SESAR SOLUTION PJ.07-03: COST BENEFIT ANALYSIS (CBA) FOR V3

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PJ07 OAUO

PJ07 OPTIMIZED AIRSPACE USERS OPERATIONS

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Abstract

This document provides an initial V3 Cost Benefit Analysis (CBA) performed for the "Mission Trajectory Driven Processes" including the embedded activity of PJ.18-01a related to developing the enabling infrastructure.

Both PJ.07 and PJ.18 coordinated and worked together to jointly contribute to the development of the *Mission Trajectory Driven Processes*. They focus on the same concept, with Solution PJ.07-03 focusing on the operations by addressing the OI Steps allocated to Wave 1, and PJ.18-01a focusing on the associated technical enablers.

This V3 CBA is a combined effort from *Airbus*, *ANS CR (B4)* and *EUROCONTROL.*

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1 Executive Summary

This document provides the Cost Benefit Analysis (CBA) work performed on the "Mission Trajectory Driven Processes". The concept has been validated to V2 level and has also finished an initial V3 exercise, which allowed to complete V3 for the scope of solution PJ.07-03 "Sharing mission trajectory data with NM and ATC via an improved OAT Flight Plan (iOAT FPL)" focused on the planning phase . To reach full V3 maturity on the rest of the scope (e.g., execution phase) additional V3 validation exercises are planned in the scope of SESAR 2020 Wave 2 (Solution PJ.07-W2-40).

The Solution introduces a harmonized flight plan format, the improved Operational Air Traffic (OAT) flight plan (iOAT FPL) and shares the trajectory information with all actors concerned in the ECAC (European Civil Aviation Conference) area. A prerequisite for the Solution is a single source of civil/military environment data.

The Mission Trajectory (MT) driven processes have evolved since the V2 CBA and the new elements included in this initial V3 CBA are that the iOAT FPLs are now expected to comply with the full set of Air Traffic Management (ATM) network rules (RAD). This will lead to a different 4D MT compared to one prepared today for the same mission.

From the OI steps allocated to the mission trajectory driven processes, only AOM-0303, AOM-0304-A and AUO-0215 have completed V3/TRL6 and are under the scope of solution PJ.07-03 "Sharing mission trajectory data with NM and ATC via an improved OAT Flight Plan (iOAT FPL)". The "Mission Trajectory Driven Processes" scope is wider and include in addition the rest of the OI steps. Solution PJ.07-03 captures those elements that were validated to V3/TRL6 in the context of SESAR 2020 Wave 1:

- The management of mission trajectory (MT) with variable profile areas (VPA) type of airspace reservations (ARES) as shared via iOAT FPL in the planning phase.
- The ARES conceptual evolution allowing more precise identification of ARES Entry and Exit location and time, to support the increased quality of the trajectory prediction in the corresponding wing operations centre (WOC), network manager (NM) and ATC systems. This includes the evolutions of the VPA module reference as integral part of the evolved iOAT FPL syntax & concept.
- The B2B services for iOAT FPL filing from WOC to NM as well as for the iOAT FPL distribution from NM to ATC. B2B services were as well successfully validated to connect Regional ATFCM (NM) and local ATC FMP systems.

The CBA covers however the full scope of the Mission Trajectory driven processes. Mission Trajectory driven processes is expected to provide small capacity increase benefits as compliance to the RAD should decrease the complexity for the Network Manager (NM) & Air Traffic Control (ATC) units due to the reduced complexity of OAT and GAT (General Air Traffic) trajectory interactions. In addition, military flight planning efficiency will increase through information sharing and the full integration of Military Wing Operation Centres (WOC) in the overall Air Traffic Management. The sharing of the full military trajectory should lead to some predictability improvements on the civil side. This additional level of awareness could also reduce associated capacity buffers and provide a small increase in capacity.

While the benefits monetised in the CBA are relatively small there are other key benefits from Mission Trajectory driven processes which should be considered. These include the added value of the Solution to the European defence capability level and its contribution to the security of European citizens. Additionally, in affected areas during periods of crisis it is assumed that the Solution could provide significant additional civil and military benefits due to the increased awareness from having iOAT FPL data in the ATM System. Civil benefits in periods of crisis include:

- Fewer potential conflict situations between GAT and OAT.
- Fewer flight cancellations.
- Less Air Traffic Flow Management (ATFM) delay (i.e. more capacity in the planning phase).
- More efficient flight trajectories for GAT.

These benefits are not included in the CBA as it considers the nominal case of peacetime operations.

The Net Present Value (NPV) of –367 M€ reflects that many systems across ECAC need to be upgraded while the monetised benefits for civil Airspace Users (AU), i.e. capacity gain and better predictability, are limited. Confidence in the benefits is relatively low as they are based on top-down Validation Targets (and not validation exercise results).

The NPV has been calculated with an 8% discount rate over the period 2019 to 2040, with PJ.07-03 being deployed between 2025 and 2033 and with benefits starting to be realised in 2028. There is no payback year as the benefits included in the CBA do not offset the costs within the CBA timeframe.

On the cost side the per-unit costs for the Air Navigation Service Provider (ANSP), NM and WOC are based on a per Enabler analysis. On the military side, WOC systems need to be upgraded to be able to produce and process the iOAT FPL and to integrate aeronautical environmental data, including ATM Network Rules (RAD), from the central Network Manager database.

On the NM side there is a need to update the systems for flight planning and validation (IFPS) and for tactical flow management and demand and capacity balancing (DCB) (ETFMS).

SWIM based B2B (Business-to-Business) interfaces need to be established between WOC and NM to allow a higher level of automation in the flight plan filing and validation process. Also, between ATC and NM for flight plan distribution and sub-regional/local ATC/ATFCM (Air Traffic Flow and Capacity Management) systems, i.e. Flow Management Position (FMP) tools.

On the ANSP side, the ATC Systems need to be updated with regards to the format of the iOAT FPL and the information flow, i.e. OAT flight plans will no longer be received directly from the WOC, but will be received via NM.

However, in each case the associated confidence level in the cost values is generally low because:

- ANSP: the costs differ depending on the level of integration between civil and military systems and on the functionalities that are already deployed, which differs across ATC centres.

- NM: the changes that will be required in NM systems to provide the enabler functionalities are still being assessed.

- WOC: the costs for the necessary WOC upgrades/developments are rather uncertain as the requirements are expected to differ significantly from state to state.

Also some of the enablers required for this Solution will also enable other Solutions. For now the entire Enabler cost has been included in this CBA as a conservative approach[1].

Recommendations and next steps

This V3 CBA refined the V2 version, incorporates the results on the scope that completed V3 (i.e., PJ.07-03 "Sharing mission trajectory data with NM and ATC via an improved OAT Flight Plan (iOAT FPL)") and it should be further reviewed und updated in line with the additional future V3 validations required to achieve full V3 maturity for the MT concept (i.e., PJ.07-W2-40 in SESAR 2020 Wave 2).

Areas which have been identified for further V3 CBA work in Wave 2 include:

- Improving the assumptions underlying the number of deployment locations, especially for the WOC Enablers (highlighted as a key area in the sensitivity analysis)
- Discussing further with WOC experts and MEPS about the assumption of a WOC set-up consisting of a central server and a set of clients
- Reviewing the cost estimations to increase the associated levels of confidence and also to look at the possibility of providing ranges per category of Sub-Operating Environment
- Explore the possibility to monetise some of the military benefits, e.g. related to crises
- Identify any opportunities to gather additional data from V3 validation exercises addressing the execution phase.

[1] Consolidation of CBA results will be considered by PJ19

2 Introduction

2.1 Purpose of the document

This document provides the initial V3 Cost Benefit Analysis (CBA) performed for the "Mission Trajectory Driven Processes". The concept has been validated to V2 level and has recently finished an initial V3 exercise, which allowed to complete V3 for PJ.07-03 "Sharing mission trajectory data with NM and ATC via an improved OAT Flight Plan (iOAT FPL)". To reach full V3 maturity for the full scope of the Mission Trajectory Driven Processes additional V3 validation exercises are needed; these will be addressed in SESAR 2020 Wave 2 Solution PJ.07-W2-40.

Past validation activities had shown that the solution concept is feasible and have validated it to a V2 maturity level. An initial V3 exercise confirmed the feasibility of the Mission Trajectory (MT) concept aspects that have evolved since then, and of those, some aspects have reached V3, which have been captured in solution PJ.07-03 "Sharing mission trajectory data with NM and ATC via an improved OAT Flight Plan (iOAT FPL)":

- The management of mission trajectory (MT) with variable profile areas (VPA) type of airspace reservations (ARES) as shared via iOAT FPL in the planning phase.
- The ARES conceptual evolution allowing more precise identification of ARES Entry and Exit location and time, to support the increased quality of the trajectory prediction in the corresponding wing operations centre (WOC), network manager (NM) and ATC systems. This includes the evolutions of the VPA module reference as integral part of the evolved iOAT FPL syntax & concept.
- The B2B services for iOAT FPL filing from WOC to NM as well as for the iOAT FPL distribution from NM to ATC. B2B services were as well successfully validated to connect Regional ATFCM (NM) and local ATC FMP systems.

However, as explained in the V2 CBA, due to the nature of the Solution (i.e. introduction of a harmonized military flight plan format), direct benefits for the civil Airspace User (AU) community are hard to measure. The initial V3 validation activity focussed on military flight planning, while the performance gains expected for the civil Airspace Users, i.e. Predictability and En-route Airspace Capacity, will only be realised in the execution phase, which was not fully V3 validated and would require additional V3 activities in the frame of Wave 2 under solution PJ.07-W2-40. Therefore, these potential benefits could not be measured in the initial V3 validation exercise and are not applicable for solution PJ.07-03.

The CBA considers the deployment of the "Mission Trajectory Driven Processes" as a whole and each iteration of the CBA will incorporate the new results from the latest validation exercises. Therefore, aspects of the Solution which were not addressed in the initial V3 validation exercise have retained the assumptions taken in the V2 CBA.

2.2 Scope

This document provides an initial V3 Cost Benefit Analysis (CBA) performed for the "Mission Trajectory Driven Processes".

There was one CBA delivered for V2.. For this initial V3 CBA, both the costs and benefits have been reviewed and updated to produce this version of the CBA which will be delivered as part of the PJ.07-03 D4.2 data pack, even if it covers the full scope of the “Mission Trajectory Driven Processes”.

This initial V3 CBA covers the following Operational Improvement (OI) Steps:

AOM-0303: **Pan-European Operational Air Traffic (OAT) Transit Service**

AUO-0210: Participation in Collaborative Decision Making (CDM) through initial Shared Mission Trajectory (iSMT) and Target Time (TTO) negotiation

AUO-0211: Wing Operation Centre (WOC) Management of initial Reference Mission Trajectory (iRMT) via improved OAT Flight Plan (FPL)

AUO-0215: **Sharing iSMT through improved OAT flight plan**

AUO-0228: Agreed iRMT

AOM-0304-A: **Improved and Harmonised OAT Flight Plan**

Only AOM-0303, AOM-0304-A and AUO-0215 have completed V3 under the scope of solution PJ.07-03 “Sharing mission trajectory data with NM and ATC via an improved OAT Flight Plan (iOAT FPL)”.

The geographical scope of this CBA is the ECAC area and the main stakeholders involved in the deployment are ANSPs (civil and military), the Network Manager and WOCs.

2.3 Intended readership

The intended readership for this document includes:

SESAR 2020 Projects:

- PJ.07 Optimised Airspace Users Operations
- PJ.08 Advanced Airspace Management
- PJ.09 Advanced Demand and Capacity Balancing
- PJ.18 4D Trajectory Management
- PJ.19 Content Integration
- PJ.22 Validation and Demonstration Engineering

State Airspace User representatives:

- Civil-Military ATM Coordination (CMAC)
- Military Engagement Plan for SESAR (MEPS)

Others:

- Civil / Military ANSPs

- SESAR Joint Undertaking (SJU)

2.4 Structure of the document

The following sections of this document cover:

- Section 3 describes the objectives and scope of this initial V3 CBA
- Sections 4 and 5 detail, respectively, the benefits and the costs
- Sections 6, 7 and 8 contain, respectively, details of the CBA model, the CBA results and the sensitivity analysis
- Section 9 provides recommendations
- Section 10 lists applicable and reference documents
- Appendix A shows the mapping of Key Performance Areas (KPA)
- Appendix B provides the OI Step – Enabler - Stakeholder matrix

2.5 Background

This Solution has undertaken an initial V3 validation activity as a final part of its Wave 1 activities. This follows a series of V2 validation activities undertaken under SESAR 2020 Wave 1 and SESAR 1 which focussed on the planning and execution phases and covered the domains of WOC, Airspace Management (ASM) and NM.

