SESAR PJ.07-W2- 39: COST BENEFIT ANALYSIS (CBA) FOR V3

Deliverable ID:	D3.1.011
Dissemination Level:	PU
Project Acronym:	PJ.07-S39
Grant:	874465
Call:	H2020-SESAR-2019-1
Topic:	SESAR-IR-VLD-WAVE2-06-2019
Consortium coordinator:	EUROCONTROL
Edition date:	11 May 2023
Edition:	01.01.03
Template Edition:	02.00.06

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Authoring & Approval

Authors of the document

Beneficiary	Date
EUROCONTROL	11 May 2023

Reviewers internal to the project

Beneficiary	Date
EUROCONTROL	28 February 2023
AIRBUS	1 March 2023
SKYGUIDE	2 March 2023

Reviewers external to the project

Beneficiary	Date

Approved for submission to the S3JU By - Representatives of all beneficiaries involved in the project

Beneficiary	Date

Rejected By - Representatives of beneficiaries involved in the project

Beneficiary	Date

Document History

Edition	Date	Status	Beneficiary	Justification
01.01.01	16 March 2023	Draft	EUROCONTROL	First draft of the document
01.01.02	6 March 2023	Submission to SJU	EUROCONTROL	For SJU
01.01.03	11 May 2023	Final	EUROCONTROL	SJU's comments addressed

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Copyright Statement © 2023 – EUROCONTROL, AIRBUS, CRIDA/ENAIRE, DSNA, METRON AVIATION, SKYGUIDE, THALES. All rights reserved. Licensed to SESAR3 Joint Undertaking under conditions.

PJ.07-S39

PJ07-W2 OAUO OPTIMISED AIRSPACE USERS OPERATIONS

This report is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874465 under European Union's Horizon 2020 research and innovation programme.

Abstract

This document provides the V3 Cost Benefit Analysis (CBA) results based on an ECAC-level view of the deployment of SESAR Project PJ.07-W2-S39 Collaborative framework for managing arrival delay within an ATFM regulation. It looks into the deployment of this Solution's main OI step (AUO-0210 Collaborative framework for managing arrival constraints at Local DCB level) through assessment of the expected cost associated to this deployment for the key stakeholders involved, as well as its expected impacts at the ECAC level in terms of achievement of KPIs set-out in the SESAR Performance Framework.

Table of Contents

EUROPEAN PARTNERSHIP

Co-funded by the European Union

List of Tables

EUROPEAN PARTNERSHIP

Co-funded by the European Union

List of Figures

1 Executive Summary

This document provides **V3 Cost Benefit Analysis (CBA) results based on an ECAC-level view of the deployment of SESAR Solution PJ.07-W2-S39.** Its aim is to provide a view on the costs and benefits of deploying PJ.07-W2-S39 at the ECAC level for all stakeholders involved, as well as to show the expected outcomes form the Solution deployment in monetary terms.

PJ.07-W2-39 Collaborative framework for managing arrival delay within an ATFM regulation introduces a framework for single point of entry for Airspace Users (AU) to provide User Driven Prioritisation Process (UDPP) in a harmonised format that will allow the Network Manager to use these prioritisations for arrival Air Traffic Flow Management (ATFM) regulations. This Solution greatly extends the ability of an AU to influence the sequence of arrivals for regulated flights in the pre-departure phase. The key benefit will be the reduction of costs to AU operations by minimising the operational and therefore financial impact of delay.

The Operational Improvement (OI) step linked to this Solution is **AUO-0110: Collaborative framework for managing arrival constraints at Local DCB level.**

The Solution is expected to generate benefits for Airspace Users by allowing for an integrated and collaborative approach to the coordination and resolution of constraints limited to arrivals management, ensuring a continued stability and performance of the network. Furthermore, it will also provide the AUs with the possibility to prioritise their flights and consequently reduce the impact from the delays generated by ATFM planning constraints on their operations. Thus, the two **Key Performance Indicators (KPIs) that were monetised in this CBA** and as identified by the Solution partners in previous stages are:

- **PUN1 – Punctuality:** the Solution is expected to reduce the reactionary ATFM delay for the subsequent rotations in pre-departure phase of a flight by involving the AUs in Capacity Constraint Situation (CCS) resolution, allowing them to prioritise the most critical flights and thus reducing the overall delay.
- **UC3 – Airspace User Cost Efficiency:** the involvement of AUs in the resolution of a CCS by using UDPP mechanisms would help manage the reactionary delay, and thus help the AU manage the subsequent aircraft rotations and associated passenger connections and curfew infringements.

Regarding the deployment of the Solution that was considered for the scope of this CBA, it is expected that **it will be deployed in large and very large airports in ECAC** (a total of 32) **by their main carriers** (it was assumed for this CBA that one hub carrier per airport will be deploying PJ.07-W2-39). These AUs' Flight Operations Centres are expected to make the necessary changes/updates to benefit from the system, which would require some investments on the AUs side.

Furthermore, the **Network Manager is expected to be involved in the development and implementation of the system** to allow the operations within the scope of PJ.07-W2-39. This system is then assumed to be made available to all the concerned Air Navigation Service Providers (ANSPs) / Area Control Centres (ACCs) that will use the system without requiring any additional investments on their side.

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Regarding the timeline of the CBA, the start of deployment is expected in 2027, end of deployment and full operational capability in 2033, with the ramp up of benefits starting to be generated as of 2027.

