SCN-PJ09W2S44-V3-VALP-0001-TS2	89	19.75	-
SCN-PJ09W2S44-V3-VALP-1001-TS2		18.12	-8.25

SCN-PJ09W2S44-V3-VALP-0001-TS5	119	19.08	-
SCN-PJ09W2S44-V3-VALP-1001-TS5		18.53	-2.88
SCN-PJ09W2S44-V3-VALP-0001-TS4	72	19.20	
SCN-PJ09W2S44-V3-VALP-1001-TS4		19.37	0.89
SCN-PJ09W2S44-V3-VALP-0001-TS2**	71	19.65	-
SCN-PJ09W2S44-V3-VALP-1001-TS2**		19.30	-1.78

Table 24: Time Efficiency results for EXE-PJ.09-W2-44-V3-VALP-001.

- *EXE-PJ.09-W2-44-V3-VALP-002* ran four scenarios within the ENR High Complexity operating environment classifying them according to two criteria: the day of operation (i.e., D-1 and D-OPS) and the military scenario. Having in mind that the objective of the simulation is to assess the impact of the exchange of DAC and DMA updates on the key actors, the main considerations for the Fuel Efficiency assessment are: (a) since D-1 and D-OPS refers to the same traffic scenario, only D-OPS values are considered for the metric calculus; (b) validation exercise provides the route extension and the delay caused by the DMA/ARES allocation; and (c) *TEFF6* is analysed as a delta (i.e., additional flying time); and (d) the exercise consists of a real-time gaming simulation. Table 25 collects the results for the D-OPS for the Time Efficiency analysis.

Scenario	Nb. Flights	Delay [Δmin]	Delay [Δmin/flight]
MScen2 D - OPS Reference	150	51.7	0.34
MScen2 D - OPS Solution	148	78.1	0.52
MScen3 D – OPS Reference	150	74.4	0.50
MScen3 D – OPS Solution	150	33.4	0.22

Table 25: Time Efficiency results for EXE-PJ.09-W2-44-V3-VALP-002.

- *EXE-PJ.09-W2-44-V3-VALP-005* analyses the flight duration through TEFF6 in the two traffic samples executed in four different scenarios, depending on the applied DCB measures. Table 26 summarizes the results obtained from Appendix E VALR, under the following assumptions: (a) different solution scenarios are considered for the same traffic sample and all of them are included in the Time Efficiency analysis; and (b) the figures are obtained from an ATC Real Time Simulation.

Scenario	TEFF6 [min/flight]	ΔTEFF6 [%]
Reference TS1 RUN1/1	18.03	-
Solution TS1 RUN3/1	18.04	0.04
Solution TS1 RUN4/1	17.97	-0.35
Solution TS1 RUN5/1	18.04	0.03
Reference TS2 RUN1/2	18.22	-
Solution TS2 RUN3/2	18.06	-0.87
Solution TS2 RUN5/2	18.06	-0.89

Table 26: Time Efficiency results for EXE-PJ.09-W2-44-V3-VALP-005.

The local aggregation of TEFF6 metrics results in the figures shown in Table 27. For all the exercises, the metric is calculated as the average value of reference and solution scenario. Besides, the last column includes the difference of the flight duration between solution and reference scenario, $\Delta TEFF6$, and the non-dimensional value of the time reduction.

$$\Delta TEFF6\ [min/flight] = \Delta TEFF6_{solution} - TEFF6_{reference}$$

$$\Delta TEFF6\ [\%] = \frac{TEFF6_{solution} - TEFF6_{reference}}{TEFF6_{reference}} = \frac{\Delta TEFF6\ [min/flight]}{TEFF6_{reference}}$$

According to the definition of the latest variables, a negative value means greater durations in reference scenario and then, a flight time reduction because of the operational concept.

Validation Exercise	Ref. scenario TEFF6 [min/flight]	Sol. scenario TEFF6 [min/flight]	$\Delta TEFF6$ [min/flight]	$\Delta TEFF6$ [%]
EXE-PJ.09-W2-44-V3-VALP-001	19.47	18.82	-0.66	-3.37

EXE-PJ.09-W2-44-V3-VALP-002	-	-	-0.07	-
EXE-PJ.09-W2-44-V3-VALP-005	18.13	18.03	-0.09	-0.51

Table 27: Summary of TEFF6 PI per validation exercise.

The average value of the flight duration reduction is 0.27 min/flight (positive impact).

According to the definition of the validation activities, the three exercises examined under the scope of Operational Efficiency area contribute to the OIs showed in Table 28.

	EXE-PJ.09-W2-44-V3-VALP-001	**EXE-PJ.09-W2-44-V3-VALP-002**	**EXE-PJ.09-W2-44-V3-VALP-005**
CM-0102-B			X
CM-0103-B	X		
CM-0104-C	X		X
DCB-0210	X	X	X
AOM-0805		X	
AOM-0809-A		X	X

Table 28: OIs addressed by the exercises contributing to TEFF.

Therefore, the six OIs addressed by PJ.09-W2-44 contribute to the benefits drawn in terms of Time Efficiency and their relative contribution to the KPIs is shown in Table 29.

OI step	Relative benefits contribution to TEFF6
CM-0102-B	10%
CM-0103-B	10%
CM-0104-C	10%
DCB-0210	40%
AOM-0805	15%
AOM-0809-A	15%
TOTAL	100%

Table 29: Relative benefits contribution to TEFF6 by OI.

4.6.3 Extrapolation to ECAC wide

From the Common assumptions 2019 T-0010, the average ECAC flight time is 1.7 hours. Additionally, from the aggregation assumptions for 2035, the contribution to total ENR traffic from the Sub-Operating Environments affected by the operational concept are shown in Table 15.

ID	Sub-OE	Year	Value	Comment
ER-VHC-2035	Very High Complexity ER	2035	31,33%	Contribution to total En-Route traffic from the specific sub-OE
ER-HC-2035	High Complexity ER	2035	27,98%	Contribution to total En-Route traffic from the specific sub-OE

Table 30: Values for extrapolation at ECAC level

The flight time reduction resulting from the validation activities is ***0.27 min/flight*** (positive impact) in very high and high complexity airspace, which represent 59.31% of the ECAC traffic and therefore, ***Time Efficiency at ECAC level*** is:

$$\Delta TEFF6_{ECAC} = \Delta TEFF6 \cdot Traffic_{SubOE} = 0.27\ min/flight \cdot 59.31\% = 0.16 \frac{\text{min}}{\text{flight}}$$

Finally, considering the average ECAC flight time from the Common Assumptions, the ***average flight time reduction per ECAC as a percentage of the total flight time*** is:

$$\Delta TEFF1_{ECAC_{flight}} = \Delta TEFF6_{ECAC_{flight}} = \frac{0.16\ min/flight}{102\ min/flight} = 0.16\%$$

KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
TEFF1 Gate-to gate flight time	Min/flight	Average of the distribution of actual gate-to-gate flight durations	YES	*-0.16 min/flight* *Positive impact (i.e., reduction of flight time)*	*-0.16 %* *Positive impact (i.e., reduction of flight time)*
TEFF6 En-Route time	Min/flight	Average of the distribution of actual en-route durations	NO	*-0.16 min/flight* *Positive impact (i.e., reduction of flight time)*	*-0.16 %* *Positive impact (i.e., reduction of flight time)*

Table 31: Flight Times benefits for Mandatory KPIs /PIs

Table 32 shows the impact on flight phases (provided when it is possible).

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
TEFF1 Gate-to gate flight time	N/A	N/A	100%	N/A	N/A
TEFF6 En-Route time	N/A	N/A	100%	N/A	N/A

Table 32: Flight duration contribution per flight phase.

4.6.4 Discussion of Assessment Result

Aligned with the discussion on Fuel Efficiency about the confidence level of the results, validation techniques designed for the measurement of PJ.09-W2-44 in terms of Time Efficiency are in accordance with the target Maturity Gate. For that reason, along with the addressment of the six OIs, the ***confidence level of the results*** under the Time Efficiency focus area ***is high***.

On the other hand, from the qualitative scale published by PJ.19 in 'PJ19_04 – D4_7 Validation Targets – SESAR2020 Wave 2 & Wave 3', the expected impact of PJ.09-W2-44 on Flight duration is *level 2*. The results evince the alignment with the expectation.

Finally, *main differences regarding PJ19 estimations are on the Operating environment*: PJ19 expectations include TMA as Operating Environment where PJ.09-W2-44 results may provide benefits regarding Time Efficiency. However, PJ.09-W2-44 is focused on En-Route Very High and High complexity sub-operating environments (i.e., En-Route Airspace).

4.6.5 Additional Comments and Notes

No additional comments or notes.

4.7 Predictability

4.7.1 Performance Mechanism

Performance Benefit Impact Mechanisms for Predictability can be checked in Appendix A.