2.6 Glossary of terms

Term	Definition	Source of the definition
Cost Benefit Analysis	A Cost Benefit Analysis is a process of 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.	SESAR 1 (Section 10.2 [9])
Business Case	A Business Case is a neutral financial tool that 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 for the decision. A Business Case has a wider scope than a CBA.	SESAR 1 (Section 10.2 [9])

Term	Definition	Source of the definition
Net Present Value	Net Present Value (NPV) is the sum of all discounted cash inflows and outflows during the CBA time horizon.	Investopedia

Table 1: Glossary of Terms

2.7 List of Acronyms

Acronym	Definition
4D	4 Dimensional
A/C	Aircraft (type)
ACC	Area Control Centre
AFTN	Aeronautical Fixed Telecommunication Network
AFUA	Advance Flexible Use of Airspace
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Service
ANSP	Air Navigation Service Provider
AMC	Airspace Management Cell (Regional)
AO	Airport Operator
AOC	Airline Operations Centre
AOI	Area of Interest
AOR	Area of Responsibility
APT	Airport
ARES	Airspace Reservation
ASM	Airspace Management
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATFCM	Air Traffic Flow and Capacity Management
ATFM	Air Traffic Flow Management
ATFMX	Exemption from ATFCM delays (flight plan status indicator)
ATM	Air Traffic Management
ATS	Air Traffic Service
AU	Airspace User
AUC	Airspace User Cost (Efficiency)
AUP	Airspace Use Plan
B2B	Business-to-Business

Acronym	Definition
BA	Business Aviation
CACD	Central Airspace and Capacity Database
CAP	Capacity
CBA	Cost Benefit Analysis
CDM	Collaborative Decision Making
CEF	Cost Efficiency
CIV	Civil
CMAC	Civil-Military ATM Coordination
CMC	Civil-Military ATM Coordination
CNS	Communication Navigation and Surveillance
CO2	Carbon Dioxide (emissions)
CONOPS	Concept of Operations
CR	Change Request
CTOT	Calculated Take-Off Time
DCB	Demand and Capacity Balancing
DCN	Diplomatic Clearance Number
DS	Dataset
EAD	European Aeronautical Database
EATMA	European ATM Architecture
E-ATMS	European Air Traffic Management System
EAUP	European Airspace Use Plan
ECAC	European Civil Aviation Conference
eFPL / EFPL	Extended Flight Plan
ER	En-route
ETFMS	Enhanced Tactical Flow Management System (@NM)
EUR	Euro
EUROAT	EUROCONTROL Specifications for harmonized Rules for Operational Air Traffic (OAT) under Instrument Flight Rules (IFR) inside controlled Airspace of the ECAC Area
FEFF	Fuel Efficiency
FDP	Flight Data Processing
FDPS	Flight Data Processing System
FLX	Flexibility
FMP	Flow Management Position

Acronym	Definition
FOC	Flight Operation Centre / Full Operating Capability
FPL	Flight Plan
GA	General Aviation
GAT	General Air Traffic
HC	High complexity
ICAO	International Civil Aviation Conference
IFR	Instrument Flight Rules
INTEROP	Interoperability Requirements
iOAT	Improved OAT (Flight Plan)
IOC	Initial Operating Capability
IFPS	Integrated Flight Plan System (@NM)
IFPZ	IFPS Zone (geographical zone where IFPS is used)
iMT	Initial MT
IP	Internet Protocol
iSMT	Initial SMT
iRMT	Initial RMT
K	Kilo (= thousand (EURO))
KPA	Key Performance Area
KPI	Key Performance Indicator
LC	Low complexity
LSSIP	Local Single Sky Implementation Plan
M	Million (EURO)
MAC	Mid-Air Collision
MC	Medium Complexity
MEPS	Military Engagement Plan for SESAR
MET	Meteorology
MIL	Military
Mins	Minutes
MP	Master Plan (European ATM Master Plan)
MT	Mission Trajectory
N/A	Not Applicable
NM	Network Manager
NMOC	Network Manager Operations Centre

Acronym	Definition
NOP	Network Operations Plan
NPV	Net Present Value
NSA	National Supervisory Authority
O	Optional (Enabler)
OAT	Operational Air Traffic
OATTS	OAT Transition Service
OBT	Off-Block Time
OE	Operational Environment
OI	Operational Improvement
OSED	Operational Service and Environment Definition
PAR	Performance Assessment Report
PCP	Pilot Common Project
PI	Performance Indicator
PJ	Project
PRD	Predictability
PUN	Punctuality
QoS	Quality of Service
R	Required (Enabler)
RAD	Route Availability Document
RBT	Reference Business Trajectory
RES	Resilience
RMK	Remark (Flight plan item 18 indicator)
RMT	Reference Mission Trajectory
RPAS	Remotely Piloted Aircraft Systems
RTECORRATC	Route Coordination with ATC
SA	Scheduled Airlines
SAC	Safety Criteria
SAF	Safety
SBT	Shared Business Trajectory
SEC	Security
SOBT	Shared OBT
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking

Acronym	Definition
SMT	Shared Mission Trajectory
SPR	Safety and Performance Requirements
STATFOR	Statistical Forecast Office (EUROCONTROL)
STAY	Stay indicator in a FPL linking the trajectory to a reserved airspace (ARES)
STS	Flight plan status indicator
SWIM	System Wide Information Model
TACAN	Tactical Air Navigation
TMA	Terminal Manoeuvring Area
TM	4D Trajectory Management
TS	Technical Specification
TTA	Target Time of Arrival
TTO	Target Time Over
UDPP	User-Driven Prioritisation Process
V2	E-OCVM lifecycle phase: Feasibility
V3	E-OCVM lifecycle phase: Pre-industrial development & integration
VFR	Visual Flight Rules
VHC	Very High Complexity
VPA	Variable Profile Area
WOC	Wing Operations Centre

Table 2: List of Acronyms

3 Objectives and scope of the CBA

3.1 Problem addressed by the solution

Today the military Airspace Users (AU) in each State use slightly different flight plan formats (from each other and from civil operators) which results in a need for more coordination between States when planning cross-border military flights. This process could be more efficient if all the Military flights were planned using a consistent flight plan format.

In contrast to General Air Traffic (GAT) flight plans, Operational Air Traffic (OAT) flight plans or OAT portions of mixed flight plans are not currently validated and managed centrally by the Network Manager, which leads to an incomplete Traffic Demand and Tactical Flow picture.

Partial non-compliance to ATM Network rules (RAD) by OAT flights increases the complexity of the interaction between the civil and military traffic. This leads to some buffer capacity at ATS, which is not being declared officially, to be able to cope with the unpredicted military movements which are often more complex than civil flights.

As each nation (currently) has different procedures and practises, cross-border and Pan-European military flight planning, as well as operations, are complex to prepare and execute.

The common aeronautical database (EAD/CACD), prepared and maintained centrally by NM for Civil Airspace Users should ideally also be used by the Military Airspace Users.

3.2 SESAR Solution description

The project addressed the evolution of the "Mission Trajectory Driven Processes" Concept developed in SESAR 1 (Solutions #37 and #46[2])::

"Mission Trajectory Driven Processes refer, through a full integration of the WOC within the ATM system, to the updating of wing operations centre (WOC) processes for the management of the shared and reference mission trajectory (SMT/RMT). These processes respond to the need to accommodate individual military airspace user needs and priorities without compromising optimum ATM system outcome and the performance of all stakeholders."

The following section is based on section 3.1 of the OSED (Edition 00.01.00) [13] and provides an overview of the 'Mission Trajectory Driven Processes' concept.

The initial Mission Trajectory is integrated through the use of the iOAT FPL in ATM network operations hence raising awareness for all operational stakeholders and increasing the predictability related to military demand. This means that at the Network Manager Operations Centre (NMOC), they will have a more complete picture of the actual traffic load and related airspace capacity. iOAT FPL will, in general, be compliant to the ATM network rules (RAD) which will allow their smooth integration in the general traffic flows to be managed. Where mission objectives do not allow this, exemption mechanisms can be used. These need to be pre-coordinated with concerned ATS before the execution of the flight.

[2] Solutions #37 (Extended flight plan (EFPL) and #46 (Initial system-wide information management (SWIM) technology solution)

Consequently, ANSPs would not need to limit capacity as much as is currently the case to ensure their service provision to OAT (i.e. the capability to accept OAT flights for which NM and the ANSP have no prior knowledge, and to offer the required operational flexibility to OAT). Furthermore, the awareness of the iOAT FPL will enable better co-ordination between neighbouring ACCs and facilitate hand-over processes.

As each nation (currently) has different procedures, this section describes the recommended best practices from the point of view of a (future) WOC function and supporting Technical Systems in line with the SESAR driven ATM evolution. The text does not deal with the differences amongst State Airspace Users' processes around Europe, nor does it try to show national specificities.

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

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

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

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

When specific conditions are met, the iSMT becomes the initial Reference Mission Trajectory (iRMT). This transition between the two states represents the conclusion of the planning phase and the start of the execution phase.

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

The Mission Trajectory Driven Processes refer to the integration of WOC operations into the ATM network operations through the updating of WOC processes for the management of the shared and reference initial Mission Trajectory (iSMT/iRMT). These processes respond to the need to accommodate the individual military AU needs and priorities without compromising optimum ATM system outcomes and the performances of all stakeholders.

Mission Trajectory Driven Process is dependent on the following Solutions:

- SESAR 1 #37: Extended flight plan (EFPL) (superseded by solution PJ.18-02c "eFPL distribution to ATC"
- SESAR 1 #46: Initial system-wide information management (SWIM) technology solution
- PJ.09-03: Collaborative Network Management Functions

Mission Trajectory Driven Process is necessary for Solution:

- PJ.08-01 Management of Dynamic Airspace configurations (AFUA)

Table 3 provides an overview of the OI Steps that are related to Mission Trajectory Driven Processes.

SESAR Solution ID	OI Steps ref.	OI Steps definition
Mission Trajectory Driven Processes	AOM-0303	Pan-European OAT Transit Service
	AUO-0210	Participation in CDM through iSMT and Target Time (TTO) negotiation
	AUO-0211	WOC Management of iRMT via improved OAT FPL
	AOM-0304-A	Improved and Harmonised OAT Flight Plan
	AUO-0215	Sharing iSMT through improved OAT flight plan
	AUO-0228	Agreed iRMT

Table 3: Mission Trajectory Driven Processes Scope and related OI steps

From the OI steps above, only **AOM-0303, AOM-0304-A and AUO-0215** have completed V3/TRL6 and are under the scope of solution PJ.07-03 "Sharing mission trajectory data with NM and ATC via an improved OAT Flight Plan (iOAT FPL)". This solution has been developed in the context of the validation of the wider "Mission Trajectory Driven Processes", which also covers the rest of the OI steps. Solution PJ.07-03 captures those elements that were validated to V3/TRL6 in the context of SESAR 2020 Wave 1:

- The management of mission trajectory (MT) with variable profile areas (VPA) type of airspace reservations (ARES) as shared via iOAT FPL in **the planning phase**.
- The ARES conceptual evolution allowing more precise identification of ARES Entry and Exit location and time, to support the increased quality of the trajectory prediction in the corresponding wing operations centre (WOC), network manager (NM) and ATC systems. This includes the evolutions of the VPA module reference as integral part of the evolved iOAT FPL syntax & concept.
- The B2B services for iOAT FPL filing from WOC to NM as well as for the iOAT FPL distribution from NM to ATC. B2B services were as well successfully validated to connect Regional ATFCM (NM) and local ATC FMP systems.

Table 4 provides an overview of the OI Steps and Enablers that are relevant for the Mission Trajectory Driven Processes (and for solution PJ.07-03). All the listed Enablers are 'Required' except for those where the Enabler code is followed by (O) which means the Enabler is 'Optional'. For details of the Enablers and Stakeholder links see Appendix B where it is also easier to see which Enablers are linked to several OI Steps.

Enablers with (PCP) after their name are linked to the Pilot Common Project[3].

It should be noted that the list of Enablers associated with the OI Steps in DS20 Draft (and DS19) include Enablers which the Project consider are not applicable for the Solution. Table 4 only includes the Enablers which the Solution considers are applicable, while Appendix B includes the full list of Enablers but those which the Solution do not consider relevant are shown in grey.

[3] This means that they are included (for certain stakeholders and in certain operating environments) in the SESAR Deployment Manager Deployment Programme. For now, the conservative approach means that those enabler costs are included in this initial V3 CBA, however, in some locations these enablers may already be deployed and would therefore not need to be deployed again.

OI Steps ref.	Enabler[4] code	Enabler definition
AOM-0303	AAMS-10a	Initial airspace management system enhanced with commonly applied GAT/OAT handling
	AIMS-19b	Aeronautical Information system is interfaced to receive and distribute aeronautical information electronically to military systems.
	AOC-ATM-14	Upgrade of WOC system to handle improved OAT flight plans
	ER APP ATC 143	Upgrade of ATC System to handle Improved OAT Flight Plan
	MIL-0501 (O) (PCP)	Specifications for the interoperability of military ground systems with SWIM
	MIL-0502 (O) (PCP)	Upgrade of military ground systems to allow bi-directional exchanges with non-military IP networks
	MIL-STD-03	Update of IFPS User Manual to include OAT Specificities in the Flight Plan (Improved OAT flight plan)
	MIL-STD-04	Procedure to implement EUROAT rules.
	NIMS-35	Flight Planning management sub-system enhanced to process improved OAT flight plans
AUO-0210	AOC-ATM-14	Upgrade of WOC system to handle improved OAT flight plans
	AOC-ATM-20 (PCP)	Sharing of trajectory data between AOC/WOC and the ATM world using B2B web services
	MIL-0106	Wing Operations Centre Mission Support System enhanced to support the CDM process
	NIMS-35	Flight Planning management sub-system enhanced to process improved OAT flight plans
	NIMS-45	Initial Flight Planning management enhanced to support initial Mission Trajectory
	PRO-076	Procedures for the iSMT in the CDM process
AUO-0211	AOC-ATM-20 (PCP)	Sharing of trajectory data between AOC/WOC and the ATM world using B2B web services
	ER APP ATC 82b	Enhance FDP to process iSMT/iRMT

[4] This includes System, Procedural, Human, Standardisation and Regulation Enablers

OI Steps ref.	Enabler[4] code	Enabler definition
	MIL-0103	Wing Operations Centre Mission Support System (including update/revision) of iMT
	NIMS-45	Initial Flight Planning management enhanced to support initial Mission Trajectory
	PRO-077	Procedures facilitating iRMT management
AOM-0304-A	AIMS-19b	Aeronautical Information system is interfaced to receive and distribute aeronautical information electronically to military systems.
	AOC-ATM-14	Upgrade of WOC system to handle improved OAT flight plans
	AOC-ATM-15 (O) (PCP)	Upgrade of Wing Ops System Technical Architecture to provide Military Mission Trajectory Services
	ER APP ATC 143	Upgrade of ATC System to handle Improved OAT Flight Plan
	ER APP ATC 168	Enable ATC System to manage improved OAT flight plans with inherent ARES information (reservation restrictions) in accordance with VPA design principle.
	MIL-0501 (O) (PCP)	Specifications for the interoperability of military ground systems with SWIM
	MIL-0502 (PCP)	Upgrade of military ground systems to allow bi-directional exchanges with non-military IP networks
	MIL-STD-03	Update of IFPS User Manual to include OAT Specificities in the Flight Plan (Improved OAT flight plan)
	NIMS-35	Flight Planning management sub-system enhanced to process improved OAT flight plans
	SWIM-INFR-05a (PCP)	General SWIM Services infrastructure Support and Connectivity.
	SWIM-NET-01a (PCP)	SWIM Network Point of Presence
AUO-0215	ER APP ATC 143	Upgrade of ATC System to handle Improved OAT Flight Plan
	MIL-0501 (PCP)	Specifications for the interoperability of military ground systems with SWIM
	MIL-0502 (PCP)	Upgrade of military ground systems to allow bi-directional exchanges with non-military IP networks
	MIL-STD-03	Update of IFPS User Manual to include OAT Specificities in the Flight Plan (Improved OAT flight plan)
	NIMS-35	Flight Planning management sub-system enhanced to process improved OAT flight plans

OI Steps ref.	Enabler[4] code	Enabler definition
AUO-0228	AOC-ATM-20 (PCP)	Sharing of trajectory data between AOC/WOC and the ATM world using B2B web services
	NIMS-21b (PCP)	Flight Planning management enhanced to support 4D

Table 4: OI steps and related Enablers

3.3 Objectives of the CBA

This initial V3 CBA will provide a first order of magnitude on the costs and benefits of deploying the Solution in an ECAC-level CBA Scenario to help build the 'big picture'. While the views of individual stakeholders involved in the deployment are considered, this CBA task does not provide CBA results for specific local deployments. In addition, it does not try to monetise benefits on the military side; i.e. support to European defence capabilities and the security of European citizens.