Based on these assumptions, the CBA model was run to provide the following results:

- **Net Present Value** (NPV) for the period 2023-2043 (discounted at 8%): **316 €M.** This corresponds to undiscounted net benefits of 993 €M for the same period.
- The **payback period is of 1 year**, with benefits overcoming the costs as of 2027.

The main limitations to this CBA are linked to its main uncertainties, which are two-fold:

- On the one hand, there is a degree of uncertainty about the number of deployment locations: it was assumed that one major AU per in-scope airport will be deploying the Solution, resulting in 32 airlines investing, however, it is possible that more or fewer AUs will invest.
- On the other hand, there is the per-unit deployment cost for the AUs: it is expected that each Airspace User Flight Operations Centre will invest € 500,000 to implement the Solution, however, the real cost may vary according to the specific conditions of each AU.

A sensitivity analysis was conducted on these parameters to account for these uncertainties, which showed that **a larger number of Airspace Users deploying the Solution can result in a decrease of about 3% in the net benefit,** meaning that the costs from such an increase are higher than the corresponding benefits and thus, the extension of the scope of deployment needs to be carefully assessed beforehand.

Given all the above, two main recommendations can be made. First of all, considering the largely positive outcome from this CBA, PJ.07-W2-39 is considered interesting to deploy in the selected airports, and a wider scope of deployment (i.e. beyond the hub airlines) can be envisaged pending a careful consideration of the underlying conditions and possible deployment efficiencies. Secondly, it is recommended to assess the systems currently in place by both the ANSPs and the AUs that could be used in the Solution implementation, to understand whether there could be some cost savings in this regard.

2 Introduction

2.1 Purpose of the document

This document provides V3 Cost Benefit Analysis (CBA) results based on an ECAC-level view of the deployment of SESAR Project PJ.07-W2-S39.

The aim of this document is to provide a view on the costs and benefits of deploying PJ.07-W2-S39 at the ECAC level for all stakeholders involved, as well as to show the expected outcomes form the Solution deployment in monetary terms.

2.2 Scope

This document provides the Cost-Benefit Analysis related to SESAR Solution PJ.07-W2-39 at V3. The CBA looks into the impacts of the deployment of this Solution at the ECAC level by the stakeholders involved (i.e. Airspace Users, Airports, ANSPs and Network Manager (NM)).

The analysis is performed over a period of 20 years, starting from 2023 and until 2043.

2.3 Intended readership

The intended audience of this document is:

- PJ.07-W2 Members – Optimised Airspace User Operations
- Airspace Users involved in PJ.07-W2
- PJ.19 as the Content Integration Project
- PJ.04-W2 Total Airport Management
- SESAR Joint Undertaking / SESAR Programme Management
- PJ.20 as Master Plan Maintenance project

2.4 Structure of the document

Chapter 1 – Executive summary.

Chapter 2 – Introduction provides introductory information about the present document, such as its scope, purpose, as well as a list of relevant terms and abbreviations.

Chapter 3 – Objectives and scope of the CBA introduces the key information about the Solution and the Cost-Benefit Analysis performed, including the description of the Solution, the objective of the CBA, its main assumptions, stakeholders affected, etc.

Chapter 4 – Benefits provides a detailed description of the benefits that are considered in the CBA as resulting from the implementation of the Solution.

Chapter 5 – Cost assessment provides an overview of the costs associated to the deployment of the Solution, as well as the main assumptions taken in this regard.

Chapter 6 – CBA Model includes an attachment to the CBA model and the relevant sources used.

Chapter 7 – CBA Results provides an analysis of the results of the CBA in terms of expected costs, benefits and Net Present Value (NPV).

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Chapter 8 – Sensitivity and risk analysis provides an assessment of the results of the sensitivity scenario that was run on the CBA model to assess the changes in key parameters.

Chapter 9 – Recommendations and next steps provides the main conclusions and recommendations that arise from the analysis of the CBA results.

Chapter 10 – References and Applicable Documents provides a list of the key documents used for the elaboration of this report.

Appendix A – Mapping of ATM Master Plan and SESAR KPAs provides a brief overview of the main KPAs and KPIs that are referred to throughout this report and assessed in the CBA.

2.5 Background

In SESAR 1 and S2020 Wave 1, different approaches and Use Cases for the management of arrival constraints have been defined and validated using specific local tools.

SESAR 1 Solution #18 "Calculated Take-off Time (CTOT) and Target Time of Arrival (TTA)" validated the concept of Target Time Management in the planning phase from a Network perspective for arrival traffic allowing provision for AU interactions.

SESAR 1 Solutions #20 "Initial Collaborative Network Operations Plan (NOP)" and #21 "Airport Operations Plan (AOP) and its seamless integration with the Network Operations Plan (NOP)", validated the process for local Demand Capacity Balancing (DCB) actors to collaborate with the Network in the TTA allocation process.

Wave 1 PJ24 Very Large Demonstration (VLD) Exercises at Barcelona, Palma de Majorca and Heathrow airports addressed the hotspot resolution (local DCB issues) based on TTAs proposed for arriving flights (in pre-flight phase) by local DCB tools and applying local business/operational rules. The Target Times (TTs) were defined at local (airport) level and shared with the Network Manager via the AOP connected to the NOP. Some limited provision was defined for AU integration, but an active AU participation as described within UDPP concept was not integrated in the local processes.

