INDUSTRIAL RESEARCH

SESAR Solution PJ07-W2-40 SPR/INTEROP-OSED for V3 - Part V-Performance Assessment Report (PAR)

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PJ07 OAUO

INITIAL 4D MISSION TRAJECTORY DEVELOPMENT WITH INTEGRATED DMA TYPES 1 AND 2 SUPPORTED BY AUTOMATION AND DYNAMIC CIVIL-MILITARY CDM

This SESAR Solution PJ07-W2-40 SPR/INTEROP-OSED for V3 - Part V - PAR is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874465 under European Union's Horizon 2020 research and innovation programme.

Abstract

This document provides the performance assessments results obtained in the validation exercise EXE-07-W2-40–V3-01 – 'Mission Trajectories management with integrated DMA of types 1 and 2', real time simulation with humans in the loop, of solution PJ07-W2-40.

Table of Contents

List of Tables

1 Executive Summary

This document provides the Performance Assessment Report (PAR) for Solution PJ07-W2-40, *'Initial 4D Mission Trajectory development with integrated DMA types 1 and 2 supported by automation and dynamic civil-military CDM'.*

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

Description:

The solution PJ07-W2-40 builds upon the results of SESAR 2020 Wave 1 solutions PJ07.03 and PJ08.01 and refines, integrates and further validates to a V3 maturity level operational concept elements of Mission Trajectory and Advanced Flexible Use of Airspace – Dynamic Mobile Areas DMA of types 1 and 2. It addresses local actors and the processes for the development of an initial 4D mission trajectory by integrating airspace reservations designed and managed in accordance with the DMA of types 1 and 2 principles with enhanced automation support and civil-military collaborative decision-making.

Assessment Results Summary:

The following tables summarises the assessment outcomes per KPI (Table 1) and mandatory PI (Table 2) puts them side-by side against Validation Targets in case of KPI from PJ19 [9]. The impact of a Solution on the performances are described in Benefit Impact Mechanism. All the KPI and mandatory PI from the Benefit Mechanism were the Solution potentially impact have to be assessed via validation results, expert judgment etc.

There are three cases:

1. An assessment result of 0 with confidence level other level High, Medium or Low indicates that the Solution is expected to impact in a marginal way the KPI or mandatory PI.

2. An assessment result (positive or negative) different than 0 with confidence level High, Medium or Low indicates that the Solution is expected to impact the KPI or mandatory PI.

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

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits 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	*ISI*	*No negative impact on safety*	*High*
FEFF1: Fuel Efficiency - Actual average fuel burn per flight	*Medium*	*-6,5 kg per ENR flight (VH, H, M complexity sub-OEs) (0,2%)*	*Medium*
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	*Medium*	*+2,07% (local)*	*Medium*
CAP3: Airport Capacity – Peak Runway Throughput (Mixed mode).	*N/A*	*N/A*	*N/A*
TEFF1: Gate-to-gate flight time	*Low*	*-0,15 min/per ENR flight (VH, H, M complexity sub-OEs)* *-0,15%*	*Low*
PRD1: Predictability – Average of Difference	*Medium*	*-0,002 min* *-0,002%*	*Low*

[1] Negative impacts are indicated in red.

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

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits at Network Level (ECAC Wide or Local depending on the KPI)[1]	Confidence in Results[2]
in actual & Flight Plan or RBT durations			
PUN1: Punctuality – Average departure delay per flight	*N/A*	*N/A*	*N/A*
CEF2: ATCO Productivity – Flights per ATCO-Hour on duty	*Medium*	*Not assessed*	*Not assessed*
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 (conflicting trajectories)	*-9,75%*	*Low due to limits of the validation (only FTS and Gaming limited to the scenario timeline)*
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*

[3] Negative impacts are indicated in red.

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

Mandatory PI	Performance Benefits Expectations at Network Level (ECAC Wide or Local depending on the KPI)[3]	Confidence in Results[4]
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	*N/A*	*N/A*
SEC2: Risk Treatment has been carried out	*N/A*	*N/A*
SEC3: Residual risk after treatment meets security objective.	*N/A*	*N/A*
ENV1: Actual Average CO2 Emission per flight	*-20,5 kg CO2/per ENR flight (VH, H, M complexity sub-OEs)*	*Medium*
NOI1: Relative noise scale	*N/A*	*N/A*
NOI2: Size and location of noise contours	*N/A*	*N/A*
NOI4: Number of people exposed to noise levels exceeding a given threshold	*N/A*	*N/A*
LAQ1: Geographic distribution of pollutant concentrations	*N/A*	*N/A*
CAP3.1: Peak Departure throughput per hour (Segregated mode)	*N/A*	*N/A*
CAP3.2: Peak Arrival throughput per hour (segregated mode)	*N/A*	*N/A*
CAP4: Un-accommodated traffic reduction	*N/A*	*N/A*
RES1: Loss of Airport Capacity Avoided	*N/A*	*N/A*
RES1.1: Airport time to recover from non-nominal to nominal condition	*N/A*	*N/A*
RES2: Loss of Airspace Capacity Avoided.	*N/A*	*N/A*
RES2.1: Airspace time to recover from non-nominal to nominal condition.	*N/A*	*N/A*
RES4: Minutes of delays.	*N/A*	*N/A*

Mandatory PI	Performance Benefits Expectations at Network Level (ECAC Wide or Local depending on the KPI)[3]	Confidence in Results[4]
RES5: Number of cancellations.	*N/A*	*N/A*
TEFF2: Taxi in time	*N/A*	*N/A*
TEFF3: Taxi out time	*N/A*	*N/A*
TEFF4: TMA arrival time	*N/A*	*N/A*
TEFF5: TMA departure time	*N/A*	*N/A*
TEFF6: En-Route time	*-0,15 min/flight (VH, H, M complexity sub-OEs).*	*Medium*
PRD2: Variance of Difference in actual & Flight Plan or RBT durations	*N/A*	*N/A*
PUN2: % Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather-related delay causes	*N/A*	*N/A*
CEF1: Direct ANS Gate-to-gate cost per flight	*N/A*	*N/A*
AUC3: Direct operating costs for an airspace user	*N/A*	*N/A*
AUC4: Indirect operating costs for an airspace user	*N/A*	*N/A*
AUC5: Overhead costs for an airspace user	*N/A*	*N/A*
CMC1.1: Allocated vs. Requested ARES duration	*100 % of the duration requested*	*High*
CMC1.2: Allocated vs. Requested ARES dimension	*100 % of the dimension requested*	*High*
CMC1.3: Deviation of Transit Time to/from airbase to ARES	*Between -1,89% and -5,85% of transit time proportion in the total mission time*	*Medium*
CMC 1.3.1: Allocated ARES duration vs. total mission duration	*Between +1,89% and +5,85% ARES time proportion in the total mission time.*	*Medium*
CMC 1.3.2: Deviation of total mission duration by iOAT FPL validation	*N/A*	*N/A*
CMC 1.4.1: Rate of iOAT FPLs acceptance by NM systems	*N/A*	*N/A*
CMC 1.4.2: Rate of iOAT FPLs acceptance by ATC systems	*N/A*	*N/A*

Mandatory PI	Performance Benefits Expectations at Network Level (ECAC Wide or Local depending on the KPI)[3]	Confidence in Results[4]
CMC2.1: Fuel and Distance saved by GAT	*- 6,5 kg fuel per ENR flight (VH, H, M complexity sub-OEs).* *-0,2 NM distance per ENR flight (VH, H, M complexity sub-OEs).*	*Medium*
HP1: Consistency of human role with respect to human capabilities and limitations	*Covered*	*High*
HP2: Suitability of technical system in supporting the tasks of human actors	*Covered*	*High*
HP3: Adequacy of team structure and team communication in supporting the human actors	*Covered*	*High*
HP4: Feasibility with regard to HP-related transition factors	*Covered*	*High*
FLX1: Average delay for scheduled civil/military flights with change request and non-scheduled or late flight plan request	*Not assessed*	*Not assessed*

Table 2 Mandatory PIs Assessment Summary

Additional Comments and Notes:

No.

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

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

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 Wave 1 projects:

- PAGAR 2019: Performance Assessment and Gap Analysis Report (2019), where are collected the final benefits from SESAR 2020 Wave 1
- PJ 08.01 Dynamic Airspace Configurations
- PJ07.03 Mission Trajectory driven processes

PJ19 will manage and provide:

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

projects. Where are also included performance aggregation assumptions, with traffic data items.

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

2.4 Glossary of terms

See the AIRM Glossary [1] [8] for a comprehensive glossary of terms.

2.5 Acronyms and Terminology

Term	Definition
AIM	Accident Incident Model
ANS	Air Navigation Service
ANSP	Air Navigation Service Provider
ARES	Airspace Reservation/Restriction
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATFM	Air Traffic Flow Management
ATFCM	Air Traffic Flow and Capacity Management
ATM	Air Traffic Management
ATS	Air Traffic Services
BAD	Benefits Assessment Date
BAER	Benefit Assessment Equipment Rate
BT	Business Trajectory

[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

Term	Definition
CAT	Common Airspace management Tool
CBA	Cost Benefit Analysis
CDM	Collaborative Decision Making
CMC	Civil-Military Cooperation and Coordination
DAC	Dynamic Airspace Configuration
DMA	Dynamic Mobile Area
DOD	Detailed Operational Description
DB	Deployment Baseline
DMA	Dynamic Mobile Area (airspace design principle for ARES)
E-ATMS	European Air Traffic Management System
ECAC	European Civil Aviation Conference
ENR	En-Route
EOC	Essential Operational Change
FRA	Free Route Airspace
IFR	Instrument Flight Rules
KPA	Key Performance Area
KPI	Key Performance Indicator
(i)MT	(initial)Mission Trajectory
N/A	Not Applicable
(i)OAT FPL	(improved initial) Operational Air Traffic Flight Plan
OI	Operational Improvement
PAR	Performance Assessment Report
PI	Performance Indicator
PRU	Performance Review Unit
RPAS	Remotely Piloted Aircraft System
QoS	Quality of Service

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Term	Definition
RBT/RMT	Reference Business / Mission Trajectory
SESAR	Single European Sky ATM Research Programme
S3JU	SESAR3 Joint Undertaking (Agency of the European Commission)
SMT	Shared Mission Trajectory
SESAR2020 Programme	The programme which defines the Research and Development activities and Projects for the S3JU.
TBO	Trajectory Based Operations
TTO	Target Time Over
VPA	Variable Profile Area (airspace design principle for ARES)
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
Airspace User Cost-Efficiency Focus Area	Cost-Efficiency obtained by Airspace Users other than direct gate-to-gate ATS costs (CEF1) or AU cost improvements assessed through other KPIs: Fuel Efficiency, Punctuality, etc. Note: Benefits assessed through other KPIs should not be included in this focus area to avoid double counting of benefits. AU Cost-Efficiency includes reduction of direct (AUC3) and indirect (AUC4) operational costs of the AU, as well as overhead costs (AUC5). In addition, there are two specific PIs, Strategic Delay (AUC1) and Sequence Optimisation Benefit (AUC2).	PAGAR

Term	Definition	Source
ARES Capacity	The ability of an ATM system to accommodate specific training events which require airspace reservations and/or restrictions during a specific period of time, considering 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)
Business Trajectory	A trajectory which aims to give its owner the most cost-efficient routing	Introduction to the Mission Trajectory, V1.0, 2010
Civil-military coordination and cooperation	The coordination between the civil and military parties authorised to make decisions and agree a course of action.	Performance Framework 2017
Cost-Benefit Analysis	A Cost-Benefit Analysis is a process for quantifying in economic terms the costs and benefits of a project or a programme over a certain period, and those of its alternatives (within the same period), in order to have a single scale of comparison for unbiased evaluation. This process helps decision-makers to compare an investment with other possible investments and/or to make a choice between different options / scenarios and to select the one that offers the best value for money while considering all the key criteria affecting the decision.	PAGAR
Deployment Scenario	Set of SESAR Solutions selected to satisfy the specific Performance Needs of operating environments in the European ATM System and based on the timescales in which their performance contribution is needed in the respective operating environments.	PAGAR

Term	Definition	Source
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
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

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Term	Definition	Source
Key Performance Indicator	Current/past performance, expected future performance (estimated as part of forecasting and performance modelling), as well as actual progress in achieving performance objectives is quantitatively expressed by means of indicators (sometimes called Key Performance Indicators, or KPIs). To be relevant, indicators need to correctly express the intention of the associated performance objective. Since indicators support objectives, they should not be defined without having a specific performance objective in mind. Indicators are not often directly measured. They are calculated from supporting metrics according to clearly defined formulas, e.g. cost-per-flight-indicator = Sum (cost)/Sum (flights). Performance measurement is therefore carried out through the collection of data for the supporting metrics." In SESAR2020 Performance Framework, Key Performance Indicators are those that have a validation target associated derived from the corresponding Performance Ambition.	ICAO Doc 9883 Performance Framework
Local Air Quality Focus Area	One of the SESAR performance Focus Areas concerned with Environment. Local air quality is a term commonly used to designate the state of the ambient air to which humans and the ecosystem are typically exposed at a specific location. In the case of aviation, local air quality studies are generally conducted near airports.	PAGAR
Mission Trajectory	A trajectory which aims to give its owner the most mission effective routing and usage of the airspace. It represents an airspace user's intention with respect to a given mission objective.	Introduction to the Mission Trajectory, V1.0, 2010
Noise Focus Area	One of the SESAR performance Focus Areas concerned with Environment. The term Noise is used in this document to designate noise pollution, which is defined as unwanted sound. The impact of unwanted sounds on the recipients (in this case, people living around airports) causes adverse effects.	PAGAR
Operational Environment (OE)	An environment with a consistent type of flight operations.	EUROCONTROL ATM Lexicon
Performance Ambitions	Performance capability that may be achieved if SESAR Solutions are made available through R&D activities, deployed in a timely and, when needed, synchronised way and used to their full potential.	EUROCONTROL ATM Lexicon
Performance assessment	This term relates to the quantitative estimate of the potential performance benefit of an operational improvement based on outputs from validation projects, collected and analysed by PJ19.04.02	ICAO Doc 9883 updated in PAGAR

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

Term	Definition	Source
Security	(aviation) Safeguarding civil aviation against acts of unlawful interference. This objective is achieved by a combination of measures and human and material resources. Note: ATM Security is concerned with those threats that are aimed at the ATM System directly, such as attacks on ATM assets, or where ATM plays a key role in the prevention of or response to threats aimed at other parts of the aviation system (or national and international assets of high value). ATM security aims to limit the effects of a threats on the overall ATM Network. ATM Security is a subset of Aviation Security (as defined by ICAO in Annex 17).	EUROCONTROL ATM Lexicon, Note are from PAGAR
SESAR2020	The Programme for SESAR2020 was created with a clear and agreed need for continuing research and innovation in ATM beyond the SESAR 1 development phase. SESAR2020 is structured into three main research phases, starting with Exploratory Research, which is then further expanded within a Public-Private-Partnership (PPP) to conduct Industrial Research and Validation. Finally, it further exploits the benefits of the PPP in Demonstrating at Large Scale the concepts and technologies in representative environments to firmly establish the performance benefits and risks.	Performance Framework 2017
SESAR Programme	The programme which defines the Research and Development activities and Projects for the 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 Solution PJ-07-W2-40 contributes to Essential Operational Change EOC ATM interconnected network, which is a basic prerequisite for Trajectory Based Operations TBO and fully dynamic and optimised airspace.

Relevant to the ATM planning phase, the solution demonstrates the dependency between all the conceptual elements, which constitute a backbone of the entire operational concept of Mission Trajectory and related to Trajectory Management, advanced ASM, ATFCM including CDM, to be better developed and validated to V3 maturity.

In order to facilitate better understanding of the evolution of the Mission Trajectory concept PJ07-W2-40 develops and validates the concept of DMA of types 1 and 2 as integral part of the Mission Trajectory development, providing to military and civil planners an additional option, more flexible and dynamic, for the management of military ATM demand.

The solution develops and validates new operating methods and tool prototypes that enable more flexibility and dynamicity to the management of shared mission trajectory data to be considered by all users performing activities in temporary restricted/reserved airspace and by the concept of dynamic airspace configuration DAC. The expectation is an optimised and coordinated organisation and management of airspace and traffic flows in medium to short-term ATM planning phase and improved collaboration between pertinent ATM actors to equally benefit civil and military airspace users.

The new operating methods proposed by the Solution provides a detailed description of the integrated military ATM demand that evolves through trajectory lifecycle undertaking modification through collaborative decision-making (CDM) and dynamic sharing of data. The operational processes validated are enabled by automation[6] of information exchanges and impact assessments. Key to timely decisions is a single 4D data source of information on mission trajectory elements in the relevant military ATM domains (WOC, ASM, and ATFCM).

3.2 Detailed Description of relationship with other Solutions

Solution Number	Solution Title	Relationship	Rational for the relationship
PJ09-W2-44	Dynamic Airspace Configurations	Compatible-Independent-cross effect	If deployed together with DAC in the same FRA EPWW, solution 40 will increase the capacity of ATC sector configuration to accommodate the traffic demand with a maximum of 67

[6] In the context of the Solution 40, human process automation and CDM implies the development of functional system algorithms that facilitate operational processes and the exchange of information in an automatic mode with the participation of a human, since the latter is the last link in the decision-making chain.

			movements in average increase per hour for ENR of High, Very High and Medium complexity , which represents 2,07% benefit expectation. Both of solutions could be used together in 100% of the cases [12].
PJ07-W2-38	Enhanced integration of AU trajectory definition and network management processes	Preferable to	S38 needs ASM and MT information to raise the awareness to AUs of network-activated constraints, potential constraints and opportunities. With early information on mission trajectories, network management processes in the trajectory definition phase could gain more predictability. Integration of MT information into traffic flow management processes may increase predictability. However, the values of performance metric assessment (0,002%) do not reflect the positive expectation of DMA type 1 and 2 concerning the reduction of airspace segregation impact on traffic demand. The cause stays in the local level of validation scenario.
PJ13-W2-117	IFR RPAS integration in Airspace Class A to C	Preferable to	S117 could use DMA type 1 and 2 design principles for airspace segregation as a more effective way for RPAS integration into the IFR controlled airspace compared to the current constraints generated by static airspace design principles. Considering the considerably differences in requirements for airspace reservation between manned aircraft and RPAS, an estimation of a combined performance benefit of the two solutions is not possible.

Table 5: Relationships with other Solutions

The paragraphs below provide a more descriptive presentation of Solution 40 relationships:

Relationship with solution 44:

Solution 40 provides the function for the definition and sharing of DMA type 1 and 2 that are further optimized and integrated into DAC validated by solution 44.

Solution 44 provides an integrated DAC function for DMA type 1 and 2 allocation. The allocated DMA are further integrated into the development of mission trajectory, when required by mission planning.

Solution 44 can be deployed without mission trajectory, but the efficiency of DAC could be improved by the integration of DMA type 1 and 2. Furthermore, DAC needs the WOC function participation in

CDM for the optimization and full integration of DMA type 1 and 2 into the processes for the airspace structures configuration.

Else ways, solution 40 can be deployed without DAC as far as allocation of ARES of all types remains a national prerogative, which is exercised with or without the dynamicity provided by solution 44 but the flexibility and dynamicity required by the military mission is highly supported by DAC processes. In the future ATM environment, DAC integrates fully the ASM, ATFM and ATC functions. Hence, the effectiveness of ATM support to military mission is enhanced by DAC.

A synchronized deployment of the solutions 40 and 44 ensures maximum exploitation of DMA type 1 and 2 benefits to both of the airspace configuration and traffic flow management in the ATM planning phase.

Relationship with solution 38:

Enhanced integration of the processes for AU trajectory definition and network management processes needs ASM and MT information to raise the awareness to AUs of network-activated constraints, potential constraints and opportunities.

A continuous and dynamic sharing of information on the definition and development of mission trajectory with DMA type 1 and 2 supports a more accurate definition of network management requirements and constraints for the integration of traffic demand.

Sharing of the early flight intent provides timely information on the restrictions/reservations that need to be considered by AUs in the definition of their trajectories.

Furthermore, the flexibility and dynamicity enabled by DMA type 1 and 2 support network management processes for the coordination of airspace configurations and traffic flows as close as possible to AU needs for optimal trajectories.

Consequently, solution 38 prefers the deployment of DMA type 1 and 2 and the sharing of mission trajectory data via the improved OAT FPL to the previous operating method with static ARES and limited sharing of information on OAT flights.

Relationship with solution 117:

Mission Trajectories with integrated DMA type 1 and 2 provides improved opportunities for an effective integration of IFR RPAS flights into the controlled airspace of class C.

The dynamicity and flexibility provided by DMA type 1 and 2 to mission planning may ensure the integration of RPAS flights with less restrictions and conflicts with the participating traffic. Consequently, airspace capacity could be better managed to deliver more opportunities to both manned and unmanned categories of airspace users.