4.7.2 Assessment Data (Exercises and Expectations)

Within the Operational Efficiency area, DES Performance Framework examines Predictability through ***PRD1*** and ***PRD2***: *PRD1* represents the average of the distribution of the differences between flown trajectories & Flight Plans or RBT durations; whilst *PRD2* means the standard deviation of the distribution of the differences between flown trajectories & Flight Plans or RBT durations. Since the operating environment applicable for PJ.09-W2-44 is En-route, both metrics correspond to *PRD11* and *PRD12*, which respectively represent the average and the variability in En-route durations.

The assessment of validation objective OBJ-PJ09W2S44-V3-VALP.023 carried out by EXE-PJ.09-W2-44-V3-VALP-001 and EXE-PJ.09-W2-44-V3-VALP-005 through EXE1-CRT-PJ09W2S44-V3-VALP-014-001 and EX5-CRT-PJ09W2S44-V3-VALP-023-001, respectively, allows the extrapolation of the local results to ECAC level.

- *EXE-PJ.09-W2-44-V3-VALP-001* analyses the impact on Predictability from the results obtained in the ATC Real Time Simulation and under the same assumptions posed for the Time Efficiency study: (a) sector entry time and sector exit time are determined from flight plan data instead of radar track info; (b) all those flights already overflying the airspace of analysis when the simulation initiates are withdrawn from the sample; all those flights that are inside the analysis area when stopping the simulation are also removed from the calculus; (c) because of the regulations imposed in the first leg of the exercise (i.e., LTM execution) traffic sample in the ATC timeframe do not match and, for a fairer comparison, only those flights shared between both samples are considered in the analysis; (d) 0001 ID refers to Reference scenarios; meanwhile 1001 belongs to solution ones; and (e) the difference between actual and flight plan durations considers the absolute value (i.e., negative values computes as positive and hence, reductions are considers as bad as delays for predictability calculus). Table 33 gather the results available in Appendix A [25].

Scenario	Nb. Flights	$PRD11$ [min]	$PRD12$ [min^2]
SCN-PJ09W2S44-V3-VALP-0001-TS2	88	0.16	0.07
SCN-PJ09W2S44-V3-VALP-1001-TS2		0.56	6.23
SCN-PJ09W2S44-V3-VALP-0001-TS5	105	0.42	1.41
SCN-PJ09W2S44-V3-VALP-1001-TS5		0.22	0.13
SCN-PJ09W2S44-V3-VALP-0001-TS4	68	0.27	0.81
SCN-PJ09W2S44-V3-VALP-1001-TS4		0.14	0.04
SCN-PJ09W2S44-V3-VALP-0001-TS2**	58	0.21	0.05

SCN-PJ09W2S44-V3-VALP-1001-TS2**		0.43	2.48

Table 33: Predictability results for EXE-PJ.09-W2-44-V3-VALP-001.

- *EXE-PJ.09-W2-44-V3-VALP-005* measures the benefits in terms of Predictability through PRD11 in seconds. The main considerations for the aggregation are: (a) different solution scenarios are considered for the same traffic sample and all of them are included in the Time Efficiency analysis; (b) the figures are obtained from an ATC Real Time Simulation; and (c) the impact on Predictability is reported considering, on one hand, all the flights and, on the other hand, only the flight assumed by ATCo, hereafter, under the scope of the Predictability analysis, the latter figures (i.e., handled flights only) are considered.

Scenario	PRD11 [s]	PRD11 [min]
Reference TS1 **RUN1/1**	61.10	1.02
Solution TS1 **RUN3/1 (DAC Solution)**	89.90	1.50
Solution TS1 **RUN4/1 (DCB Solution)**	10.30	0.17
Solution TS1 **RUN5/1 (DAC+DCB Solution)**	49.10	0.82
Reference TS2 **RUN1/2**	233.10	3.89
Solution TS2 **RUN3/2 (DAC Solution)**	141.90	2.37
Solution TS2 **RUN5/2 (DAC+DCB Solution)**	107.60	1.79

Table 34: Predictability results for EXE-PJ.09-W2-44-V3-VALP-005.

From the exercise analysis, the local aggregation of Predictability leads to the results shown in Table 35 and Table 36 for PRD11 and PRD 12, respectively. To do so, the average of the outcome of the scenarios is calculated along with the difference between reference and solution results according to the following equation:

$$\Delta PRD11\ [min] = PRD11_{solution} - PRD11_{reference}$$

$$\Delta PRD12\ [\mathrm{min}^2] = PRD12_{solution}[\mathrm{min}^2] - PRD12_{reference}[\mathrm{min}^2]$$

Validation Exercise	Ref. scenario PRD11 [min]	Sol. scenario PRD11 [min]	ΔPRD11 [min]
EXE-PJ.09-W2-44-V3-VALP-001	0.28	0.33	0.06
EXE-PJ.09-W2-44-V3-VALP-005	2.45	1.33	-1.12

Table 35: Summary of PRD1 per validation exercise.

Validation Exercise	Ref. scenario PRD12 [min^2]	Sol. scenario PRD12 [min^2]	ΔPRD12 [min^2]
EXE-PJ.09-W2-44-V3-VALP-001	0.67	2.22	1.56
EXE-PJ.09-W2-44-V3-VALP-005	-	-	-

Table 36: Summary of PRD2 per validation exercise.

According to the definition of the latter equations, a negative value means that the either the mean or the variance of the distribution of the differences between flown trajectories & Flight Plans or RBT durations decreases due to the operational concept (i.e., the difference between both times is smaller and therefore, flow trajectories get closer to the flight plans, improving predictability). Considering the results, PJ.09-W2-44 improves Predictability in terms of the mean value (i.e., PRD11) but the distribution of the differences is wider (i.e., the variance of the distribution increases).

Flight plan adherence increase in terms of PRD11 in 0.53 min (positive impact); meanwhile, the variance of the distribution gets worse in 1.56 min^2.

According to the definition of the validation activities, the two exercises examined under the scope of Predictability contribute to the OIs showed in Table 37.

	EXE-PJ.09-W2-44-V3-VALP-001	EXE-PJ.09-W2-44-V3-VALP-005
CM-0102-B		X
CM-0103-B	X	
CM-0104-C	X	X
DCB-0210	X	X
AOM-0805		
AOM-0809-A		X

Table 37: OIs addressed by the exercises contributing to Predictability.

OI step	Relative benefits contribution to PRD1	Relative benefits contribution to PRD2
CM-0102-B	15%	15%
CM-0103-B	15%	15%
CM-0104-C	10%	10%
DCB-0210	40%	40%
AOM-0805	N/A	N/A
AOM-0809-A	20%	20%
TOTAL	100%	100%

Table 38: Relative benefits contribution to PRD11 & PRD12 by OI.

4.7.3 Extrapolation to ECAC wide

From the Common assumptions 2019 T-0011, B2B variability (variance) is 49 min^2. Additionally, from the aggregation assumptions for 2035, the contribution to total ENR traffic from the Sub-Operating Environments affected by the operational concept are shown in Table 39.

ID	Sub-OE	Year	Value	Comment
ER-VHC-2035	Very High Complexity ER	2035	31,33%	Contribution to total En-Route traffic from the specific sub-OE
ER-HC-2035	High Complexity ER	2035	27,98%	Contribution to total En-Route traffic from the specific sub-OE

Table 39: Values for extrapolation at ECAC level

The average value for PRD1 and PRD2 resulting from the validation activities are ***-0.53 min*** (positive impact) and ***1.56 min^2*** (negative impact) in very high and high complexity airspace, which represent 59.31% of the ECAC traffic and therefore, the ***extrapolation for both average and variance of the difference between flown trajectories & Flight Plans at ECAC level*** is:

$$\Delta PRD1_{ECAC} = \Delta PRD1 \cdot Traffic_{SubOE} = -0.53\,min \cdot 59.31\% = -0.32\text{ min}$$

$$\Delta PRD2 = \Delta PRD2 \cdot Traffic_{SubOE} = 1.56\,min^2 \cdot 59.31\% = 0.92\text{ min}^2$$

Finally, considering the whole B2B variability from the Common Assumptions, the ***analysis of the flight plan adherence results***:

$$\Delta PRD2_{ECAC_{flight}} = \frac{0.92\,min^2}{49\,min^2} = 1.88\%$$

KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
PRD1 Average of Difference in actual & Flight Plan or RBT durations	Minutes	Average of the distribution of the differences between flown trajectories & Flight Plans or RBT durations	YES	*-0.32 min* *Positive impact (i.e., better adherence to flight plan)*	*N/A*
PRD2 Variance[6] of Difference in actual & Flight Plan or RBT durations	$Minutes^2$	Variance of the distribution of the differences between flown trajectories & Flight Plans or RBT durations	YES	*0.92 min^2* *Negative impact (i.e., increase of variance)*	*1.88%* *Negative impact (i.e., increase of variance)*

Table 40: Predictability benefits for Mandatory KPIs /PIs

Table 41 is showing the impact on flight phases (provided when it is possible).