Wave 1 PJ25 shadow mode Exercise at Zurich Airport addressed the hotspot resolution through the local (Flow Management Position (FMP) and AU) management of arrival regulations, for building an optimized sequence based on airlines' priorities. A limited part of UDPP was integrated in the local process.

These exercises provided a very initial demonstration of how TTAs and AUs flights' prioritisation could be combined.

The collaborative framework builds on these past activities and aims at:

- Reconciling and standardising local initiatives developed for managing arrival delay constraints.
- Providing AUs with a single harmonized entry point through NM to manage their priorities.
- Supporting further integration of Network/Airport processes.
- Addressing remaining issues and gaps identified by SESAR Wave 1.

EUROPEAN PARTNERSHIP

Co-funded by the European Union

2.6 Glossary of terms

Term	Definition	Source of the definition
ATM Master Plan	The European ATM Master Plan is the agreed roadmap to bring ATM R&I to the deployment phase, introducing the agreed vision for the future European ATM system. It provides the main direction and principles for SESAR R&I, as well as the deployment planning and an implementation view with agreed deployment objectives. Through the SESAR Key Features, the ATM Master Plan identifies the Essential Operational Changes (both Essential Operational Changes featured in the Pilot Common Project and New Essential Operational Changes) and key R&I activities that support the identified performance ambition. The ATM Master Plan is updated on a regular basis in collaboration and consultation with the entire ATM community. Amendments are submitted to the S3JU Administrative Board for adoption. The content of the European ATM Master Plan is structured in three levels (Level 1 – Executive View, Level 2 – Planning and Architecture View, and Level 3 – Implementation View) to allow stakeholders to access the information at the level of detail that is most relevant to their area of interest. The intended readership for Level 1 is executive-level stakeholders. Levels 2 and 3 of the ATM Master Plan provide more detail on the operational changes and related elements and therefore the target audience is expert-level stakeholders.	SESAR2020 Project Handbook, European ATM Master Plan (9 Edition)
Cost-Benefit Analysis	A Cost-Benefit Analysis is a process for quantifying in economic terms the costs and benefits of a project or a programme over a certain period, and those of its alternatives (within the same period), in order to have a single scale of comparison for unbiased evaluation. This process helps decision-makers to compare an investment with other possible investments and/or to make a choice between different options / scenarios and to select the one that offers the best value for money while considering all the key criteria affecting the decision.	PAGAR
Deployment Scenario	Set of SESAR Solutions selected to satisfy the specific Performance Needs of operating environments in the European ATM System and based on the timescales in which their performance contribution is needed in the respective operating environments.	PAGAR
Key Performance Area	A way of categorising performance subjects related to high level ambitions and expectations. ICAO Global ATM Concept sets out these expectations in general terms for each of the 11 ICAO defined KPAs.	EUROCONTROL ATM Lexicon

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Term	Definition	Source of the definition
Key Performance Indicator	Current/past performance expected future performance (estimated as part of forecasting and performance modelling), as well as actual progress in achieving performance objectives is quantitatively expressed by means of indicators (sometimes called Key Performance Indicators, or KPIs). To be relevant, indicators need to correctly express the intention of the associated performance objective. Since indicators support objectives, they should not be defined without having a specific performance objective in mind. Indicators are not often directly measured. They are calculated from supporting metrics according to clearly defined formulas, e.g., cost-per-flight-indicator = Sum (cost)/Sum (flights). Performance measurement is therefore carried out through the collection of data for the supporting metrics." In SESAR2020 Performance Framework, Key Performance Indicators are those that have a validation target associated derived from the corresponding Performance Ambition.	ICAO Doc 9883 Performance Framework
Large airport	An airport with an annual number of IFR movements ranging between 150,000 and 250,000.	EUROCONTROL Standard Inputs for Economic Analyses
Net Present Value	Net Present Value (NPV) is the sum of all discounted cash inflows and outflows during the time horizon period.	*Investopedia*
Operational Environment (OE)	An environment with a consistent type of flight operations.	EUROCONTROL ATM Lexicon
Performance assessment	This term relates to the quantitative estimate of the potential performance benefit of an operational improvement based on outputs from validation projects, collected and analysed by PJ19.04.02	ICAO Doc 9883 updated in PAGAR
SESAR ATM Solution	SESAR Solutions relate to either an Operational Improvement (OI) step or a group of OI steps with associated Enablers (technical system, procedure, or human), which have been designed, developed and validated in response to specific Validation Targets and that are expected deliver operational and/or performance improvements to European ATM, when translated into their effective realisation. SESAR Technological Solutions relate to verified technologies proven to be feasible and profitable, which may therefore be considered to enable future SESAR Solutions.	SESAR2020 Project Handbook
SESAR Programme	The programme which defines the Research and Development activities and Projects for the S3JU.	EUROCONTROL ATM Lexicon
SESAR Solution	A term used when referring to both SESAR ATM Solution and SESAR Technological Solution.	SESAR2020 Project Handbook