4 Solution Performance Assessment

4.1 Assessment Sources and Summary of Validation Exercise Performance Results

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

Organisation	Document Title	Publishing Date
EUROCONTROL	D4.1.010, SESAR Solution PJ.07-03: SPR/INTEROP-OSED for V2 - Part V - Performance Assessment Report (PAR), edition 00.01.02	18 October 2018
EUROCONTROL	D2.1.24, SESAR Solution 08.01 SPR/INTEROP-OSED V2 - Part V - Performance Assessment Report (PAR), edition 00.03.01	05 July 2019

Table 6: Pre-SESAR2020 Wave 2 Exercises

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

Exercise ID	Exercise Title	Release	Maturity	Status
EXE-07-W2-40–V3-01	Mission Trajectories Management with integrated DMA type 1 and 2		V3	Completed

Table 7: SESAR2020 Validation Exercises

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

Exercise	OI Step	Exercise scenario & scope	Performance Results	Notes
EXE-07-W2-40-V3-01	AOM-0208-B	DMA type 1 and 2 are defined and shared in EFI (Early Flight Intent) and iSMT (Shared MT) as full part of 4D mission trajectory profile description. The flexible parameters of DMA1&2 are used by DAC actors to reduce the impact on local traffic demand based on CDM with WOC. The DMA 1&2 flexibility enables also the identification and negotiation of a target time (TTO) over the mission trajectory profile for the same purpose.	Within the overall solution contribution, the expected % performance benefit of AOM-0208B: • 70% to KPI/PIs FEFF1, ENV1, CAP2, TEFF1, PRD1 • 80% to CMC1.1, CMC1.2, CMC1.3, CMC1.3.1, CMC2.1	

	AUO-0216	An Early Flight Intent (EFI) consisting of basic trajectory profile elements with integrated DMA type 1 and 2 is shared by WOC with local DAC actors. EFI provides ASM and ATFCM functions of DAC the possibility to assess the impact on traffic demand and identification of an ASM solution to alleviate the effects.	Within the overall solution contribution, the expected % performance benefit of AUO-0216: • 5% to KPI/PIs FEFF1, ENV1, CAP2, TEFF1, PRD1 • 5% to CMC1.1, CMC1.2, CMC1.3, CMC1.3.1, CMC2.1	
	AUO-0210	The sharing of iSMT data and their integration into local traffic demand trigger a civil-military CDM process in order to balance the specific iMT requirements with the iBT requirements. The result of CDM is a TTO/iMT (15'minutes delay of DMA activation) enabling optimization of sub-regional/local traffic flow management.	Within the overall solution contribution, the expected % performance benefit of AUO-0210: • 20% to KPI/PIs FEFF1, ENV1, CAP2, TEFF1, PRD1 • 10% to CMC1.1, CMC1.2, CMC1.3, CMC1.3.1, CMC2.1	
	AOM-0304-B	The MT profile is described by a 4D dataset and shared with the local DAC actors via dedicated services. The 4D data set enables extraction of DMA type 1 and 2 data for ASM purposes. Furthermore, enables the CDM process for DMA optimization as well as the assessment of the consequent impact on mission trajectory effectiveness.	Within the overall solution contribution, the expected % performance benefit of AUO-0216: • 5% to KPI/PIs FEFF1, ENV1, CAP2, TEFF1, PRD1 • 5% to CMC1.1, CMC1.2, CMC1.3, CMC1.3.1, CMC2.1	

Table 8: Summary of Validation Results.

4.2 Conditions / Assumptions / Deviations for Applicability

The following Table 9 summarises the applicable operating environments.

OE	Applicable sub-OE	Special characteristics
En Route	Very high complexity High complexity Medium complexity	Free Route Airspace: POLFRA Airspace reservations for military training missions designed in accordance with DMA type 1 and 2

Table 9: Applicable Operating Environments.

4.2.1 Performance assessment assumptions/conditions:

- Polish Free Route Airspace POLFRA as well as DMA of types 1 and 2 will be fully implemented by 2035; furthermore, for ECAC level figures we consider that FRA will be implemented in all ECAC States.
- The traffic sample used for simulation purposes represents the forecast for 2035 applied to 29 October 2021 as provided by EUROCONTROL R-NEST simulation tool by using the respective AIRAC data. The forecast takes into account the impact of COVID crises.
- Solution 40 applies to very high, high, and medium complexity 2035 En-route airspace, which represents 97.20% of the forecasted ECAC traffic [6].
- In the solution scenario applicable to 2035, the POLFRA (EPWW) aggregates very high, high, and medium complexity sub-OEs.
- The analysis of the performance impact of the solution is based on the comparison of the measurement results obtained after the simulation of static scenario, respectively solution scenarios; the solution scenario reflects the final description of mission trajectories with allocated DMAs and TTO applied.
- For the extrapolation of the local scenario assessment results to ECAC level, the following assumptions and resulting scale factor are used:
  - The recurrent military training activities are performed during working days; considering the number of 52 weeks for a year, the total training days is 250, which represents 68% of the total number of days; the assumption is that the airspace reservation configuration in the solution scenario used in simulation is representative for an average working day training in ECAC States.
  - Considering additional holidays, we consider the application of a 0,65-scale factor as acceptable assumption for the magnitude of solution impact at ECAC level; consequently, the factor will be applied to all ECAC level figures in this report.
- The validation exercise consisted in two runs of successful real time simulation of the new operating methods. They were preceded by two successful and complete simulations performed during the dry runs.
- The analysis of the four simulations reflects similar results, thus this report provides the figures from RUN 1 of the live exercise considered as the most significant to performance expectations.
- The minor differences between the simulation results of the runs have been generated by the expert judgement variations in optimizing the location of the DMAs. The DMA optimization proposals provided by the tool were analysed by military experts throughout the CDM process, hence the final parameters of DMAs represent a human expert decision.

Conclusion: Although supported by automation for the definition of DMAs, impact assessments, and optimization purposes, the decisions concerning the ATM parameters of military mission remains solely human. Consequently, there is no standard configuration of DMAs that could be considered for performance assessment purposes.

- The total number of flights operating in EPWW FRA during the solution scenario (08:00 to 10:35 AM) played in validation is 294. The figure is provided by R-NEST tool.

- The number of flights rerouted due to static ARES activation in the reference scenario is 121 = 41,16% of total trajectories, while in the solution scenario, the rerouted trajectories impacted by the solution is 49 = 16,67%.

Conclusion: with the implementation of DMA of types 1 and 2 the expectation is a reduction of the number of flights impacted by airspace reservation/restriction in EPWW FRA up to 60%.

At ECAC level (application of scale factor of 0.65), the expectation is a reduction up to 39% of the flights impacted by DMA of types 1 and 2 compared to static airspace reservation/restriction.

4.2.2 Deviations

The performance assessments did not address the CEF2 KPI and the FLX 1 PI. However, the lack of assessments does not constitute a blocking issue for the evaluation of solution maturity in terms of expected benefits and rationales are presented below.

The expectation is to further prove the benefits of iMT management with DMA of type 1 and 2 for CEF2 and FLX in the SESAR solutions part of the next R&D cycle that will address interactions with ATCO and the NM.

KPI CEF2

Rationale:

The ATC actor was not available for the validation exercise as it was not required by the scope of validation (the KPI was apportioned to the solution before the revision of the scope imposed by the COVID crisis impact on the availability of resources). The ATC function is not directly involved in the phase of MT development.

Technically, it was not possible to measure the KPI because neither the simulation of peak traffic nor the ATCO planning was captured in the validation scenario. The configuration of ATC sectors did not change during the validation exercise; hence, the number of flights handled by ATCOs was not depending on their availability and planning.

However, we consider that ATCO productivity will benefit from the implementation of the solution thanks to the increase of sector occupancy while reducing the workload as proven in the performance assessment report, section 4.6.2.2.1.

PI FLX

Rationale:

The PI requires the calculation of the total delay for scheduled flights with change request and non-scheduled or late filling flights |AOBT – SOBT|, divided by number of movements. Technically, the calculation of the PI was not possible as the validation scenario addressed a forecasted traffic and not differentiated the scheduled flights. Finally, the delays aspect was not in the scope of the solution as does not affect/is not affected by the scope of concept development and validation.

Reversely , a delay in the planning phase, was agreed and applied via a TTO to a mission trajectory with the aim of reducing the impact on traffic demand. The delay did not affect the effectiveness of mission trajectory. However, a benefit expectation assessment is not feasible as far as a similar delay (TTO) cannot be applied in a static ARES scenario environment. Furthermore, the assessment of the PI for civil flights was not possible due to the scope of the validation.

4.3 Safety

The information provided in this section is in-line with the SESAR Safety Reference Material (SRM [13] and Guidance [15]) methodology to be applied for performing the safety assessment of the Solution.

4.3.1 Safety Design drivers and Performance Mechanism

The design safety driver is the specification of the changed service limited to the potential safety implication on the side of the ATS service provider or aviation undertaking (e.g. airline) using that service. Taking into consideration that the solution addresses the planning processes and procedures for integrated definition and development of iMT with DMA type 1 and type 2 and iSMT revision at national/sub-regional level, it can be considered as "Other than ATS operational solution".

The changes brought by the solution does not affect directly ATS services (no direct impact on the way ATCOs and Pilots act, interact and make use of tools/equipment in view of delivering ATS), but rather focuses on the planning phase of the management of the integrated civil-military ATM demand – therefore, services delivered to civil and military AU and ANSPs prior to the execution phase.

The solution is not expected to have immediate and direct safety impacts to the delivery of ATS. As the scope of the solution is on the planning phase potential issues encountered during the planning may however result in safety impact in the execution phase.

4.3.2 Data collection and Assessment

The safety assessment was conducted according to SRM [13]. The Safety Requirements at Service level identified refer to the functionalities & performance characteristics derived from the (potential) operational use cases envisaged for the solution limited to the potential safety implication on the side of the operational users (i.e. ATS service provider).

For this reason, the safety assessment was initiated by a preliminary safety impact assessment, including initial hazard identification, involving operational experts which are relevant for the use of the concept. This approach allowed to understand the potential safety implication of the solution.

The HP&SAF Scoping & Change Assessment session, Safety metrics and indicators session and HAZID workshop were performed with the participation of PJ07-W2-40 solution partners including military representatives (WOC), FMP, ASM, ATM experts, human factors, and safety experts.

In order to identify Initial set of Safety Requirements at Design Level (SRD) a dedicated workshop with subject matters experts was conducted addressing both success approach (defining at the level of each component what it is required to fulfil in terms of functionality and performance) and failure approach (defining at the level of each component what it is required to fulfil in terms of integrity and additional functionalities). During the workshop the potential HP and safety issues were discussed and accordingly the mitigation actions were identified.

The online workshop was conducted with the participation of PJ07-W2-40 solution partners including, Subject Matter Experts (DAC and WOC representatives) concept designers and tool developers, human factors, and safety experts.

The impact of the concept on the safety levels in the validation exercise was measured based on the number of the conflicting trajectories. The objective measurements obtained in the reference and solution runs were compared to determine the benefits in the terms of the number of conflicting trajectories. In the reference run, the total number of conflicts (inside and entry conflicts) is 54 (Nb of inside conflicts = 52 and Nb of entry conflicts = 2). In the solution run the registered total number of conflicts was reduced to 46 (Nb of inside conflicts = 44 and Nb of entry conflicts = 2), this means a reduction by 15% of the conflicting trajectories.

4.3.3 Extrapolation to ECAC wide

Considering the 15% of reduction expected at local level (EPWW FRA) and applying the scale factor of 0,65, the expectation at ECAC level for reduction of the number of conflicting trajectories is 9,75%.

Considering the assumption that by rerouting fewer aircraft, the workload of the controllers should also be less impacted by the changes imposed by the military activities, and consequently the safety will at least not degrade.

4.3.4 Discussion of Assessment Result

As the concept addressed by the solution does not affect directly ATS services (no direct impact on the way ATCOs and Pilots act, interact and make use of tools/equipment in view of delivering ATS), but rather focuses on the planning phase of the management of the integrated civil-military ATM demand and potential benefits it might bring in the execution phase, two indicators characterizing the execution were considered as relevant form safety point of view: number of conflicts and number of rerouted trajectories. The results obtained indicate benefits in terms of both number of conflicts (less conflict when concept applied vs. static ARES) and rerouted trajectories (less aircraft to be rerouted when DMA type 1 and 2 applied vs. number of rerouted trajectories with static ARES).

4.3.5 Additional Comments and Notes

No additional comments.

4.4 Environment: Fuel Efficiency / CO2 emissions

Does the Solution impact this KPA? Yes

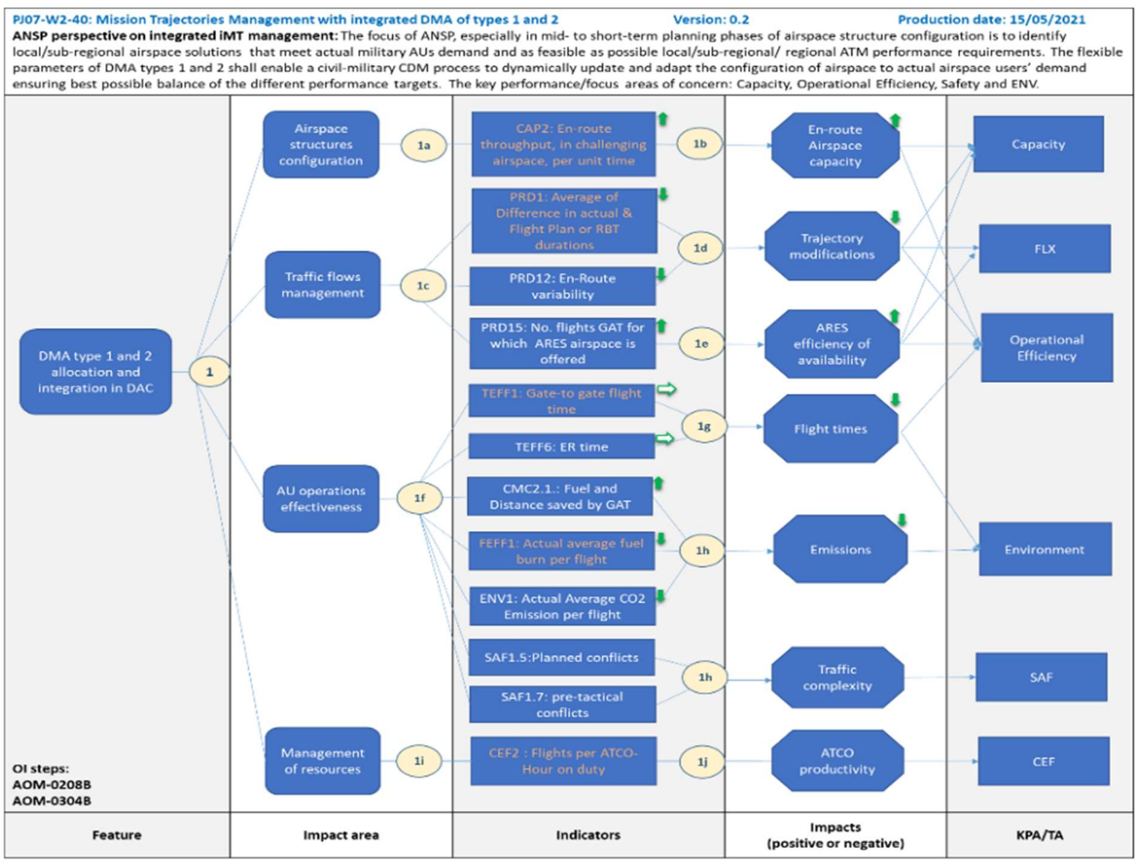
This solution is expected to bring benefits by reducing the impact of static airspace segregation on planned trajectories and profiles within EPWW – Polish FRA airspace (extrapolated at ECAC level when feasible) resulting in reduced fuel burn and CO2 emissions.

DMA flexible parameters enable a dynamic adjustment of airspace reservation/restriction to FRA needs for direct routes with consequent benefit to the efficiency of operations – reduced deviations of trajectories and flight times.

Efficient operations mean more direct routes, thus less fuel consumption. Less fuel consumption enables a reduction of CO2 emissions, which means a positive impact on environment.

4.4.1 Performance Mechanism

Is there a Benefit Mechanism available? Yes.



4.4.2 Assessment Data (Exercises and Expectations)

4.4.2.1 Fuel efficiency

The source of the figures used in this section is presented in Appendix B.

The extra fuel burn for the trajectories rerouted by the activation of ARES in static scenario is 5522 kg. The extra fuel burn for the trajectories rerouted by the activation of DMAs 1&2 in solution scenario is 2503 kg. The absolute fuel burn saving expectation in EPWW FRA is 3019 kg, respectively 10,3 kg in average per flight (the total of flights is 294).

4.4.2.2 CO2 emissions

The average CO2 emission saving expectation per flight is 10,3 kg (fuel burn) * 3,15 kg[7] = 32,4 kg.

4.4.3 Extrapolation to ECAC wide

For ECAC level impact of the solution, the following figures are considered in accordance with the common performance assumptions, reference [6]:

- Average fuel burn per ECAC flight = 5280 kg (common assumption *F-0001*).
- En-route fuel consumption contribution is 66% (common assumption *F-0005*) = 3.484,8 kg.
- According to the traffic distribution assumption, in the ENR of VH, H, M complexity sub-OEs, the average fuel burn per flight is 3.484,8 * 97,20/100 = 3.387,23 kg.

Assuming that with the application of the solution, the average fuel saving per flight is 10,3 kg, the ECAC level performance expectation for fuel efficiency is:

- the absolute average fuel saved in ENR of VH, H, and M complexity sub-OEs (aggregated) is 10,3*97,20%*0,65[8] = 6,5 kg per flight.
- the average % expected fuel saving per flight in ENR of VH, H, and M complexity sub-OEs (aggregated) is: 6,5 *100 / 3.387,23= 0,2 %.

ECAC level performance expectation for CO2:

- the absolute average CO2 emissions saving per flight in ENR of VH, H, and M complexity sub-OEs (aggregated) is 6,5 kg *3,15 = 20,5 kg.
- the average % expected CO2 emissions saving per flight in ENR of VH, H, and M complexity sub-OEs (aggregated) is 20,5*100 / 3.387,23*3,15= 0,2%.

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	*6,5 kg fuel saving per ECAC ENR (VH+H+M) flight*	*0,2 % fuel saving per ECAC ENR (VH+H+M) flight*

[7] CO2 emissions index, reference [6]

[8] ECAC level scale factor

KPIs / PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
ENV1 Actual Average CO2 Emission per flight	Kg CO2 per flight	Amount of fuel burnt x 3.15 (CO2 emission index) divided by the number of flights	YES	*20,5 kg CO2 saving per ECAC ENR (VH+H+M) flight*	*0,2 % CO2 saving per ECAC ENR (VH+H+M) flight*

Table 10: Fuel burn and CO2 emissions saving for Mandatory KPIs /PIs

	Taxi out	TMA departure	En-route (VH+H+M)	TMA arrival	Taxi in
FEFF1 Actual Average fuel burn per flight	*N/A*	*N/A*	*6,5 kg fuel saving per ENR (VH+H+M) flight (0,2%)*		
ENV1 Actual Average CO2 Emission per flight	*N/A*		*20,5 kg CO2 saving per ENR (VH+H+M) flight (0,2%)*		

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

Were there any benefits obtained in SESAR2020 Wave1 for this Solution? No. Rationale:

The conditions applied in SESAR 2020 Wave 1 to the assessments performed by the solutions (PJ 08.01 and PJ 07.03) preceding Solution 40 were different:

- in PJ 08.01, the DAC has integrated only DMAs of type 1 and 2 without mission trajectories, TTO has not been applied and the validation addressed airspace configurations that included ATC sectors, coordinated at both of the local and network levels.
- no assessments available from PJ 07.03.

4.4.4 Discussion of Assessment Result

The results provided refer to the trajectories impacted by airspace reservation/restriction and are based on the figures provided by R-NEST. Taking into account the diversity of airspace reservation/restriction configurations in time and location across ECAC, the confidence in the ECAC level figures is low. We consider that a cross border scenario for mission trajectories with DMA of types 1 and 2 could lead to improved and more accurate results.

Although all OI steps in the scope of the solution contribute to improved fuel efficiency and CO2 emissions, their impact is significantly different.

The major contribution is brought by the new operating method associated with the new design principles of ARES, the DMA of types 1 and 2 (AOM-0208 B) and the application of TTO (AUO-0210) that enable in practice a significant reduction of airspace reservation impact on trajectories rerouting (up to 60% less impacted flights).

The shared mission trajectory (AUO-0216) presents importance from two perspectives: integration into the local traffic demand of a mature and stable information on the military ATM demand and the ASM-ATFM impact analysis triggering the identification and negotiation of TTO.

Finally, although not directly accountable in figures, the sharing of mission trajectory profile described by a 4D dataset (AOM-0304 B), which contains 4D target ATM constraints is a key requisite to optimization of military ATM demand within the local ASM-ATFM processes of DAC.

The expected % ECAC level contribution of OI steps to fuel efficiency and environment KPI is presented in the table below:

OI step	Relative benefits contribution to FEFF1	Benefit % expectations FEFF1	Relative benefits contribution to ENV1	Benefit % expectations to ENV1
AOM-0208-B	70%	0,14%	70%	0,14%
AUO-0210	5%	0,01%	5%	0,01%
AUO-0216	5%	0,01%	5%	0,01%
AOM-0304-B	20%	0,04%	20%	0,04%
TOTAL	100%	0,2%	100%	0,2%

4.4.5 Additional Comments and Notes

In accordance with 2035 common assumptions (reference [6]), the number of ECAC flights will be 15173627. In accordance with the simulation results, 41,16% of the flights will be impacted by the static scenario, while 16,67% if the solution is implemented. Considering the impacted sub-OEs (VH, H, M complexity) and by applying the scale factor of 0,65, the average number of ECAC impacted flights if the solution is implemented will be 15173527*16,67%*97,20%*0,65 = 1598091. Fuel saving in average per impacted flight is 6,5 kg.

Conclusion: The implementation of the solution contributes to improving fuel efficiency ad reduction of CO_2 emissions. The extrapolation of local scenario results does not accurately reflect the magnitude of the solution implementation at ECAC level. The 0,2% benefit expectation to fuel saving and CO_2 emissions resulting from the validation exercise could be significantly improved if a cross border validation scenario for mission trajectories with DMA of types 1 and 2 is assessed.

4.5 Environment / Emissions, Noise and Local Air Quality

Does the Solution impact this KPA? No**Performance Mechanism**

N/A.

4.5.2 Assessment Data (Exercises and Expectations)

N/A.

4.5.3 Extrapolation to ECAC wide

N/A.

4.5.4 Discussion of Assessment Result

N/A.

4.5.5 Additional Comments and Notes

N/A.