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
PRD1 Average of Difference in actual & Flight Plan or RBT durations	N/A	N/A	100%	N/A	N/A
PRD2 Variance of Difference in actual & Flight Plan or RBT durations	N/A	N/A	100%	N/A	N/A

Table 41: Predictability benefit per flight phase

4.7.4 Discussion of Assessment Result

Under the scope of Operational Efficiency, five out of the six OIs addressed by PJ.09-W2-44 contribute to the results measured by the exercises. That, along with the validation techniques applied in the validation activities, ensure the ***high level confidence of the results***.

On the other hand, from the qualitative scale published by PJ.19 in 'PJ19_04 – D4_7 Validation Targets – SESAR2020 Wave 2 & Wave 3', the expected impact of PJ.09-W2-44 on Predictability is *level 2*. The results evince the alignment with the expectation.

Finally, *main differences regarding PJ19 estimations are on the Operating environment*: PJ19 expectations include TMA as Operating Environment where PJ.09-W2-44 results may provide benefits regarding Predictability. However, PJ.09-W2-44 is focused on En-Route Very High and High complexity sub-operating environments (i.e., En-Route Airspace).

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

4.7.5 Additional Comments and Notes

No additional comments or notes.

EUROPEAN PARTNERSHIP

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4.8 Punctuality

4.8.1 Performance Mechanism

Performance Benefit Impact Mechanisms for Punctuality can be checked in Appendix A.

4.8.2 Assessment Data (Exercises and Expectations)

Punctuality is the last focus area analysed under the scope of Operational Efficiency. DES Performance Framework proposes ***PUN1*** as the main KPI for Departure Punctuality: average departure delay due to reactionary delays, ATM, and weather-related delay causes. According to the latter definition, PUN1 is measured in [min/flight] and is assessed as the average delay (AOBT – SOBT) per flight due to reactionary delays, ATM and weather-related delay causes.

Validation objective OBJ-PJ09W2S44-V3-VALP.024 analyses the impact on Punctuality. Both EXE-PJ.09-W2-44-V3-VALP-002 and EXE-PJ.09-W2-44-V3-VALP-003 contribute to the performance study through EXE2-CRT-PJ09W2S44-V3-VALP.024-01 and EXE03- CRT-PJ09W2S44-V3-VALP-019-001, respectively.

- The simulation carried out by *EXE-PJ.09-W2-44-V3-VALP-002* in the INAP timeframe results in the figures provided in Table 42. The main considerations for the analysis are: (a) since D-1 and D-OPS refers to the same traffic scenario, only D-OPS values are considered for the metric calculus; (b) No additional regulation was used in MScen3; and (c) In MScen2, the Demand Capacity balancing process led to declare a regulation on the EPWBD traffic volume and results in the delays shown in Table 42.

Scenario	Nb. Flights	Delay [min]	Delay per flight [min/flight]
MScen2 D - OPS Reference	150	161	1.07
MScen2 D - OPS Solution	148	158	1.07
MScen3 D – OPS Reference	150	0	0
MScen3 D – OPS Solution	150	0	0

Table 42: Punctuality results for EXE-PJ.09-W2-44-V3-VALP-002.

- *EXE-PJ.09-W2-44-V3-VALP-003* studies the impact on the AU through the reactive delays in two scenarios, framed within the High Complexity En-Route sub-operating environment. Table 43 summarizes the results drawn by EXE-PJ.09-W2-44-V3-VALP-003 under the following considerations: (a) Scenarios ran under the scope of Fast Time Simulations are considered for the analysis, as described in the assessment of EXE03-OBJ- PJ09W2S44-V3-VALP.019, carried out by the exercise; and (b) the results represent the benefits from the ATFCM phase.

Scenario	Nb. Flights	Delay [min]	Delay per flight [min/flight]
SCN-PJ09W2S44-V3-VALP-001 Reference	623	1308	2.10
SCN-PJ09W2S44-V3-VALP-001 Solution	623	921	1.48
SCN-PJ09W2S44-V3-VALP-002 Reference	87	736	8.46
SCN-PJ09W2S44-V3-VALP-002 Solution	87	494	5.68

Table 43: Punctuality results for EXE-PJ.09-W2-44-V3-VALP-003.

Considering the average value of the previous results, Table 44 gathers the impact on PUN1 per validation exercise. Besides, the difference between solution and reference scenarios is calculated according to the following formula:

$$\Delta PUN1\ [min/flight] = PUN1_{solution} - PUN1_{reference}$$

$$\Delta PUN1\ [\%] = \frac{PUN1_{solution} - PUN1_{reference}}{PUN1_{reference}} = \frac{\Delta PUN1\ [min/flight]}{PUN1_{reference}}$$

According to the definition of the latest variables, a negative value means greater reactionary delays in reference scenario and then, a delay reduction because of the operational concept.

Validation Exercise	Ref. scenario PUN1 [min/flight]	Sol. scenario PUN1 [min/flight]	ΔPUN1 [min/flight]	ΔPUN1 [%]
EXE-PJ.09-W2-44-V3-VALP-002	0.54	0.54	0	0
EXE-PJ.09-W2-44-V3-VALP-003	5.28	3.58	-1.70	-32.23%

Table 44: Summary of PUN1 per validation exercise.

Delays caused by ATFCM regulations decrease in 0.85 min/flight (positive impact).

According to the definition of the validation activities, the two exercises examined under the scope of Punctuality focus area contribute to the OIs showed in Table 45. Therefore, five out of the six OIs addressed by PJ.09-W2-44 contribute to the proven benefits drawn in terms of Punctuality and their relative contribution to the KPIs is shown in Table 46.

	EXE-PJ.09-W2-44-V3-VALP-002	EXE-PJ.09-W2-44-V3-VALP-003
CM-0102-B		X
CM-0103-B		
CM-0104-C		X
DCB-0210	X	X
AOM-0805	X	X
AOM-0809-A	X	

Table 45: OIs addressed by the exercises contributing to PUN.

OI step	Relative benefits contribution to PUN1	Relative benefits contribution to PUN2
CM-0102-B	15%	15%
CM-0103-B	N/A	N/A
CM-0104-C	10%	10%
DCB-0210	40%	40%
AOM-0805	15%	15%
AOM-0809-A	20%	20%
TOTAL	100%	100%

Table 46: Relative benefits contribution to PUN1 by OI.

4.8.3 Extrapolation to ECAC wide

From the Common assumptions 2019, there is not a figure representing the delay per flight due to reactionary delays, ATM and weather-related delay causes. However, Performance Review Report 2021 provides an average of the En-route ATM delay per flight in 2019: 1.57 minutes. Additionally, from the aggregation assumptions for 2035, the contribution to total ENR traffic from the Sub-Operating Environments affected by the operational concept are shown in Table 47.

ID	Sub-OE	Year	Value	Comment
ER-VHC-2035	Very High Complexity ER	2035	31,33%	Contribution to total En-Route traffic from the specific sub-OE
ER-HC-2035	High Complexity ER	2035	27,98%	Contribution to total En-Route traffic from the specific sub-OE

Table 47: Values for extrapolation at ECAC level

With regards to the latter aspect, it's important to notice that PUN1 KPI only considers the departures so, the traffic affected will be divided by two (i.e., 29.66%).

The average value for PUN1 from the validation activities is ***-0.85 min/flight*** (positive impact) in the departures passing through very high and high complexity ENR airspace, which represent 29.66% of the ECAC traffic and therefore, the ***extrapolation for the average delay per flight due to reactionary delays, ATM and weather related delay causes.*** From local to ECAC level is:

$$\Delta PUN1_{ECAC} = \Delta PUN1 \cdot Traffic_{SuboE} = -0.85 min/flight \cdot 29.66\% = -0.25 \text{ min/flight}$$

Finally, considering the as assumption the figure provided by the PRR about the average En-Route ATFM delay per flight:

$$\Delta PUN1_{ECAC} = \frac{-0.25\ min/flight}{1.57\ min/flight} = -16\%$$

KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
PUN1 Average departure delay per flight	min/flight	Average delay (AOBT – SOBT) per flight due to reactionary delays, ATM and weather related delay causes.	YES	*-0.25 min/flight* *Positive impact (i.e., (average delay decreases)*	*-16%* *Positive impact (i.e., average delay decreases)*

Table 48: Punctuality benefit for Mandatory KPIs /PIs

Table 49 shows the impact on flight phases (provided when it is possible).

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
PUN1 Average departure delay per flight	N/A	N/A	100%	N/A	N/A

Table 49: Punctuality benefit per flight phase.

4.8.4 Discussion of Assessment Result

For the assessment of PJ.09-W2-44 contribution to Punctuality, the results from EXE-PJ.09-W2-44-V3-VALP-002 and EXE-PJ.09-W2-44-V3-VALP-003 are considered. Both exercises validate DAC concept in the LTM timeframe, which is deemed as the most important phase for the analysis of the impact on delays. Besides that, RTS is the basis for the validation techniques and five out of the six OIs are addressed by the exercises already mentioned. The ***level of confidence in results*** therefore, is regarded as ***high***.