Term	Definition	Source of the definition
SESAR2020	The Programme for SESAR2020 was created with a clear and agreed need for continuing research and innovation in ATM beyond the SESAR 1 development phase. SESAR2020 is structured into three main research phases, starting with Exploratory Research, which is then further expanded within a Public-Private-Partnership (PPP) to conduct Industrial Research and Validation. Finally, it further exploits the benefits of the PPP in Demonstrating at Large Scale the concepts and technologies in representative environments to firmly establish the performance benefits and risks.	Performance Framework 2017
Single European Sky-High Level Goals	The SES High Level Goals are political targets set by the European Commission. Their scope is the full ATM performance outcome resulting from the combined implementation of the SES pillars and instruments, as well as industry developments not driven directly by the EU.	SESAR2020 Project Handbook
Sub-OE	A subcategory of an Operating environment, classified according to its complexity (e.g., high complexity TMA, medium complexity TMA, low complexity TMA).	EUROCONTROL ATM Lexicon
Very large airport	An airport with an annual number of IFR movements above 250,000	EUROCONTROL Standard Inputs for Economic Analyses

Table 1: Glossary of terms

EUROPEAN PARTNERSHIP

Co-funded by the European Union

2.7 List of Acronyms

Acronym	Definition
ACC	Area Control Centre
ADES	Aerodrome of Destination
ANSP	Air Navigation Service Provider
AOP	Airport Operations Plan
ATFCM	Air Traffic Flow and Capacity Management
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
AU	Airspace User
CAPEX	Capital Expenditure
CASA	Computer-Assisted Slot Allocation
CBA	Cost-Benefit Analysis
CCS	Capacity Constrained Situation
CDM	Collaborative Decision-Making
CTOT	Calculated Take-Off Time
DCB	Demand Capacity Balancing
ECAC	European Civil Aviation Conference
FMP	Flow Management Position
FOC	Full Operational Capability
HC	High complexity (airport)
IOC	Initial Operational Capability
KPA	Key Performance Area
KPI	Key Performance Indicator
LC	Low complexity (airport)
NM	Network Manager
NOP	Network Operations Plan
NPV	Net Present Value
OI	Operational Improvement
OPEX	Operating Expenditure
PAR	Performance Assessment Report
PJ	Project
S3JU	SESAR3 Joint Undertaking (Agency of the European Commission)
SESAR	Single European Sky ATM Research Programme
S2020	SESAR 2020
TMA	Terminal Manoeuvring Area

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Acronym	Definition
TTA	Target Time of Arrival
UDPP	User Driven Prioritisation Process
VLD	Very Large Demonstration

Table 2: List of acronyms

EUROPEAN PARTNERSHIP
Co-funded by the European Union

3 Objectives and scope of the CBA

3.1 Problem addressed by the solution

Today, the arrival constraint management does not take into consideration the Airspace User preferences in terms of flights that are more or less critical to arrive on time. This, in turn, can result in additional costs for Airspace Users related, for example, to passenger compensation, resolution of missed critical connections, among many others.

Furthermore, and as mentioned in the OSED [13], there is an evident need for harmonisation at the European level of arrival prioritisation processes in pre-flight phase, where the AUs nowadays need to work with different interfaces when managing their priorities.

PJ.07-W2-39 aims at helping to address these points by providing a platform for a more integrated approach to coordination of constraints, where the conditions of all stakeholders involved will be taken into consideration and the Airspace Users will be able to provide their preferences in terms of prioritisation of certain flights.

3.2 SESAR Solution description

PJ.07-W2-39 introduces a framework for single point of entry for AUs to provide UDPP prioritisation in a harmonised format that will allow the Network Manager to use this prioritisation for arrival ATFM regulations. This Solution greatly extends the ability of an AU to influence the sequence of arrivals for regulated flights in the pre-departure phase. The key benefit will be the reduction of costs to AU operations by minimising the operational and therefore financial impact of delay.

The Solution's main objective is to **define and validate a Collaborative framework for the coordination and collaboration between different ATFM processes (including the so-called User Driven Prioritisation Process - UDPP), dealing with delay constraints on arrivals** (considered the most important contributor to capacity performance issues).

This Solution

- Addresses the need for harmonization at European level of arrival prioritisation processes (managed by Local DCB) in pre-flight phase, which aims to overcome the problem of AUs dealing with different interfaces to Network and local processes for the management of their priorities.
- Focuses on more integrated Network/Airport processes, beyond the current AOP/NOP integration that relies on simple data exchange.

For these reasons, it can be considered as a unique opportunity to close the gap for processes and tools, and to address the areas of improvement identified by AUs in the frame of S2020 Wave 1 activities.

Expected benefits include an improved coherency between the different processes, and an enhanced predictability by common usage of the most up-to-date flight data by all users.

In Wave 1, the integration with local DCB processes has been addressed in limited scopes (VLDs at given Airports). Thus, a number of raised questions need to be further investigated. This Solution addresses a more complete integration in Wave 2, structured on the following approach:

EUROPEAN PARTNERSHIP

Co-funded by the European Union

- Arrival framework integrating UDPP with ATFM regulations managed by CASA and applying the FPFS principle. The reconciliation of the arrival constraints resolution between the Network Management Function and the FMP/AUs local processes are addressed through the following:
  - Integration of ATFCM CASA regulations with UDPP for the calculation, updating and passing of arrival constraints to flights.
  - NM validation and, if necessary, application of Local DCB (FMP) management proposals during pre-flight phase.