The main focus of the CBA model is therefore to reflect the cost and net benefit profile associated with the deployment of the Solution over time and across the locations considered in the CBA Scenario.

3.4 Stakeholders[5] identification

Table 5 provides an overview of the stakeholders that have costs, monetisable benefits and other impacts associated with the Solution.

Stakeholder	The type of stakeholder and/or applicable sub-OE	Type of Impact	Involvement in the CBA task	Quantitative results available in the current CBA version
ANSP (civil/military)	TMA, En-route, all complexity levels Civil/Military	Costs: Invest in civil/military ATC systems that can handle the iOAT FPL Benefits: No directly monetisable benefits Other: (civil) increased awareness of military flight profile, improved interoperability, possibility to free buffer capacity due to better predictability, monitor and support military flight operation in execution	Provided cost estimation for civil ANSP enablers (upgrade/new ATC system supporting the MT concept), same values use for the military ANSP costs Provided inputs regarding the CBA scenarios and participated to analysis and review of the results	Costs
Airport Operators	All APT sub-OE	None	Not involved	None
Network Manager	Network	Costs: Invest to update NM systems; i.e. IFPS, CACD, ETFMS and B2B certificates, to provide the central validation	Provided cost estimation to upgrade NM systems	Costs

[5] Note that the terminology used to describe AU stakeholders in the CBA differs from that associated with Enablers in the dataset. This is due to costing being provided for different types of aircraft regardless of the operations they perform.

Stakeholder	The type of stakeholder and/or applicable sub-OE	Type of Impact	Involvement in the CBA task	Quantitative results available in the current CBA version
		infrastructure and common coherent aeronautical database to the benefit of military AUs. There may be extra workload due to the validation and management of military data and flight plans, in addition to the civil information handled today. Benefits: No directly monetisable benefits Other: Better information available to minimise the impact of future crises	Provided inputs regarding the CBA scenarios and participated to analysis and review of the results	
Scheduled Airlines (Mainline and Regional)	Airspace Users	Costs: None Benefits: Expected to benefit from extra capacity, due to freeing of buffer sector capacity as the result of NM and ATC having better awareness of military flight operations. Expect some benefits (reduced strategic delay) from improved predictability. Other: -	Not involved	Benefits
Business Aviation, Rotorcraft, General Aviation IFR	Airspace Users	Costs: None Benefits: May benefit as Scheduled Airlines depending on their operations. Other: -	Not involved	None
General Aviation VFR	Airspace Users	Costs: None Benefits: None expected due to the applicable sub-Operating Environments Other: -	Not involved	None

<table>
<tr><th>Stakeholder</th><th>The type of stakeholder and/or applicable sub-OE</th><th>Type of Impact</th><th>Involvement in the CBA task</th><th>Quantitative results available in the current CBA version</th></tr>
<tr><td>Industry WOC system supplier</td><td>Industry</td><td>Will provide WOC systems/ upgrades</td><td>Provided cost estimation for WOC systems
Provided inputs regarding the CBA scenarios and participated to analysis and review of the results</td><td rowspan="3">None
Industry partners are not considered as stakeholders in the CBA as their investment decisions are made internally</td></tr>
<tr><td>Industry ATC system supplier</td><td>Industry</td><td>Will provide the required system upgrade and modernisation efforts</td><td>Not involved</td></tr>
<tr><td>Industry ATM system supplier</td><td>Industry</td><td>Will provide the required system upgrade and modernisation efforts</td><td>Not involved</td></tr>
<tr><td>Military – Airborne</td><td>Airspace User</td><td>No impacts expected</td><td>Not involved</td><td>None</td></tr>
<tr><td>Military – Ground</td><td>TMA, En-route, all complexity levels</td><td></td><td>Provided inputs regarding the CBA scenarios and participated to analysis and review the results</td><td>Costs</td></tr>
<tr><td>Other impacted stakeholders (ground handling, weather forecast service provider, NSA….)</td><td>-</td><td>No impacts expected</td><td>Not involved</td><td>None</td></tr>
</table>

Table 5: SESAR Solution PJ.07-03 CBA Stakeholders and impacts

3.5 CBA Scenarios and Assumptions

This section describes the scenarios that are compared in the CBA. The aim is to reflect the delta (difference) between the Reference scenario (where the Solution is not deployed - the orange box in Figure 1) and the Solution scenario (reflecting the proposed deployment of the Solution at applicable locations across ECAC - the green box in Figure 1).

Defining the Reference Scenario has proven to be very challenging because of the assumptions that need to be made regarding the 'ongoing deployments' (blue arrow in Figure 1).). To avoid being blocked by this issue this initial V3 CBA is currently based more on the difference between the current situation (2019) and the Solution Scenario; this is reflected in the following scenario descriptions.

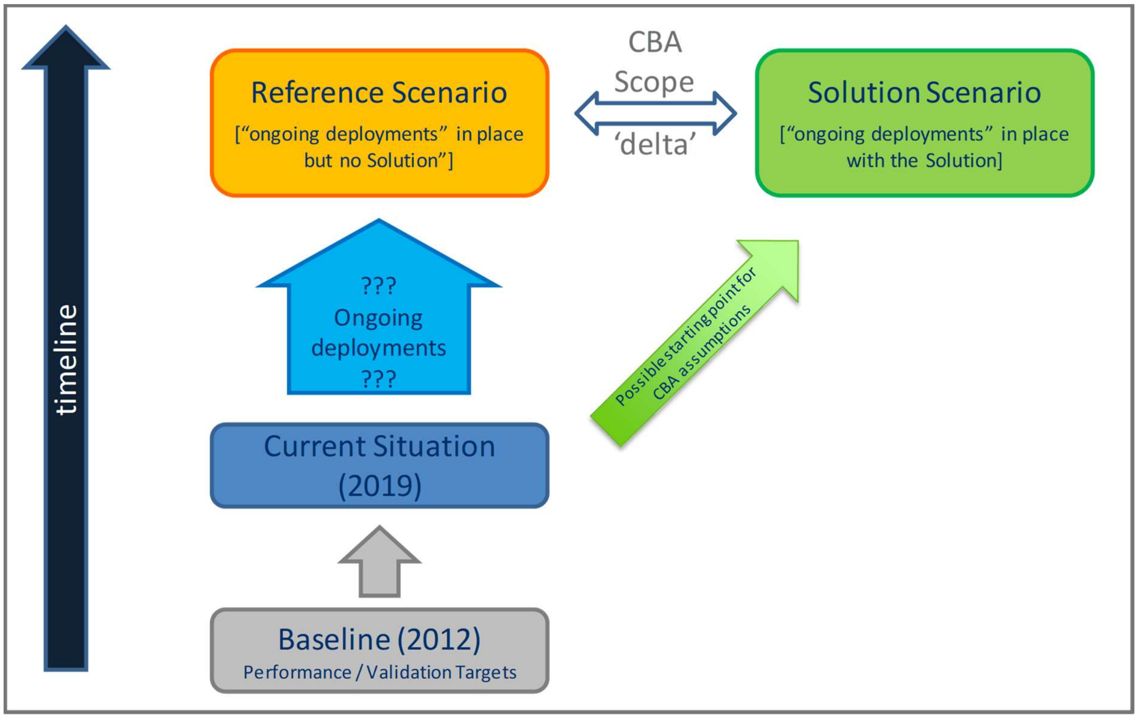

Figure 1: Scenario Overview

To aid the reader the CBA Scenarios are briefly introduced in sections 3.5.1 and 3.5.2 and then the detailed descriptions are in section 3.5.5. The details are structured by stakeholder and then by key areas of change (if needed). There are then bullets describing the Reference/current scenario followed by bullets describing the Solution Scenario.

3.5.1 Reference Scenario

The Reference Scenario for the CBA considers the entire ECAC area and is not the same as the Reference Scenario(s) considered in individual validation exercises. As mentioned above, this section reflects the current situation (2019) more than the actual Reference Scenario.

3.5.2 Solution Scenario

This Solution Scenario considers the future situation when the Solution is deployed. The description covers the full Solution concept and not just those elements that have been validated so far; this is in line with the CBA scope.

3.5.3 Detailed CBA Scenario Descriptions

Military (Ground)

Airspace Management (ASM)

Reference

- Airspace is requested by military AUs via their national ASM cell (AMC). The AMC provides the information to the regional AMC at the Network Manager. NM integrates the national

reservations into a European Airspace Use Plan (EAUP), which is made available to all AUs, to support flight planning.
- Today, the link between the individual military flights and the airspace reservations is unknown to the Network Manager and civil ATC.

Solution

- The process of requesting airspace via the AMC and the integration of the national reservations into the European AUP (EAUP) will not differ from the current situation.
- What differs, is the fact that the iOAT FPL will contain the information about the STAY ARES (the airspace where the OAT part of the trajectory will occur) and as a result this information will be available to ATC and NM and therefore can contribute to a more efficient airspace usage.
- Furthermore, the STAY ARES in the iOAT FPL will be cross checked by NM against the known reservations in the EAUP.

Wing Operations Centre (WOC)

Reference

- A multitude of military mission and flight planning systems exist in Europe. These differ from state to state and sometimes even within one state where, depending on the aircraft type, several flight plan systems might be in use.
- The flight plan systems range from text based terminals, to Windows based terminals with partial graphical elements up to modern systems, which allow mission and flight plan creation almost entirely via mouse based click and drop.
- AIP data is usually available locally for AOR, the geography of the state and AOI for neighbouring cross border missions,
- System communication uses different protocols, i.e. AFTN, B2B, etc.
- Cross-border flights require a diplomatic clearance number (DCN).

Solution

- The WOC will now use the aeronautical environmental information being maintained and managed centrally by NM for the entire ECAC area (EAD); i.e. one source including both civil and military information rather than multiple sources (see NM AIP Information below). This will assure data consistency between WOC and NM and will lead to fewer erroneous FPLs being produced.
- iOAT FPLs will be filed to NM via SWIM based B2B allowing a higher degree of automation in the flight plan filing and validation process and eliminating the use of multiple protocols.
- The workload of the WOC to produce a RAD compliant iOAT FPL is higher than for current OAT FPLs, but remains at an acceptable level. To note that current WOC systems do not include an automatic RAD checking feature to support the human operator. Such a feature would be highly appreciated by the military AUs.

Network Manager (NM)

AIP Information

Reference

- Each state is responsible for its civil and military AIP data.
- NM receives each state's civil AIP information.
- NM checks and imports that AIP information in one common civil and consistent aeronautical environmental database, i.e. EAD, for the entire Integrated Flight Planning Zone (IFPZ).
- The data is available to all AUs.
- The information in the EAD complies with ICAO conventions; i.e. naming conventions for route points.
- In parallel a second set of AIPs /of aeronautical environment data; i.e. waypoint, TACAN routes etc. exist in the military domain. Some elements in these military environmental databases do not comply with ICAO naming conventions.
- Up to now there is no common civil/military database for the complete IFPZ available although some ECAC nations have already migrated to EAD.

Solution

- NM now receives each state's civil <u>and military</u> AIP information.
- Military AIP <u>information is ICAO compliant</u>.
- NM checks and imports that AIP information in one <u>unique common and consistent aeronautical environmental database</u> **<u>both for civil and military AUs</u>**<u>, i.e. EAD, for the entire Integrated Flight Planning Zone (IFPZ).</u>
- This consistent common dataset is the reference and is used by military and civil AUs, facilitating coherent flight plan creation and consistency, reducing errors in the flight plans and contribution to a higher percentage of valid flight plans being process automatically.

<u>Flight Plans</u>

Reference

- Flight plans under GAT flight rules are validated and managed centrally by NM. OAT flights are only subject to validation by NM if they fly entirely or partially under GAT rules.
- OAT parts (entirely/partially) of flight plans, are ignored by NM, and thus are not "known" later on for Flow Management or to ATC.
- OAT flight plans differ slightly from state to state. A unique harmonised flight plan format for all military AUs is missing and is proposed by the Solution through the iOAT FPL.
- Once the GAT flight plans are validated by the IFPS system, they are passed into the Enhanced Tactical Flow Management system (ETFMS) and become subject to Demand and Capacity Balancing (DCB).
- OAT flight plans are not included in the DCB efforts in Europe.
- Flight plans are mainly received by NM via AFTN and B2B, as agreed with the client.
- Once the flight plans are validated, they are further distributed to all concerned ACCs in support of their monitoring and ATS provision during Execution.

- The addressees for the distribution of each flight plan are identified via the analysis of the volumetric airspace penetration calculated for each flight plan.
- Since OAT sections of mixed flight plans are unknown to NM, the above distribution mechanism may not be sufficient. On-top of the airspaces under OAT which remain unaddressed by the distribution, there might be further military addressees who also miss this information, i.e. air defence who should receive the flight plan distribution.

Solution

- Both Civil and Military AU flight plans are now validated and managed centrally by NM. The complete flight trajectory and profile is available to Network Management.
- iOAT FPL validation will include the cross check of a STAY ARES referenced in the flight plan, against the known airspace reservation in the EAUP. All flight plans with a trajectory going through an active airspace without the corresponding STAY ARES reference will be rejected as invalid.
- The improved OAT flight plan format, based on ICAO2012, is adopted by all participating states.
- MTs/iOAT FPLs will comply with the ATM Network rules; i.e. RAD.
- Where mission needs may not allow to comply with RAD, an exemption mechanism; i.e. route coordination with ATC before FPL submission (RMK/RTECORRATC) and exemption from ATFCM delays (STS/ATFMX), will be used. The use of these possibilities shall be limited to avoid workload and complexity increase for ATC.
- A step-wise deployment, where some states join earlier and same later is expected.
- The harmonised iOAT flight plan format is the main facilitator of the OAT Transit Service (OATTS) which will allow faster logistics for cross-border transport of troops and material within Europe.
- Once the flight plans are validated by the IFPS system, they are passed into the Enhanced Tactical Flow Management system and become subject of Demand and Capacity analysis.
- iOAT FPLs might become part step-by-step of DCB, where mission objectives are not biased by their inclusion.
- Once the iOAT FPLs are validated, they will be distributed to all concerned ACCs in support of their monitoring and ATS provision during Execution, as the complete trajectory and profile is now 'visible' to NM (concerned ACCs can be identified the same way as the current situation for civil AUs.)
- Where additional distribution is required, this information can be provided in field 18 of the iOAT FPL or be stored in the NM CACD.
- The NM systems, namely CACD, IFPS and ETFMS, will have evolved to support the concept. This evolution is expected to require significant effort for software development and potentially investment in more performant hardware and larger storage capabilities.
- Communication between concerned systems mostly relies on SWIM based B2B technologies; again eliminating multiple protocols.