EUROPEAN PARTNERSHIP

Co-funded by the European Union

4.6 Airspace Capacity (Throughput / Airspace Volume & Time)

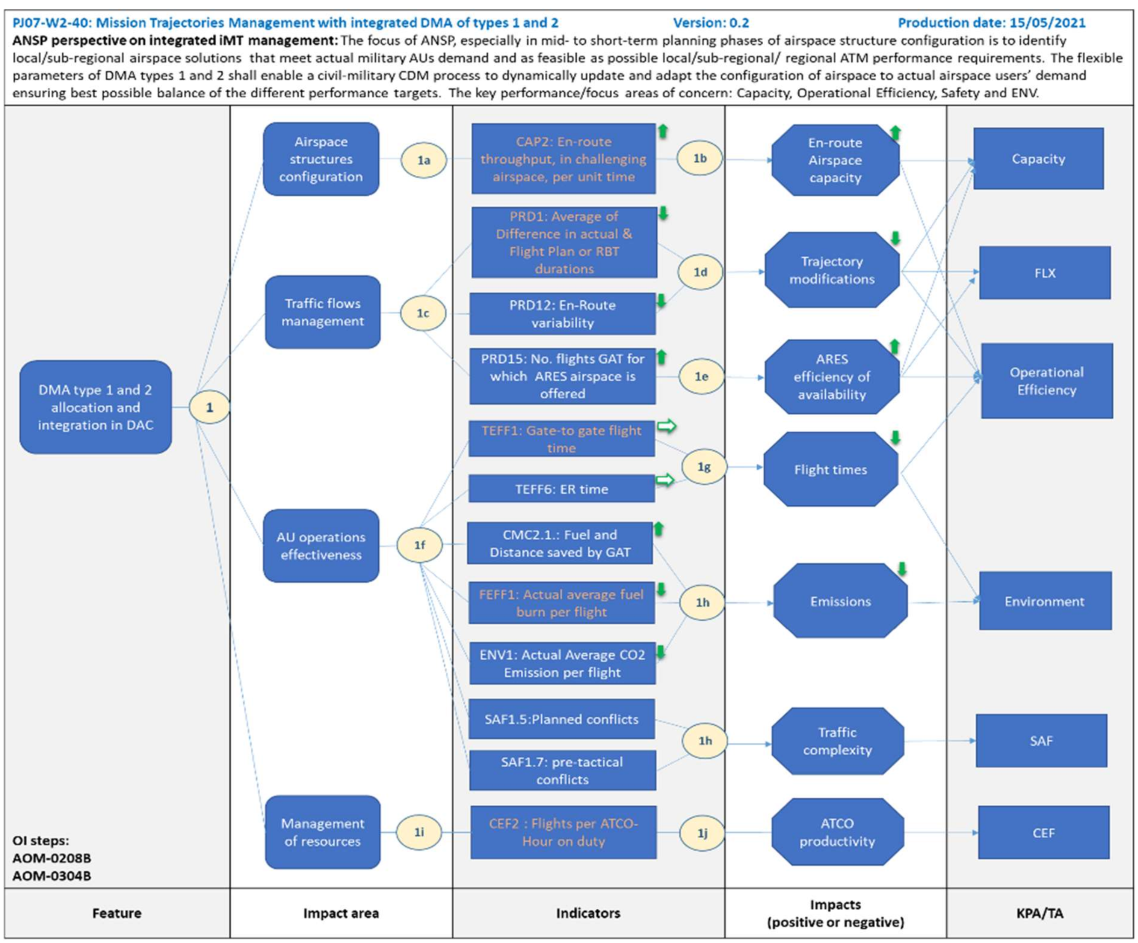
Does the Solution impact this KPA? Yes

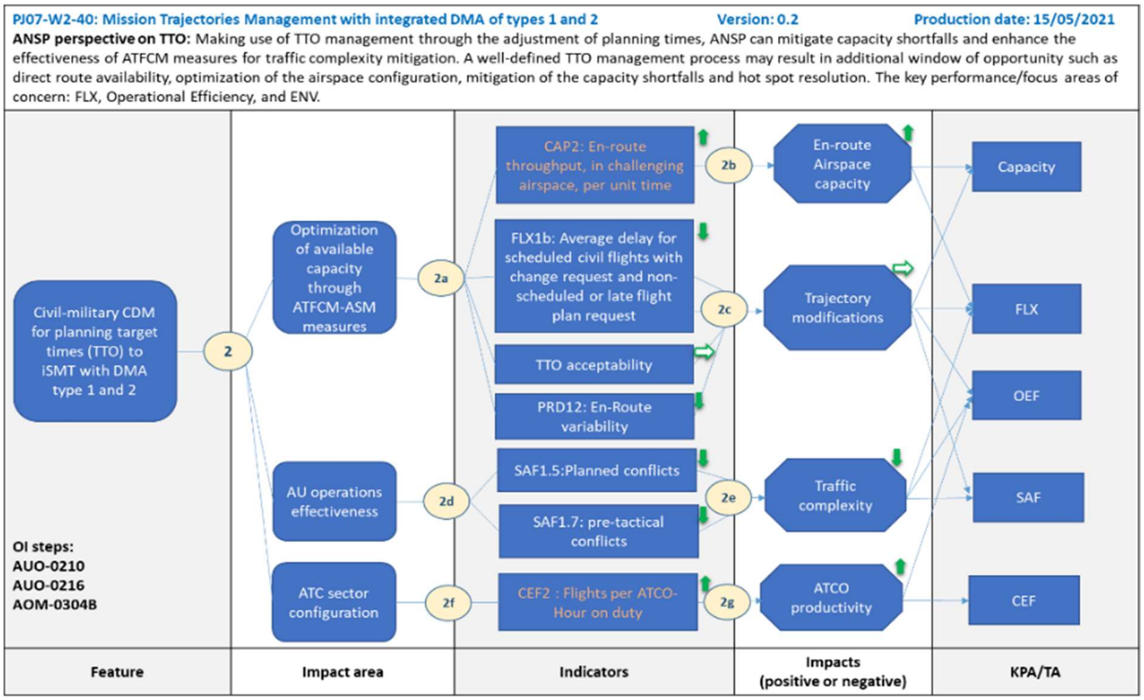
Rationales:

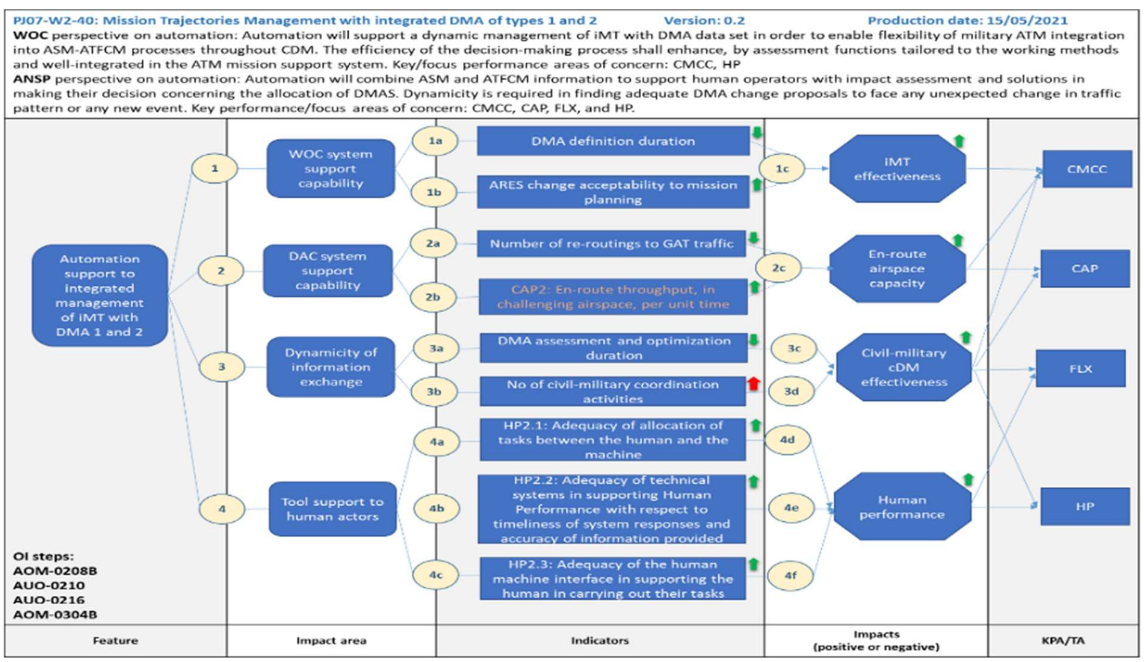
The optimization of DMAs throughout a dynamic civil-military CDM enables the reduction of airspace segregation impact on the deviations to planned FRA trajectories, hence likely improving the capability to adjust and balance the distribution of traffic amongst ATC sectors. Furthermore, the application of planning time constraints -TTO- to mission trajectory supports integrated ASM-ATFCM measures to improve ATC sectors capability to accommodate the predicted demand. CAT tool prototype enables the flow manager to identify a TTO over the DMA entry/exit point of relevant mission trajectory (ies), which leads to a reduction of airspace reservation/restrictions impact on ATC sector configuration and business trajectories. The expectation is an improvement to ATC sectors traffic throughput.

4.6.1 Performance Mechanism

Is there a Benefit Mechanism available? Yes.







4.6.2 Assessment Data (Exercises and Expectations)

The Solution has performed a single validation exercise. The expected benefits of the exercise are relevant to CAP2 KPA as the solution is addressing the en-route operating environment.

4.6.2.1 Previous validation results concerning DMA 1&2 contribution to CAP2

The validations to date do not clearly quantify DMA type 1 and 2 contribution of to CAP2 KPI. DMA contribution is embedded into the overall contribution of DAC. SESAR 2020 wave 1 PJ08.01 assessments [12]:

"*CAP2: A better balancing of ATC workload should typically lead to an increase in capacity (less imbalance, less delay…). This had been foreseen in SESAR 1, but in the two exercises carried out, only a small improvement was seen. This solution will put effort into better quantifying the benefit in terms of EN ROUTE Capacity. And, as for SESAR 1, the expected gain is close to 3%. This impact will be on more than 60% of the HL and Medium complexity En-route sectors in FRA.*

The increase of capacity will also be reinforced by the use of the DMA type of ARES. The foreseen improvement will be in terms of civil sectors around the DMA. However, it is expected that the impact on capacity will be small as the DMA will not be the only deployable ARES in the ASM.

PAR 2018: EXE1 & EXE4 show a slight positive impact on CAPACITY with a better task load but this needs to be assessed with human in the loop simulation instead of model based. The level of confidence is low as more measurement needs to be performed. Both DMA and DAC contribute to the reduction of workload. In the absence of results from the validation exercise, we keep the estimation from previous year (2017).

PAR 2019: EXE2 focused more on the implementation of the CDM process for the two DAC models presented in the OSED. The validation was carried out with an equivalent traffic sample between the reference and solutions scenarios, so real impact on capacity could be assessed. For the DMA, as only a few flights were impacted, the gain in capacity is not considered as relevant."

4.6.2.2 Solution 40 performance assessment results for CAP2

Appendix B provides the sources for the figures used in the performance assessments of this section.

In the case of Solution 40, the main approach followed for the optimization of mission trajectories with integrated DMA type 1 and 2 was to reduce the impact of airspace reservation on the planned business trajectories, specifically to reduce the number of impacted trajectories. The solution could enable a 50% reduction to the rerouted trajectories during the DMA activation time, hence allowing a better distribution and balance of traffic demand within the ATC sectors impacted than in the case of static ARES activation.

Requisites to CAP2 related performance assessments:

- The impact of solution on capacity is assessed for the ATC sectors open during DMA activations based on figures provided by R-NEST following to the simulation of airspace configuration
- There are no sector entry or occupancy thresholds established; we followed the variation of counts between the reference and the solution scenario
- The controller workload threshold is set at 42 minutes, constant for all ATC sectors
- There are no ATFM measures applied
- The time window for the validation scenario, hence the ATC sector configuration duration could be considered as at traffic peak time (08:00 to 10:35 AM)

Note: the assessments are exclusively related to the planning phase of operations.

The following sector configurations were active in EPWW FRA during the validation scenario execution:

- from 0800 to 1030 - 4e4e
- from 1030 to 1130 - 5e4e

Active sectors:

- High sectors: EPWWBDH, EPWWFGNEH, EPWWJKRZH, EPWWTCH
- Low sectors- EPWWBDL, EPWWTCL, EPWWFGNEL, EPWWJKRZL

Exercise ID or Expert judgement	Benefits contribution to CAP1	Benefits contribution to CAP2
EXE-07-W2-40–V3-01	N/A	+ 2,07 %

Table 12: Airspace Capacity benefits per Exercise

4.6.2.2.1 CAP2 KPI metrics assessment

Analysis		Total traffic	Average entry counts per hour	Average occupancy counts per hour	Average ATC sector workload variation (min)	Impact		
						Variation of entry counts	Variation of occupancy (#/%)	Variation of workload (min)
High sector EPWWBDH	Reference scenario	94	36,66	42,33	+0,66	- 0,33	- 1,33 - 0,12%	-0,33
	Solution scenario	96	36,33	41,33	0			
High sector EPWWGNEH	Reference scenario	77	32	39	+0,66	+1,33	+ 2,33 + 5,97%	+0,67
	Solution scenario	86	33,33	41,33	+ 1,33			
High sector EPWWJKRZH	Reference scenario	89	33,33	43,66	-2,33	+ 0,67	+ 1,33 + 1,53%	-1
	Solution scenario	90	34	44,33	-1,33			
High sector EPWWTCH	Reference scenario	110	43,33	53,33	+1,33	- 1,67	- 1,67 - 3,14%	-2,33
	Solution scenario	107	41,66	51,66	-1			
Low sector EPWWBDL	Reference scenario	118	46,33	53,33	+1,66	+ 0,33	+ 0,33 + 0,71%	-2
	Solution scenario	120	46,66	54,33	-0,66			
Low sector EPWWTCL	Reference scenario	128	51,66	59,66	+2,66	+ 2	+ 2 + 3,82%	-1
	Solution scenario	130	53,66	60	-1,66			
Low sector EPWWFGNEL	Reference scenario	94	35	42,33	0	+ 1	+ 1,33 +3,14%	+0,33
	Solution scenario	98	36	43,66	+0,33			
Low sector EPWWJKRZL	Reference scenario	111	45	55	-1,66	0	+ 0,66 + 1,20%	+1
	Solution scenario	111	45	55,66	-0,66			
Solution impact: The overall results of solution scenario simulation reflect an increase of 67 (838-821) movements per hour within the active ATC sector configuration, which						+3,33	+4,98 +1,63%	-0,58 min

Analysis	Total traffic	Average entry counts per hour	Average occupancy counts per hour	Average ATC sector workload variation (min)	Impact		
					Variation of entry counts	Variation of occupancy (#/%)	Variation of workload (min)
represents 2,07% gain in en-route capacity compared to the application of reference static scenario. The analysis of results per each active ATC sector reflect an average increase of 4,98 movements per hour in the solution scenario, representing 1,63 % more than applying the static reference scenario. The variation of workload is less than 1 minute (0,58 min.), thus could be considered as insignificant. However, the overall tendency is a reduction of workload with the application of solution scenario.							

Tables 14 presents an expert judgement analysis of the contribution of OI steps to airspace capacity KPI.

OI step	Relative benefits contribution to CAP1	Relative benefits contribution to CAP2	Benefit expectations CAP2
AOM-0208 B	N/A	70%	1,45%
AUO-0210	N/A	5%	0,10%
AUO-0216	N/A	5%	0,10%
AOM-0304 B	N/A	20%	0,42%
TOTAL	N/A	100%	2,07%

Table 13: Airspace Capacity relative benefits per OI step

KPIs / PIs	**Unit**	**Calculation**	**Mandatory**	**Absolute expected performance benefit in SESAR2020**	**% expected performance benefit in SESAR2020**
CAP1 TMA throughput, in challenging airspace, per unit time	N/A	N/A	N/A	*N/A*	*N/A*
CAP2 En-route throughput, in challenging airspace, per unit time	Relative change of movements (% and number of movement)	% and also total number of movements, per volume of En-Route airspace per hour for specific traffic mix and density, for High and Medium Complexity airspace at peak demand hours.	YES	*Average of 67 movements increase per hour for local ENR of High, Very High and Medium complexity*	*+ 2,07% increase for local ENR of High, Very High and Medium complexity*

Table 14: Airspace benefits for Mandatory KPIs /PIs

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

Solution 40 performance assessment results cannot be directly associated (e.g. added) to previous results due to the different conditions applied. The main difference consists of the configuration of

ATC sectors, which in solution 40 is a constant. The rationale for that is the absence of both of NM and ATC actors as well as their validation platforms.

Reversely, the results obtained in SESAR 2020 Wave 2 by solution 40 and solution 44 could be consolidated, hence providing the expectation of CAP 2 improvements by an integrated contribution of DAC and MT with DMA type 1 and 2.

4.6.3 Extrapolation to ECAC wide

N/A

There is no ECAC wide extrapolation required for this KPI in the Performance Assessment Report.

4.6.4 Discussion of Assessment Result

The solution assessed and set an expectation of mission trajectory with DMA type 1 and 2 ARES contribution to local En-route capacity. The aim was to reflect solely the contribution of DMA flexibility, which was not the case in previous SESAR validation cycles.

We assessed the impact of the solution on capacity throughout the analysis of the ATC sector entry counts, occupancy counts, and workload as well as expert judgement. The impact of the solution is given by the difference between the results obtained for the reference and the solution scenarios in the simulations performed in RUN1 (for consistency with the assessments provided for all KPAs) for each of the active sectors.

In every analysed sector, occupancy increased at least during certain periods of time, which means that, provided the sector configuration and ATC planning are adequate, the implementation of the solution could contribute to increase airspace capacity.

The main contribution of DMA type 1 and 2 derives from the significant reduction of impact on planned trajectories, specifically less deviations, with a consequent positive impact on the distribution of traffic across the ATC sectors based on the analysis and decision of airspace and traffic flow managers. Improvement is highly supported by the 3D flexibility of DMA parameters, used by decision makers to optimize the position of DMAs in accordance with the predicted evolution of traffic demand.

Expert judgements:

- Total movements per EPWW FRA volume: the total number of movements associated with the activation of airspace reservations has increased while the workload was reduced, which allows an expectation of better ATC sector throughput.
- Occupancy counts: although the overall figure is positive, the sector level analysis reflect a decrease in occupancy in two out of eight sectors; it is likely impossible to increase the occupancy in all sectors impacted by airspace reservations, hence expert analysis on the prioritization of capacity needs and distribution of traffic amongst sectors is decisive.
- Workloads: within the limited scope of the solution (one FRA volume only and no adjustments to ATC sector configuration), the impact of solution on workloads is not significant. However, the workload was more homogeneous and slightly more balanced during the solution scenario execution runs compared to the reference scenarios (2,66 minutes variation compared to 5,32 minutes variation).

- Although DMAs type 1 and 2 have solely a positive impact on traffic accommodation their contribution could be maximized by an integrated approach to the assessment of DAC benefits, meaning the combination of ATC sector configuration and DMAs adjustment measures.
- As DMA type 1 and 2 will not be the only type of ARES design for mission trajectories, the results obtained in validation needs to be judged accordingly.

Qualitative assessment of OI step contribution:

OI step	Impact on CAP2
AOM-0208 B	DMA contains flexible parameters that are integrated into the MT dataset and are shared for airspace configuration optimization purposes. Flexible DMA parameters are the key attributes used by the ASM and ATFM components of DAC to minimize adverse impact of airspace segregation on trajectory rerouting, hence on optimized accommodation by ATC sector configuration.
AUO-0216	The main aim of shared mission trajectories is to better address military specific information related to ARES DMA type 1 and 2 to be integrated into MT description and shared with all ATM actors concerned. When shared, the mission trajectories already contain optimized DMAs, however considering the changes to traffic demand evolution, additional adaptations at a smaller scale could be still possible.
AUO-0210	The sharing and integration into the local traffic demand of mission trajectory data triggers a CDM process aiming at balancing the specific mission requirements with the business trajectory requirements, specifically their accommodation without alterations by airspace configuration. The identification and negotiation of a target time over a specific point of mission trajectory (in the case of solution 40 validation, over the entry point of DMA) leads to an additional optimization of mission trajectory profile allowing local traffic flow managers to reduce deviations to planned direct trajectories.
AOM-0304 B	The description and sharing of mission trajectory profile, including DMAS by a 4D dataset exchanged via tools connectivity enable more dynamicity to information exchange between military and civil ATM actors. That dynamicity has a great value for the integration and management of short notice military requests.

Conclusion: The implementation of the solution could boost the local airspace capacity by 2,07%. The results need to be seen from the perspective of standing ATC sector configuration used during the validation. The experts consider that a joint optimization of DMA and ATC sector configuration could maximise the potential benefit of DMAs to airspace capacity.

4.6.5 Additional Comments and Notes

No.