The OI steps associated to this Solution

AUO-0110: Collaborative framework for managing arrival constraints at Local DCB level

In case of Target Times (Arrival) generated by local DCB processes overlaying network constraints in pre-flight phase, collaborative recovery procedures and associated predictive and decision support tools are required, for ensuring reconciliation of local DCB measures with airport Collaborative Decision-Making (CDM) and network management process. These procedures may include the allocation of CASA regulations or arrival flights' management tools combined with the UDPP into the overall reconciliation process, also in case of multiple constraints. Expected benefits would include coherency between the different processes, enhanced predictability from common usage of most up-to-date flight data by all users, and reduced impact of delays on Airspace Users operations.

Rationale

- Need for new collaborative operational procedures between ANSP, AU, Airport, and Network to manage local DCB issues at arrival (in pre-flight phase), minimizing the risk of imposing multiple penalties to Airspace Users or increased workload for FMPs.
- Better management of disruptions by increasing flexibility (integration of AU priorities via UDPP and speeding up of the recovery to normal operations).
- More automated tools and reduction of the 'Human-In-the-Loop' for the collaborative processes are also expected to evaluate the proposed UDPP solution, and its impact on the overall operational performance (AUs, Airports and Network effect).

The following table provides an overview of the Solution in terms of OI Steps and related Enablers.

SESAR Solution ID	OI Steps ref.	OI Steps definition	OI step coverage	Source reference
PJ.07-W2-39 Collaborative framework managing delay constraints on arrivals	AUO-0110	Collaborative framework for managing arrival constraints at Local DCB level	Fully	SPR-INTEROP/OSED reference D3.1.008

Table 3: PJ.07-W2-S39 Scope and related OI steps

EUROPEAN PARTNERSHIP
Co-funded by the European Union

OI Steps ref.	Enabler[1] ref.	Enabler definition	Applicable stakeholder	Source reference
AUO-0110	AOC-ATM-18 (R)	Flight Operations Centre adaptation to support UDPP	Airspace User - Civil Flight Operations Centre	SPR-INTEROP/OSED reference D3.1.008 EATMA
AUO-0110	NIMS-44 (R)	Evolution of NIMS to support management of UDPP, inclusion of user preferences and priority as part of SBT	Airspace User - Civil Flight Operations Centre Network Manager	SPR-INTEROP/OSED reference D3.1.008 EATMA
AUO-0110	NIMS-46 (R)	Integrated local DCB working position	ANSP Airport Operator Network Manager	SPR-INTEROP/OSED reference D3.1.008 EATMA
AUO-0110	NIMS-46b (R)	Interface to the integrated local DCB working position	ANSP Network Manager	SPR-INTEROP/OSED reference D3.1.008 EATMA

Table 4: OI steps and related Enablers

According to the information available on eATM Portal, all enablers except NIMS-46 are to be developed by PJ.07-W2-39. NIMS-46 is an enabler that is meant to be only used by PJ.07-W2-39 and is developed under PJ.04-W2-44.

3.3 Objectives of the CBA

The aim of the V3 CBA is to provide an assessment of the economic interest of the deployment of PJ.07-W2-39 at the ECAC level. In order to achieve this, the CBA will monetise the costs underlying the deployment of the solution, as well as its benefits, to assess whether the latter ones exceed the former ones. This is done by the analysis of the NPV of the investment over the defined timeline. If the NPV is positive, then the Solution deployment is expected to generate greater benefits than its costs.

The NPV is calculated overall for the Solution, as well as for each stakeholder group, to allow for a more detailed analysis. Furthermore, a sensitivity analysis is performed to account for fluctuations in the main underlying conditions.

Please note that the CBA provides results at ECAC-level and therefore, it does not provide sufficient detail to support individual deployment decisions that must take into account the local environment/situation (e.g. current operational systems, their lifespan(s), replacement timing, etc.

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

EUROPEAN PARTNERSHIP
Co-funded by the European Union

3.4 Stakeholders[1] identification

The table below provides an overview of the stakeholders impacted by the Solution, as well as an overview of their corresponding impacts, involvement in the CBA analysis and the quantitative of results available in the CBA.

Stakeholder	The type of stakeholder and/or applicable sub-OE	Type of Impact	Involvement in the analysis	Quantitative results available in the current CBA version
ANSP	ACCs	No expected costs, since the stakeholder will benefit from the system put in place by NM Benefit from continuous stability and performance of the network	Provided feedback on the costs and assumptions	No quantified impact
Airport Operators	Not impacted	Not impacted	Not impacted	Not impacted
Network Manager	Regional ATFCM current environment	Investment in the system deployment No specific benefits expected	No direct involvement at the stage of building of the CBA.	Costs monetised in the model
Scheduled Airlines (Mainline and Regional)	Airline Operation System environment	Investment in the system deployment Benefit from more tailored flight prioritisation, resulting in increased punctuality and lower costs	No direct involvement at the stage of building of the CBA.	Both costs and benefits monetised in the model
Business Aviation	Not impacted	Not impacted	Not impacted	Not impacted

[1] 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.