ANSPs - Air Traffic Control (ATC)

Reference

- Today, the situation on the ATC side is heterogeneous for a variety of reasons. However, for the CBA the key factor is whether the civil and military ATC operations are separated, co-located (at the same site but separated control for military and civil flights) or integrated. Civil and military can use the same technical system or have two dedicated systems.
- Currently only some states in the ECAC area have an integrated civil-military air traffic control, where both civil and military flights in the same sector are controlled by one ATCO and flight plan information and trajectory information is processed by one and the same system.
- Flight plans for cross-border and operations transiting through several countries require significant preparation effort. This includes organising the required diplomatic clearance numbers, managing the high level of manual interventions and co-ordinating efforts via telephone with neighbouring sectors. This is due to the lack of full integration of the EUROAT agreement, the lack of a harmonised flight plan format as well as the partially unknown (OAT parts) trajectories for mixed flight plans.
- ATC procedures to handle military flights can differ from one state to the other.

Solution

- Since the full iMT information, including OAT parts, is now shared between all actors and a harmonized flight plan format and harmonized procedures are used in the ECAC area, cross-border and transiting operations can be planned and operated much faster and more easily. The automation level in the information exchange, validation and sharing is higher than in the reference scenario.
- Common use of one centrally managed source of aeronautical environmental data by civil and military actors will lead to higher data consistency and less need for manual intervention and correction.
- As ATC are now aware of the OAT traffic they can reduce the capacity buffers, which they maintained to enable them to cope with unexpected military traffic.

3.5.4 Solution Deployment Timeline

The CBA uses the following dates from EATMA (DS20 Draft) as the basis for the timing of cost and benefits. Table 6 lists the key dates and Figure 2 shows them over a timeline.

Dates	Year[6]
Start of deployment date: the start of investments for the first deployment location	2025
End of deployment date: the end of the investments for the final deployment location	Same as FOC

[6] The dates are taken from DS20 Draft where the OI Step IOC and FOC dates that are calculated from the V3 Enabler dates provided by the Solution Project.

Initial Operating Capability (IOC): the time when the first benefits occur following the ***minimum deployment*** necessary to provide them. Costs continue after this date as further deployment occurs at other locations.	2028
Final Operating Capability (FOC): Maximum benefits from the ***full deployment***[7] of the Solution at applicable locations. Investment costs are considered to end[8] here although any operating cost impacts would continue.	End of 2033

Table 6: CBA Investment and Benefit Dates

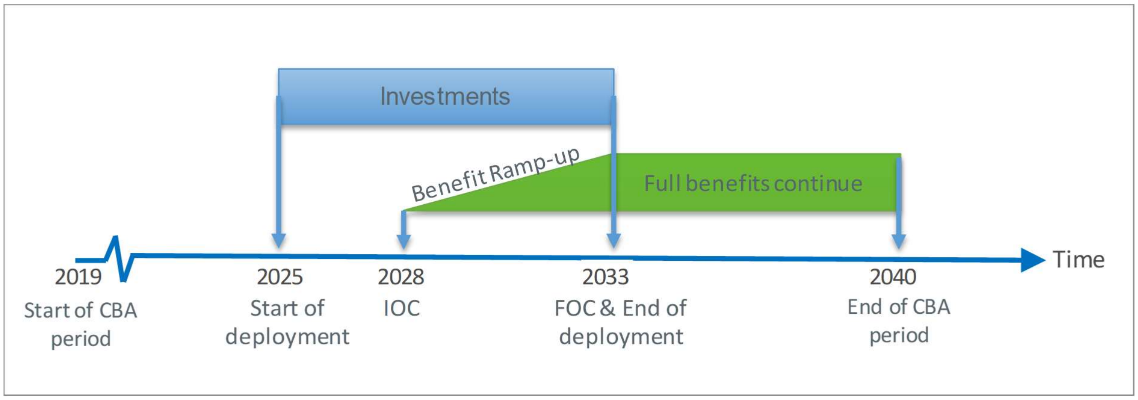

Figure 2: Overview of CBA Dates

Figure 2 shows that:

- Investment costs are spread linearly between the Start and End of Deployment dates.
- Benefits ramp-up linearly between IOC and FOC and then continue up to the end of the CBA period.
- Operating cost impacts (increases or decreases) would also start at IOC and ramp-up linearly to FOC before continuing for the rest of the CBA duration, however, none have been identified for PJ.07-03.

In line with PJ.19-04 guidance, the CBA model calculates the cash flows up to 2040 and then discounts the values back to 2019[9] to calculate the Net Present Value. The discount rate of 8% is used for all stakeholders.

3.5.5 Assumptions

The following general assumptions underlie the CBA results.

- The deployment of the MT concept (PJ.07-03 and PJ.18-01a) is ECAC wide.

[7] Where ***full deployment*** means deploying the Solution in the all the locations where it makes sense to deploy it (i.e. it does not mean it has to be deployed everywhere)

[8] The basic assumption is that infrastructure does not need to be replaced during the CBA period

[9] as specified in the PJ19.04 Common Assumptions [4]

- States will adhere to:
  - the harmonisation of their national AIP data to comply to ICAO standards
  - a common harmonized FPL format; i.e. iOAT FPL
  - common procedures on how to handle military flights in the ECAC/IFPS zone.
- Adherence of the military organisations of the ECAC states to the MT concept will be realised state by state over a period of time; it will not happen in "one shot". This is reflected in the current situation where the first countries have already migrated to EAD for military flight planning and 17 countries have already signed an agreement on common procedures support.

Note that Stakeholder related assumptions with relevance to their cost are detailed in Chapter 5.

Table 7 provides some data on other assumptions used in the CBA model.

Scenario feature		Year 2019	Year 2025	Year 2040	Source
ECAC traffic (M # flights) in line with [4]		11.4	14.0	19.5	STATFOR Long/Medium Term forecasts [2018]
Equipage rate		N/A – no airborne equipage required for Solution			
Applicability: Number of locations where Solution is deployed		Deployment location values are provided in the cost assessment section and the CBA model			PJ20 WP2.2 sub-OE data files
Impacted traffic, i.e. experiencing the benefits from the Solution(s)	'000 # IFR flights per year	All Scheduled Airline traffic (≈80% of ECAC traffic) is considered for the SA benefits			ECAC traffic above
	'000 # IFR flight hours per year	No benefits are based on flight hours			-

Table 7: SESAR Solution PJ.07-03 CBA Solution Scenario Assumptions

4 Benefits

The following benefit sections describe the wider benefits from the solution as well as those that have been monetised in the CBA.

4.1 European Benefits

While fundamental from the military perspective, this initial V3 CBA does not monetise the potential beneficial contribution of the Solution on the defence capabilities. Harmonised iOAT FPL and sharing of EAD data, along with IFR OAT rules, OATTS and MT data sharing are key enablers to improve the capabilities of the European rapid mobility response to crises at a pan-European level. Typically, crises in Europe involve military re-deployments, areas of combat with active fire, large military exercises and OAT flights going from/to military bases and/or ships (e.g. Charles de Gaulle aircraft carrier).

Current crises are in the following ECAC areas:

- Syria (nearby Cyprus and Turkey)
- Island of Cyprus between Turkey and Cyprus
- Ukraine (Crimea and a large portion of airspace closed)
- Baltic States (large military exercises both of Russian and NATO forces)

Past crises include:

- Desert Storm in Iraq in 1991
- First Yugoslavian war in 1994
- Kosovo crisis 1999

The Solution is expected to provide civil and military benefits in impacted areas during crisis periods due to the increased awareness from having iOAT FPL data in the ATM System. Associated civil benefits include:

- Fewer potential conflict situation between GAT-OAT
- Fewer flight cancellations
- Less ATFM delay (i.e. more available capacity in the planning phase)
- More efficient flight trajectories for GAT

It could be expected that benefits will be much higher in periods/areas of crisis (most recently the Cyprus airspace due to the Syria crisis) than those considered when defining the validation targets (i.e. nominal situation with no crisis). Particularly, the "avoidance of civil cancellations" during crises could be included as a benefit (i.e. Resilience KPA) if relevant data is available.

4.2 Military Airspace User Benefits

This initial V3 CBA does not include quantified military benefits, as military KPA/KPI are not part of the SESAR 2020 Performance Framework; only PI which do not have validation targets and are not measured in the validation exercises.

Concerning military benefits it is expected that "Military Mission (OAT) flight efficiency" and the standardisation of systems, will lead to economies of scale in military procurement and in military maintenance costs which will have a positive impact on the CBA.

The key benefits the Solution brings to military Airspace Users include:

- Harmonised iOAT FPL format for military IFR flights in controlled airspace across ECAC states
- Harmonised reference data for cross-border flights in controlled airspace
- Harmonised ATS provision to military IFR flights in controlled airspace
- Improved ability to address military specific requirements for IFR flights operating in controlled airspace (air-to-air refuelling, formation flights, usage of ARES of different types, etc.)
- Enhanced ability to participate in collaborative planning and sharing of the airspace resource
- Increased flexibility to get access to airspace at short notice
- Flexibility to refine the Military AU demand and change it in real time
- Mutual awareness on each other's demand; Military/Military and Civil/Military
- Automated processing of iOAT FPL across the military infrastructure
- Increased predictability in cross-border operations
- Officially applied and agreed exemption policy
- Facilitating implementation and execution of single or combined RPAS operations.
- Cost reduction opportunities through the use of network level solutions for the submission and exchange of flight plan data
- Simplification of national military infrastructures supporting ATM
- Avoidance of (potentially costly) adaptation of legacy systems.

4.3 Civil Airspace User Benefits

In general it is estimated that the potential monetisable benefits for civil AUs, detailed below, are of such a small magnitude, that it is very challenging to try to measure them in validation exercises. It is possible that the measurements might be impacted by an error range that is potentially higher than the absolute figures being measured. This is especially valid for the nominal case, with no crisis in Europe.

PJ.07-03 are expected to impact the KPI in Table 8. As the validation exercises could not provide qualitative figures, this initial V3 CBA monetises the benefits based on the Validation Targets provided by PJ19.04 [12].

KPA	Validation Target (2019)	Stakeholder that benefits in the CBA
CAP2: En-route Airspace Capacity – En-route Throughput in challenging airspace, per unit time	0.505%	AU (reduced delay)
PRD1: Predictability - Flight duration variability, between actual and flight plan or Reference Business Trajectory (RBT) durations	0.155%	AU (reduced delay)
SAF1: Accidents and incidents with ATM contribution per year	-1.13%	Not monetised

Table 8: Overview of Validation Targets

PJ.07-03 has used the Single Solution CBA model developed by PJ.19-04 and therefore these benefits are calculated using the benefit monetisation mechanisms that it includes. The mechanism diagrams shown in the following sections are taken from or based on the CBA Reference material [3].

4.3.1 En-route Airspace Capacity (CAP2)

- **En-route Capacity**: 0.505% increase in peak hour throughput. This is applicable in the **En-route** sub-operating environments (sub-OE) identified as being Very High Complexity (VHC), High Complexity (HC), Medium Complexity (MC) and Low Complexity (LC) (all sub-OE are allocated 0.505%).

En-route Airspace Capacity is monetised in the CBA as a reduction in tactical and strategic delay for civil Airspace Users, where:

- Tactical ATFM Delay is unpredictable delay on the day of operations that exceeds the delay buffer foreseen in the flight plan.
- Strategic Delay is delay that is included in airline schedules (flight plan).

The link between capacity and delay is estimated using the elasticity approach developed in the SESAR Integrated CBA model [11].

The figures below show the monetisation mechanisms used in the CBA model.

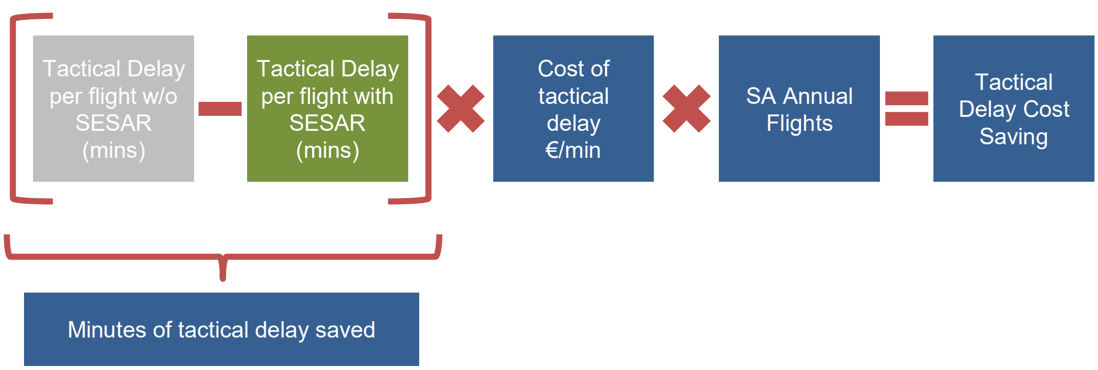

Figure 3: Tactical Delay Monetisation Mechanism

Figure 4: Strategic Delay Monetisation Mechanism (from tactical delay)

The Performance Assessment provides a percentage increase expected in capacity-constrained airspace during the hours when it is actually constrained (peak-hours), i.e. at a local-level. However, the CBA is at ECAC-level and so the 0.505% value (Table 8) needs to be scaled so that it only applies to

Very High / High / Medium /Low Complexity En-route ACCs during peak-hours[10]. The following simple scaling method should be reviewed for the next version of the V3 CBA (i.e. in Wave 2).

The scaling factor uses the values in the Common Assumptions [4] for the peak traffic percentage in each category of En-route operating environment.

En-route Airspace sub-OE	% traffic in peak hours
Very High Complexity	13.5%
High Complexity	15.7%
Medium Complexity	10.9%
Low Complexity	0%
Scaling factor	**40.1%**
Scaled En-route Capacity	**0.203%** (0.505% x 40.1%)

Table 9: Airspace Capacity Scaling Factor Calculation

The scaled En-route Capacity increase (0.203%) is used to calculate the 'Tactical (ATFM) Delay per flight with SESAR (mins)' (green box in Figure 3) as well as the part of the Strategic delay savings[11] linked to Tactical delay (Figure 4).

4.3.2 Predictability (PRD1)

- **Predictability**: 0.155% reduction in variance of block-to-block flight time. This is applicable in the **En-route** sub-OE identified as being VHC (0.074%), HC (0.041%), MC (0.035%) and LC (0.005%)

Predictability is monetised through avoidance of strategic delay; this is not double counted with the capacity benefit.

The improvements with SESAR can be calculated via their impact on the duration of the strategic buffer. When the variability in flight time reduces, the estimated buffer in order to achieve a given % of flights arriving on time will also reduce, using a normal distribution.