4.7 Airport Capacity (Runway Throughput Flights/Hour)

Does the Solution impact this KPA? No **Performance Mechanism**

N/A**Assessment Data (Exercises and Expectations)**

N/A

4.7.3 Extrapolation to ECAC wide

N/A

4.7.4 Discussion of Assessment Result

N/A

4.7.5 Additional Comments and Notes

N/A

EUROPEAN PARTNERSHIP

Co-funded by the European Union

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

Does the Solution impact this KPA? No

4.8.1 Performance Mechanism

N/AAssessment Data (Exercises and Expectations)

N/A

4.8.3 Extrapolation to ECAC wide

N/A

4.8.4 Discussion of Assessment Result

N/A

4.8.5 Additional Comments and Notes

N/A

4.9 Flight Times

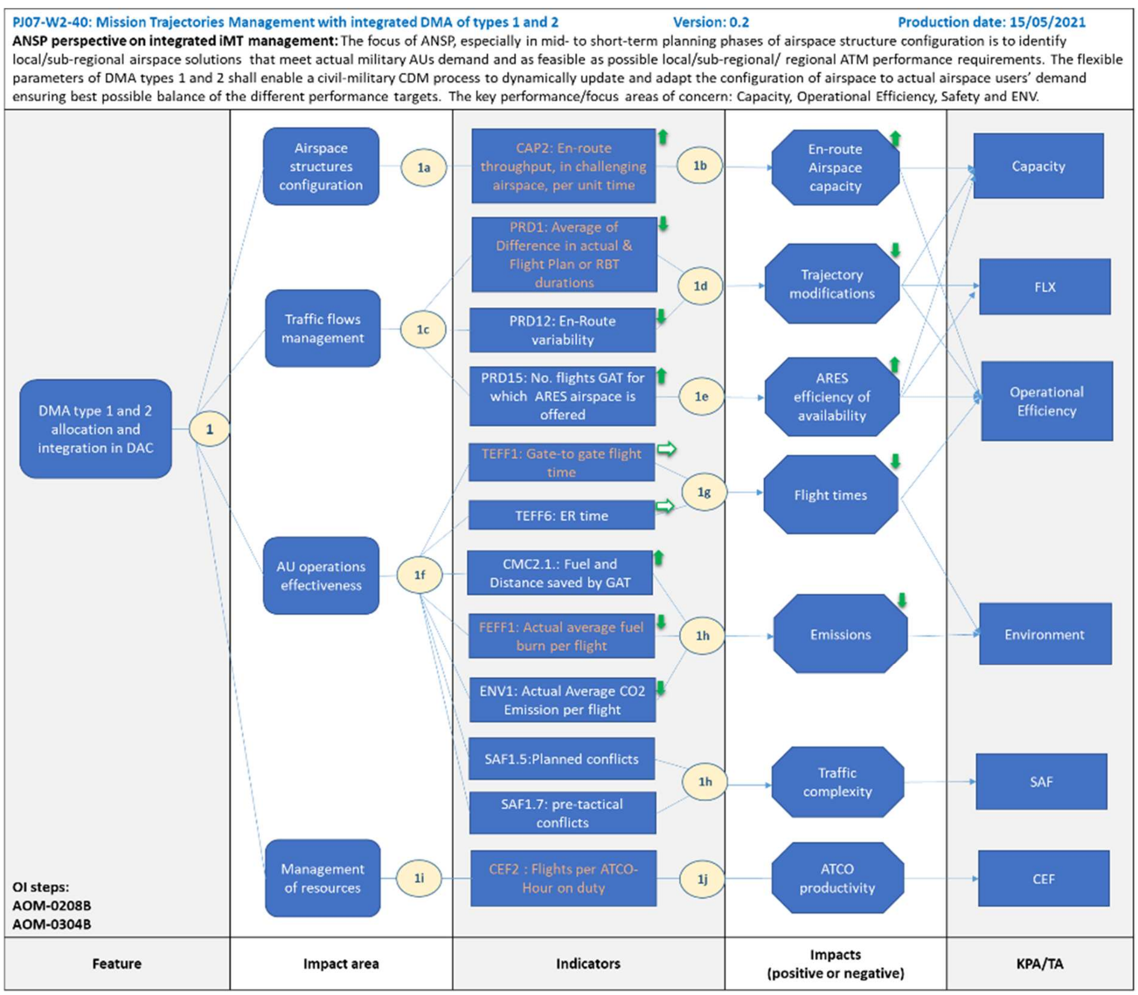
Does the Solution impact this KPA? Yes

Rationales:

Sharing of early flight intent with DMA type 1 and 2 and the civil-military CDM on DMA allocation enables less modifications to AU preferences for trajectories. That could improve the efficiency of operations by reducing the flight times.

Furthermore, the flexible allocation of DMA 1 and 2 as well as the application of target times over mission trajectory profile enable less ARES overbooking and consequently more opportunities to GAT flights to directly cross the ARES airspace offered. This could also have a potential benefit to reducing the flight times.

Is there a Benefit Mechanism available? Yes.



4.9.1 Assessment Data (Exercises and Expectations)

The data used for assessments are presented in Appendix B.

The extra duration of flights rerouted by the activation of static ARES in the reference scenario is 98 minutes. The extra duration of flights rerouted by the activation of DMAs in the solution scenario is 76 minutes. Hence, the absolute time saving by the application of the solution is 22 minutes.

For the total number of flights in the scenario, the average time saving per flight is 22/294 = 0,09 minutes. The average flight time in EPWW FRA is 40 minutes. Consequently, the % performance expectation is: 0,23%.

Table 22 presents the expectation for solution contribution to flight times in EPWW FRA:

Exercise ID or Expert judgement	Benefits contribution to TEFF1	Benefits contribution to TEFF2	Benefits contribution to TEFF3	Benefits contribution to TEFF4	Benefits contribution to TEFF5	Benefits contribution to TEFF6*
EXE-07-W2-40–V3-01	*-0,09 min/flight (-0,23%)*	N/A	N/A	N/A	N/A	*-0,09 min/flight (-0,23%)*

**the operating environment for the solution is exclusively ENR*

Table 15: Flight Times benefits per Exercise

Table 23 presents the expert judgement results for the contribution of OIs to flight times:

OI step	Relative benefits contribution to TEFF1		Relative benefits contribution to TEFF2	Relative benefits contribution to TEFF3	Relative benefits contribution to TEFF4	Relative benefits contribution to TEFF5	Relative benefits contribution to TEFF6	
AOM-0208 B	70%	0,06 min / flight	N/A	N/A	N/A	N/A	70%	0,06 min / flight
AUO-0216	20%	0,02 min / flight	N/A	N/A	N/A	N/A	20%	0,02 min / flight
AUO-0210	5%	0,005 min/flight	N/A	N/A	N/A	N/A	5%	0,005 min/flight
AOM-0304 B	5%	0,005 min/flight	N/A	N/A	N/A	N/A	5%	0,005 min/flight
TOTAL	100%	0,09 min / flight	100%	100%	100%	100%	100%	0,09 min / flight

Table 16: Flight Times relative benefits per OI step

4.9.2 Extrapolation to ECAC wide

ECAC level extrapolation:

TEFF1:

- The average ECAC flight time is 1,7 hours (102 minutes) in accordance with the common assumptions, reference [6].
- The absolute expected performance benefit is (0,09*102/40)*0,65[9] = 0,15 minutes in average per gate-to-gate flight.
- The % expected performance benefit is 0,15*100/102 = 0,15 % time saving per gate-to-gate flight.

[9] Scale factor

TEFF6:

According to the traffic distribution assumption [6] in the ENR of VH, H, M complexity sub-OEs, represents 97,20% of the total. Consequently, the average ECAC flight time in the ENR of VH, H, M complexity sub-OEs is 102*97,20% = 99,14 minutes.

The absolute expected performance benefit is (0,09*99,14/40)*0,65 = 0,15minutes saving in average per flight and the % expected performance benefit is 0,14*100/99,14 = 0,15% reduction in average per flight operating in ENR of VH, H, M complexity sub-OEs.

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	*N/A (0,15 min saving per flight)*	*N/A (0,15% saving per flight)*
TEFF2 Taxi in time	Min/flight	Average of the distribution of actual taxi-in (including ground queuing during taxi-in) durations	When relevant	*To be completed with a single or a range of values if easier*	*To be completed with a single or a range of values if easier (%)*
TEFF3 Taxi out time	Min/flight	Average of the distribution of actual taxi-out (including ground queuing during taxi-out) durations	When relevant	*To be completed with a single or a range of values if easier*	*To be completed with a single or a range of values if easier (%)*
TEFF4 TMA arrival time	Min/flight	Average of the distribution of actual TMA arrival (including holdings) durations	When relevant	*To be completed with a single or a range of values if easier*	*To be completed with a single or a range of values if easier (%)*
TEFF510 TMA departure time	Min/flight	Average of the distribution of actual TMA departure durations	When relevant	*To be completed with a single or a range of values if easier*	*To be completed with a single or a range of values if easier (%)*
TEFF6 En-Route time	Min/flight	Average of the distribution of actual En-route durations	When relevant	*N/A (0,15 min saving per flight)*	*N/A (0,15% saving per flight)*

Table 17: Flight Times benefits for Mandatory KPIs /PIs

Table 18 is showing the impact on flight phases (provided when it is possible).

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

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
TEFF1 Gate-to gate flight time	*N/A*	*N/A*	*-0,15 min / flight (-0,15%)*	*N/A*	*N/A*
TEFF2 Taxi in time	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
TEFF3 Taxi out time	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
TEFF4 TMA arrival time	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
TEFF5 TMA departure time	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
TEFF6 En-Route time	*N/A*	*N/A*	*0,15 min / flight (-0,15%)*	*N/A*	*N/A*

Table 18: Flight times benefit per flight phase.

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

4.9.3 Discussion of Assessment Result

Taking into account the single source (R-NEST) providing automatically values for performance metrics as well as the assumptions used for the assessment of the KPIs, the confidence in the assessment results for flight times is medium. We also consider that the magnitude of reduction by almost 60% of the trajectories impacted by airspace reservation/restriction when DMA concept element is applied could not be accurately reflected by the results for flight times at ECAC level. That is mainly due to the exclusive local perspective of the validation, which cannot capture the likely improved cross-border airspace configurations and their enhanced positive benefit on cross-border flights.

4.9.4 Additional Comments and Notes

Conclusion: The implementation of mission trajectory with DMA of types 1 and 2 could have a significant positive benefit on intra ECAC cross-border flights. However, the exercise validation results reflect a possible solution benefit of 6 minutes (6%) reduction in average per flight of the impact of airspace reservation/restrictions.

4.10 Predictability

Does the Solution impact this KPA? Yes.

Performance Mechanism

Is there a Benefit Mechanism available? Yes.

Sharing of early flight intent with DMA type 1 and 2 and the civil-military CDM on DMA allocation enables less modifications to AU preferences for trajectories. Furthermore, the implementation of DMA 1 and 2 leads to less ARES overbooking and supports better awareness on the actual status of airspace, thus improved predictability for the planning FRA operations.

4.10.2 Assessment Data (Exercises and Expectations)

The solution scenario simulation results reflect a reduction up to 60% of the impact of mission trajectories with DMA types 1&2 on the planned trajectories. This should lead to an overall reduction of variances between the planned and actual flights.

Within the scope of the validation, we consider as ‘planned’ the flights provided by the R-NEST forecast, without airspace reservation/restriction activated. Furthermore, we assimilate the ‘actual’ flights with those resulting from the activation of airspace reservations, assuming that there are no alterations during the execution.

In the static scenario the variation of flights duration after the activation of static ARES is 98 min. Relative to the number of flights operating in EPWW FRA during the simulation (294) that represents an average of 0,33 min deviation per flight.

In the solution scenario the variation of flights duration after the activation of DMA types 1 and 2 is 76 min. Relative to the number of flights operating in EPWW FRA during the simulation (294) that represents an average of 0,26 min per flight. This leads to a reduction of flight duration variation with 0,07 min in average per flight.

Exercise ID or Expert judgement	Benefits contribution to PRD1	Benefits contribution to PRD2
EXE-07-W2-40–V3-01	0,07 min/flight	N/A

Table 19: Predictability benefits per Exercise

OI step	Relative benefits contribution to PRD1	Relative benefits contribution to PRD2
AOM-0208 B (70%)	0,06min/flight	N/A
AUO-0210 (20%)	0,007 min/flight	N/A
AUO-0216 (5%)	0,004 min/flight	N/A
AOM-0304 B (5%)	0,004 min/flight	N/A
TOTAL	0,07 min/flight	100%

Table 20: Predictability relative benefits per OI step

4.10.3Extrapolation to ECAC wide

In accordance with the common assumption T007 [6], the contribution of ENR to variability is 5%. Consequently, the absolute expected performance benefit is 0,07*5%*0,65[11] = 0,002 min per flight in average. The expected % performance benefit, relative to the 99,14 minutes average flight duration (ENR of VH ,H, M complexity sub-OEs) is 0,002*100/99,14 = 0,002%.

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	*0,002 min reduction in average per flight (ENR of VH , H, M complexity sub-OEs)*	*0,002% reduction (ENR of VH , H, M complexity sub-OEs)*
PRD2 Variance[12] of Difference in actual & Flight Plan or RBT durations	$Minutes^2$	Variance of the distribution of the differences between flown trajectories & Flight Plans or RBT durations	YES	*N/A*	*N/A*

Table 21: Predictability benefits for Mandatory KPIs /PIs

Table 22 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*	*-0,002 min (-0,002%)*	*N/A*	*N/A*
PRD2 Variance of Difference in actual & Flight Plan or RBT durations	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*

Table 22: Predictability benefit per flight phase

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

4.10.4Discussion of Assessment Result

Having regard to the ECAC figures presented in table 28, we consider the impact of the solution on predictability KPI as irrelevant and we recommend to not be taken into consideration.

However, we also consider that the results were influenced by the local nature of the validation scenario, which cannot capture a network level perspective on the value of mission trajectory sharing to predictability. Flexibility of DMAS could definitely contribute to obtain better network level values

[11] Scale factor.

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

if supported by corresponding validation scenarios addressing cross border mission trajectories with DMAs and airspace configurations. Consequently, the confidence in the assessment results is low.

4.10.5 Additional Comments and Notes

Conclusion: The values obtained for the PRD 1 KPI are not relevant to make a conclusion on the contribution of the solution to predictability. We consider that a cross-border scenario for validation could lead to relevant figures, considering that the application of the solution reduces significantly the impact of airspace reservation/restriction on re-routings and flight times.

4.11 Punctuality

Does the Solution impact this KPA? No.**Performance Mechanism**

N/A

4.11.2 Assessment Data (Exercises and Expectations)

N/A

4.11.3 Extrapolation to ECAC wide

N/A

4.11.4 Discussion of Assessment Result

N/A

4.11.5 Additional Comments and Notes

N/A

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

Does the Solution impact this KPA? Yes.

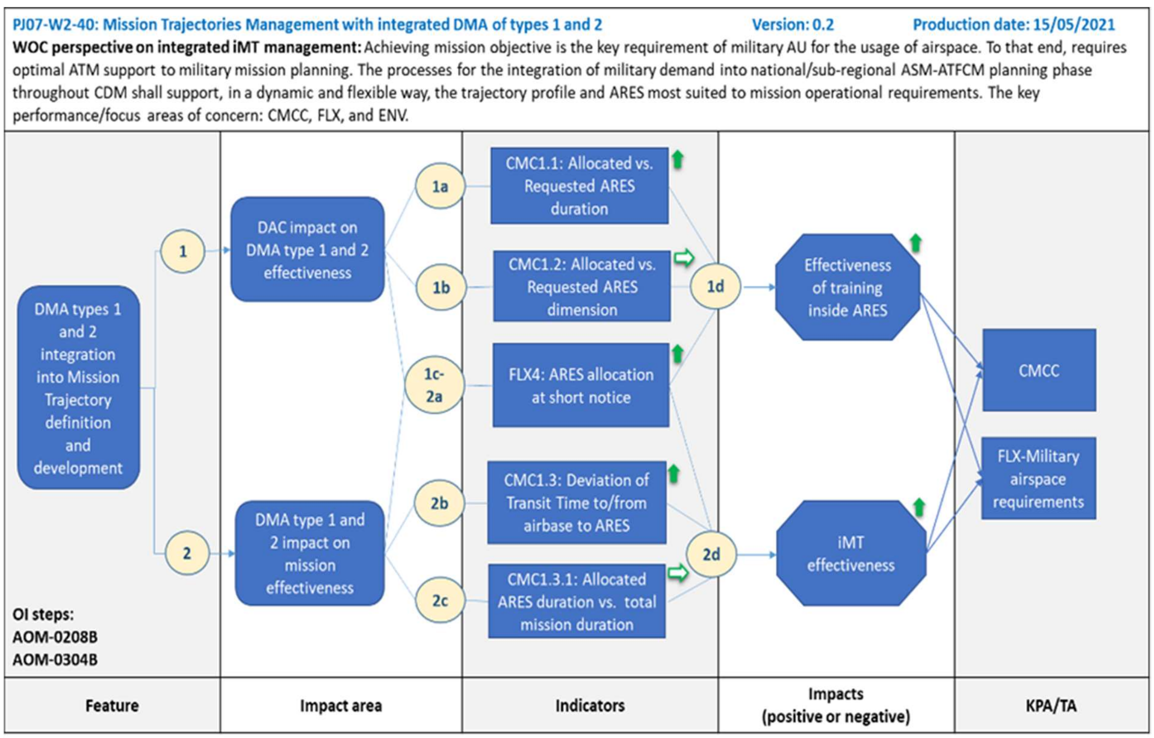
Rationales:

The integration of DMA types 1 and 2 into the management of mission trajectories has a twofold impact on the effectiveness of military mission: in one side, the flexibility of DMAs provides more options to military planners to cope with the dynamicity of changes to mission requirements inside reserved airspaces while, reversely could have an impact on the entire mission profile, specifically in cases where multiple airspace reservations are associated to a trajectory profile.

The overall expectation is that the solution will ensure the provision of optimized ATM support to achieving mission objectives by maintaining the parameters of trajectory profile and associated airspace reservation/restriction within the appropriate limits in accordance with the flexibility pre-defined by the mission trajectory user.

4.12.1Performance Mechanism

Is there a Benefit Mechanism available? Yes.

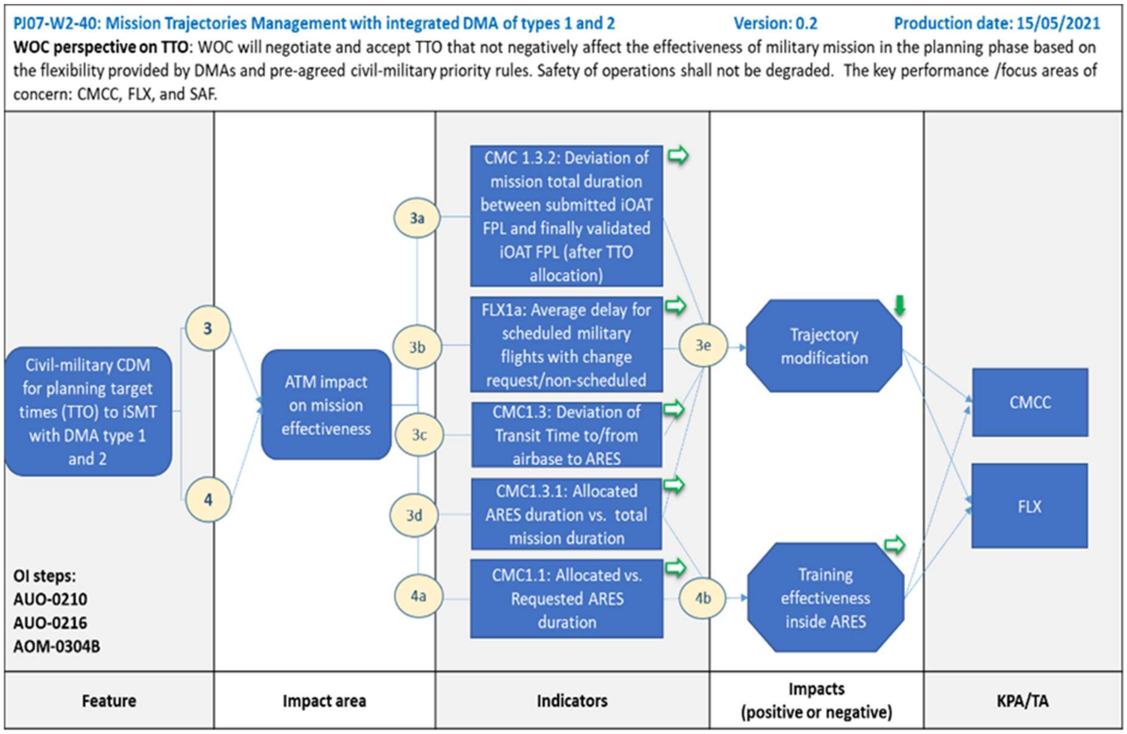


The duration of training inside an ARES is dictated exclusively by operational requirements. With DMAs, flexibility allows adjustments of airspace configuration to enable the AU to execute its mission as required. The time allocated is equal/ higher than requested.

The volume of airspace necessary for a training event in ARES is dictated exclusively by operational requirements. The different shapes proposed by DMA definition tool and integration of DMA in DAC throughout optimization of request do not alter the dimensions of airspace (horizontal, vertical, altitude block) requested by the AU.

Integration of DMA type 1 and 2 in DAC throughout CDM provides the AU the possibility to preserve the parameters (time, volume of airspace, short notice adaptations) required for an effective execution of mission based on actual operational requirements.

The flexibility of DMA type 1 and 2 is suited to mission planning constraints. DMA location flexibility ensures the disposal of ARES at the required distance/flight time from/to a specific reference point. The consequent update to trajectory does not generate unacceptable deviations of transit time.



TTO generates changes to the elapsed times of MT and EOBT. Based on DMA flexibility, the change of EOBT and/or DMA entry/exit times do not affect the duration of the flight required for the execution of the planned mission(s).

TTO over ARES entry point stays within the predefined flexibility by the airspace user with no effect on the duration of transit to/from airbase or to/from a consecutive ARES connected to the same MT.

Integration of TTO into the MT profile does not affect the AU the possibility to preserve the parameters (time, volume of airspace, short notice adaptations) required for an effective execution of mission inside DMAs based on actual operational requirements.

4.12.2Assessment Data (Exercises and Expectations)

The data used for the assessment of the metrics associated to CMCC KPI were collected from the tool prototypes of the WOC mission support system (the ASM tool and the DMAS tool). Appendix B presents the values of each trajectory profile collected from the respective iOAT FPL generated by the DMAS tool in accordance with the parameters provided by mission planners and the ASM tool.

The assessment consists of the comparison between the values obtained in the reference and solution scenarios for two categories of assets considered as critical (actively contributing) for achieving the mission objectives: fighters and tankers.