Co-funded by the European Union

Rotorcraft	Not impacted	Not impacted	Not impacted	Not impacted
General Aviation IFR	Not impacted	Not impacted	Not impacted	Not impacted
General Aviation VFR	Not impacted	Not impacted	Not impacted	Not impacted
Military – Airborne	Not impacted	Not impacted	Not impacted	Not impacted
Military – Ground	Not impacted	Not impacted	Not impacted	Not impacted
Other impacted stakeholders (ground handling, weather forecast service provider, NSA….)	Not impacted	Not impacted	Not impacted	Not impacted

Table 5: SESAR PJ.07-W2-S39 CBA Stakeholders and impacts

EUROPEAN PARTNERSHIP

Co-funded by the European Union

3.5 CBA Scenarios and Assumptions

This CBA considers the deployment of Solution PJ.07-W2-S39. This means that the full costs for the enablers are included in the CBA even if they will also enable other Solutions. In addition, the starting assumption for the CBA is that the Solution OI Steps are considered to be deployed in each relevant deployment location.

The CBA Solution Scenario (green box in Figure 1) considers the situation where the Solution OI Steps are being deployed at relevant locations across ECAC. The CBA Reference Scenario (orange box in Figure 1) describes the same future situation but where the Solution is not being deployed. The CBA reflects the delta (difference) between the CBA Reference and Solution Scenarios (i.e. between the orange and green boxes in Figure 1).

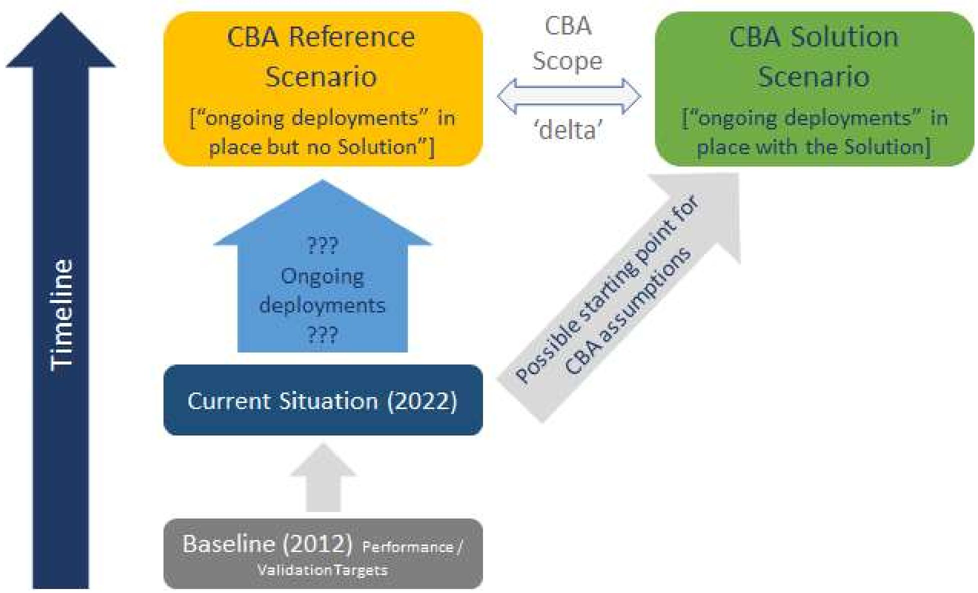

Figure 1: CBA Scenario Overview

3.5.1 Reference Scenario

The CBA reference scenario represents the expected situation in the operational, geographical and time scope of the study, without the implementation of the Solution. In the case of PJ.07-W2-39, the Solution is expected to be deployable and operational in the current operating environment and procedures, not requiring any specific pre-requisites for its implementation (i.e. other than the implementation of the necessary enablers).

Please refer to section 3.4 of PJ.07-W2-39 SPR-INTEROP/OSED for V3 Part V[12] for detailed information on the relationships between PJ.07-W2-S39 and other solutions.

3.5.2 Solution Scenario

The CBA Solution Scenario considers deployment of the relevant enablers by the stakeholders at the ECAC level, as described in section 3.2. In terms of deployment scope, the Solution is expected to be implemented in large and very large airports.

EUROPEAN PARTNERSHIP
Co-funded by the European Union

As specified in the Solution SPR-INTEROP/OSED reference report (D3.1.008), the majority of functionalities used by the solution rely on the current ATFCM operations manual and can be implemented in the current environment and in the SESAR 2020 environment. The implementation of the different enablers is expected to entail the following:

- ***AOC-ATM-18:*** development of a system supporting UDPP integrated within Flight Operations Centre systems to support Airspace Users' prioritisation processes in collaboration with the other ATM stakeholders.
    - **Stakeholders affected:** Airspace Users Flight Operations Centres
- ***NIMS-44:*** development of a system supporting UDPP integrated with DCB systems to consider airspace user's preferences and priorities in the DCB activity, in particular 'Flight Priority within Fleet/Operator Priority'.
    - **Stakeholders affected:** Airspace Users Flight Operations Centres; Network Manager
- ***NIMS-46:*** integrated local DCB working position with improved situation awareness need to be developed for better identification and integration of local measures (including the link to ATC and Airports) and the interface with regional NM for coordinated 4D constraints management.
    - **Stakeholders affected:** Air Navigation Service Providers, Airport Operators, Network Manager
- ***NIMS-46b*:** an interface to the Integrated local DCB working position with improved situation awareness for better identification and integration of local measures (including the link to airports and airlines). The Integrated Local DCB working position is to be developed by NIMS-46; this Enabler therefore provides the interface to the said working position.
    - **Stakeholders affected:** Air Navigation Service Providers, Network Manager

The Solution will build on existing operating methods for resolving Capacity Constraint Situations (CCS) and incorporate additional features:

- Collaborative resolution of the CCS: all key stakeholders are involved in the resolution of DCB imbalance problem on arrivals to an Aerodrome of Destination (ADES).
- Integration of UDPP into the CCS resolution process: the central part of resolving the DCB imbalance problem on arrivals at ADES is the inclusion and consideration of AU prioritisation in the process.