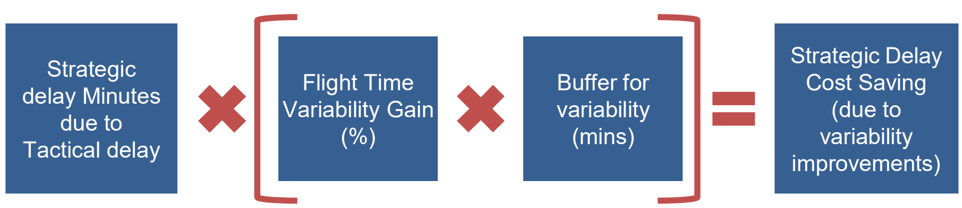

Figure 5: Strategic Delay Monetisation Mechanism (from Predictability)

[10] Ideally, the local capacity gains are fed into a network-wide fast time simulation to assess the impact on delays. However, this is a significant task that is not feasible at Solution level; hence, the use of the simple scaling approach.
[11] The other part of the Strategic delay savings are calculated using the Flight Time Variability (Predictability) performance assessment results.

4.3.3 Safety

- **Safety**: -1.13% reduction in safety. This is applicable in relation to reducing the risk of mid-air collisions in **En-route** (-0.95%) and in the **TMA** (-0.18%).

The PJ.07-03 Safety Validation target is the reduction in the total number of Mid Air Collision (MAC) accidents per year of -1.13% in En Route and TMA, due to SESAR 2020 improvements with respect to a hypothetical "do nothing" scenario. In that scenario no changes are made to ATM safety of the Baseline (2005) while traffic is allowed to increase until it reaches the capacity level targeted for SESAR in 2035. In other words, this reduction is required so that the overall safety level will be maintained when the increase in capacity results in more aircraft being airborne.

The safety benefits of 'avoided MAC' are not monetised in the CBA. This reflects both the very low number of MAC occurring in the applicable sub-OE and also the general resistance in European ATM to using avoided loss-of-life benefits in Cost Benefit Analyses.

4.4 ANSP / NM Benefits

While not included in the Validation Targets, PJ.07-03 does expected to result in some reduction in ATCO/support staff workload as the iOAT flight plans will be equivalent to civil flight plans and so will not require the additional processing that occurs today. Being equivalent to civil flight plans means that the iOAT flight plans will be distributed from the same source (Regional ATFCM), validated and integrated into the ATM network as well as being in the same ICAO format. This could also enhance the potential integration of civil / military ANSP systems resulting in one ATCO controlling all flights in his AoR and hence reducing the need for (civ/mil) co-ordinations.

In addition, as most iOAT FPLs will comply with the RAD, workload should reduce for ATCOs and NM/IFPS operators. Military FPLs will become less specific and the complexity of the trajectory interactions with GAT will reduce.

These workload reduction benefits are expected to be realised with the deployment of the Solution, however, based on the validation exercises undertaken so far it has not been possible to measure the scale of the impacts. Validation planning for the future V3 validation exercises should consider if it will be feasible to make such measurements depending on the scope and objectives of the exercises.

For the civil ANSPs and NM this workload reduction could translate into increased ATCO Productivity, with associated impacts on supporting staff levels; details of these mechanisms are described in [3]. From the military perspective, the civil approach to ATCO productivity (flight hours managed per ATCO hour in operations) is not applicable and any savings in related workload are not considered to impact military staffing levels.

4.5 Benefit Monetisation of the Performance Framework KPI/PI

Performance Framework KPA[12]	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	Year 2019	Year N+x	Year 2040
Cost Efficiency	ANS Cost efficiency	**CEF2** Flights per ATCO-Hour on duty	Nb	ATCO employment Cost change	€/year		No Validation Target	
Cost Efficiency	ANS Cost efficiency	**CEF2** Flights per ATCO-Hour on duty	Nb	Support Staff Employment Cost Change	€/year		No Validation Target	
Cost Efficiency	ANS Cost efficiency	**CEF2** Flights per ATCO-Hour on duty	Nb	Non-staff Operating Costs Change	€/year		No Validation Target	
Cost Efficiency	ANS Cost efficiency	**CEF3** Technology cost per flight	EUR / flight	G2G ANS cost changes related to technology and equipment	€/year		No Validation Target	
Cost Efficiency	Airspace User Cost efficiency	**AUC3** Direct operating costs for an airspace user	EUR / flight	Impact on direct costs related to the aeroplane and passengers. Examples: fuel, staff expenses, passenger service costs, maintenance and repairs, navigation charges, strategic delay, landing fees, catering	€/year		No Validation Target	
Cost Efficiency	Airspace User Cost efficiency	**AUC4** Indirect operating costs for an airspace user	EUR / flight	Impact on operating costs that don't relate to a specific flight. Examples: parking charges, crew and cabin salary, handling prices at Base Stations	€/year		No Validation Target	
Cost Efficiency	Airspace User Cost efficiency	**AUC5** Overhead costs for an airspace user	EUR / flight	Impact on overhead costs. Examples: dispatchers, training, IT infrastructure, sales.	€/year		No Validation Target	
Capacity	Airspace capacity	**CAP1** TMA throughput, in challenging airspace, per unit time	% and # movements	Tactical delay cost (avoided-; additional +)	€/year		No Validation Target	
Capacity	Airspace capacity	**CAP1** TMA throughput, in challenging airspace, per unit time	% and # movements	Strategic delay cost (avoided-; additional +)	€/year		No Validation Target	

[12] For information, the mapping to the Performance Ambition KPAs (used in the ATM Master Plan) is available in Appendix A.

Performance Framework KPA[12]	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	Year 2019	Year N+x	Year 2040
		CAP2 En-route throughput, in challenging airspace, per unit time	% and # movements	Tactical delay cost (avoided-; additional +)	€ over CBA period[13]	202 M€ (Undiscounted) 52 M€ (Discounted)		
			% and # movements	Strategic delay cost (avoided-; additional +)		36 M€ (Undiscounted) 9 M€ (Discounted)		
	Airport capacity	**CAP3** Peak Runway Throughput (Mixed mode)	% and # movements	Value of additional flights	€/year	No Validation Target		
	Resilience	**RES4a** Minutes of delays	Minutes	Tactical delay cost (avoided-; additional +)	€/year	No Validation Target		
		RES4b Cancellations	% and # movements	Cost of cancellations	€/year			
		Diversions	% and # movements	Cost of diversions	€/year			
Predictability and Punctuality	Predictability	**PRD1** Variance of Difference in actual & Flight Plan or RBT durations	Minutes^2	Strategic delay cost (avoided-; additional +)	€ over CBA period	25 M€ (Undiscounted) 7 M€ (Discounted)		
	Punctuality	**PUN1** % Departures <+/- 3 mins vs. schedule due to ATM causes	% (and # movements)	Tactical delay cost (avoided -; additional +)	€/year	No Validation Target		
Flexibility	ATM System & Airport ability to respond to changes	**FLX1** Average delay for scheduled civil/military flights with change request and non-	Minutes	Tactical delay cost (avoided -; additional +)	€/year	No Validation Target		

[13] See the CBA model embedded in section 6 for annual values (sheet 'Output_tables' rows 95 to 98)

Performance Framework KPA[12]	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	Year 2019	Year N+x	Year 2040
	in planned flights and missions	scheduled / late flight plan request						
Environment	Time Efficiency	**FEFF3** Reduction in average flight duration	% and minutes	Strategic delay: airborne: direct cost to an airline excl. Fuel (avoided-; additional +)	€/year	No Validation Target		
	Fuel Efficiency	**FEFF1** Average fuel burn per flight	Kg fuel per movement	Fuel Costs	€/year			
	Fuel Efficiency	**FEFF2** CO2 Emissions	Kg CO2 per movement	CO2 Costs	€/year			
Civil-Military Cooperation & Coordination	Civil-Military Cooperation & Coordination	**CMC2.1a** Fuel saving (for GAT operations)	Kg fuel per movement	Fuel Costs	€/year	No Validation Target		
		CMC2.1b Distance saving (for GAT operations)	NM per movement	Time Costs	€/year			

Table 10: Results of the benefits monetisation per KPA

5 Cost assessment

5.1 ANSPs costs (Civil and Military)

The ANSP stakeholder covers several different service provision aspects including ATS provision (at Aerodromes, in Approach and En-route), AIS, Civil-Military Airspace Management Cell, CNS, MET and SWIM. Within different States these services may be provided by different entities however the CBA considers the cost envelope of all the Enablers related to these ANSP-related services. See Appendix B for expansions of the ANSP abbreviated names used in Table 11.

5.1.1 ANSPs cost approach

ANSP costs cover the Enablers in Table 11, although see Table 13 for details of some exclusions. In Table 11 there are enablers which are required 'R' for the Solution or optional 'O' and also indicates if an enabler is linked to the 'PCP'[14]).

OI Steps							ANSP														
							Civil							Military							
AOM-0303	AOM-0304-A	AUO-0210	AUO-0211	AUO-0215	AUO-0228	Enabler Code	ANSP-CIV-AERO	ANSP-CIV-AIS	ANSP-CIV-AMC	ANSP-CIV-APP	ANSP-CIV-ER	ANSP-CIV-MET	ANSP-CIV-SWIM	ANSP-MIL-AERO	ANSP-MIL-AIS	ANSP-MIL-AMC	ANSP-MIL-APP	ANSP-MIL-CNS	ANSP-MIL-ER	ANSP-MIL-MET	ANSP-MIL-SWIM
R	R					AIMS-19b		X							X						
			R	R		ER APP ATC 82b		X		X	X						X		X		
R	R			R		ER APP ATC 143				X	X						X		X		
	R					ER APP ATC 238					X								X		
			R			MIL-0103								X			X		X		
O	R			R		MIL-0502 (PCP)								X			X		X		
R						MIL-STD-04	X			X	X			X			X		X		
R	R					PRO-015	X			X	X			X			X		X		
		R				PRO-076					X										
			R			PRO-077					X						X		X		
	R					SWIM-INFR-05a (PCP)	X			X	X		X	X			X		X		X
	R					SWIM-NET-01a (PCP)	X			X	X	X	X	X			X		X	X	X

Table 11: Enablers assigned to civil and military ANSPs

[14] This will be reviewed in the next version of the V3 CBA because if those enablers have already been deployed in some locations for the PCP, then those costs will not need to be included here.

Enabler Code	Enabler Title
AIMS-19b	Aeronautical Information system is interfaced to receive and distribute aeronautical information electronically to military systems.
ER APP ATC 82b	Enhance FDP to process iSMT/iRMT
ER APP ATC 143	Upgrade of ATC System to handle Improved OAT Flight Plan
ER APP ATC 238	Enable ATC System to manage improved OAT flight plans with inherent ARES information (reservation restrictions) in accordance with VPA design principle.
MIL-0103	Wing Operations Centre Mission Support System (including update/revision) of iMT
MIL-0502 (PCP)	Upgrade of military ground systems to allow bi-directional exchanges with non-military IP networks
MIL-STD-04	Procedure to implement EUROAT rules. (see Table 13)
PRO-015	Harmonised ATC Procedures for providing a standardized service to OAT flights at pan-European level
PRO-076	Procedures for the iSMT in the CDM process
PRO-077	Procedures facilitating iRMT management
SWIM-INFR-05a (PCP)	General SWIM Services Infrastructure Support and Connectivity. (see Table 13)
SWIM-NET-01a (PCP)	SWIM Network Point of Presence (see Table 13)

Table 12: ANSP Enabler Descriptions

The Enablers in Table 13 are required for the Solution and are assigned to the ANSP stakeholders however their costs are not (fully) included here for the reasons given below.

Standardisation Enablers	
MIL-STD-04	Procedure to implement EUROAT rules.
Not costed as the standard was published in 30/10/2013 and 17 States have already implemented it	
SWIM Enablers	
SWIM-INFR-05a (PCP)	General SWIM Services infrastructure Support and Connectivity
SWIM-NET-01a (PCP)	SWIM Network Point of Presence
Only the aspects of these SWIM Enablers which are required for the Solution are considered in the CBA. These Enablers are needed in many Solutions and it is considered as an overstatement to allocate the full cost to this Solution.	

Table 13: ANSP and NM Enablers not (fully) included in the ANSP and NM Cost Assessments

5.1.2 ANSP cost assumptions

The ANSP per-unit cost is based on the following assumptions:

- The per-unit cost varies in function of whether the ANSP unit handles both GAT and OAT traffic (GAT + OAT) or only GAT traffic (Only GAT). Where a unit handles both GAT and OAT it is considered as either Integrated or Co-located in the CBA, see Table 14. Where a unit handles Only GAT it is considered Separated in the CBA.

- The per-unit cost does not vary in function of the traffic complexity level managed by the ANSP unit (En-route Airspace, Terminal Airspace or both En-route and Terminal Airspace).
- Where Civil and Military ANSPs operate the same ATS system (Integrated), the costs are allocated to the civil ANSP.
- The ATC costs are consolidated from the per Enabler inputs.
- The costs have been estimated for a single ACC first and have then been applied to the number of ACCs in the ECAC area, see section 5.1.3. The confidence level in the per-ACC cost is estimated to be low / moderate.

Further refinements of the cost inputs are expected, as the enabler definitions are further developed in V3.

Table 14 provides an overview of the assumptions used to explain the differences between the categories of Separated, Co-located or Integrated, which are used to describe the Civil / Military ATS provision. Note that 'OAT traffic controlled by' refers to transit flights only and excludes training flights or air defence missions as they are always under the control of a military controller (air defence control units). Indicative numbers of Separated, Co-located and Integrated centres have been estimated from the inputs provided by Member States through the LSSIP[15] process.

	#	Military ATS System is:	OAT traffic controlled by:	Costs allocated to:
Separated	1	Same as Civil ANSP System	Military controller	Civil ANSP
	2	Separate Military ATS System	Military controller	Military ANSP
Co-located	3	Same as Civil ANSP System	Military controller	Civil ANSP
	4	Separate Military ATS System	Military controller	Civil ANSP
Integrated	5	Same as Civil ANSP System	Civil controller	Civil ANSP

Table 14: Main Civil-Military ANSP Organisations

The deployment costs at Co-located (#3 and #4) and Integrated (#5) locations are considered to be covered by the civil ANSP costs. The assumption for #4 locations is that the upgrade of the systems will result in the move towards either (#3 or #5) hence the allocation of costs to the civil ANSP.

The deployment costs at Separated locations are assigned to the Military ANSP in the CBA; see Table 16.

5.1.3 Number of Deployment Locations (units)

All ANSP units will need to be able to handle the new OAT flight plan format. In this initial V3 CBA a high-level approach is taken where all the Enablers are assumed to be deployed at each considered

[15] Local Single Sky Implementation Plan

deployment location. This assumption should be reviewed in Wave 2 as, for example, not every ACC has its own Flight Data Processing System, some will only receive a data feed. In the absence of such data the Solution has used the PJ20 WP2.2 Sub-Operating Environment data [10] to identify a potential number of investment instances; see Table 15.