On the other hand, from the qualitative scale published by PJ.19 in 'PJ19_04 – D4_7 Validation Targets – SESAR2020 Wave 2 & Wave 3', the expected impact of PJ.09-W2-44 on Punctuality is *level 3*. The results evince the alignment with the expectation.

Finally, *main differences regarding PJ19 estimations are on the Operating environment*: PJ19 expectations include TMA as Operating Environment where PJ.09-W2-44 results may provide benefits regarding Punctuality. However, PJ.09-W2-44 is focused on En-Route Very High and High complexity sub-operating environments (i.e., En-Route Airspace).

4.8.5 Additional Comments and Notes

No additional comments or notes.

4.9 Cost Efficiency

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

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

4.9.1 Performance Mechanism

Performance Benefit Impact Mechanisms for Cost Efficiency can be checked in Appendix A.

4.9.2 Assessment Data (Exercises and Expectations)

Results for ***Cost Efficiency*** are extracted from the assessment of OBJ-PJ09W2S44-V3-VALP.019, which comprises one success criteria: CRT-PJ09W2S44-V3-VALP-019-001, the integration of Dynamic Airspace Configuration with INAP shows an improvement in Capacity.

In *EXE-PJ.09-W2-44-V3-VALP-001*, CEF2 is analysed in the four high complexity scenarios. The results are collected through Real Time Simulations in the ATC service provision timeframe and are presented in Table 50.

Traffic Sample	Ref Scenario	Sol Scenario
SCN-PJ09W2S44-V3-VALP-X001-TS2	3.00	3.00
SCN-PJ09W2S44-V3-VALP-X001-TS5	4.80	2.90
SCN-PJ09W2S44-V3-VALP-X001-TS4	2.30	2.80
SCN-PJ09W2S44-V3-VALP-X001-TS2**	3.40	3.60

Table 50: ATCO WL results for EXE-PJ.09-W2-44-V3-VALP-001.

Table 50 shows the average workload per scenario and for the different traffic samples performed during the exercise. With these values, the increase in productivity is shown in Table 51.

Traffic Sample	WL reduction [%]
SCN-PJ09W2S44-V3-VALP-1001-TS2	0
SCN-PJ09W2S44-V3-VALP-1001-TS5	39.58
SCN-PJ09W2S44-V3-VALP-1001-TS4	-21.74
SCN-PJ09W2S44-V3-VALP-1001-TS2**	-5.88

Table 51: WL reduction per Traffic Sample.

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Taking into account the values shown in Table 51, and using the definition of increase in productivity provided by PJ19 in [4],

$$Increase\ in\ productivity = \frac{1}{1 - \frac{0.75 \cdot Workload\ Reduction}{2}} - 1$$

The values obtained for the increase in productivity are the collected in Table 52.

Traffic Sample	Increase in productivity [%]
SCN-PJ09W2S44-V3-VALP-1001-TS2	0
SCN-PJ09W2S44-V3-VALP-1001-TS5	17.43
SCN-PJ09W2S44-V3-VALP-1001-TS4	-7.54
SCN-PJ09W2S44-V3-VALP-1001-TS2**	-2.16

Table 52: Increase in Productivity per Traffic Sample

With this information, the average value for Increase in Productivity is **1.93%.**

Getting back to the definition of the validation activities, the exercise examined under the scope of the environment area contribute to the OIs as showed in Table 53.

	EXE-PJ.09-W2-44-V3-VALP-001
CM-0102-B	
CM-0103-B	X
CM-0104-C	X
DCB-0210	X
AOM-0805	
AOM-0809-A	

Table 53: OIs addressed by the exercise contributing to CEF2.

Thus, the six OIs addressed by PJ.09-W2-44 contribute to the benefits drawn in terms of Productivity and their relative contribution to the KPIs is shown in Table 54.

OI step	Relative benefits contribution to CEF2
CM-0102-B	N/A
CM-0103-B	20%
CM-0104-C	30%

DCB-0210	50%
AOM-0805	N/A
AOM-0809-A	N/A
TOTAL	100%

Table 54: Relative contribution to CEF2 per OI

4.9.3 Extrapolation to ECAC wide

From the aggregation assumptions for 2035, the contribution to total ENR traffic from the Sub-Operating Environments affected by the operational concept are shown in Table 55.

ID	Sub-OE	Year	Value	Comment
ER-VHC-2035	Very High Complexity ER	2035	31,33%	Contribution to total En-Route traffic from the specific sub-OE
ER-HC-2035	High Complexity ER	2035	27,98%	Contribution to total En-Route traffic from the specific sub-OE

Table 55: Values for extrapolation at ECAC level

The increase in productivity measured by the validation activities is ***1.93 %*** (positive impact) in very high and high complexity airspace, which represent 59.31% of the ECAC traffic and therefore, the ***increase in productivity at ECAC level*** is:

$$\Delta CEF2_{ECAC} = \Delta CEF2_{local} \cdot Traffic_{SubOE} = 1.93\ \% \cdot 59.31\% = 1.14\ \%$$

KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
CEF2[7] Flights per ATCO-Hour on duty	No	Count of Flights handled divided by the number of ATCO-Hours applied by ATCOs on duty.	YES		*1.14%* *Positive Impact*
CEF3 Technology cost per flight	EUR / flight	G2G ANS cost changes related to technology and equipment.	YES	N/A	N/A

Table 56: Cost Efficiency benefit for Mandatory KPIs /PIs

4.9.4 Discussion of Assessment Result

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

Validation techniques designed for the measurement of PJ.09-W2-44 in terms of Cost Efficiency are Real Time Simulations of both INAP and ATC timeframe. Therefore, the ***confidence level of the results is high***.

On the other hand, from the qualitative scale published by PJ.19 in 'PJ19_04 – D4_7 Validation Targets – SESAR2020 Wave 2 & Wave 3', the expected impact of PJ.09-W2-44 on Cost Efficiency is level 3. The results evince the alignment with the expectation.

4.9.5 Additional Comments and Notes

No additional comments or notes.

4.10 Airspace User Cost Efficiency

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

4.10.1 Performance Mechanism

Although there could be some marginal benefits for the airspace users derived from the operational concept described in PJ09.02, this KPA was out of the scope of PJ09-W2-44, which was focused on the ANSP-LTMs needs.

4.10.2 Assessment Data (Exercises and Expectations)

N/A

4.10.3 Extrapolation to ECAC wide

PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
AUC3 Direct operating costs for an airspace user	EUR	Impact on direct costs related to the aeroplane and passengers. Examples: fuel, staff expenses, passenger service costs, maintenance and repairs, navigation charges, strategic delay, landing fees, catering.	Yes, where an impact is foreseen on AU cost efficiency	N/A	N/A
AUC4 Indirect operating costs for an airspace user	EUR	Impact on operating costs that don't relate to a specific flight. Examples: parking charges, crew and cabin salary, handling prices at Base Stations.	Yes, where an impact is foreseen on AU cost efficiency	N/A	N/A
AUC5 Overhead costs for an airspace user	EUR	Impact on overhead costs. Examples: dispatchers, training, IT infrastructure, sales.	Yes, where an impact is foreseen on AU cost efficiency	N/A	N/A

Table 57: Airspace User Cost Efficiency benefit for Mandatory KPIs /PIs

4.10.4 Discussion of Assessment Result

N/A

4.10.5 Additional Comments and Notes

N/A

4.11 Security

4.11.1 The SecRAM 2.0 methodology and the Security Performance Mechanism

4.11.2 Security Assessment Data Collection

PIs	Unit	Calculation	Mandatory	Current value
SEC1 A security risk assessment has been carried out	Binary Vector – with maximum 7 components with Y/N (according to the prioritization and maturity level of the solution)	A security risk assessment has been carried out applying SecRAM 2.0, and the following steps have each been carried out: The identification of Primary Assets, Supporting Assets, Threat Scenarios and Vulnerabilities; The evaluation of Impacts, Likelihoods and Risks.	YES	Y,Y,Y,Y,Y,Y,Y
SEC2 Risk Treatment has been carried out	Binary Vector – 2 components with Y/N	Following SecRAM 2.0, Security controls have been identified by Security Experts and implemented in the Solution.	YES	Y,N
SEC3 Residual risk after treatment meets security objective.	Risk Level – 2 levels are possible: medium or low	After Security Controls have been implemented, the Risk Level achieved per Supporting Asset decreases (H → M, M→L, H→L). It is important to notice that according to SecRAM the Risk Level achieved should be "Low" otherwise justifications must be provided.	YES	LOW

Table 58: Security benefit for Mandatory PIs

4.11.3 Extrapolation to ECAC wide

There is no ECAC wide extrapolation required for this KPI.

4.11.4 Discussion of Assessment Result

N/A

4.11.5 Additional Comments and Notes

There is no ECAC wide extrapolation required for this KPI.