This will, in turn, ensure the continued stability and performance of the network and will give the opportunity to the Airspace Users to prioritize their flights, thereby reducing the impact of the delays generated by the ATFM planning constraints to limit the excess costs on their operations.

Within the CBA, the Solution is considered to be deployed when the assigned Stakeholders have deployed the required enablers and the system is operational and providing benefits.

Table 6 lists the key dates used in the CBA.

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Dates	
Start of deployment date: the start of investments for the first deployment location	2027
End of deployment date: the end of the investments for the final deployment location	Same as FOC
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.	2027
Final Operating Capability (FOC): Maximum benefits from the ***full deployment***[3] of the Solution at applicable locations. Investment costs are considered to end[4] here although any operating cost impacts would continue.	2033

Table 6: CBA Investment and Benefit Dates

Figure 2 below presents an overview of the expected timeline for PJ.07-W2-S39, highlighting its key investment moments and benefit generation stages.

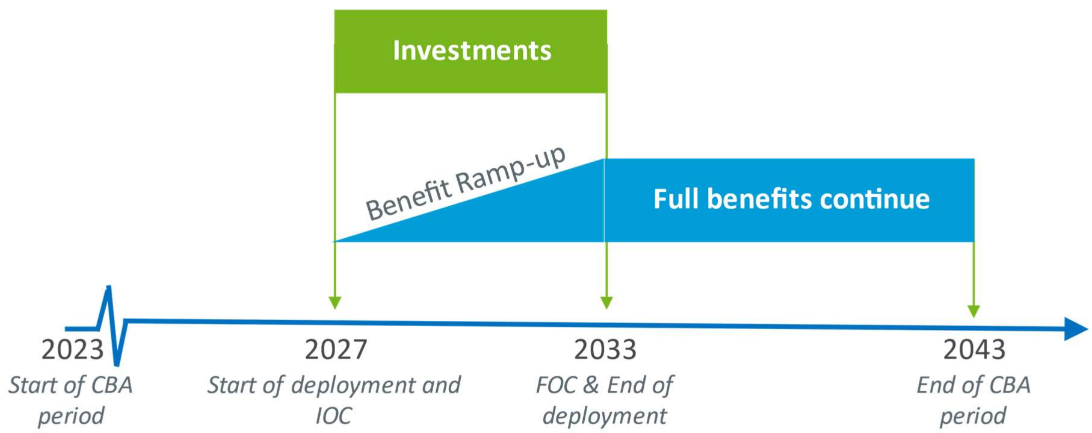

Figure 2: Overview of S39 CBA dates

It can be observed in the figure that the investments are expected to be spread linearly between the start and end of deployment dates. The benefit ramp-up is expected to happen in a linear fashion between IOC and FOC, after which it will continue to linearly increase until the end of the CBA timeline (i.e. 2043).

[3] 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)
[4] The basic assumption is that infrastructure does not need to be replaced during the CBA period

EUROPEAN PARTNERSHIP
Co-funded by the European Union

3.5.3 Assumptions

The table below presents an overview of the main assumptions used in the elaboration of the CBA.

Scenario feature		2022	2030	2040	Source
ECAC traffic (M # flights) in line with [9]		11,718,541	13,846,705	16,200,145	STATFOR Long Term forecasts [2018]
Deployment scope		Large and very large airports in ECAC			PJ.07-W2-39 SPR-INTEROP/OSED for V3 - Part V - PAR
Flight phase affected		Departures			PJ.07-W2-39 SPR-INTEROP/OSED for V3 - Part V - PAR
Equipage rate		No airborne equipage required			
Applicability: Number of locations where Solution is deployed (# OEs)	Large airports at ECAC	18	18	18	PJ.07-W2-39 SPR-INTEROP/OSED for V3 - Part V - PAR
	Very large airports at ECAC	14	14	14	
Applicability: Airlines that will use the solution	Big airlines whose hub is in the considered airports	32	32	32	Assumption

Table 7: Key assumptions used in the CBA

Co-funded by the European Union

4 Benefits

PJ.07-W2-39 is expected to generate benefits by allowing for an integrated and collaborative approach to the coordination and resolution of constraints limited to arrivals management, ensuring a continued stability and performance of the network. Furthermore, it will also provide the AUs with the possibility to prioritise their flights and consequently reduce the impact from the delays generated by ATFM planning constraints on their operations.

EUROPEAN PARTNERSHIP

Co-funded by the European Union

4.1 PUN1 Punctuality

The Punctuality KPI, as presented in SESAR Performance Framework, represents the average departure delay due to reactionary delays, ATM, and weather-related delay causes. The objective highlighted in the ATM Master Plan Performance Ambitions is a reduction of 2012 baseline delay of 9.5 minutes per flight to 7.0 minutes, representing a 26% decrease. Solution PL.07-W2-39 contributes to this objective by increasing the punctuality of individual flights, focussing on those that can have significant impacts on the AU fleet.