Considering each classified ANSP unit (excluding towers) results in 278 locations. A proposal to further refine this approach is to look at the Enabler costs per location type and complexity to see if lower values could be applied to the medium and low complexity ACCs; this will be considered in the V3 CBA activities in Wave 2.

	TMA				ACC							
					En-route				Mixed (En-route + TMA)			
	VH	H	M	L	VH	H	M	L	VH	H	M	L
GAT + OAT	2	3	17	35	3	3	6	2	3	0	2	2
	57				14				7			
	Investment instances: 78 GAT + OAT (Integrated + Co-located)											
GAT Only	7	6	54	85	1	6	13	4	1	3	12	8
	152				24				24			
	Investment instances: 200 GAT Only (Separated)											
Total Civil Investment instances: 78 + 200 = 278												

Table 15: Number of investment instances – ANSPs (civil)

ANSP systems used to provide ATS at airports and aerodromes are not included independently in the CBA; they are assumed to be covered by the above costs.

Military ANSP costs for Separated situations are included separately in the CBA.

	Separated
Military (OAT Only)	41

Table 16: Number of investment instances – ANSPs (Military – separate ATS System)

5.1.4 Cost per-unit

The cost shown in Table 17 includes the enablers listed in section 5.1.1.

Cost category	Airport	TMA				ACC			
	All Sub-OE	VH	H	M	L	VH	H	M	L
Pre-Implementation Costs	Not Applicable	1.9 M€ per civil / military ACC (controlling TMA / En-route /or En-route and Terminal Airspace)							
Implementation costs		ACC which have already have an integrated system with the Military would have lower costs ≈ 1.3 M€							

Founding Members

Cost category	Airport	TMA				ACC			
	All Sub-OE	VH	H	M	L	VH	H	M	L
Operating costs		No impact on annual operating cost was identified at this stage							

Table 17: Cost per Unit – ANSP

See section 5.7 for the overview of the cost calculation and values included in the CBA.

5.2 Airport Operators costs

Civil and Military Airport operators are not required to invest in any Enablers for this Solution.

5.3 Network Manager cost

5.3.1 Network Manager cost approach

Network Manager costs have been reviewed to update the assessment originally made in an exercise that considered all the SESAR2020 Enablers assigned to NM, as defined in DS18a at the start of 2018. The review included the new NM Enablers that have been defined since the previous assessment.

NM costs cover the Enablers in Table 18 (which are required for the Solution):

OI Steps							NM
AOM-0303	AOM-0304-A	AUO-0210	AUO-0211	AUO-0215	AUO-0228	Enabler Code	NET-MAN
R						AAMS-10a	X
			R			MIL-0103	X
R						MIL-STD-04	X
					R	NIMS-21b (PCP)	X
R	R	R		R		NIMS-35	X
		R	R	R		NIMS-45	X
R	R			R		PRO-014	X
		R				PRO-076	X
			R			PRO-077	X
	R					SWIM-INFR-05a (PCP)	X
	R					SWIM-NET-01a (PCP)	X

Table 18: Enablers assigned to the Network Manager

Enabler Code	Enabler Title
AAMS-10a	Initial airspace management system enhanced with commonly applied GAT/OAT handling
MIL-0103	Wing Operations Centre Mission Support System (including update/revision) of iMT
MIL-STD-04	Procedure to implement EUROAT rules. (see Table 13)
NIMS-21b (PCP)	Flight Planning management enhanced to support 4D
NIMS-35	Flight Planning management sub-system enhanced to process improved OAT flight plans
NIMS-45	Initial Flight Planning management enhanced to support initial Mission Trajectory
PRO-014	Procedures harmonised at pan-European level for the management of the Improved OAT FPL (flight plan filing, validation, acceptance and distribution)
PRO-076	Procedures for the iSMT in the CDM process
PRO-077	Procedures facilitating iRMT management
SWIM-INFR-05a (PCP)	General SWIM Services Infrastructure Support and Connectivity (see Table 13)
SWIM-NET-01a (PCP)	SWIM Network Point of Presence (see Table 13)

Table 19: NM Enabler Descriptions

5.3.2 Network Manager cost assumptions

Network Manager costs are provided based on a consolidation of per Enabler values. The current cost range has a low confidence level as detailed understanding of the changes that will be required to provide the enabler functionalities are still being assessed.

In addition, some of the Enablers required for this Solution will also enable other Solutions. For now the entire Enabler cost range has been included in this CBA as a conservative approach.

5.3.3 Network Manager cost figures

Cost category	Network Manager
Pre-Implementation costs	30 – 50 M€
Implementation costs	(low confidence)
Operating costs	No impact on annual operating cost was identified at this stage

Table 20: Cost Range – Network Manager

See section 5.7 for the overview of the cost calculation and values included in the CBA.

5.4 Airspace User costs

Civil Airspace Users are not required to invest in any Enablers, either airborne or in their Flight Operation Centres, for the Solution.

5.5 Military costs (Airspace User – WOC)

The term WOC can mean different things to different people, in the context of PJ.07-03 the term WOC refers to the WOC functions associated with flight planning and the iOAT FPL activities.[16]

5.5.1 Military cost approach

There is no airborne equipage required for the Military AU fleet.

The WOC systems will need to be upgraded to produce the required flight plan format and to disseminate it to the Network Manager.

WOC costs cover the Enablers in Table 21 (which are required for the Solution; 'O' reflects an optional enabler and 'PCP' shows the enabler is linked to the PCP):

OI Steps						Enabler Code	Airspace Users	
AOM-0303	AOM-0304-A	AUO-0210	AUO-0211	AUO-0215	AUO-0228		AU-CIV-FOC	AU-MIL-W
R	R					AIMS-19b	X	X
R	R	R				AOC-ATM-14		X
	O					AOC-ATM-15 (PCP)		X
		R	R		R	AOC-ATM-20 (PCP)	X	X
			R			MIL-0103		X
		R				MIL-0106		X
O	O			R		MIL-0501 (PCP)		X
O	R			R		MIL-0502 (PCP)		X
R	R			R		MIL-STD-03	X	X
R	R			R		PRO-014		X
		R				PRO-076		X
			R			PRO-077	X	X
	R					SWIM-INFR-05a (PCP)	X	X
	R					SWIM-NET-01a (PCP)	X	X

Table 21: Enablers assigned to the Wing Operation Centres

[16] In other projects the term WOC is used in reference to different WOC functions and therefore make different assumptions about the number of deployment locations, e.g. PJ.08-01 refers to the Airspace Management functions of the WOC and hence assumes deployment once per State.

Enabler Code	Enabler Title
AIMS-19b	Aeronautical Information system is interfaced to receive and distribute aeronautical information electronically to military systems.
AOC-ATM-14	Upgrade of WOC system to handle improved OAT flight plans
AOC-ATM-15 (PCP)	Upgrade of Wing Ops System Technical Architecture to provide Military Mission Trajectory Services
AOC-ATM-20 (PCP)	Sharing of trajectory data between AOC/WOC and the ATM world using B2B web services
MIL-0103	Wing Operations Centre Mission Support System (including update/revision) of iMT
MIL-0106	Wing Operations Centre Mission Support System enhanced to support the CDM process
MIL-0501 (PCP)	Specifications for the interoperability of military ground systems with SWIM
MIL-0502 (PCP)	Upgrade of military ground systems to allow bi-directional exchanges with non-military IP networks
MIL-STD-03	Update of IFPS User Manual to include OAT Specificities in the Flight Plan (Improved OAT flight plan)
PRO-014	Procedures harmonised at pan-European level for the management of the Improved OAT FPL (flight plan filing, validation, acceptance and distribution)
PRO-076	Procedures for the iSMT in the CDM process
PRO-077	Procedures facilitating iRMT management
SWIM-INFR-05a (PCP)	General SWIM Services Infrastructure Support and Connectivity.
SWIM-NET-01a (PCP)	SWIM Network Point of Presence

Table 22: Military Enabler Descriptions

5.5.2 Military cost assumptions

The cost has been estimated for one WOC. The exact number of WOCs per ECAC country is still not available at the time of this initial V3 CBA. It is assumed that for each military A/C type in operation in a country a dedicated WOC flight planning system is required.

Each WOC system is assumed to consist of a central WOC server and 10 clients to support squadrons at remote airbases. This last assumption has been developed for the purpose of the CBA and its technical aspects are not part of the OSED or Technical specification of the recent validation. In reality, the detailed deployment is expected to be very specific for each country and could vary significantly from this assumption.

5.5.3 Number of Deployment Locations (units)

For the purpose of this V3 CBA it has been estimated that the range of military A/C types in operations per country on average in the ECAC area varies between 4-8; i.e. 1-2 fighters, 1-2 transport types, 2-4 helicopters (rotorcraft).

In consequence, the CBA considers that for each of the 44 ECAC countries 4-8 WOC installations have to be upgraded or newly deployed.

Military	
Ground facilities	Air vehicles
176 – 352 WOC	None required

Table 23: Number of investment instances – Military WOC

5.5.4 Cost per-unit

The per-unit cost values provided below are a starting point to build the CBA. However, for this, and other per-unit costs, there is expected to be a wide variation in reality due to the different situations in each state, e.g. current systems, number of aircraft types, etc.

Cost category	Military	
	Ground facility	Air vehicle
Pre-Implementation costs	1-2 M€ per WOC	No airborne investment needed
Implementation costs		
Operating costs	No impact on annual operating cost was identified at this stage	

Table 24: Cost per unit – Military

See section 5.7 for the overview of the cost calculation and values included in the CBA.

5.6 Other relevant stakeholders

No other stakeholders are considered in this CBA.

5.7 Cost Mechanism Summary

This section provides a summary of how the data in the previous sections is used to feed the CBA model., Table 25, Table 26 and Table 27 show the mid-range values which are used to produce the 'base' CBA results while the low and high range values are used in the sensitivity analysis, see section 8.

ANSP Costs (Civil + Military)

	Cost per-unit		Deployment Locations		Cost
Civil ANSP (Integrated / Co-located)	1.3 M€ per ACC	x	78	=	101 M€
Civil ANSP (Separated)	1.9 M€ per ACC	x	200	=	380 M€
					481 M€

Military ANSP(Separated)	1.9 M€ per ACC	x	41	=	78 M€
					559 M€

Table 25: ANSP Cost Summary

NM Costs

	Cost per-unit		Deployment Locations		Cost
Network Manager	40 M€	x	1	=	**40 M€**

Table 26: Network Manager Cost Summary

WOC Costs

	Cost per-unit		Deployment Locations		Cost
WOC	1.5 M€	x	264	=	**396 M€**

Table 27: Wing Operation Centre Cost Summary

6 CBA Model

The embedded CBA model is based on the Single Solution CBA model (s6.2.41) produced by PJ.19-04. It has been adapted to provide results for the stakeholder breakdown used in the PJ.07-03 CBA (e.g. splitting ANSP into civil and military).

s.6.2.41-PJ07-03_v8.
xlsm

6.1 Data sources

Cost Inputs

The sources for the Solution cost data are the relevant PJ.07-03 and PJ.18-01 partners. Cost inputs have been provided based on the Enablers and collated to provide the values in section 5.

Benefit Inputs

The source for the benefit calculation inputs are the 2019 Validation Targets assigned to PJ.07-03 by PJ19.04 [12].

Other Input Parameters

The data sources for the non-Solution specific CBA Model parameters are referenced in the various inputs sheets of the CBA Model with details provided in the sheet 'Source of Reference'. These are part of the Common Assumptions [4].

7 CBA Results

The negative CBA results for this initial V3 CBA reflect that the Solution requires changes to systems across ECAC while the benefits are not easily monetisable.

7.1 Discounted Values

The values in this section are discounted to account for the time value of money[17]. Undiscounted values are shown in section 7.2.

Table 28 shows that the CBA, which is based on the assumptions defined in previous sections, results in a Net Present Value of -367 M€. The NPV is discounted at 8% over the period 2019 to 2040.

There is no payback year as the NPV is negative and the benefits do not offset the costs within the CBA timeframe. This is shown in Figure 6 where the discounted cumulative net benefits line does not cross back over the x-axis.

While this PJ.07-03 initial V3 CBA has a negative NPV it should be remembered that:

- The CBA considers the standalone deployment of PJ.07-03 and does not take into consideration that some of the enablers required for PJ.07-03 are also required to enable other OI steps/Solutions. Therefore, once these shared enablers are deployed in a location then it can be expected that the costs will be less than the sum of the individual CBA solution values. Enablers which are linked with PJ.07-03 and other Solutions[18] include:
    - AIMS-19b (Aeronautical Information system is interfaced to receive and distribute aeronautical information electronically to military systems) which is also needed for #34 (Digital Integrated Briefing)
    - AOC-ATM-15 (Upgrade of Wing Ops System Technical Architecture to provide Military Mission Trajectory Services) which is also needed for #31 (Variable profile military reserved areas and enhanced (further automated) civil-military collaboration)
    - AOC-ATM-20 (Sharing of trajectory data between AOC/WOC and the ATM world using B2B web services) which is also needed for PJ.04-01 (Enhanced Collaborative Airport Performance Planning and Monitoring), PJ.09-01 (Network Prediction and Performance), #18 (CTOT and TTA) and #37 (Extended Flight Plan)
    - MIL-0501 (Specifications for the interoperability of military ground systems with SWIM) and MIL-0502 (Upgrade of military ground systems to allow bi-directional

[17] The time value of money reflects the idea that 1€ received today has more value than 1€ received in 2040 because it could be invested an earn interest over that period.

[18] As several of these Solutions relate to SESAR 1 Solutions, it is likely that a number of these enablers will already be deployed in some locations before the deployment of PJ.07-03; this would reduce the investments needed in those locations. Assumptions on the impact of this can be explored in further V3 CBA activities in Wave 2.

exchanges with non-military IP networks) which are both also needed for #20 (Collaborative NOP for Step 1), #31 (see AOC-ATM-15) and #46 (SWIM Yellow Profile).

 - NIMS-21b (Flight Planning extended with eFPL Distribution service) which is needed for PJ.07-02 (AU Fleet Prioritization and Preferences (UDPP)), PJ.18-02c (eFPL Supporting SBT Transition to RBT) and PJ.09-03 (Collaborative Network Management Functions).

- There was limited potential to explore the Solution's performance (benefits) in the V2 and initial V3 validation exercises. Therefore solution benefits are limited to those validated for PJ.07-03 "Sharing mission trajectory data with NM and ATC via an improved OAT Flight Plan (iOAT FPL)". This was due to the type of validation, which made sense to explore the concept feasibility, not being well adapted to capture performance measurements.

- These results are based on the data available by August 2019 and will be reviewed in V3 (Wave 2) to see if any new data inputs or assumptions should be considered.

Looking at the discounted results of individual stakeholders it is clear that ANSPs (civil and military), NM and the WOC have costs[19] but no monetisable benefits (based on the validation targets). The monetisable benefits are realised by the civil Airspace Users, who have no associated costs for this Solution. Based on the current assumptions and inputs, the expected benefits are insufficient to offset the overall costs.