Airspace user request in accordance with the mission planning [7], which constitutes the reference values for assessing the impact of the solution on CMCC KPA:

Type	# of a/c or formation	Time requested for mission inside ARES/DMA			Total time
		DACT	AAR	BFM	
Fighter	4	4x60'=240'	4x20'=80'	4x40'=160'	480'
Tanker	2		2x20'=40'		40'
Total	6	240'	120'	160'	520'

The data below presents an aggregation of the figures collected from the iOAT FPLs of fighters and tankers after the simulation of the two different scenarios:

Reference scenario:

	Segment 1 (departure)	Segment 2	Segment 3	Segment 4 (arrival)	**Total transit planned time**	**Total Stay (ARES) planned time**	**Total mission planned time**
Tanker 1	24'16"			23'40"	**47'56"**	**20'**	**67'56"**
Tanker 2	23'51"			24'39"	**48'30"**	**20'**	**68'30"**
Total tankers	**48'07"**			**48'19"**	**96'26" (70%)***	**40' (30%)***	**136'26"**
Fighter 1	2'10"	10'11"	9'54"	4'04"	**26'19"**	**130'**	**156'19"**
Fighter 2	1'15"	10'12"	9'54"	4'04"	**25'25"**	**130'**	**155'25"**
Fighter 3	3'04"	10'12"	9'54"	4'04"	**27'14"**	**130'**	**157'14"**
Fighter 4	0'20"	10'12"	9'54"	4'04"	**24'30"**	**130'**	**154'30"**
Total fighters	**6'49"**	**40'47"**	**39'36"**	**16'16"**	**103'28" (16,5%)***	**520' (83,5%)***	**623'28"**
Grand total					**199'54" (26,21%)***	**560' (73,79%)***	**759'54"**

Solution scenario:

	Segment 1(departure)	Segment 2	Segment 3	Segment 4 (arrival)	**Total transit planned time**	**Total Stay(DMA) planned time**	**Total mission planned time**
Tanker 1	19'40"			19'41"	**39'21"**	**25'**	**64'21"**
Tanker 2	20'17"			19'31"	**39'48"**	**25'**	**64'48"**
Total tankers	**39'57"**			**39'12"**	**79'09" (61%)**	**50' (39%)**	**129'09"**
Fighter 1	1'11"	2'38"	3'34"	1'09"	**23'36"**	**125'**	**148'36"**
Fighter 2	54"	2'24"	2'28"	1'08"	**20'50"**	**125'**	**145'50"**
Fighter 3	1'11"	2'12"	3'12"	1'09"	**18'44"**	**125'**	**143'44"**
Fighter 4	1'11"	1'57"	2'57"	1'09"	**16'14"**	**125'**	**141'14"**
Total fighters	**4'27"**	**35'11"**	**35'11"**	**4'35"**	**79'24" (13,6%)***	**500' (86,4%)***	**579'24"**
Grand total					**158'33" (22,31%)***	**550' (77,69%)***	**708'33"**

*Note: *the percentages inside the brackets represent values relative to the total mission time*

CMC1.1 Allocated vs. Requested ARES duration

In both of the reference and solution scenarios the airspace user request for training inside ARES/DMA is fulfilled, consequently the conditions for mission objectives achievement are ensured.

The values obtained from the calculation of trajectory parameters from the iOAT FPLs reflect 20 minutes more training time planned for fighters inside static areas (ARES) than inside DMA. Reversely, in the solution scenario, 10 minutes more are planned for AAR in the solution scenario than in the static one.

The differences are generated by the two following factors:

- the positioning of entry and exit points and not to adaptations of DMA during the CDM for allocation process
- expert judgements on the priority and criticality of different missions simulated in the scenarios. Real AAR mission is considered as the most critical one for the completion of mission scenario.

Conclusion: CMC1.1 PI absolute performance value expectation is considered as = 1, while the performance benefit expectation is 100% satisfaction to military airspace user request for training time inside airspace reservation/restriction.

CMC1.2 Allocated vs. Requested ARES dimension

Throughout the entire ARES/DMA 1&2 definition, optimization, and allocation process the volume of airspace (defined by the horizontal dimension and vertical flight level band) requested by the user for all types of missions has not been altered. The tool prototypes in both of the WOC and DAC functions are able to define, process and preserve the respective volume parameters.

Absolute performance value expectation: (Allocated ARES surface/ Requested ARES Surface) x (Allocated FL band/Requested FL band) = 1.

Performance benefit expectation is: 100% satisfaction to military airspace user request for volume of airspace allocated to training inside airspace reservation/restriction

CMC1.3 Deviation of Transit Time to/from airbase to ARES

This metric is considered as very important to assessing the impact of ATM on the effectiveness of military mission. The main criterion for assessment is the proportion of transit time relative to the total duration of mission. The end goal is to reduce/preserve the planned transit duration in the benefit of operational training duration.

As the missions simulated in the exercise scenarios contain multiple DMAs, we consider the summation of the times spent on the associated trajectory segments, from departure to arrival, as the transit time.

Our assessment followed the variation of the above-mentioned proportions between the static and solution scenarios simulation results.

In the static scenario: transit time of tankers represent 70% and the transit time of fighters 16.5% out of the total duration of missions.

In the solution scenario: transit time of tankers represent 61% and the transit time of fighters 13.6% out of the total duration of missions.

In our opinion, an expected performance benefit for the transit time in absolute values is not realistic. The transit time fluctuates in accordance with multifarious factors such as the type of aircraft, the configuration of ARES/DMA, the flight profile, the size of airspace reservation. Hence, the main criterion and the expected performance benefit should be expressed by the variation of the proportion of transit time out of the total duration of the mission between static and DMA scenarios.

The expected performance benefit for CMC1.3 is the reduction of deviation of transit time proportion relative to the total mission duration between 2.9% and 9%.

CMC 1.3.1 Allocated ARES duration vs. total mission duration

This metric is also considered as very important to assessing the impact of ATM on the effectiveness of military mission. In the context of DMA flexible allocation, the main criterion for assessment is the proportion of ARES/DMA allocated time relative to the total duration of mission. The end goal is to preserve/improve the planned training duration in the benefit of operational training.

Our assessments followed the variation of the above-mentioned proportions between the static and solution scenarios simulation results.

In the static scenario: time allocated for AAR mission ARES represent 30% and the time for fighter training ARES 83.5% out of the total duration of missions.

In the solution scenario: time allocated for AAR mission DMA represent 39% and the time for fighter training ARES 86.4% out of the total duration of missions.

In our opinion, an expected performance benefit for the allocated mission duration in absolute values is not realistic. The mission duration and the consequent ARES/DMA allocation fluctuates in accordance with multifarious factors such as the type of mission, the number and type of aircraft, the flight profile. Hence, the main criterion and the expected performance benefit should be expressed by the variation of the proportion of time allocated to operational activities/training throughout ARES/DMA allocation out of the total duration of the mission between static and DMA scenarios.

The expected performance benefit for CMC1.3.1 is the increase of the proportion of allocated ARES duration between 2.9% and 9%.

CMC2.1 Fuel and Distance saved by GAT

For the fuel save see the results in section 4.4.2.1.

For distance saving assessment, we use the following figures (reference in Appendix B):

- The additional length of trajectories impacted by ARES in static scenario is 618 NM
- The additional length of trajectories impacted by DMAs in solution scenario is 533 NM
- During the exercise scenario, 294 flights operate in EPWW FRA

The absolute average figure for distance saving per flight operating in EPWW FRA during the activation of DMAs according to the scenario is (618-533) / 294 = 0,3 NM.

Exercise ID or Expert judgement	Benefits contribution to CMC1.1	Benefits contribution to CMC1.2	Benefits contribution to CMC1.3	Benefits contribution to CMC1.3.1	Benefits contribution to CMC1.3.2	Benefits contribution to CMC1.4.1	Benefits contribution to CMC1.4.2	Benefits contribution to CMC2.1
EXE-07-W2-40–V3-01	100% satisfaction	100% satisfaction	2.9% - 9% reduction of transit time	2.9% - 9% increase of ARES duration	N/A	N/A	N/A	10,27 kg fuel saved per flight. 0,3 NM distance saved per flight.

Table 23: Civil-Military Cooperation and Coordination benefit per Exercise

OI step	Relative benefits contribution to CMC1.1	Relative benefits contribution to CMC1.2	Relative benefits contribution to CMC1.3	Relative benefits contribution to CMC1.3.1	Relative benefits contribution to CMC1.3.2	Relative benefits contribution to CMC1.4.1	Relative benefits contribution to CMC1.4.2	Relative benefits contribution to CMC2.1
AOM-0208 B (80%)	100% satisfaction	100% satisfaction	2,32 – 7,2 %	2,32 – 7,2 %	N/A	N/A	N/A	8,22 kg fuel 0,2 NM
AUO-0210 (10%)	100% satisfaction	100% satisfaction	0,29 – 0,9 %	0,29 – 0,9 %	N/A	N/A	N/A	1,03 kg fuel 0,03 NM
AUO-0216 (5%)	100% satisfaction	100% satisfaction	0,14 – 0,45 %	0,14 – 0,45 %	N/A	N/A	N/A	0,52 kg fuel 0,015 NM
AOM-0304 B (5%)	100% satisfaction	100% satisfaction	0,14 – 0,45 %	0,14 – 0,45 %	N/A	N/A	N/A	0,52 kg fuel 0,015 NM
TOTAL (100%)	100% satisfaction	100% satisfaction	2.9% - 9% reduction of transit time	2.9% - 9% increase of ARES duration	N/A	N/A	N/A	10,27 kg fuel saved per flight. 0,3 NM distance saved per flight.

Table 24: Civil-Military Cooperation and Coordination relative benefit per OI step

4.12.3Extrapolation to ECAC wide

CMC1.1 Allocated vs. Requested ARES duration

CMC1.1 PI absolute performance value expectation is considered as = 1 (the time allocated for DMAs is always equal to the time requested by user). The performance benefit expectation is 100% satisfaction to military airspace user request for training time inside airspace reservation/restriction.

CMC1.2 Allocated vs. Requested ARES dimension

Absolute performance value expectation: (Allocated ARES surface/ Requested ARES Surface) x (Allocated FL band/Requested FL band) = 1. The volume of airspace allocated for DMAs is always equal to that requested by user.

Performance benefit expectation is: 100% satisfaction to military airspace user request for volume of airspace allocated to training inside airspace reservation/restriction

CMC1.3 Deviation of Transit Time to/from airbase to ARES

Based on the opinion expressed in the previous section for this metric, extrapolation at ECAC level is not realistic either.

To extrapolate the expected performance benefit for CMC1.3 at ECAC level we apply the scale factor identified in the assumptions. Consequently, the expectation is a reduction of deviation of transit time proportion relative to the total mission duration between 1,89% (2.9%*0.65) and 5,85% (9%*0,65).

CMC 1.3.1 Allocated ARES duration vs. total mission duration

Based on the opinion expressed in the previous section for this metric, extrapolation at ECAC level is not realistic either.

To extrapolate the expected performance benefit for CMC1.3 at ECAC level we apply the scale factor identified in the assumptions. Consequently, the expectation is an increase of the proportion of allocated ARES duration relative to the total mission duration between 1,89% (2.9%*0.65) and 5,85% (9%*0,65).

The expected performance benefit for CMC1.3.1 is the increase of the proportion of allocated ARES duration between 2.9% and 9%.

CMC2.1 Fuel and Distance saved by GAT

ECAC level performance expectation for fuel efficiency: see section 4.4.3.

For the distance saving metric, by applying the scale factor of 0.65, the absolute benefit expectation for average distance saved per flight impacted by airspace reservation/restriction at ECAC level is 0,3*0.65 = 0,2 NM.

Category	PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
Impact of ATM Solutions on the effectiveness of military mission	**CMC1.1** Allocated vs. Requested ARES duration	%	It is calculated as proportion between the time allocated for ARES after completing the ASM planning phase (including the civil-military CDM process for airspace configuration) and the time initially requested by the user: Time allocated / time requested for airspace reservation/restriction. It could be calculated for an individual ARES or for a group of ARES depending on the validation scenario objectives and specifications. It is applicable to Variable Profile Area (VPA), Dynamic Mobile Area (DMA), and modular types of design for ARES. The indicator supports the assessment of the impact of ASM planning and civil-military decision-making processes on the training time for military mission inside ARES.	When relevant	*The time allocated for DMAs is always equal to the time requested by user. Consequently, the value of proportion is 1.*	*100 % satisfaction to airspace user request*

Category	PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
	CMC1.2 Allocated vs. Requested ARES dimension	%	It is calculated as the proportion between the volume of the ARES allocated after completing the ASM planning phase (including the civil-military CDM process for airspace configuration) and the volume initially requested by the user: (Allocated ARES surface/ Requested ARES Surface) x (Allocated FL band/Requested FL band). It could be calculated for an individual ARES or for a group of ARES depending on the validation scenario objectives and specifications. It is applicable to VPA, DMA, and modular types of design for ARES. It provides an indication on how closely the allocated ARES conforms to the required airspace dimensions for the execution of the training inside ARES.	When relevant	*The volume of airspace allocated for DMAs is always equal to that requested by user. Consequently, the value of proportion is 1.*	*100 % satisfaction to airspace user request*
	CMC1.3 Deviation of Transit Time to/from airbase to ARES	+/- Minutes	It represents the difference between the transit time in the initial request of the military Airspace User and the transit time resulting from the airspace configuration processes (including the civil-military CDM for ASM). Transit time is defined as the time to be flown from the airbase of departure to the entry point in ARES or from a reference point specified by the military user to the entry point in ARES. It is applicable in situations where a time/distance constraint is defined by the military airspace user for the location of ARES. It could be calculated for individual ARES and then the results could be summed up to provide a global figure for the entire military airspace use plan. It is applicable to VPA, DMA type 1, and modular types of design for ARES. It provides an indication on the effectiveness of ARES location.	When relevant	*The deviation of transit time will not affect the execution of operational training/mission*	*A reduction of transit time proportion in the total mission time between 1,89% and 5,85%.*

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Category	PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
	CMC 1.3.1 Allocated ARES duration vs. total mission duration	%	It is calculated as the difference in mean values of the ratios between time spent in DMA(s) versus total mission time (based on mid-speed) before (initial military request) and after the completion of airspace configuration (ARES allocation throughout civil-military CDM) processes. It could be calculated for individual ARES or a group of ARES depending on the missions defined in the exercise scenarios. It is applicable to VPA, DMA, and modular types of design for ARES. It supports the assessment of the achievement of military training objectives inside ARES.	When relevant	*The allocated ARES duration will satisfy military mission operational requirements*	*An increase of ARES allocation time proportion in the total mission time between 1,89% and 5,85%.*
	CMC 1.3.2 Deviation of total mission duration by iOAT FPL validation	+/- Minutes	It is calculated as the difference between the duration of the mission in the validated iOAT FPL (Reference Mission Trajectory RMT) and the duration of the mission in the submitted iOAT FPL (Shared Mission Trajectory SMT). It could be calculated for a single or the total FPLs submitted by WOC to the Network Manager (NM). It supports the assessment of the impact of NM flight plan validation processes on the effectiveness of military Mission Trajectory planning, especially for cross border flights.	When relevant	*N/A*	*N/A*
	CMC 1.4.1 Rate of iOAT FPLs acceptance by NM systems	%	The indicator it is calculated as a proportion between the number of FPLs submitted by WOC to NM and the number of FPLs validated by NM systems against the flight planning and ATM route network rules. The measurements could include both of the validation and tactical flow management systems of NM or could be limited to one of them. It supports the assessment of the acceptability of military requirements and exemptions by NM systems.	When relevant	*N/A*	*N/A*
	CMC 1.4.2 Rate of iOAT FPLs acceptance by ATC systems	%	The indicator is calculated as a proportion between the number of FPLs distributed after processing by NM to ATC systems and the number of FPLs accepted by the ATC systems. It supports the assessment of the viability of IOAT FPL to ATC as well as of the ability of ATC systems to provide services to OAT flights.	When relevant	*N/A*	*N/A*

Category	PIs	Unit	Calculation	Mandatory	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
Contribution of CMCC to ATM performance gains	**CMC2.1** Fuel and Distance saved by GAT	Kg and NM	Kg of fuel and distance saved by GAT due optimisation of the ATM network through Demand Capacity balancing and to the new ARES design and management	When relevant	*6,5 kg fuel save per ENR (VH, H, M complexity sub-OEs) flight.* 0,2 NM distance save per *ENR (VH, H, M complexity sub-OEs) flight*.	*0,2% fuel save per ENR (VH, H, M complexity sub-OEs) flight.*

Table 25: Civil-Military cooperation and coordination benefit for Mandatory KPIs /PIs

Table 26 is showing the impact on flight phases (provided when it is possible).

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
CMC1.1 Allocated vs. Requested ARES duration	*N/A*	*N/A*	*100 % satisfaction to airspace user request*	*N/A*	*N/A*
CMC1.2 Allocated vs. Requested ARES dimension	*N/A*	*N/A*	*100 % satisfaction to airspace user request*	*N/A*	*N/A*
CMC1.3 Deviation of Transit Time to/from airbase to ARES	*N/A*	*N/A*	*A reduction of transit time proportion in the total mission time between 1,89% and 5,85%.*	*N/A*	*N/A*
CMC 1.3.1 Allocated ARES duration vs. total mission duration	*N/A*	*N/A*	*An increase of ARES allocation time proportion in the total mission time between 1,89% and 5,85%.*	*N/A*	*N/A*
CMC 1.3.2 Deviation of total mission duration by iOAT FPL validation	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
CMC 1.4.1 Rate of iOAT FPLs acceptance by NM systems	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
CMC 1.4.2 Rate of iOAT FPLs acceptance by ATC systems	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
CMC2.1	*N/A*	*N/A*	*6,5 kg fuel save per ENR (VH, H,*	*N/A*	*N/A*

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
Fuel and Distance saved by GAT			*M complexity sub-OEs) flight.* *0,3 NM distance save per ENR (VH, H, M complexity sub-OEs) flight.*		

Table 26: Civil-Military cooperation and coordination benefit per flight phase.

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

4.12.4Discussion of Assessment Result

Overall, military mission effectiveness is not affected by the adaptation of mission trajectory profile to ATM efficiency needs. That is manly ensured by the optimization performed within the limits of predefined flexibility of DMAs as well as by the sole human decision competence.

Improvement is brought concerning the time available for training inside airspace/reservation restriction. This enforces the results of airspace capacity assessment results.

The confidence in the ECAC level results is low, mainly due to the wide range of peculiarities amongst ECAC states concerning the training modalities, different approaches to mission planning and the associated organization and management of airspace reservation/restriction.

Conclusion: the military mission effectiveness is safeguarded throughout the new operating methods for the mission trajectory with integrated DMA of types 1 and 2.

Conclusion: the solution contributes to enhancing the capacity of airspace to equally benefit ATM needs for traffic demand accommodation and the military operational requirements.

4.12.5Additional Comments and Notes

No.

4.13Flexibility

Does the Solution impact this KPA? Yes but it was not assessed due to the scope of validation, actors, and data availability.

A delay, in the planning phase, was agreed and applied via a TTO to a mission trajectory with the aim of reducing the impact on traffic demand. The delay did not impact the effectiveness of mission trajectory. Furthermore, a benefit expectation assessment is not feasible as far as a similar delay (TTO) cannot be applied in a static ARES scenario environment.**Performance Mechanism**

Is there a Benefit Mechanism available? Yes. However, the assessment of this KPI was not possible.

4.13.2Assessment Data (Exercises and Expectations)

No.

4.13.3Extrapolation to ECAC wide

No.

4.13.4Discussion of Assessment Result

No.

4.13.5Additional Comments and Notes

No.

4.14 Cost Efficiency

Does the Solution impact this KPA? Yes but it was not assessed due to the scope of validation, actors available and data unavailability. The ATC actor was not available for the validation exercise. The configuration of ATC sectors did not change during the validation exercise, hence the number of flights handled by ATCOs remained the same.**Performance Mechanism**

Is there a Benefit Mechanism available? Yes. However, the assessment of the KPI has not been performed.

4.14.2 Assessment Data (Exercises and Expectations)

No.

4.14.3 Extrapolation to ECAC wide

No

4.14.4 Discussion of Assessment Result

N/A**Additional Comments and Notes**

N/A.

4.15 Airspace User Cost Efficiency

Does the Solution impact this KPA? No

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

4.15.1 Performance Mechanism

Is there a Benefit Mechanism available? No.

4.15.2 Assessment Data (Exercises and Expectations)

N/A

4.15.3 Extrapolation to ECAC wide

N/A

4.15.4 Discussion of Assessment Result

N/A

4.15.5 Additional Comments and Notes

N/A

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4.16 Security

4.16.1 The SecRAM 2.0 methodology and the Security Performance Mechanism

N/A

4.16.2 Security Assessment Data Collection

N/A

4.16.3 Extrapolation to ECAC wide

N/A

4.16.4 Discussion of Assessment Result

N/A

4.16.5 Additional Comments and Notes

N/A

4.17 Human Performance

4.17.1 HP arguments, activities, and metrics

The HP Assessment for solution PJ.07-W2-40 was conducted according to SESAR Human Performance Assessment Guidance for V3 [17] and consequently the following deliverables were produced:

- Human Performance Assessment Plan (PJ07-W2-40 VALP Part IV) presenting the scope of the assessment, coverage of the arguments, issues and benefits identified and human performance assessment activities.
- Human Performance Assessment Report (PJ07-W2-40 OSED Part IV) describing the evidence gathered during the validations and elicitation of the recommendations and requirements for the concept and further validations.

The following activities were performed to accomplish the HP assessment:

1. Scope and change assessment workshop
2. HP metrics and indicators workshop
3. EXE-07-W2-40–V3-01 Real Time Simulation
4. HP results and requirements consolidation workshop

The scope of the HP assessment was equal to the scope of PJ07-W2-40 OSED Part I, ensuring that all relevant HP aspects for V3 phase have been identified and considered for the operational and technical development of the concept. The coverage of arguments is presented in the Table below.