4.12 Human Performance

4.12.1 HP arguments, activities and metrics

For further details on the HP arguments, activities and metrics covered by PJ09-W2-44, please refer to [23] SESAR Solution PJ.09-W2-44 SPR-INTEROP/OSED Part IV – Human Performance Assessment Report.

PIs	Activities & Metrics	Second level indicators	Covered
HP1 Consistency of human role with respect to human capabilities and limitations	**HITL - RTS**	**HP1.1** Clarity and completeness of role and responsibilities of human actors	**Yes**
		HP1.2 Adequacy of operating methods (procedures) in supporting human performance	**Yes**
		HP1.3 Capability of human actors to achieve their tasks in a timely manner, with limited error rate and acceptable workload level	**Yes**
HP2 Suitability of technical system in supporting the tasks of human actors	**HITL - RTS**	**HP2.1** Adequacy of allocation of tasks between the human and the machine (i.e. level of automation).	**Yes**
		HP2.2 Adequacy of technical systems in supporting Human Performance with respect to timeliness of system responses and accuracy of information provided	**Yes**
		HP2.3 Adequacy of the human machine interface in supporting the human in carrying out their tasks.	**Yes**
HP3 Adequacy of team structure and team communication in supporting the human actors	**HITL - RTS**	**HP3.1** Adequacy of team composition in terms of identified roles	**Yes**
		HP3.2 Adequacy of task allocation among human actors	**Yes**
		HP3.3 Adequacy of team communication with regard to information type, technical enablers and impact on situation awareness/workload	**Yes**
HP4 Feasibility with regard to HP-related transition factors	**HITL - RTS**	**HP4.1** User acceptability of the proposed solution	**Yes**
		HP4.2 Feasibility in relation to changes in competence requirements	**Yes**
		HP4.3 Feasibility in relation to changes in staffing levels, shift organization and workforce relocation.	**No**

PIs	Activities & Metrics	Second level indicators	Covered
		HP4.4 Feasibility in relation to changes in recruitment and selection requirements .	No
		HP4.5 Feasibility in terms of changes in training needs with regard to its contents, duration and modality.	Yes

Table 59: HP arguments, activities and metrics

4.12.2Extrapolation to ECAC wide

There is no ECAC wide extrapolation required for this KPI.

4.12.3Open HP issues/ recommendations and requirements

For further details on the HP arguments, activities and metrics covered by PJ09-W2-44, please refer to [23] SESAR Solution PJ.09-W2-44 SPR-INTEROP/OSED Part IV – Human Performance 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	6	4	0
HP2 Suitability of technical system in supporting the tasks of human actors	1	1	1
HP3 Adequacy of team structure and team communication in supporting the human actors	4	2	0
HP4 Feasibility with regard to HP-related transition factors	2	0	2

Table 60: Open HP issues/ recommendations and requirements

4.12.4Concept interaction

Potential concept interactions have been identified with PJ.07-W2-39, PJ.07-W2-40 and PJ.10-W2-93. No issues/benefits have been derived from these interactions.

4.12.5 Most important HP issues

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	HP Issue: The role and responsibilities of the planner controller might require further assessment in high traffic demand situations.	N/A
	HP Issue: The operating methods related to the coordination between LTM/EAP and SUP using the automated support tool for the management of sector configurations is not clear enough.	N/A
	HP Benefit: The consideration of different Key Performance Indicators for the implementation of demand and capacity measures might increase the efficiency of the different actors decision-making process.	N/A
HP2 Suitability of technical system in supporting the tasks of human actors	HP Issue: When NM sends targets to local DAC, and local DAC has its own targets, if these targets are conflicting they might be overlooked.	N/A
HP3 Adequacy of team structure and team communication in supporting the human actors	HP Benefit: The provision of the What-Else functionality for demand and capacity measures decision making might reduce LTM/EAP workload and increase the efficiency of the measures taken.	N/A
	HP Benefit: The implementation of digital communication between LTM/EAP/SUP and executive and planner controller (hotspot information, demand and capacity measures information) might lead to improved ATCo situational awareness and reduced ATCo workload, in particular for the implementation of short-term measures by the EC/PC.	N/A
	HP Benefit: The provision of the Network Impacted Assessment	N/A

PIs	Most important issue of the solution	Most important issues due to solution interdependencies
	for the solutions taken by the local LTM/EAP might increase the situational awareness of all the relevant actors and the efficiency of the measures taken.	
HP4 Feasibility with regard to HP-related transition factors	HP Issue: Knowledge, skills and experience requirements for conducting the new operating methods might be underestimated (e.g. highly specialised vs. generic training).	N/A
	HP Issue: If the ATCos are not sufficiently trained for the new sectors, their workload might increase and the benefit of the concept might not be reached.	N/A

Table 61: Most important HP issues

4.12.6Additional Comments and Notes

No additional comments or notes.

4.13Gap Analysis

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits at Network Level (ECAC Wide or Local depending on the KPI)[8]	Rationale[9]
SAF1: Safety - Total number of estimated accidents with ATM Contribution per year	Yes	See Section 4.3 Safety	N/A
FEFF1: Fuel Efficiency - Actual average fuel burn per flight	Impact Level 3	4.75 kg/flight (≈0.09%) Positive impact (i.e., fuel savings)	Fuel Efficiency has been measured in High Complexity sub-operating environments, although the results have been extrapolated to Very High Complexity sub-OE as well. The Performance benefits reported by PJ.09-W2-44 corresponds to Impact Level 2, instead of Level 3. However, solutions experts agree on the alignment of expectations and results.
CAP1: TMA Airspace Capacity - TMA throughput, in challenging airspace, per unit time.	N/A	N/A	N/A

[8] Negative impacts are indicated in red.

[9] Discuss the outcome if the gap indicates a different understanding of the contribution of the Solution (for example, the Solution is enabling other Solutions and therefore is not contributing a direct benefit). **Please contact your PJ19.04 Solution Champion to clarify when the Gap Rational is needed.**

CAP2: En-Route Airspace Capacity - En-route throughput, in challenging airspace, per unit time	Impact Level 3	3.00% Positive impact (i.e., capacity increase)	En-Route Capacity has been addressed in High Complexity sub-operating environments, although the results are applicable for Very High Complexity sub-OE as well.
CAP3: Airport Capacity – Peak Runway Throughput (Mixed mode).	N/A	N/A	N/A
TEFF1: Gate-to-gate flight time	Impact Level 2	0.16 min/flight (≈0.16%) Positive impact (i.e., flight time reduction)	Flight Times has been measured in High Complexity sub-operating environments, although the results have been extrapolated to Very High Complexity sub-OE as well.
PRD1: Predictability – Average of Difference in actual & Flight Plan or RBT durations	Impact Level 2	0.32 min Positive impact (i.e., better adherence to flight plan)	Flight Plan adherence has been measured in High Complexity sub-operating environments, although the results have been extrapolated to Very High Complexity sub-OE as well.
PUN1: Punctuality – Average departure delay per flight	Impact Level 3	0.25 min/flight (≈16%) Positive impact (i.e., average delay decreases)	Punctuality has been measured in High Complexity sub-operating environments, although the results have been extrapolated to Very High Complexity sub-OE as well.

CEF2: ATCO Productivity – Flights per ATCO -Hour on duty	Impact Level 3	1.14% Positive impact (i.e., ATCo productivity increases)	ATCO productivity has been measured in High Complexity sub-operating environments, although the results have been extrapolated to Very High Complexity sub-OE as well.
CEF3: Technology Cost – Cost per flight	N/A	N/A	N/A

Table 62: Gap analysis Summary

5 References

[1] 08.01.03 D47: AIRM v4.1.0

[2] B05 Performance Assessment Methodology for Step 1 PJ19.04.01 Methodology for Performance Assessment Results Consolidation (2020)[10]

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

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[4] PJ.19-W2 D4.4 DES Performance Framework, November 2022

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

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

Content Integration

[7] SESAR ATM Lexicon

Performance Management

[8] PJ19.04 D4.1 Validation Targets - Wave 2 (2020)[11]

[9] PJ.19-W2 D4.0.1 Validation Targets – SESAR 2020 Wave 2 & Wave 3, May 2021

Validation

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

Safety

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

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

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

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

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[14]Accident Incident Models – AIM, release 2017

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Human Performance

[15]16.06.05 D 27 HP Reference Material D27

[16]16.04.02 D04 e-HP Repository - Release note

Environment Assessment

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

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

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

Security

[19]16.06.02 D103 SESAR Security Ref Material Level

[20]16.06.02 D137 Minimum Set of Security Controls (MSSCs).