The sensitivity analysis in section 8 explores these results in more detail to see the impact on the NPV of changing some of the assumptions; although the results remain negative.

2019-2040					
Discounted	NPV (M€)	Costs (discounted)	Benefits (discounted)	Discount rate	Discounted
ANSP (civil)	-211	211	0	8%	
ANSP (military)	-34	34	0	8%	
NM	-17	17	0	8%	
WOC	-173	173	0	8%	
Airspace Users (civil)	68	0	68	8%	
Overall	**-367**	**435**	**68**		

Table 28: Discounted CBA Results (per stakeholder and overall)

Figure 6 shows these discounted values on a year-by-year basis. The Net Benefits are the benefit value per year minus the cost value for that year; these are then shown cumulatively as a line in the figure.

[19] It should be kept in mind that SESAR Solution CBAs focus on the overall CBA results and assumes that relevant stakeholder financing options, e.g. navigation charges recovery mechanism, state funds, etc. will be available, if needed, to support timely deployment.

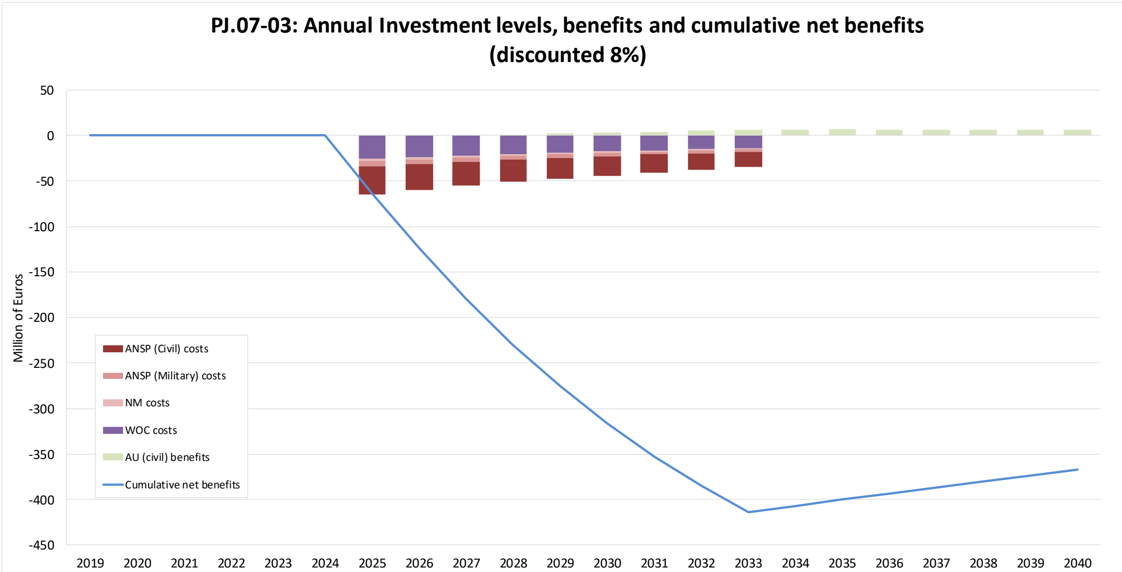

Figure 6: Annual investment levels and benefits (discounted)

7.2 Undiscounted Values

The values shown in this section do not consider the time value of money, so one unit of currency spent or received in any future year is considered to have the same value as one unit of currency spent or received today.

Table 29 shows the undiscounted values, i.e. doing the CBA calculation with a discount rate of 0%.

Undiscounted 2019-2040	Net Benefits (M€)	Costs (undiscounted)	Benefits (undiscounted)
ANSP (civil)	-481	481	0
ANSP (military)	-78	78	0
NM	-40	40	0
WOC	-396	396	0
Airspace Users (civil)	262	0	262
Overall	**-733**	**995**	**262**

Table 29: Undiscounted CBA Results (per stakeholder and overall)

Figure 7 shows the undiscounted costs and benefits over each year. The undiscounted cumulative net benefits line is not included to avoid readers considering any point it crosses the x-axis as the payback year.

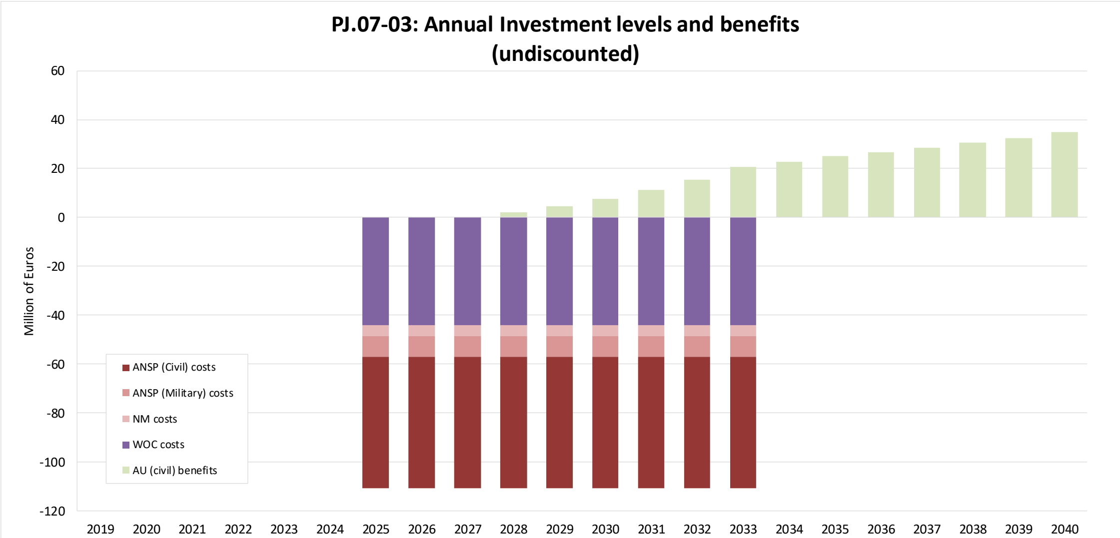

Figure 7: Annual investment levels and benefits (undiscounted)

The undiscounted values are useful, especially for the costs, as they provide an idea of the overall investments that will be required. For example, based on these results, the stakeholders will be required to 'write cheques' totalling 995 M€ to deploy this Solution over the deployment period. The 435 M€ discounted cost value, Table 28, simply reflects the present value of those investments in 2019.

As there are many uncertainties in the assumptions and values used to calculate these CBA results, the following section will explore the impact on the NPV of changing input values.

7.3 Differences from the V2 CBA results

The V2 CBA [14] showed a negative NPV of -792 M€. The key changes between that result and those shown in this document are:

- A reduction in overall costs from 1788 M€ (undiscounted) to 995 M€. Key drivers for this are:
  - A reduction of the ANSP per-unit costs (from 6.2 M€ to 1.9 M€) following a detailed review of the underlying assumptions
  - Use of the lower ANSP per-unit cost for the Integrated CBA locations (value of 4.3 M€ cited for V2 but not used, now 1.3 M€ is used for 78 locations)
- Updated IOC and FOC dates which are more realistic. IOC is now 3 years later than in the V2 CBA [14]; it was 2025 and is now 2028. FOC is now 4 years later; it was 2029 and is now 2033. These changes impact the discounting calculation (e.g. benefits that occur further into the future than previously assumed, will have a lower present value).
- The use of the PJ19.04 Single CBA model [4] which has revised values and traffic forecasts which impact all the calculations including the benefits.

- The scaling of the En-route Airspace Capacity benefits to reflect that they are realised only during peak hours; this reduced the benefit value by around 53 M€ (undiscounted).

8 Sensitivity and risk analysis

This section[20] explores a set of what-ifs to see how sensitive the CBA results are to changes in the input values. The 'base' values, which produce the discounted results in section 7.1, are shown with a green background.

The following sub-sections look at these questions:

- 8.1) What-if we use a lower discount rate?
- 8.2) What-if we use the lower or higher values of the ANSP per-unit cost range?
- 8.3) What-if we use the lower or higher values of the NM cost range?
- 8.4) What-if we change the number of WOC deployments and the per-unit WOC cost?

Each of the what-ifs, except 8.4, is considered separately, i.e. only the mentioned value is changed and all other inputs are set at the 'base' values. In 8.5 the number of units and the per-unit values are adjusted simultaneously.

The sensitivity analysis included below reflects the change of certain values with regard to the 'base' values as shown in section 5.7. Rows coloured green reflect the discounted values from the 'base' situation.

8.1 Discount rate

The discount rate is used to reflect the time value of money[17] so reducing the discount rate reduces the difference between the value of money today and its value in the future.

Table 30 shows that if we use lower discount rates that the NPV will become more negative (as the future costs are discounted less and so have a higher (negative) present value.

Discount Rate	NPV (M€)	
8%	-367	As shown in Table 28
6%	-437	
4%	-519	
2%	-617	
0% (undiscounted)	-733	As shown in Table 29

[20] Risk Analysis has not been performed for this initial V3 CBA and will be addressed in the following V3 phase if an appropriate tool / Excel functionality is available. Risk Analysis uses Monte Carlo simulation techniques to calculate the NPV results for thousands of scenarios where different combinations of the input values (taken from probability distributions) are used in each.

Table 30: Sensitivity Analysis – Discount Rate

8.2 ANSP Per-Unit Costs

Table 31 shows the impact of assuming all deployments can be made with either the lower or higher per-unit ANSP costs. The NPV is relatively insensitive to these changes.

	ANSP per-unit cost (M€)	NPV (M€)
Low range	All Deployment Locations at 1.3 M€ (78 + 200 + 41) x 1.3 M€ = 415 M€	-304
Base	1.3 M€ civil / 1.9 M€ military (78 x 1.3 M€) + (241 x 1.9 M€) = 559 M€	-367
High range	All Deployment Locations at 1.9 M€ (78 + 200 + 41) x 1.9 M€ = 606 M€	-388

Table 31: Sensitivity Analysis – ANSP (Civil) Per-Unit Costs

8.3 NM Costs

Table 32 shows that the CBA is relatively insensitive to the range of NM costs as the NPV does not change significantly.

NM Cost (M€)	NPV (M€)
30	-363
40	-367
50	-372

Table 32: Sensitivity Analysis – NM Costs

8.4 WOC Deployment Locations and Costs

Table 33 includes the WOC investment instances and cost range values (in combination) to show the range of impacts that the current inputs have on the NPV. Excluding the discount rate, these combinations have the largest Solution-related impact on the NPV of the what-ifs considered here.

WOC Investment Instances	WOC Unit Cost (M€)	WOC Costs (Undiscounted) (M€)	NPV (M€)
8 x 44 = 352	2	704	-502

WOC Investment Instances	WOC Unit Cost (M€)	WOC Costs (Undiscounted) (M€)	NPV (M€)
6 x 44 = 264	1.5	396	-367
4 x 44 = 176	1	176	-271

Table 33: Sensitivity Analysis – WOC Investment Instances and Costs

8.5 Sensitivity Comparison

Figure 8 shows the values from the tables above displayed as a tornado diagram. The x-axis value of 0 reflects the 'base' NPV result of -367 M€ and the bars show the size of the increase or decrease in NPV realised by changing the different inputs individually. The values in the bars show the resulting NPV values.

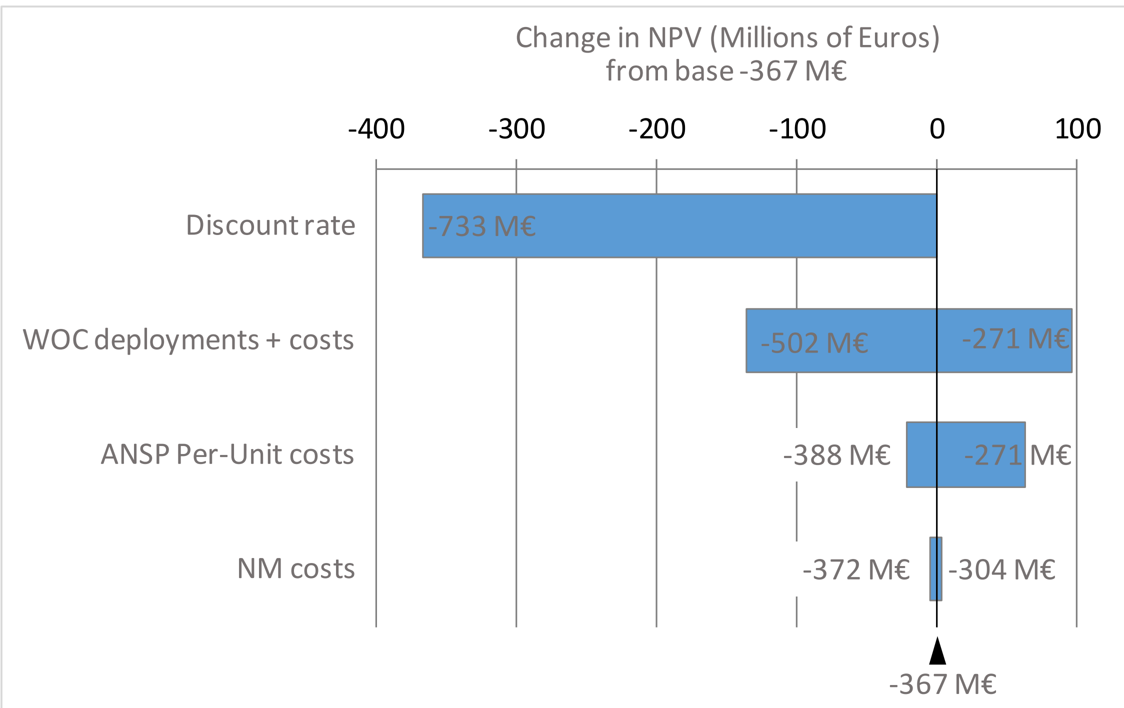

Figure 8: Tornado diagram to compare sensitivity results

Considering these sensitivity results, a key recommendation for further V3 activities is to get better data regarding the number of WOC deployment locations and per-unit costs.

9 Recommendations and next steps

The key recommendations for developing the next iteration of the CBA are to:

- Discuss further with WOC experts and MEPS about the assumptions of a technical WOC set-up, consisting of a central server and a set of clients, to improve the assumptions underlying the number of WOC deployment locations.
- Improve the assumptions underlying the number of ANSP deployment locations and look for more data on the civil/military integrated/co-located/separated aspects.
- Review the cost estimations for all Enablers to increase the associated levels of confidence, ideally more industrial partners will be involved.
- Look into providing ANSP cost ranges per category of Sub-Operating Environment.
- Explore the possibility to monetise some of the military benefits.
- Identify any opportunities to gather additional data from V3 validation exercises in Wave 2 (i.e., PJ.07-W2-40).
- Explore the possibility to monetise benefits related to crises.