PIs	Activities & Metrics	Second level indicators	Covered
HP1 Consistency of human role with respect to human capabilities and limitations	**Scoping and change assessment workshop** **VAL EXE (RTS HITL)** **Observations** **Interviews with operational experts,** **Debriefing sessions**	**HP1.1** Clarity and completeness of role and responsibilities of human actors	Covered
		HP1.2 Adequacy of operating methods (procedures) in supporting human performance	Covered
		HP1.3 Capability of human actors to achieve their tasks in a timely manner, with limited error rate and acceptable workload level	Covered
HP2 Suitability of technical system in supporting the tasks of human actors	**VAL EXE (RTS HITL)** **Observations** **Questionnaires** **Interviews with operational experts,** **Debriefing sessions,** **Subjective Measures of the following elements were conducted:** **Workload (Bedford)** **Situational awareness, (China Lakes)** **Trust (SATI)**	**HP2.1** Adequacy of allocation of tasks between the human and the machine (i.e. level of automation).	Covered
		HP2.2 Adequacy of technical systems in supporting Human Performance with respect to timeliness of system responses and accuracy of information provided	Covered
		HP2.3 Adequacy of the human machine interface in supporting the human in carrying out their tasks.	Covered

PIs	Activities & Metrics	Second level indicators	Covered
	Acceptability (CARS -adapted for the concept)		
HP3 Adequacy of team structure and team communication in supporting the human actors	**Scoping and change assessment workshop** **VAL EXE (RTS HITL)** **Interviews with operational experts & Debriefing sessions**	**HP3.1** Adequacy of team composition in terms of identified roles	Covered
		HP3.2 Adequacy of task allocation among human actors	Covered
		HP3.3 Adequacy of team communication with regard to information type, technical enablers and impact on situation awareness/workload	Covered
HP4 Feasibility with regard to HP-related transition factors	**Scoping and change assessment workshop** **VAL EXE (RTS HITL)** **Interviews with operational experts & Debriefing sessions**	**HP4.1** User acceptability of the proposed solution	Covered
		HP4.2 Feasibility in relation to changes in competence requirements	Covered
		HP4.3 Feasibility in relation to changes in staffing levels, shift organization and workforce relocation.	Covered
		HP4.4 Feasibility in relation to changes in recruitment and selection requirements .	Covered
		HP4.5 Feasibility in terms of changes in training needs with regard to its contents, duration and modality.	Covered

Table 27: HP arguments, activities and metrics

4.17.2Extrapolation to ECAC wide

There is no ECAC wide extrapolation required for this KPI.

4.17.3Open HP issues/ recommendations and requirements

PIs	Number of open issues/ benefits	Nr. of recommendations	Number of requirements
HP1 Consistency of human role with respect to human capabilities and limitations	5	8	N/A
HP2 Suitability of technical system in supporting the tasks of human actors	9	8	1
HP3 Adequacy of team structure and team communication in supporting the human actors	7	4	N/A
HP4 Feasibility with regard to HP-related transition factors	3	N/A	N/A

Table 28: Open HP issues/ recommendations and requirements

4.17.4 Concept interaction

Solutions PJ-07-W2-40 and PJ.09-W2-44 share the DMA common topic: PJ-07-W2-40 validates its integration into MT, while PJ.09-W2-44 addresses DMA integration into DAC. The HP assessment did not reveal any issues that might affect the performance and benefit gained in the solution PJ.09-W2-44.

4.17.5 Most important HP issues

The most important issues found for the solution were linked to the performance of the supporting tools to human actors. The recommendations for the improvements were provided in the PJ07-W2-40 OSED Part IV HPAR.

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	Arg. 1.1.4 The operating methods have been considered as unclear and inconsistent by end users.	N/A
	Arg. 1.1.5 Due to the introduction of new, additional tasks, the end users can not follow operating methods (procedures) in an accurate, efficient and timely manner.	N/A
	Arg. 1.3.4: Level of trust in the new concept (and associated procedures) experienced as insufficient by the end user	N/A
HP2	ARG. 2.2.1. The accuracy of information provided by the technical system is not adequate for carrying out the task. Appropriate support of the WOC and DAC	N/A

PIs	Most important issue of the solution	Most important issues due to solution interdependencies
Suitability of technical system in supporting the tasks of human actors	user when displaying the dependent DMAs to ensure the efficiency of the negotiation process.	
	Arg.2.1.4 Although additional tasks are introduced, the end users are supported by automation in task performance and workload perceived remains within acceptable limits	N/A
HP3 Adequacy of team structure and team communication in supporting the human actors	Arg. 3.2.2. The proposed task allocation between human actors is not supported by technical systems/the HMI	N/A
	Arg. 3.3.1: Intra-team and inter-team communication does not support the information requirements of team members.	N/A
HP4 Feasibility with regard to HP-related transition factors	N/A	N/A

Table 29: Most important HP issues

4.17.6Additional Comments and Notes

N/A

4.18Other PIs

N/A

4.18.1Performance Mechanism

N/A**Assessment Data (Exercises and Expectations)**

N/A**Additional Comments and Notes**

N/A

Gap Analysis

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits at Network Level (ECAC Wide or Local depending on the KPI)[13]	Rationale[14]
SAF1: Safety - Total number of estimated accidents with ATM Contribution per year	*N/A*	*X No.*	
FEFF1: Fuel Efficiency - Actual average fuel burn per flight	*Impact Level 2* *0.010% fuel saving* *impacted flights: 10.318.000[15] (68%) of ECAC En route and the fuel saving 0.75(kg) for each of them*	*6.5 kg per flight saving (0.2%)* *5.740.183 (39%) of ECAC En route (VH, H, M sub-OEs) impacted flights and 6,5 kg of fuel saving for each of them*	*No gap.* *The expected benefit is suited to the apportioned target.*
CAP1: TMA Airspace Capacity - TMA throughput, in challenging airspace, per unit time.	*N/A*	*N/A*	
CAP2: En-Route Airspace Capacity - En-route throughput, in challenging airspace, per unit time	*Impact level 2* *3,5% (local)*	*+2,07 % (local)*	*We consider there is no gap discussion. The target was apportioned based on PJ08.01 results and contained an ATC sector configuration contribution. The expected benefit of solution 40 refers to the capacity boost, DMA types 1 and 2 could provide to DAC.*

[13] Negative impacts are indicated in red.

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

[15] Reference number of flights is 15.173.627 in accordance with common assumptions document annex1.

CAP3: Airport Capacity – Peak Runway Throughput (Mixed mode).	*NA*	*N/A*	
TEFF1: Gate-to-gate flight time	*Impact Level 2* *0,05% reduction*	*0,15 min/flight reduction* *0,15 % reduction* *16,67% impacted flights and 0,15 min/ flight reduction*	*No gap.* *The expected benefit is suited to the apportioned target.*
PRD1: Predictability – Average of Difference in actual & Flight Plan or RBT durations	*Impact Level 2* *0,1% reduction of variances*	*0,002 min reduction* *0,002 % reduction* *16,67% impacted flights and 0,002 min/ flight reduction of difference*	*The results were influenced by the local nature of the validation scenario, which cannot capture a network level perspective on the value of mission trajectory sharing to predictability.*
PUN1: Punctuality – Average departure delay per flight	*NA*	*N/A*	
CEF2: ATCO Productivity – Flights per ATCO -Hour on duty	*Impact Level 2* *0,42%* *0 No flights increase*	*Not assessed*	*The ATC actor was not available for the validation exercise. The configuration of ATC sectors did not change during the validation exercise, hence the number of flights handled by ATCOs remained the same.*
CEF3: Technology Cost – Cost per flight	*NA*	*N/A*	

Table 30: Gap analysis Summary

5 References

This PAR complies with the requirements set out in the following documents:

[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)[16]

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

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

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

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

[6] D4.0.30-PJ19-SESAR 2020 Common Assumptions 2019 annex 1(1.0)

[7] SESAR Solution PJ.07-W2-40: Validation Plan (VALP) for V3 - Part I, D4.1.009, 12 April 2022, edition 01.00.00

Content Integration

[8] SESAR ATM Lexicon

Performance Management

[9] PJ19.04 D4.1 Validation Targets - Wave 2 (2020)[17]

[10] SESAR 2020 common assumptions, D4.0.30, edition 01.00.00, 16 September 2019

Validation

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

[12] SESAR solution 08.01 V2 OSED Part V PAR, ed. 00.03.01, D2.1.024

Safety

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

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

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

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

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

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

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

[16]Accident Incident Models – AIM, release 2017

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

Human Performance

[17]16.06.05 D 27 HP Reference Material D27

[18]16.04.02 D04 e-HP Repository - Release note

Environment Assessment

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

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

[20]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

[21]16.06.02 D103 SESAR Security Ref Material Level

[22]16.06.02 D137 Minimum Set of Security Controls (MSSCs).

[23]16.06.02 D131 Security Database Application (CTRL_S)

Add all references used to produce this document, for example VALS, VALPs, and VALRs.

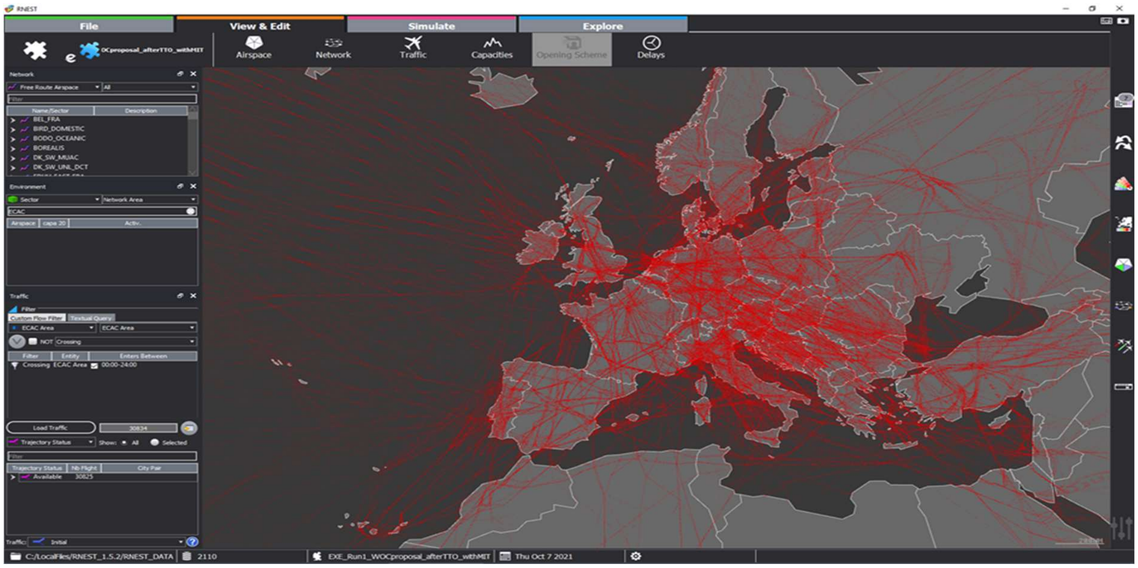
Appendix A Detailed Description and Issues of the OI Steps

OI Step ID	Title	Consistency with latest Dataset
AOM-0208-B	Dynamic Mobile Areas (DMA) of types 1 and 2	Consistent
AOM-0304-B	Integrated management of mission trajectory in trajectory based operations environment	Consistent
AUO-0210	Participation in CDM through iSMT and Target Time (TTO) negotiation	Consistent
AUO-0216	Shared Mission Trajectory Data	Consistent

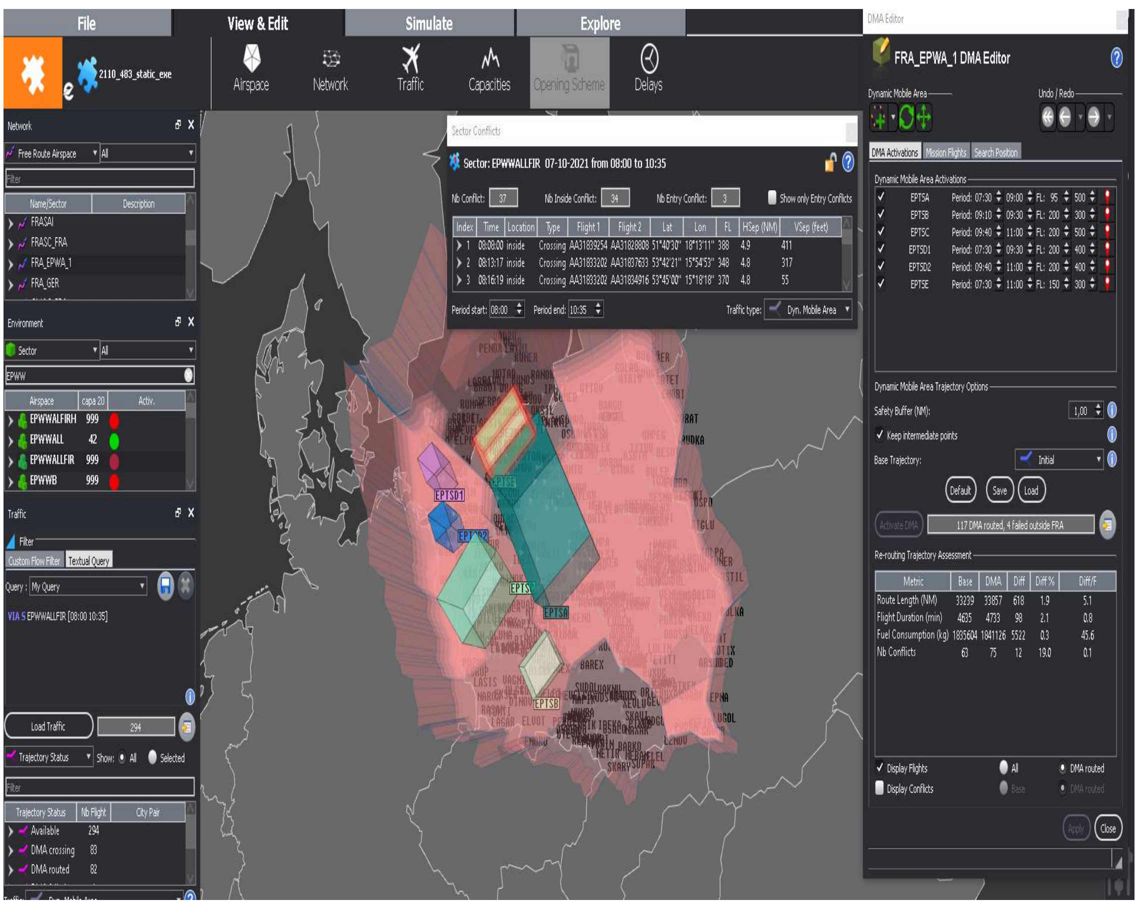
Table 31: OI Steps allocated to the Solution

Appendix B Performance data

Traffic forecast ECAC 2035, provided by R-NEST



Static scenario simulation in EPWWA FRA between 08:00 and 10:35



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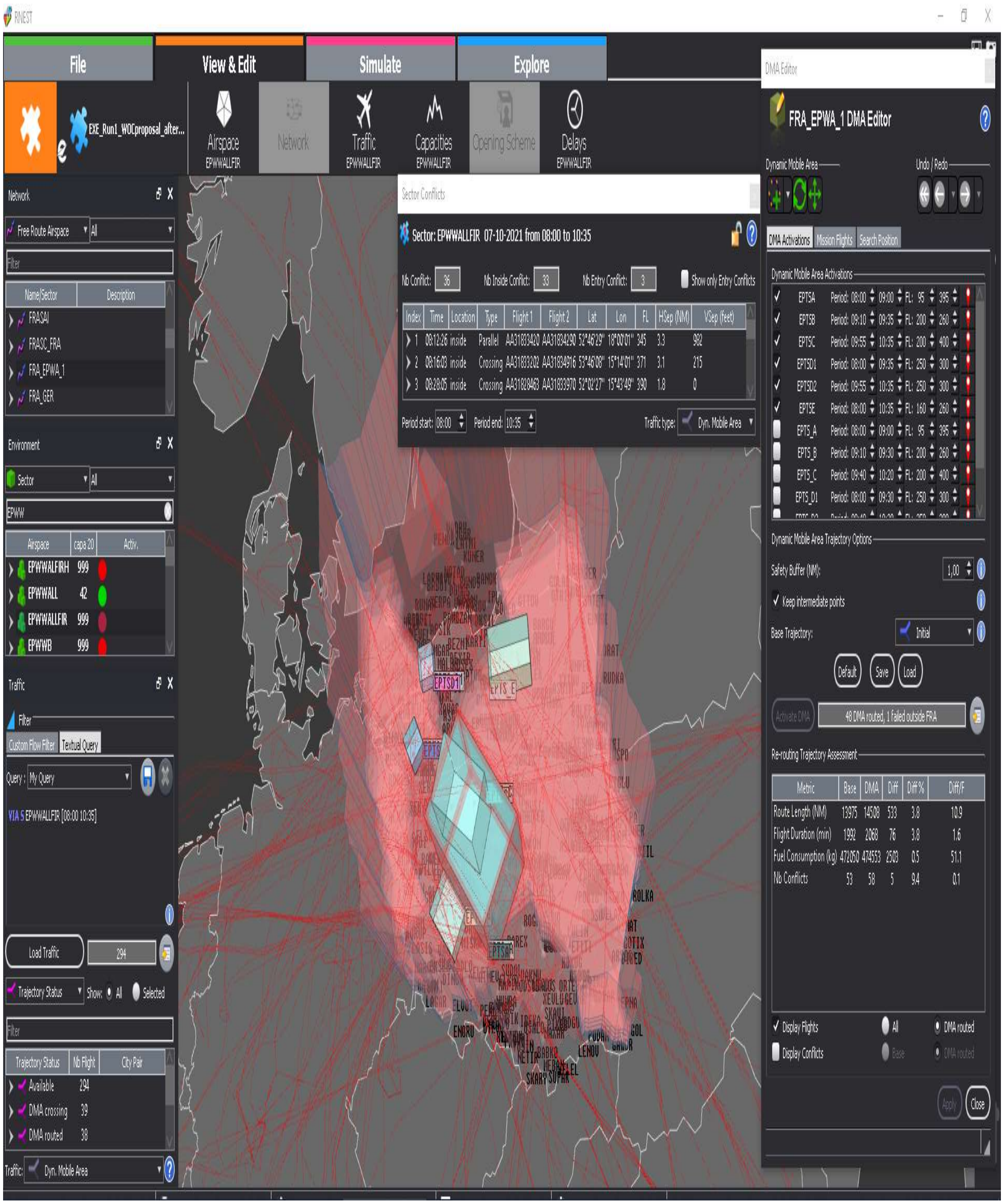

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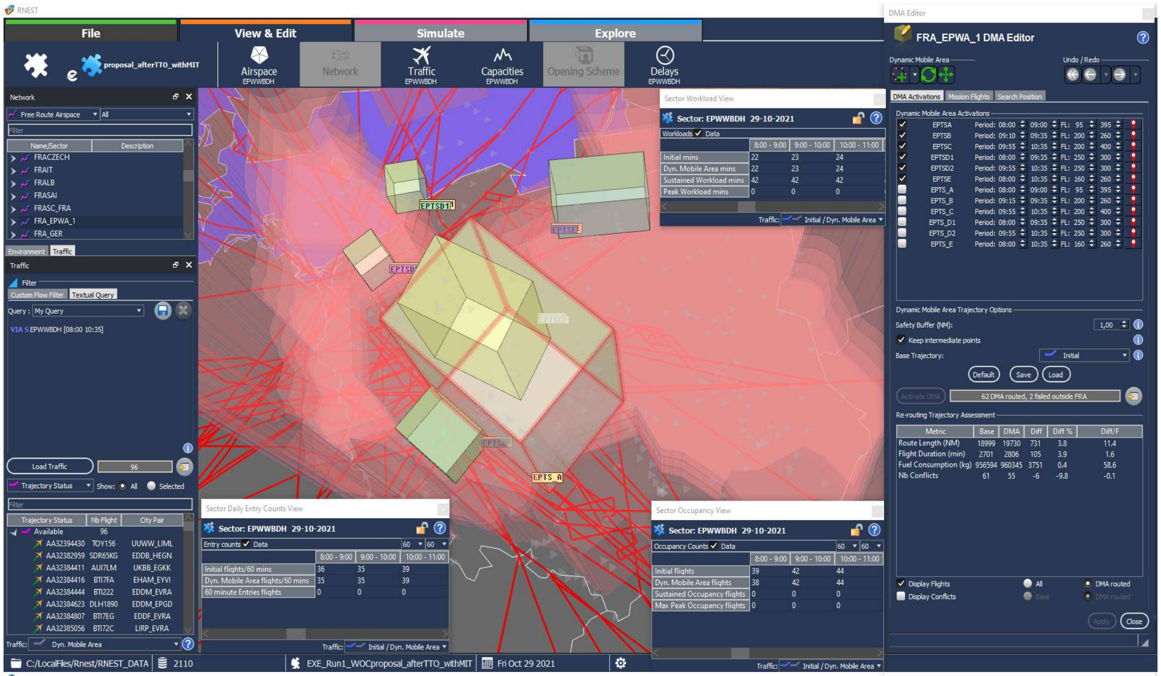