[21]16.06.02 D131 Security Database Application (CTRL_S)

PJ.09-W2-44 Deliverables

[22]SESAR Solution PJ.09-W2-44 SPR-INTEROP/OSED for V3 - Part I, July 2021, Edition 00.01.04

[23]SESAR Solution PJ.09-W2-44 SPR-INTEROP/OSED for V3 – Part IV, January 2023

[24]SESAR Solution PJ.09-W2-44 Final VALP for V3 – Part I, June 2022, Edition 00.02.01

[25]SESAR Solution PJ.09-W2-44 Final VALR for V3 – Part I, January 2023, Edition 00.02.01

Appendix A Benefit Impact Mechanisms

A.1 AOM-0805

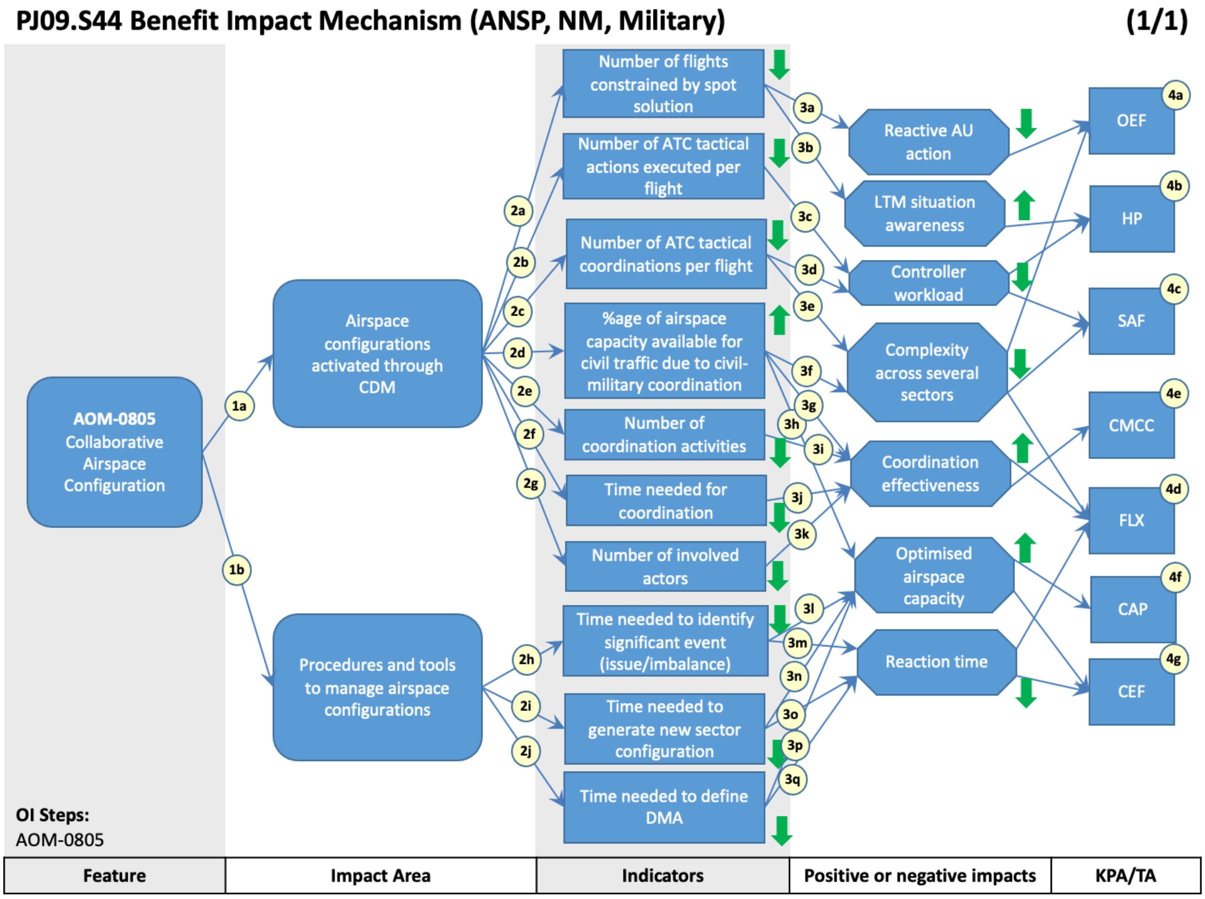

Figure 1: BIM for AOM-0805 Collaborative Airspace Configuration.

A.2 AOM-0809-A

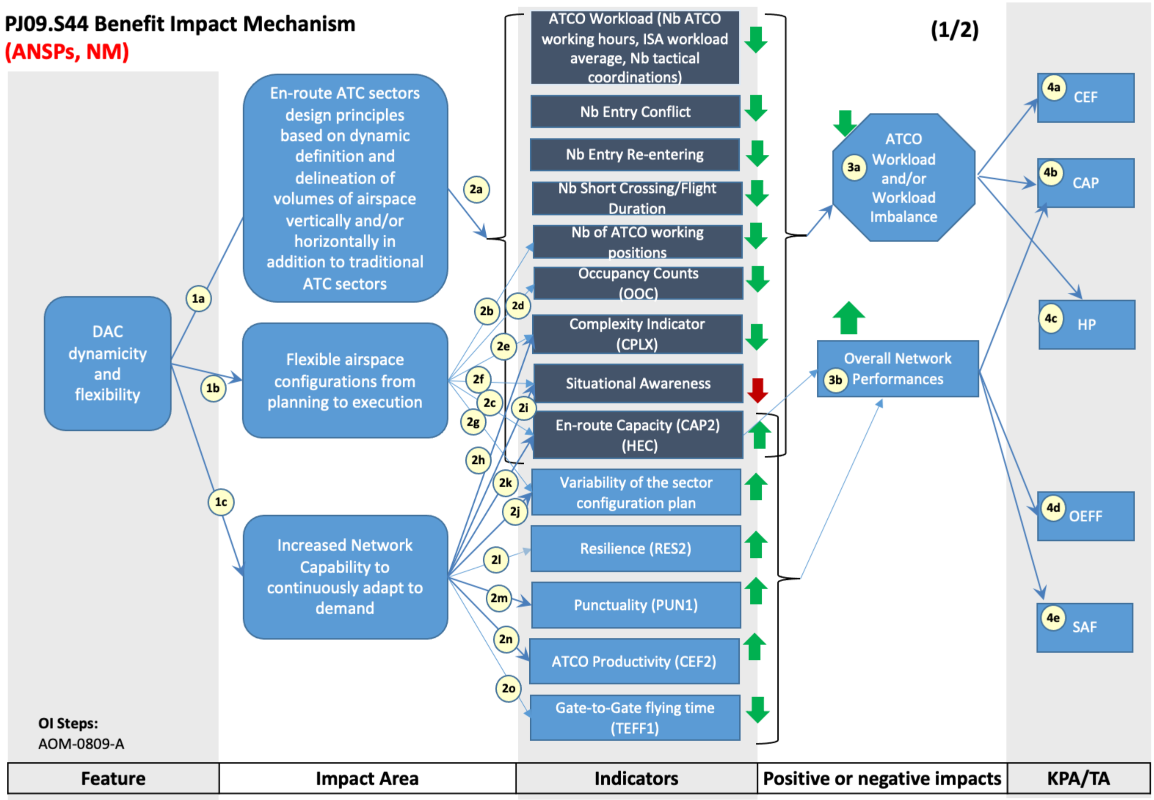

Figure 2: BIM for AOM-0809 DAC dynamicity and flexibility from ANSP and NM perspectives.

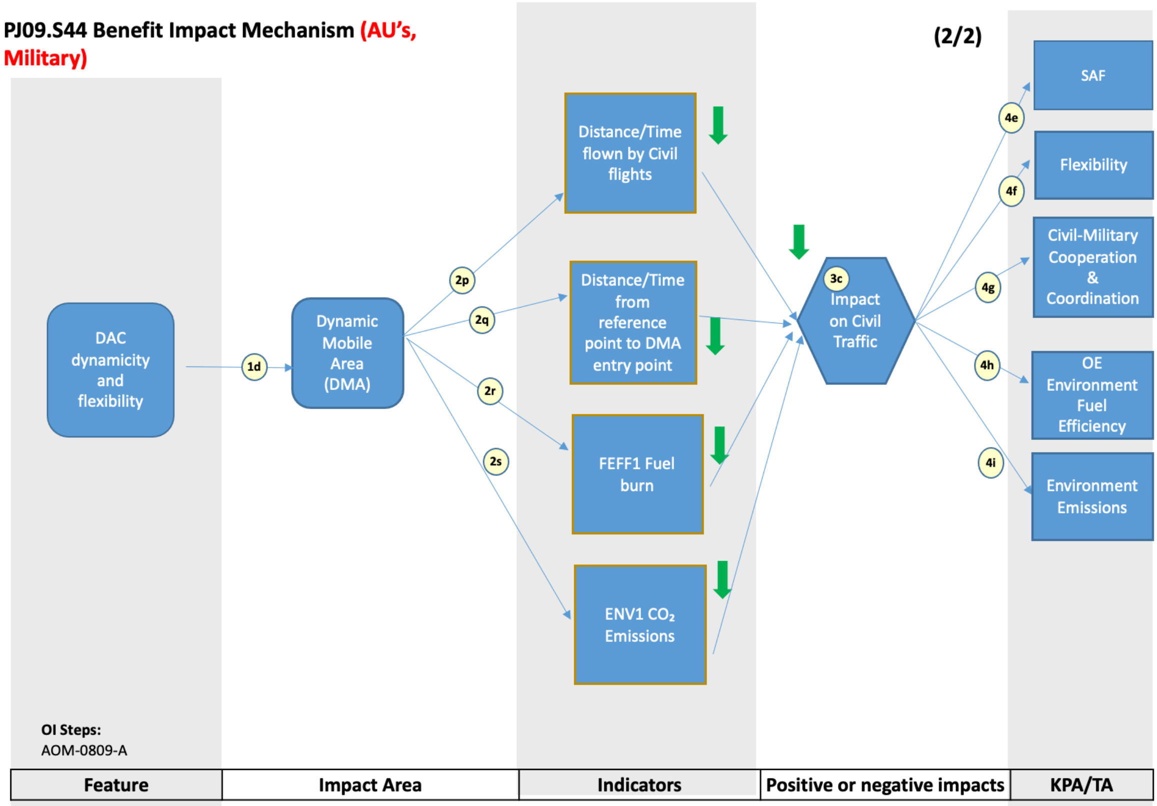

Figure 3: BIM for AOM-0809 DAC dynamicity and flexibility from AU and Military perspectives.