The next steps involves planning how and when to put the recommendations into action and will take place during the relevant Wave 2 planning activities.

10 References and Applicable Documents

10.1 Applicable Documents

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

[1] SESAR 2020 Project Handbook

[2] SESAR 23.06.06-D26_04, Guidelines for Producing Benefit and Impact Mechanisms, Edition 03.00.01

[3] SESAR 23.06.06-D26_03, Methods to Assess Costs and Monetise Benefits for CBAs, Edition 00.02.02

10.2 Reference Documents

The following documents were used to provide input / guidance / further information / other:

[4] SESAR 2020, PJ19, D4.0.30 S2020 Common Assumptions (2019), Edition 00.00.02

[5] European ATM Master Plan Portal https://www.atmmasterplan.eu/

[6] SESAR C.02-D110, Updated D02 after MP Campaign, Edition 00.01.00

[7] SESAR 2020 D108, Transition Performance Framework, Edition 00.06.00

[8] SESAR 2020 D86, Guidance on KPIs and Data Collection – Support to SESAR2020 transition

[9] SESAR 23.06.06, D48, SESAR Business Case Example – Remote Tower, Edition 00.01.02

[10] SESAR 2020, PJ20 (WP2.2), En-route and Terminal OEs Dataset, Edition December 2017

[11] SESAR 23.06.06, D68_Part 1, New CBA Model and Methods 2015, Edition 00.01.01

[12] SESAR 2020, D4.8, PJ19: Validation Targets, Edition 2019

[13] SESAR 2020, PJ.07-03 SPR-INTEROP/OSED for initial V3 – Part 1

[14] SESAR 2020, PJ.07-03 Cost Benefit Analysis (CBA) for V2, Edition 00.01.00, July 2018

[15] SESAR 2020, PJ19.04, En-route and Terminal Airspace OEs, Edition April 2019 (Draft)

Appendix A KPA Mapping Overview

Mapping between ATM Master Plan Performance Ambition KPAs and SESAR 2020 Performance Framework KPAs, Focus Areas and KPIs, [7].

ATM Master Plan SESAR Performance Ambition KPA	ATM Master Plan SESAR Performance Ambition KPI	Performance Framework KPA	Focus Area	#KPI / (#PI) / <Design goal>	KPI definition
Cost efficiency	PA1 - 30-40% reduction in ANS costs per flight	Cost efficiency	ANS Cost efficiency	CEF2	Flights per ATCO hour on duty
				CEF3	Technology Cost per flight
Capacity	PA7 - System able to handle 80-100% more traffic	Capacity	Airspace capacity	CAP1	TMA throughput, in challenging airspace, per unit time
				CAP2	En-route throughput, in challenging airspace, per unit time
	PA6 - 5-10% additional flights at congested airports		Airport capacity	CAP3	Peak Runway Throughput (Mixed Mode)
			Capacity resilience	<RES1>	% Loss of airport capacity avoided
				<RES2>	% Loss of airspace capacity avoided
	PA4 - 10-30% reduction in departure delays	Predictability and punctuality	Departure punctuality	PUN1	% of Flights departing (Actual Off-Block Time) within +/- 3 minutes of Scheduled Off-Block Time after accounting for ATM and weather related delay causes
Operational Efficiency	PA5 - Arrival predictability: 2 minute time window for 70% of flights actually arriving at gate		Variance of actual and reference business trajectories	PRD1	Variance of differences between actual and flight plan or Reference Business Trajectory (RBT) durations
	PA2 - 3-6% reduction in flight time	Environment	Fuel efficiency	(FEFF3)	Reduction in average flight duration
	PA3 - 5-10% reduction in fuel burn			FEFF1	Average fuel burn per flight
Environment	PA8 - 5-10% reduction in CO_2 emissions			(FEFF2)	CO_2 Emissions

ATM Master Plan SESAR Performance Ambition KPA	ATM Master Plan SESAR Performance Ambition KPI	Performance Framework KPA	Focus Area	#KPI / (#PI) / <Design goal>	KPI definition
Safety	PA9 - Safety improvement by a factor 3-4	Safety	Accidents/incidents with ATM contribution	<SAF1>	Total number of fatal accidents and incidents
Security	PA10 - No increase in ATM related security incidents resulting in traffic disruptions	Security	Self- Protection of the ATM System / Collaborative Support	(SEC1)	Personnel (safety) risk after mitigation
				(SEC2)	Capacity risk after mitigation
				(SEC3)	Economic risk after mitigation
				(SEC4)	Military mission effectiveness risk after mitigation

Table 34: Mapping between ATM Master Plan Performance Ambition KPAs and SESAR 2020 Performance Framework KPAs, Focus Areas and KPIs

Appendix B OI Step - Enabler - Stakeholder Matrix

Table 35 provides a table showing the links between the OI Steps, Enablers and assigned stakeholders.

To read the table:

- In the OI Step columns a green box with R shows that the enabler in that row is required for the OI Step in that column; an O indicates that the enabler is optional.
- In the stakeholder column a blue box with an X shows that the stakeholder in that column has been assigned that enabler in the Dataset. However, some of the links between enablers and stakeholders, while valid for SESAR 2020 are not applicable for this Solution (i.e. some stakeholders may not need to deploy an Enabler for this Solution but as they do need to deploy it for another Solution then this link is captured in the Dataset). The link between an enabler and a stakeholder identifies that the stakeholder has to invest to deploy the enabler.
- The grey rows at the end of table show the Enablers which are assigned to the Solution OI steps but which the Project does not consider to be relevant.
- The enablers highlighted in green correspond to those relevant for solution **PJ.07-03 "Improved OAT Flight Plan (iOAT FPL) in IFPS and its distribution to concerned ATC units"** (in **bold**, those enablers developed by the SESAR Solution)

Table 37 gives the Enabler Titles separately to make Table 35 more concise. Table 36 expands the stakeholder codes used in Table 35.

OI Steps							ANSP															AO		Airspace Users							NM
AOM-0303	AOM-0304-A	AUO-0210	AUO-0211	AUO-0215	AUO-0228	Enabler Code	ANSP-CIV-AERO	ANSP-CIV-AIS	ANSP-CIV-AMC	ANSP-CIV-APP	ANSP-CIV-ER	ANSP-CIV-MET	ANSP-CIV-SWIM	ANSP-MIL-AERO	ANSP-MIL-AIS	ANSP-MIL-AMC	ANSP-MIL-APP	ANSP-MIL-CNS	ANSP-MIL-ER	ANSP-MIL-MET	ANSP-MIL-SWIM	AP-OPR-CIV	AP-OPR-MIL	AU-CIV-BA-F	AU-CIV-FOC	AU-CIV-GA	AU-CIV-SA	AU-MIL-F	AU-MIL-T	AU-MIL-W	NET-MAN
R						AAMS-10a																									X
R	R					AIMS-19b		X							X										X					X	
R	R	R				**AOC-ATM-14**																								X	
	O					AOC-ATM-15 (PCP)																								X	

OI Steps							ANSP															AO		Airspace Users							NM
AOM-0303	AOM-0304-A	AUO-0210	AUO-0211	AUO-0215	AUO-0228	Enabler Code	ANSP-CIV-AERO	ANSP-CIV-AIS	ANSP-CIV-AMC	ANSP-CIV-APP	ANSP-CIV-ER	ANSP-CIV-MET	ANSP-CIV-SWIM	ANSP-MIL-AERO	ANSP-MIL-AIS	ANSP-MIL-AMC	ANSP-MIL-APP	ANSP-MIL-CNS	ANSP-MIL-ER	ANSP-MIL-MET	ANSP-MIL-SWIM	AP-OPR-CIV	AP-OPR-MIL	AU-CIV-BA-F	AU-CIV-FOC	AU-CIV-GA	AU-CIV-SA	AU-MIL-F	AU-MIL-T	AU-MIL-W	NET-MAN
		R	R		R	AOC-ATM-20 (PCP)																			X					X	
			R			ER APP ATC 82b		X		X	X						X		X												
R	R			R		**ER APP ATC 143**				X	X						X		X												
	R					**ER APP ATC 168**					X								X												
			R			MIL-0103								X			X		X											X	X
		R				MIL-0106																								X	
O	O			R		MIL-0501 (PCP)																								X	
O	R			R		MIL-0502 (PCP)								X			X		X				X							X	
					R	NIMS-21b (PCP)																									X
R	R	R		R		**NIMS-35**																									X
		R	R			NIMS-45																									X
R	R			R		PRO-014																								X	X
R	R					PRO-015	X			X	X			X			X		X												
		R				PRO-076					X																			X	X
			R			PRO-077					X						X		X				X		X					X	X
	R					SWIM-INFR-05a (PCP)	X			X	X		X	X			X		X		X	X	X		X					X	X
	R					SWIM-NET-01a (PCP)	X			X	X	X	X	X			X		X	X	X	X	X		X					X	X

OI Steps							ANSP															AO		Airspace Users							NM
AOM-0303	AOM-0304-A	AUO-0210	AUO-0211	AUO-0215	AUO-0228	Enabler Code	ANSP-CIV-AERO	ANSP-CIV-AIS	ANSP-CIV-AMC	ANSP-CIV-APP	ANSP-CIV-ER	ANSP-CIV-MET	ANSP-CIV-SWIM	ANSP-MIL-AERO	ANSP-MIL-AIS	ANSP-MIL-AMC	ANSP-MIL-APP	ANSP-MIL-CNS	ANSP-MIL-ER	ANSP-MIL-MET	ANSP-MIL-SWIM	AP-OPR-CIV	AP-OPR-MIL	AU-CIV-BA-F	AU-CIV-FOC	AU-CIV-GA	AU-CIV-SA	AU-MIL-F	AU-MIL-T	AU-MIL-W	NET-MAN
R						A/C-72																						X	X		
R	R					AIMS-06 (PCP-Pre)		X	X	X	X				X	X	X		X												X
R	R			R		**MIL-STD-03**																			X					X	
R						**MIL-STD-04**	X			X	X			X			X		X												X
	R					CTE-C06d												X													
				R		ER APP ATC 82				X	X																				
					R	METEO-06b (PCP)						X																			
	R					SWIM-APS-01a (PCP)		X							X							X	X								X
	R					SWIM-APS-02a (PCP)	X			X	X			X			X		X			X	X		X					X	X
	R					SWIM-APS-03a (PCP)																									X
	R					SWIM-APS-04a (PCP)	X			X	X			X			X		X			X	X		X					X	
	O					SWIM-SUPT-01a (PCP)							X								X										X
	O					SWIM-SUPT-03a (PCP)							X								X										X
	O					SWIM-SUPT-05a	X			X	X		X	X			X		X		X	X	X		X					X	X

Table 35: OI Step, Enabler and Stakeholder Overview

EN code	Enabler Title
AAMS-10a	Initial airspace management system enhanced with commonly applied GAT/OAT handling
AIMS-19b	Aeronautical Information system is interfaced to receive and distribute aeronautical information electronically to military systems.
AOC-ATM-14	Upgrade of WOC system to handle improved OAT flight plans
AOC-ATM-15 (PCP)	Upgrade of Wing Ops System Technical Architecture to provide Military Mission Trajectory Services
AOC-ATM-20 (PCP)	Sharing of trajectory data between AOC/WOC and the ATM world using B2B web services
ER APP ATC 143	Upgrade of ATC System to handle Improved OAT Flight Plan
ER APP ATC 82b	Enhance FDP to process iSMT/iRMT
ER APP ATC 238	Enable ATC System to manage improved OAT flight plans with inherent ARES information (reservation restrictions) in accordance with VPA design principle.
MIL-0103	Wing Operations Centre Mission Support System (including update/revision) of iMT
MIL-0106	Wing Operations Centre Mission Support System enhanced to support the CDM process
MIL-0501 (PCP)	Specifications for the interoperability of military ground systems with SWIM
MIL-0502 (PCP)	Upgrade of military ground systems to allow bi-directional exchanges with non-military IP networks
MIL-STD-03	Update of IFPS User Manual to include OAT Specificities in the Flight Plan (Improved OAT flight plan)
MIL-STD-04	Procedure to implement EUROAT rules. (No cost by our Solution, already implemented in17 States)
NIMS-21b (PCP)	Flight Planning management enhanced to support 4D
NIMS-35	Flight Planning management sub-system enhanced to process improved OAT flight plans
NIMS-45	Initial Flight Planning management enhanced to support initial Mission Trajectory
PRO-014	Procedures harmonised at pan-European level for the management of the Improved OAT FPL (flight plan filing, validation, acceptance and distribution)
PRO-015	Harmonised ATC Procedures for providing a standardized service to OAT flights at pan-European level
PRO-076	Procedures for the iSMT in the CDM process
PRO-077	Procedures facilitating iRMT management
SWIM-INFR-05a (PCP)	General SWIM Services infrastructure Support and Connectivity.
SWIM-NET-01a (PCP)	SWIM Network Point of Presence

Table 36: Enabler Codes and Titles

STAKEHOLDER CODE	STAKEHOLDER TITLE
ANSP	Air Navigation Service Provider
ANSP-CIV-AERO	Civil ATS Aerodrome Service Provider
ANSP-CIV-AIS	Civil AIS Service Provider
ANSP-CIV-AMC	Civil-Military Airspace Management Cell (civil side)
ANSP-CIV-APP	Civil ATS Approach Service Provider
ANSP-CIV-CNS	Civil CNS Service Provider
ANSP-CIV-ER	Civil ATS En-route Service Provider
ANSP-CIV-MET	Civil MET Service Provider
ANSP-CIV-SWIM	Civil SWIM Service Provider
ANSP-MIL-AERO	Military ATS Aerodrome Service Provider
ANSP-MIL-AIS	Military AIS Service Provider
ANSP-MIL-AMC	Civil-Military Airspace Management Cell (military side)
ANSP-MIL-APP	Military ATS Approach Service Provider
ANSP-MIL-CNS	Military CNS Service Provider
ANSP-MIL-ER	Military ATS En-route Service Provider
ANSP-MIL-MET	Military MET Service Provider
ANSP-MIL-SWIM	Military SWIM Service Provider
AO	Airport Operator
AP-OPR-CIV	Civil APT operator
AP-OPR-MIL	Military APT operator
AU	Airspace Users
AU-CIV-BA-F	Civil Business Aviation-Fixed Wing
AU-CIV-BA-R	Civil Business Aviation-Rotorcraft
AU-CIV-FOC	Civil Flight Operations Centre
AU-CIV-GA	Civil General Aviation
AU-CIV-SA	Civil Scheduled Aviation
AU-MIL-F	Military Fighter
AU-MIL-L	Military Light Aircraft
AU-MIL-T	Military Transport
AU-MIL-W	Military Wing Operations Centre
NET-MAN	Network Manager

Table 37: Stakeholder Codes and Titles

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