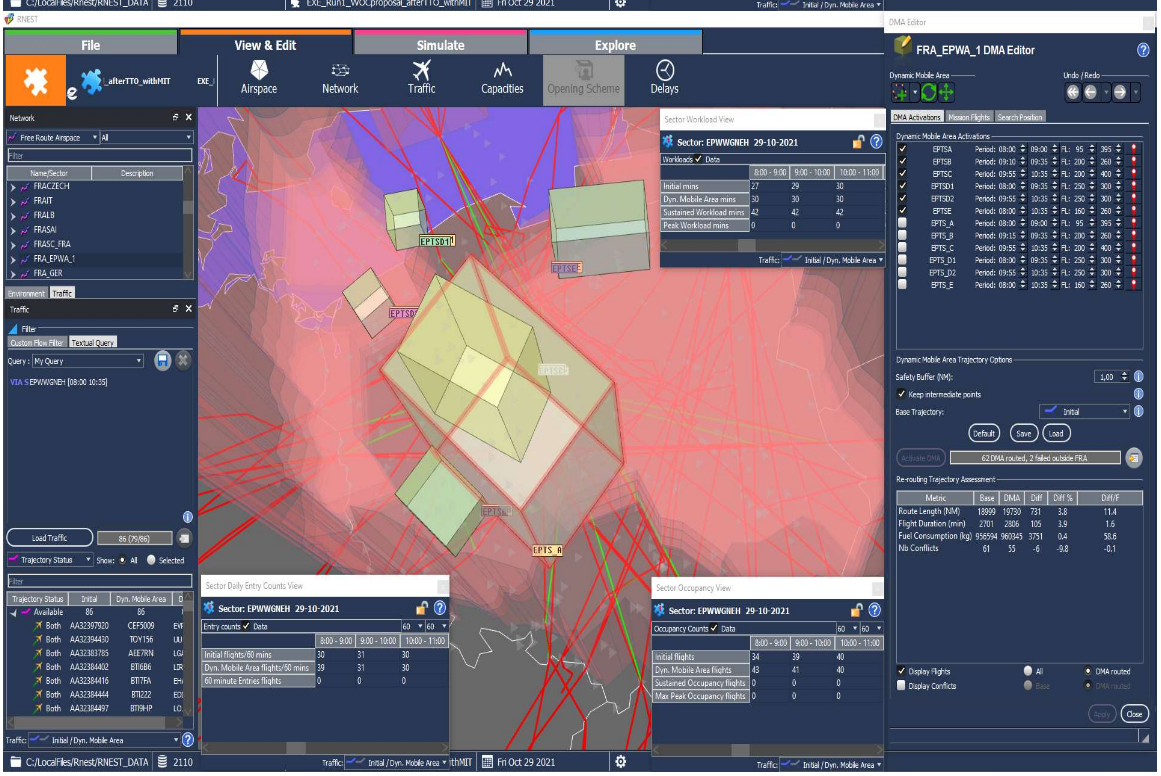

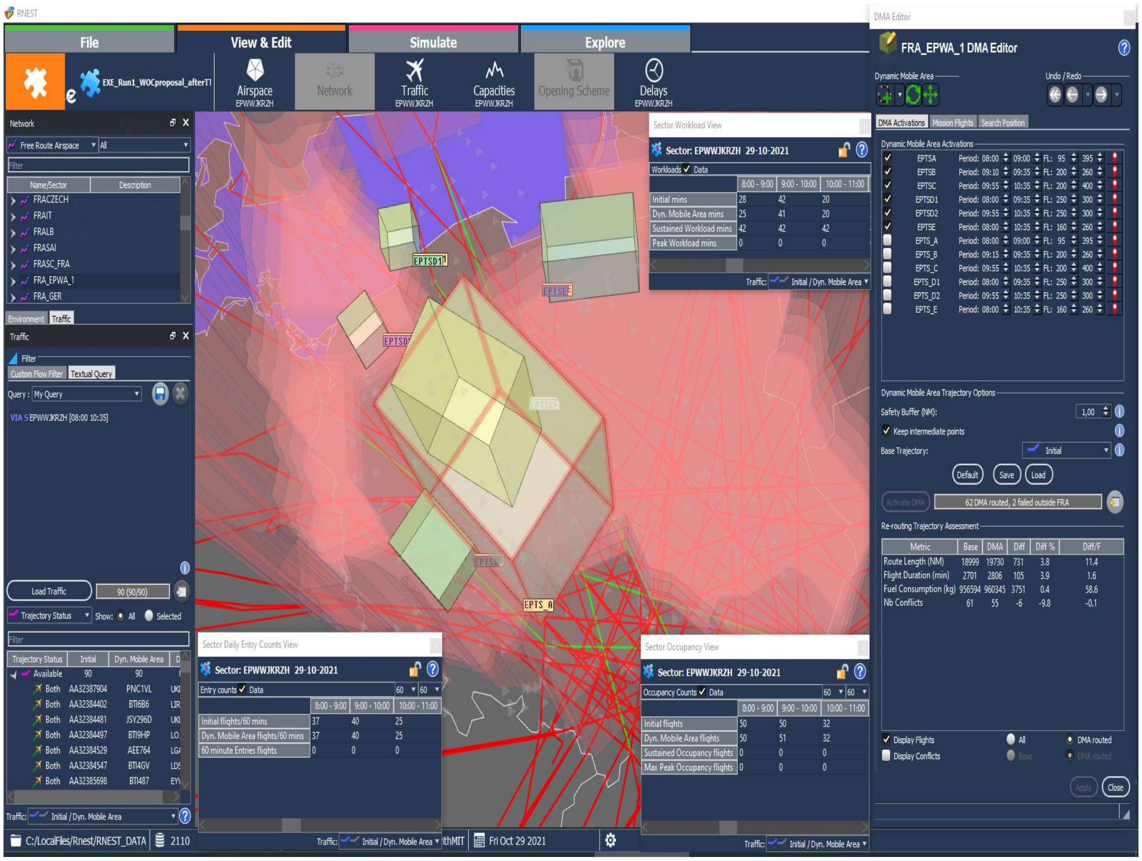
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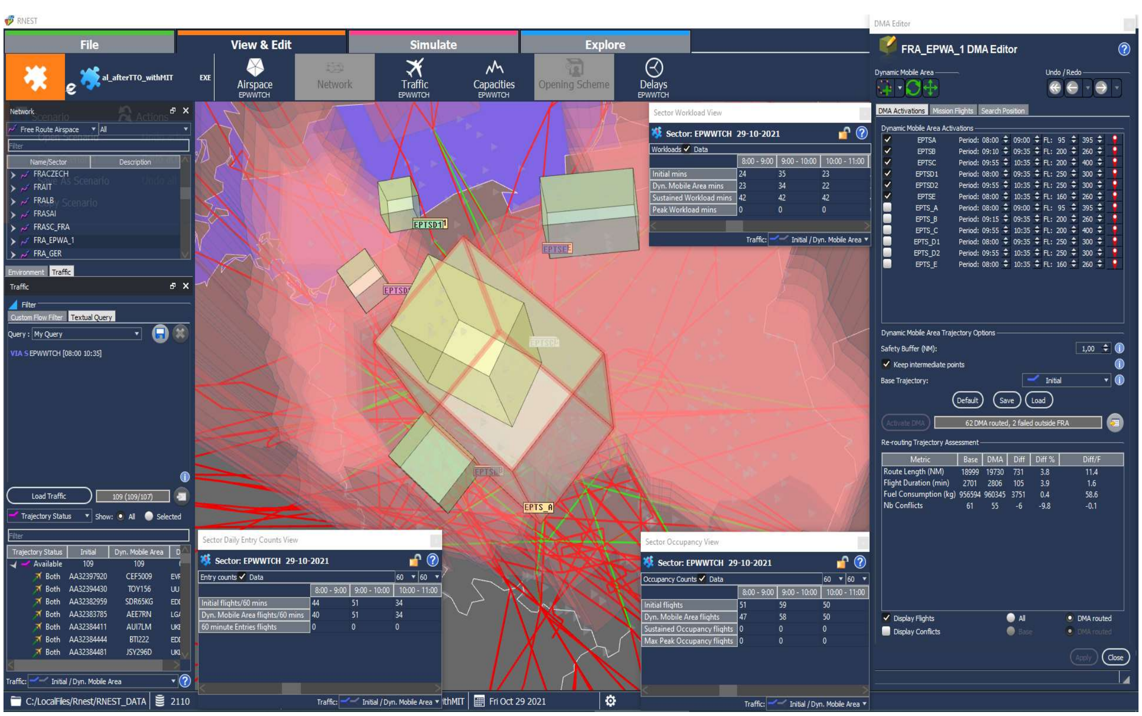
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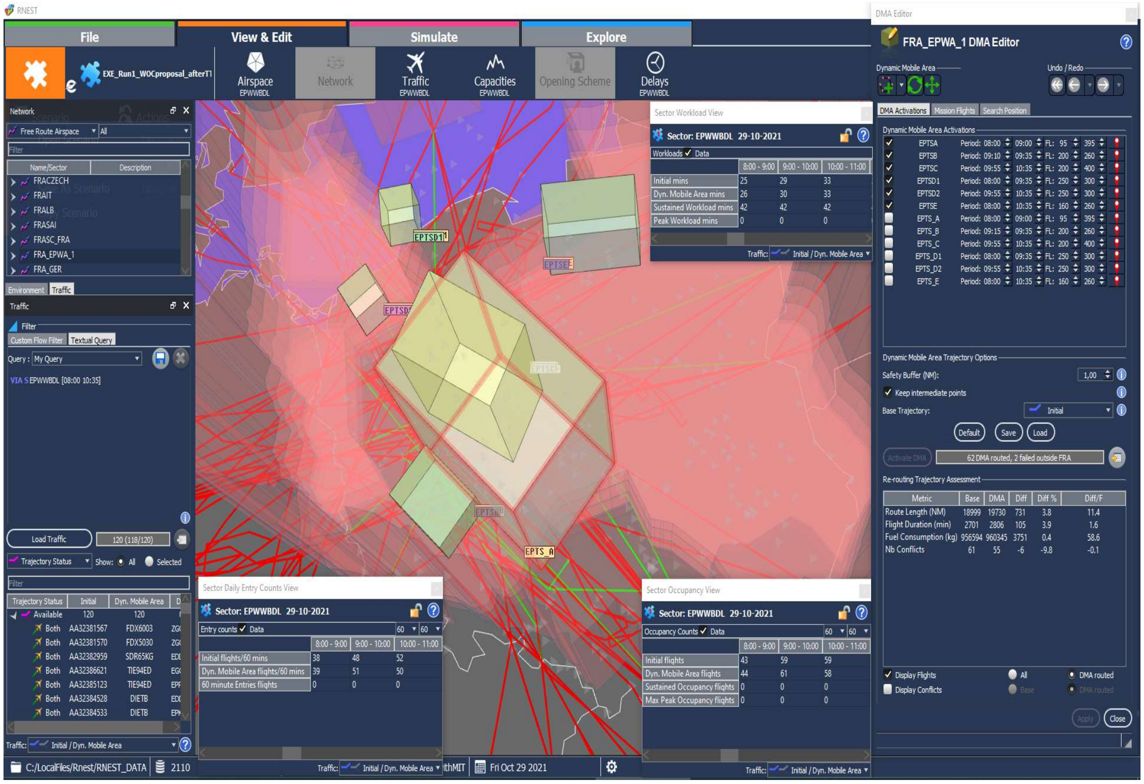
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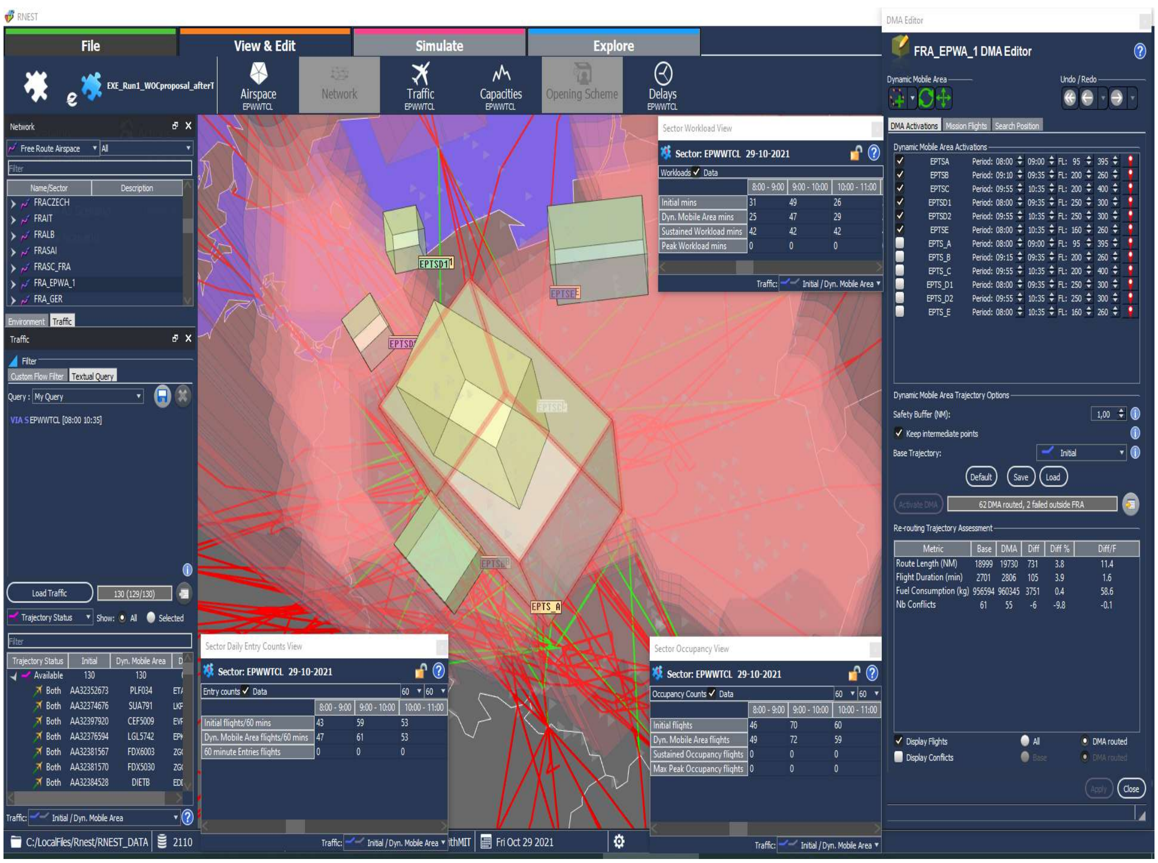
Fri Oct 29 2021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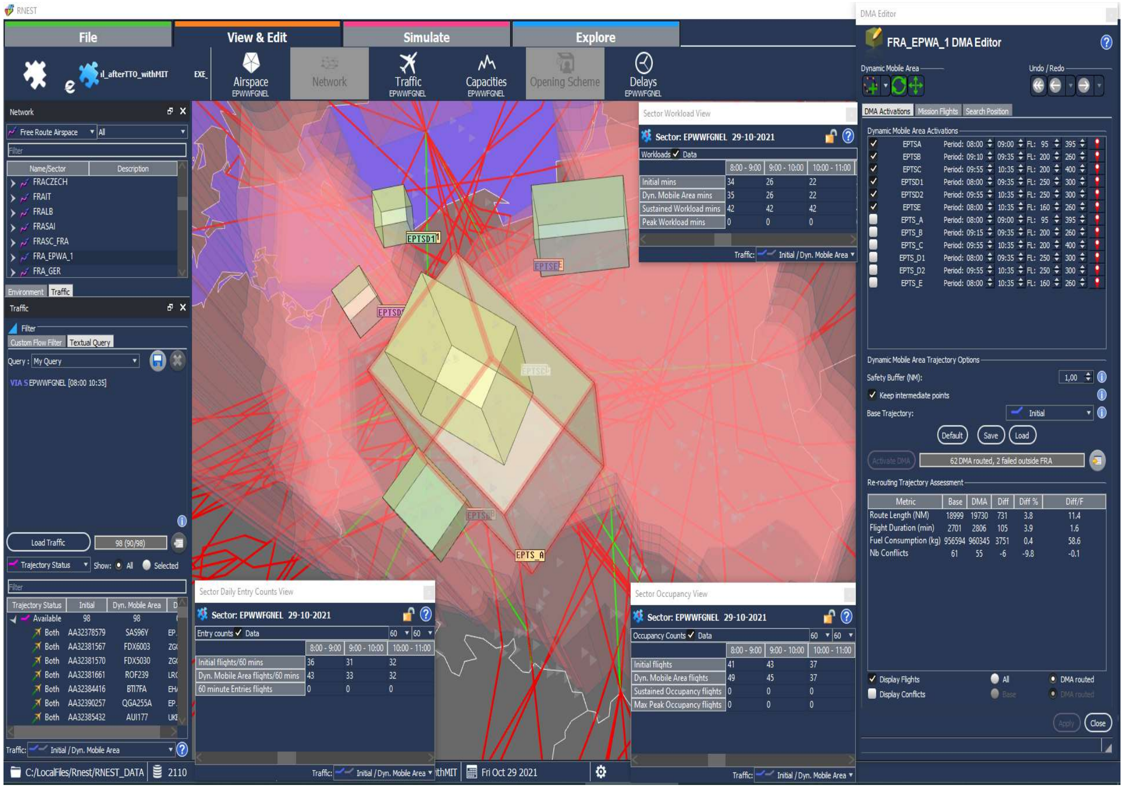
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Initial mins 34 26 22
Dyn. Mobile Area mins 35 26 22
Sustained Workload mins 42 42 42
Peak Workload mins 0 0 0
Sector: EPWWFGNEL 29-10-2021
Initial flights/60 mins 36 31 32
Dyn. Mobile Area flights/60 mins 43 33 32
60 minute Entries flights 0 0 0
Sector: EPWWFGNEL 29-10-2021
Initial flights 41 43 37
Dyn. Mobile Area flights 49 45 37
Sustained Occupancy flights 0 0 0
Max Peak Occupancy flights 0 0 0
62 DMA routed, 2 failed outside FRA
Re-routing Trajectory Assessment
Route Length (NM) 18999 19730 731 3.8 11.4
Flight Duration (min) 2701 2806 105 3.9 1.6
Fuel Consumption (kg) 956594 960345 3751 0.4 58.6
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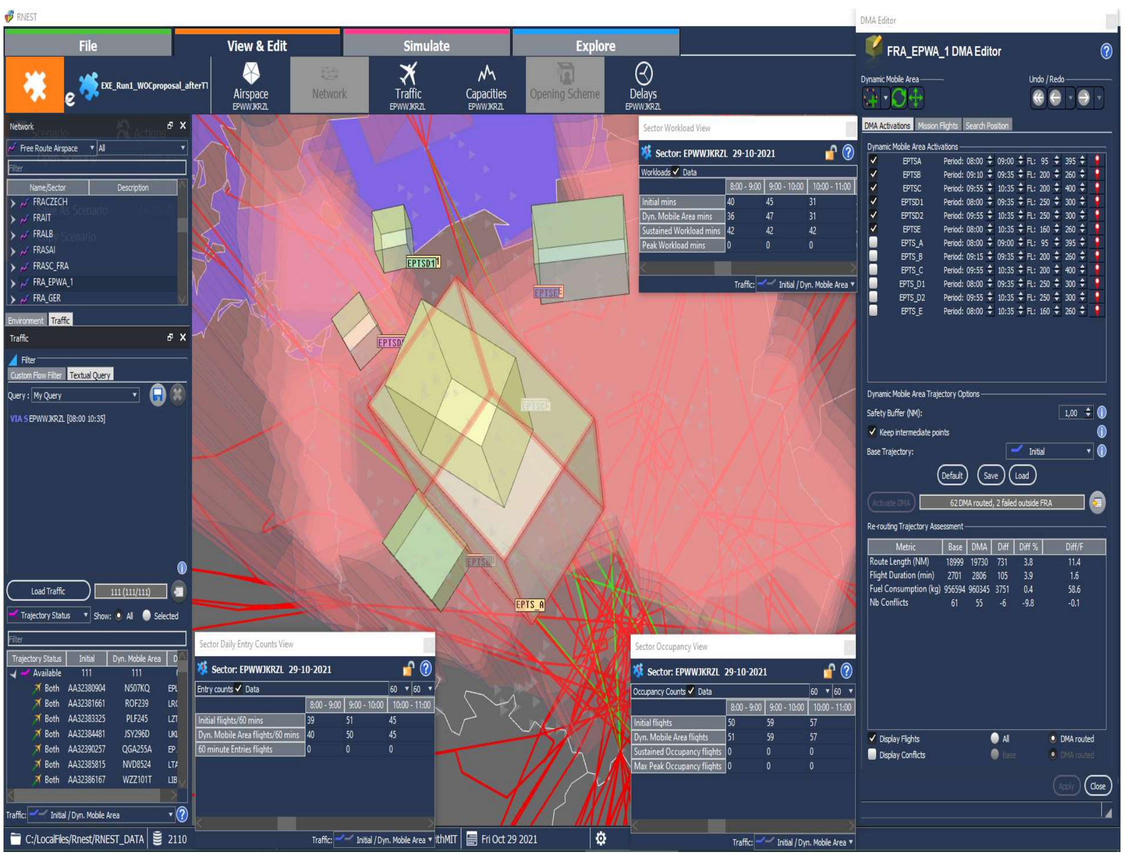
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Dyn. Mobile Area mins 36 47 31
Sustained Workload mins 42 42 42
Peak Workload mins 0 0 0
Sector: EPWWJKRZL 29-10-2021
Initial flights/60 mins 39 51 45
Dyn. Mobile Area flights/60 mins 40 50 45
60 minute Entries flights 0 0 0
Sector: EPWWJKRZL 29-10-2021
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Dyn. Mobile Area flights 51 59 57
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Max Peak Occupancy flights 0 0 0
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Re-routing Trajectory Assessment
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Flight Duration (min) 2701 2806 105 3.9 1.6
Fuel Consumption (kg) 956594 960345 3751 0.4 58.6
Nb Conflicts 61 55 -6 -9.8 -0.1
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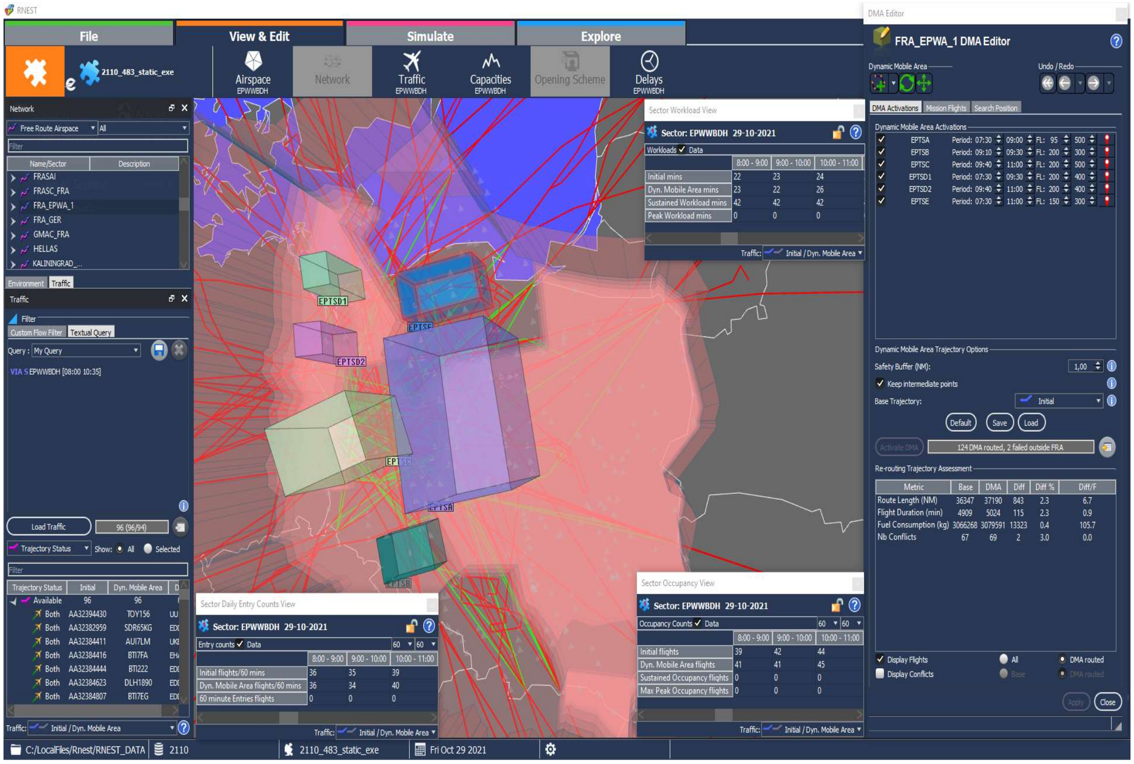
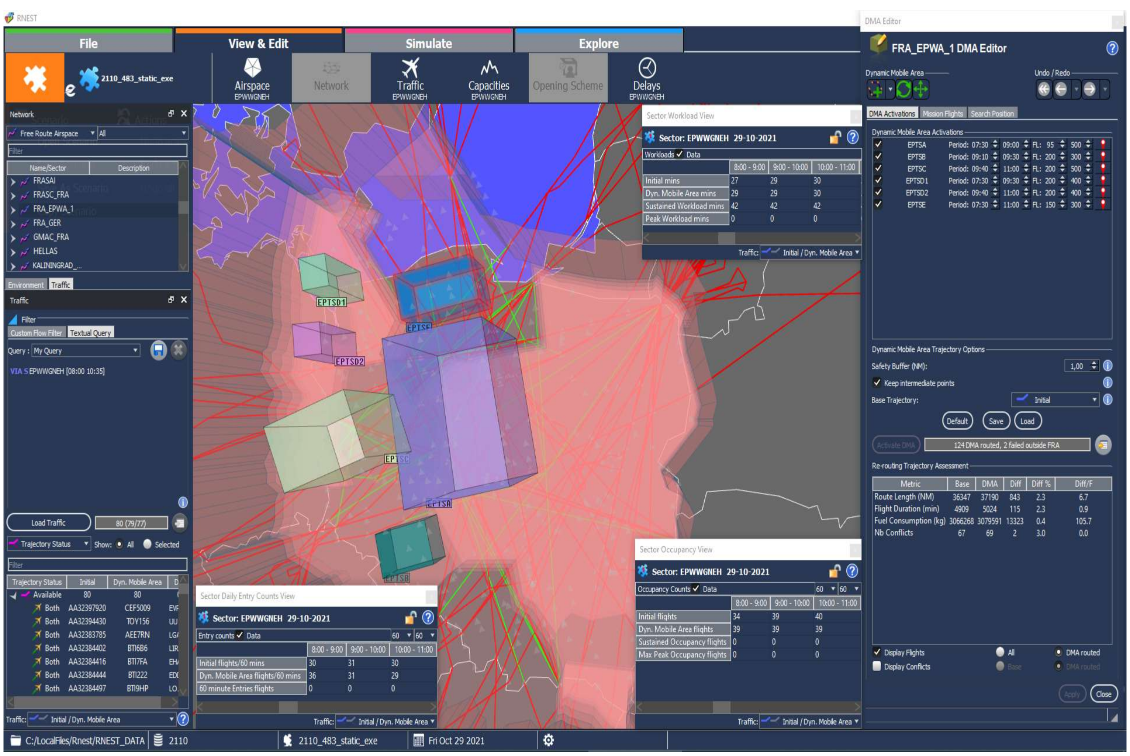
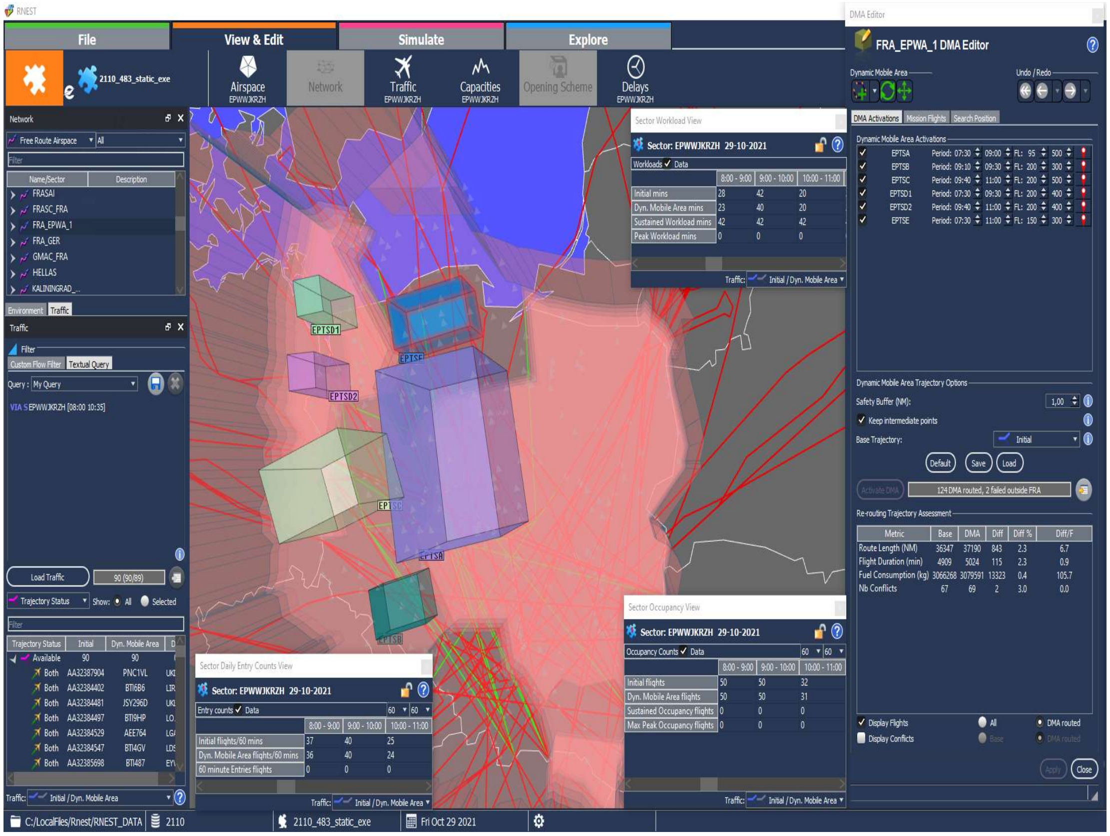
Capacity assessment data for static reference scenario