A.3 CM-0102-B

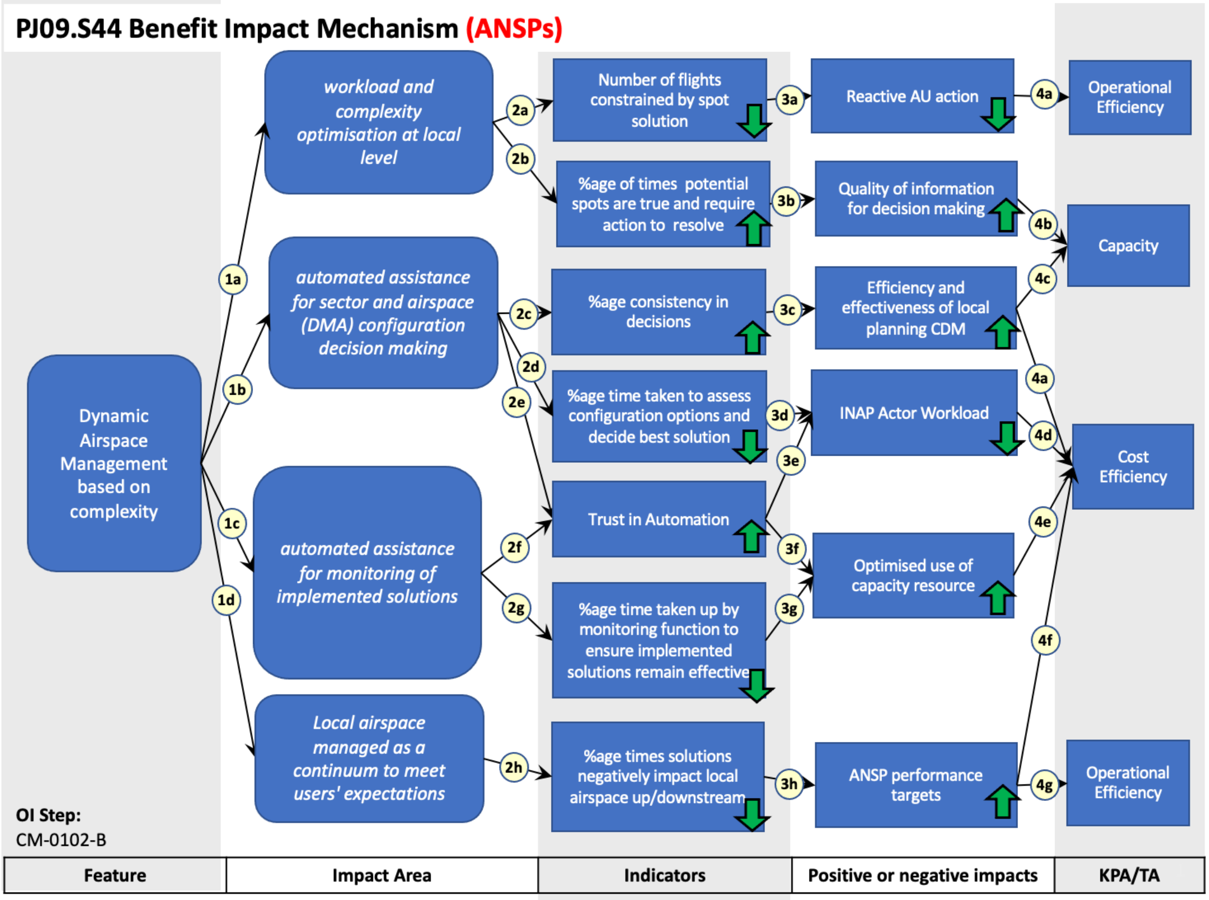

Figure 4: BIM for CM-0102-B dynamic airspace management based on complexity.

A.4 CM-0103-B

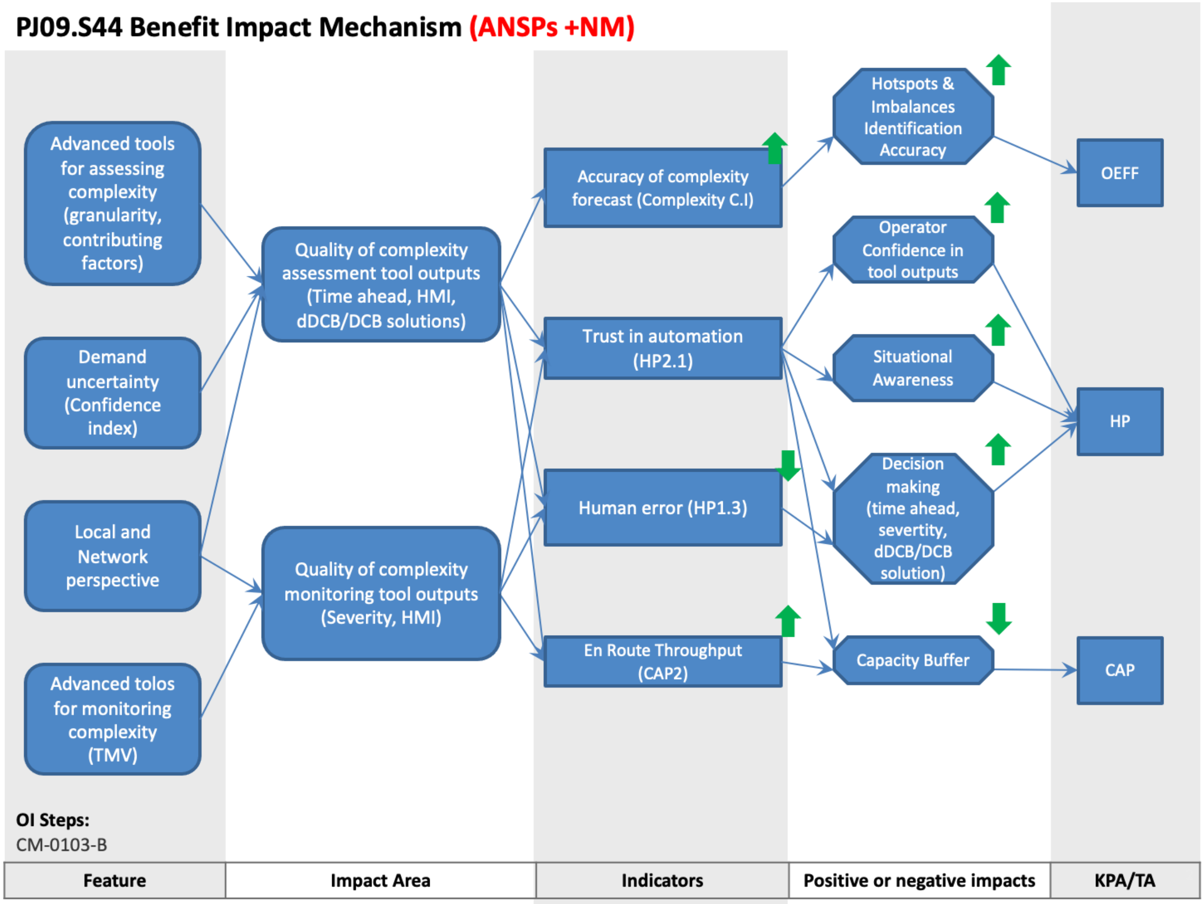

Figure 5: BIM for CM-0103-B DAC quality of complexity assessment.

A.5 CM-0104-C

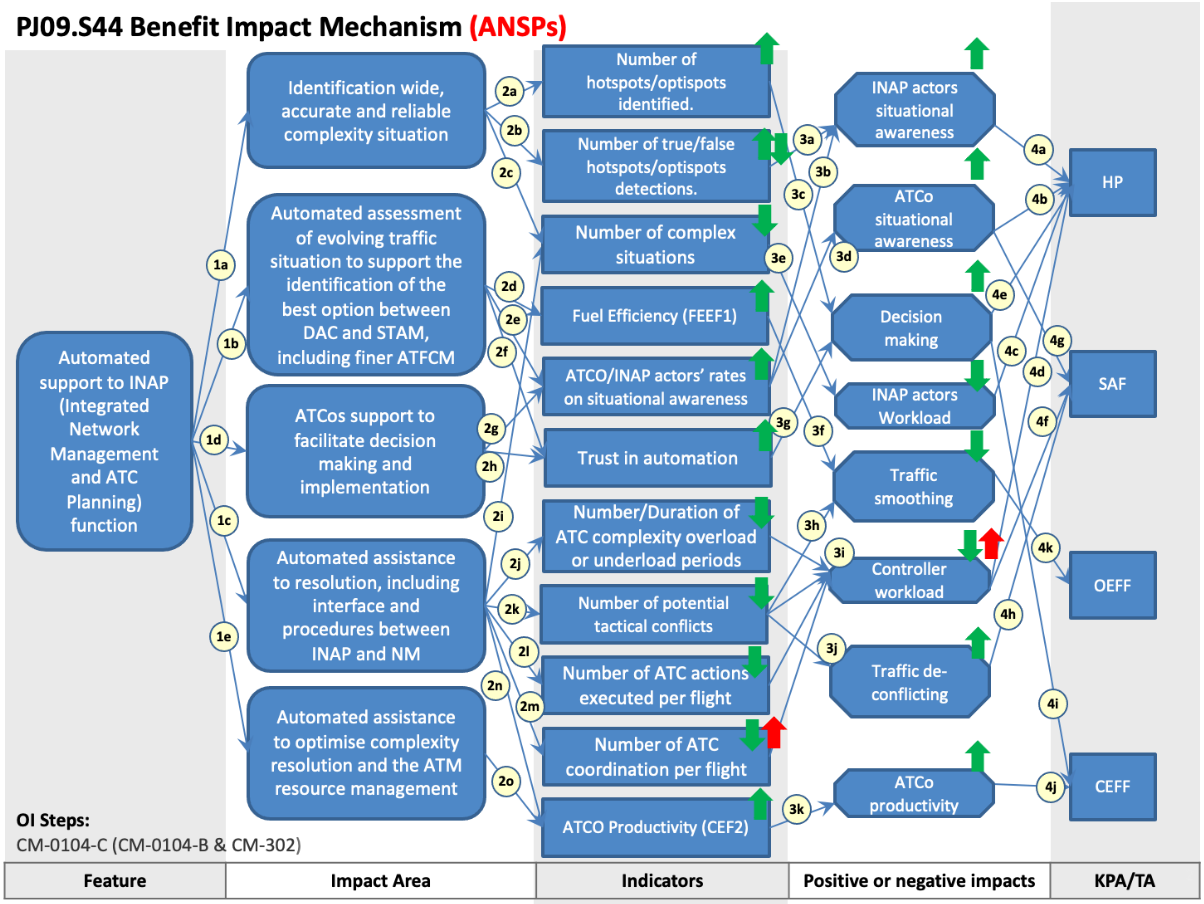

Figure 6: BIM for CM-0104-C automated support to INAP.

A.6 DCB-0210

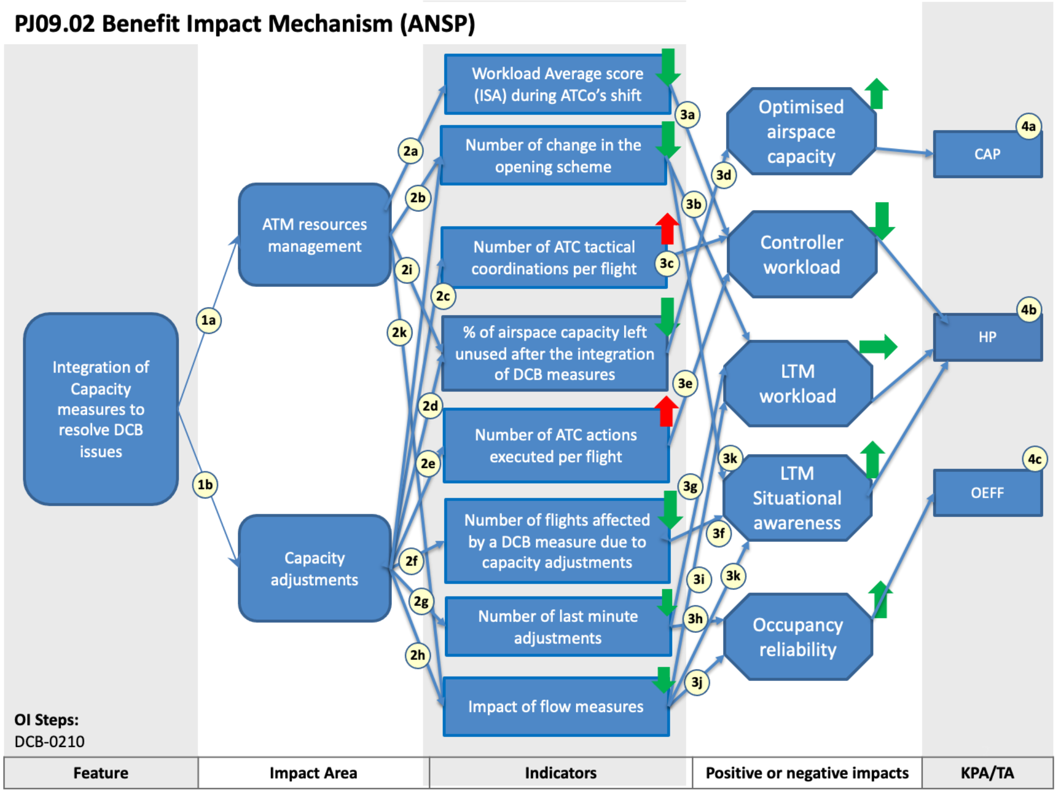

Figure 7: BIM for DCB-0210 integration of capacity measures to resolve DCB issues from ANSP perspective.

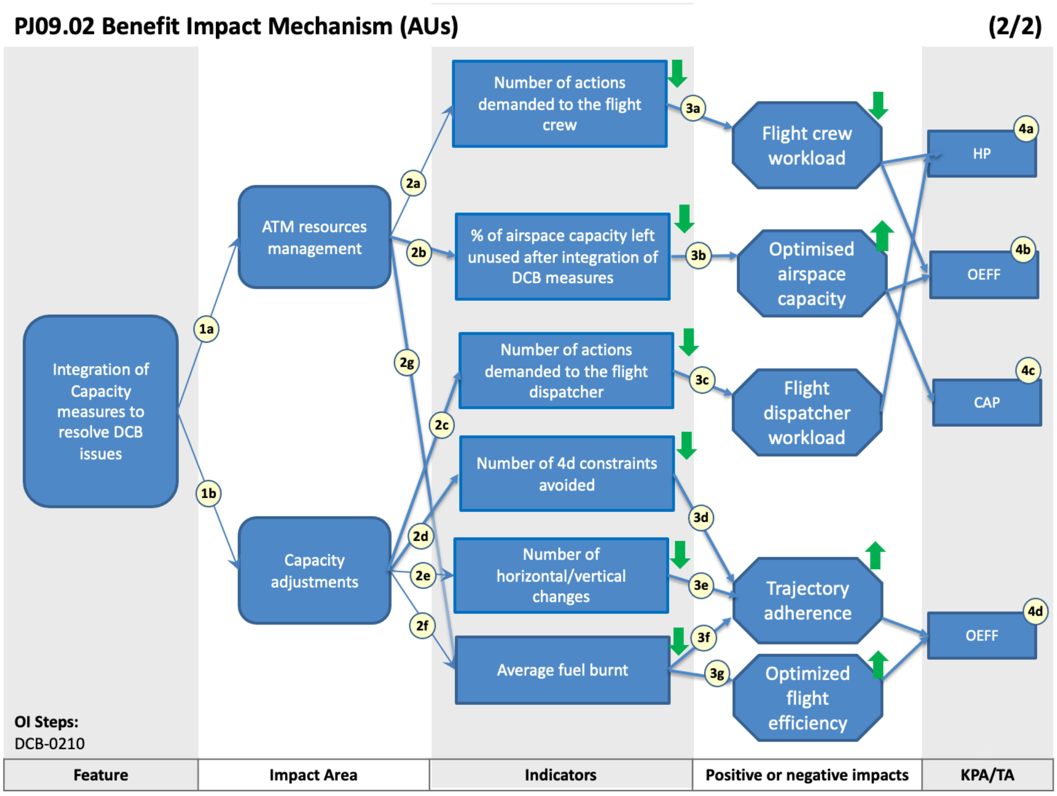

Figure 8: BIM for DCB-0210 integration of capacity measures to resolve DCB issues from AU perspective.