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Sector Occupancy View
Sector Daily Entry Counts View
Dynamic Mobile Area Activations
Dynamic Mobile Area Trajectory Options
Re-routing Trajectory Assessment
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Fuel Consumption (kg)
Nb Conflicts
EPTSD1
EPTSD2
Fri Oct 29 2021
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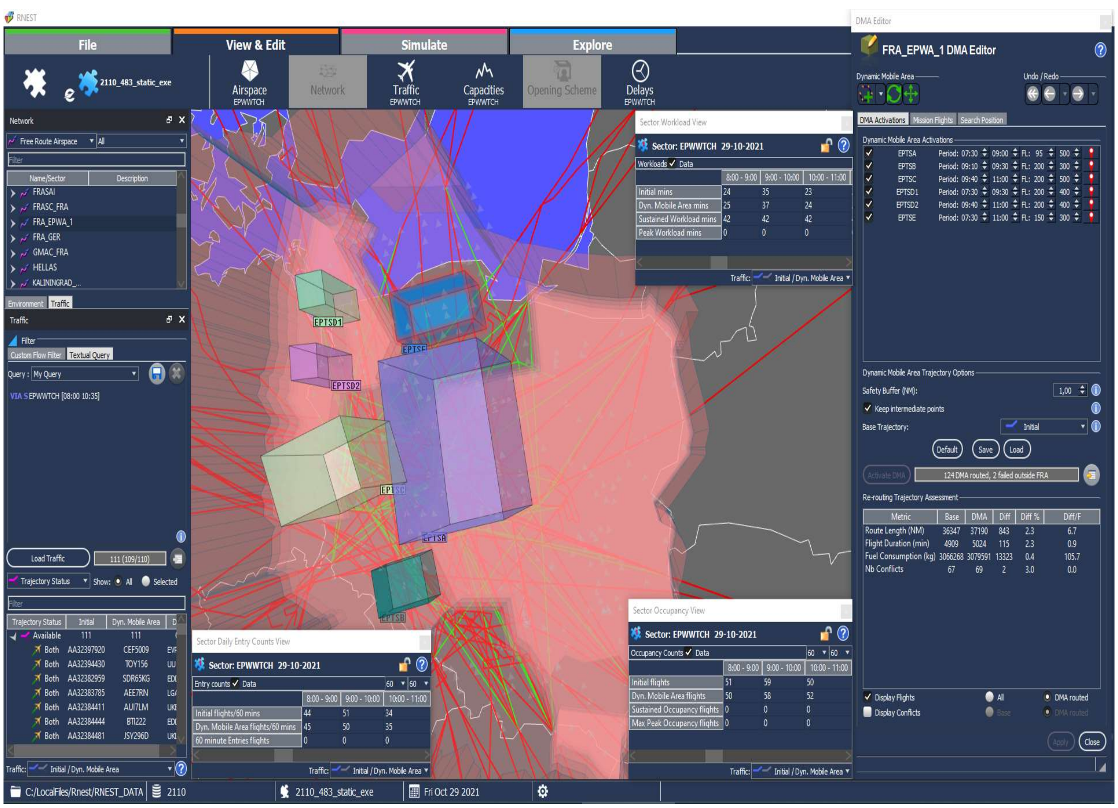
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Sector Occupancy View
Sector Daily Entry Counts View
Dynamic Mobile Area Activations
Dynamic Mobile Area Trajectory Options
Re-routing Trajectory Assessment
124 DMA routed, 2 failed outside FRA
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EPTSD2
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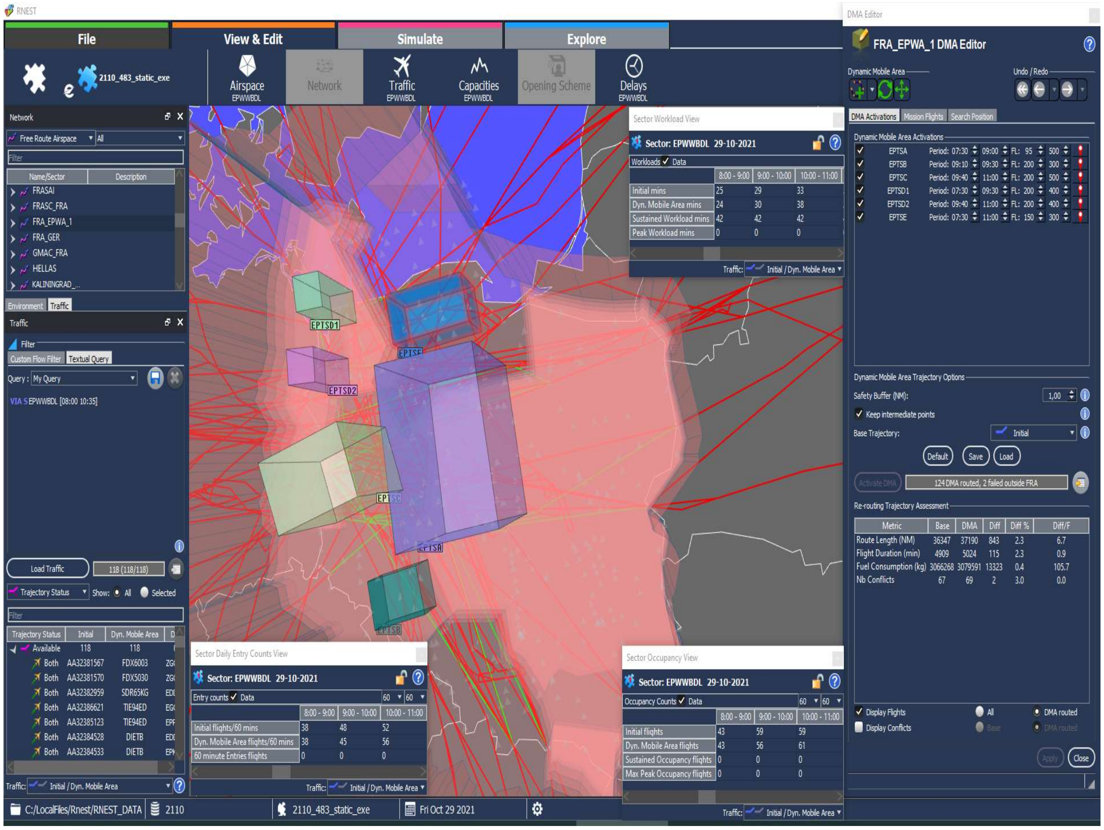
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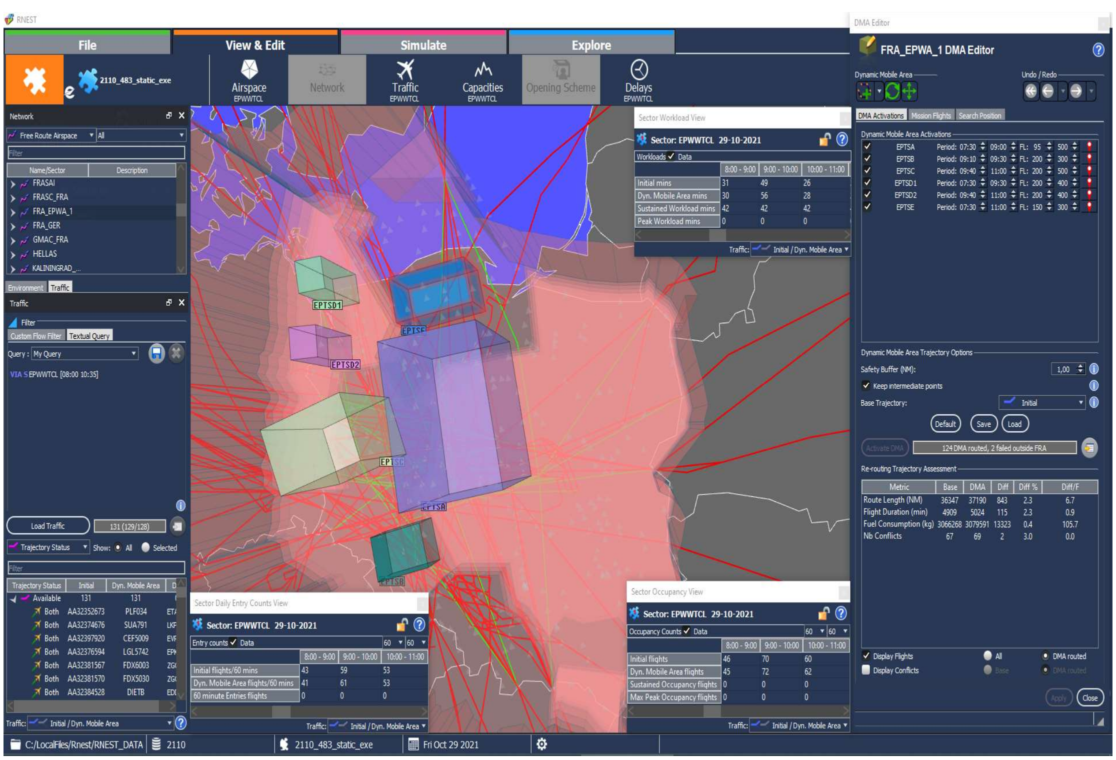
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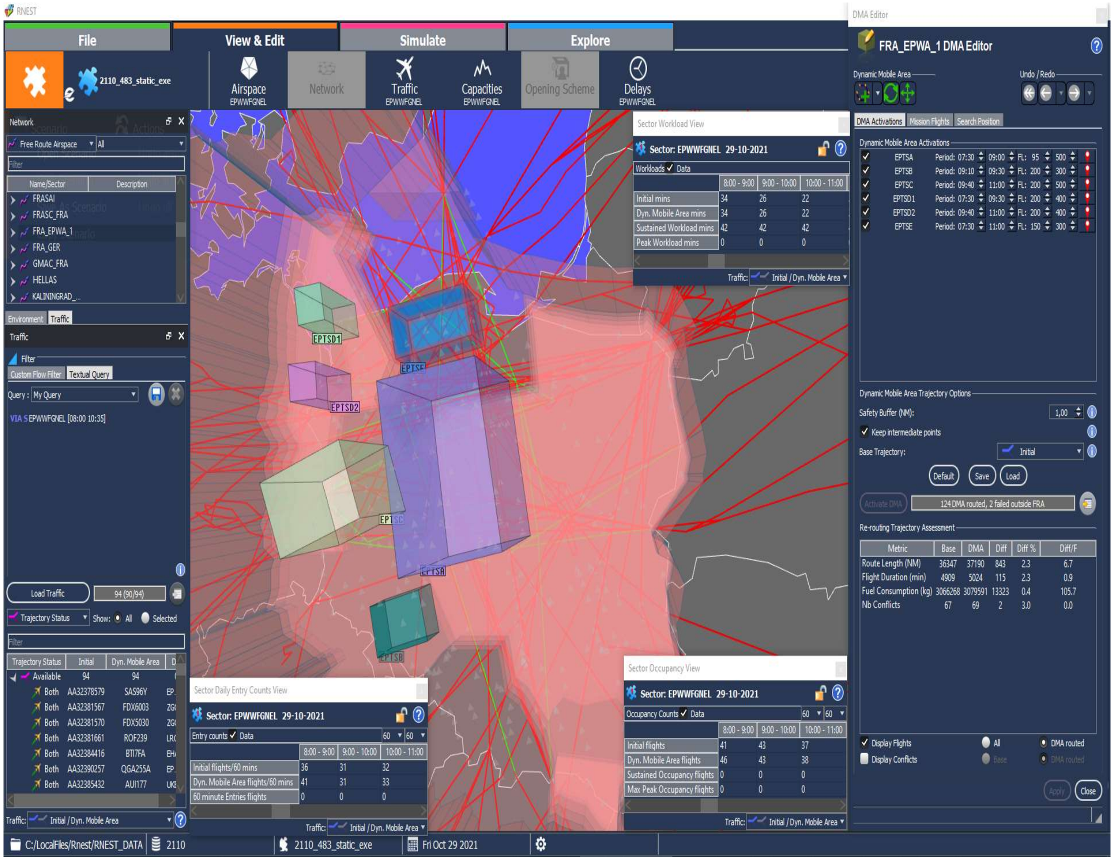
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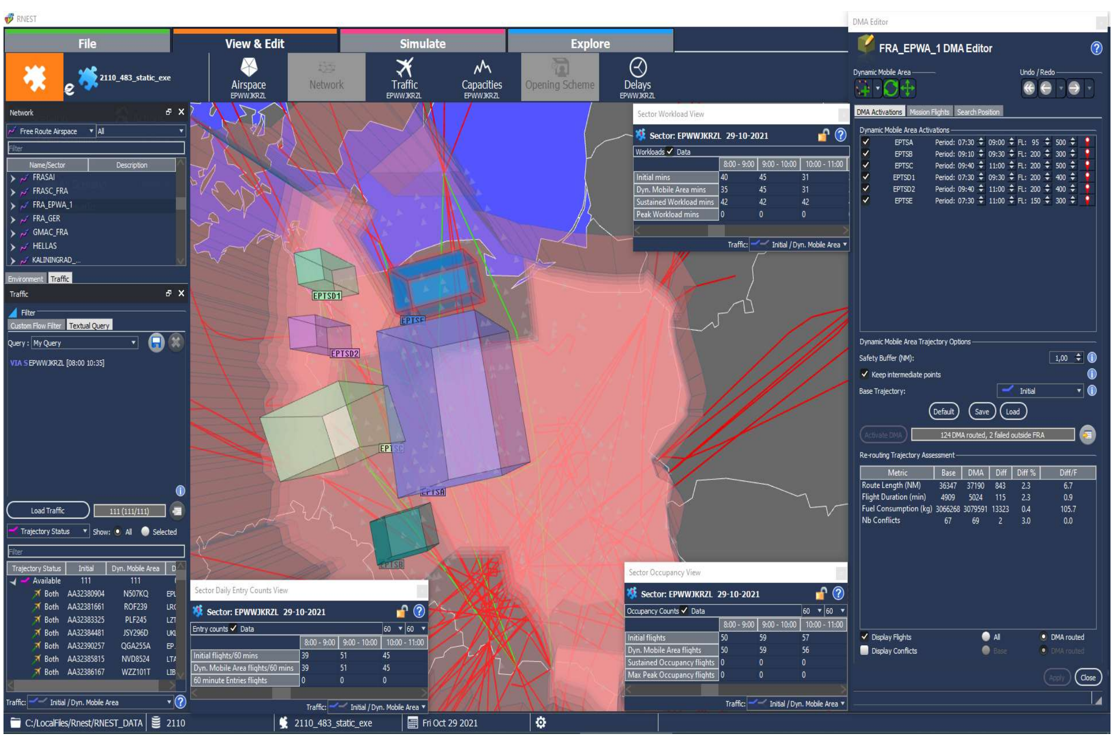
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iOAT flight plans data presenting the results of solution scenario simulation:

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