As explained in section 4.1 and in the PAR [12], PJ.07-W2-39 is expected to reduce the reactionary ATFM delay for the subsequent rotations in pre-departure phase of a flight. This would be done by involving the Airspace Users in CCS resolution, allowing them to prioritise the most critical flights and thus reducing the overall delay.

This benefit is monetised on a yearly basis following the formula below.

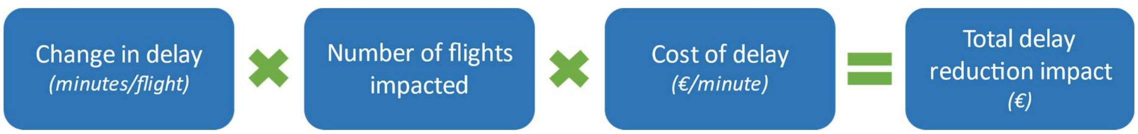

Figure 3: Formula used to monetise PUN1

In order to monetise the benefits, the model relies on the inputs calculated in the PAR, extrapolated to the ECAC level, that are listed in the table below. For detailed information on the calculations please refer to the Performance Assessment Report [12].

Indicator	Value
Number of in-scope airports (large, very large)	32
Number of yearly IFR departures in scope airports	4,384,065 (50.6% of all movements)
Absolute expected performance benefit	0.0285 min/flight
Total impact of the solution on punctuality (% delay reduction)	**0.30%**

Table 8: Overview of performance elements used in the CBA for PUN1

Similarly to what happens with the AUC3 benefit, the extrapolation of the performance assessment to the ECAC level considers a scope of all departures in the 32 large and very large airports across the area. According to PAR and discussions with Solution partners, all airlines with significant operations would be able to benefit from the Solution deployment, however the major/hub airlines would benefit the most. The assumption that one airline per airport (proxy for hub airlines) will implement the Solution for the purpose of the CBA represents a conservative approach to the benefit monetisation. The expected reduction in delay of 0.0285 minutes per flight (0.30%) resulting from the validation exercise is assumed to be applicable across ECAC.

EUROPEAN PARTNERSHIP

Co-funded by the European Union

4.2 AUC3 Airspace User Cost Efficiency

As per specification presented in SESAR Performance Framework [11], Airspace User cost efficiency refers to cost efficiency obtained by Airspace Users other than gate-to-gate ATM costs, or those that are quantified through other KPIs (e.g. fuel efficiency, time efficiency, etc.).

As explained in detail in the OSED[13] and Performance Assessment Report[12] of the Solution, UDPP aims to act on the ATFM delay of flights within an ATFCM measure in the pre-departure phase, with the objective to manage the reactionary delay on subsequent rotations, and consequently, the cost that this delay would have on AUs' operations. Involvement of AUs in the resolution of a Capacity Constrained Situation by using UDPP mechanisms would help manage the reactionary delay, and thus help the AU manage the subsequent aircraft rotations and associated passenger connections and curfew infringements.

The reduction of reactionary delays is expected to have a positive economic and operational impact on the Airspace User, leading to improved AU cost and operational efficiency. However, when monetising this benefit as part of the CBA, it is important to ensure that other KPIs that indirectly contribute to the AU cost efficiency are not double counted, such as is the case of PUN1. To do this, the inputs used in the CBA model from the PAR and in terms of direct CBA inputs focus exclusively on the operating costs of the AUs that will be avoided and that are not impacted by punctuality KPI.

The formula below is used to calculate the yearly impact related to this KPI, which is then extended to the entire CBA timeline.

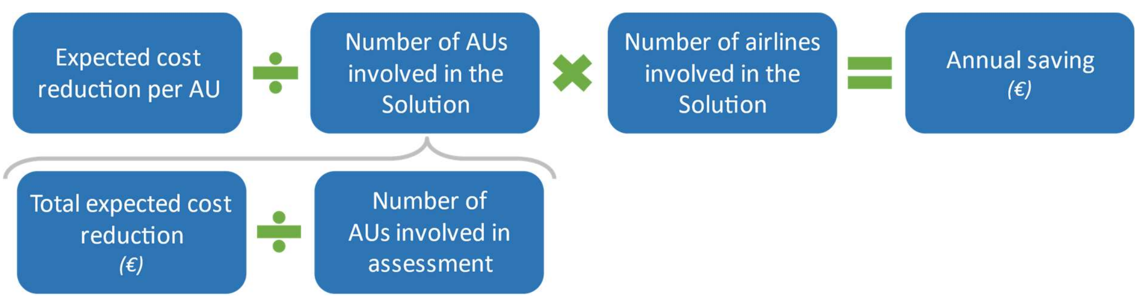

Figure 4: Formula used to monetise AUC3

The table below summarises the elements provided in the Performance Assessment Report and in the Validation Report [14] and that are used in the CBA model to monetise the benefits. Please refer to the PAR for further details.

Indicator	Value
Number of in-scope airports (large, very large)	32
Number of yearly IFR departures in scope airports	4,384,065
Expected reduction in the cost of delays ECAC-wide	10.3%
Total expected delay cost per AIRAC cycle	32 €M
Number of AUs involved in the exercise	6
Total impact of the solution on AUs direct costs (% improvement)	**4.91%**

Table 9: Overview of performance elements used in the CBA for AUC3

EUROPEAN PARTNERSHIP
Co-funded by the European Union

As shown in Table 9, the extrapolation of the observed impact on the AU costs from the Solution is done for the 32 large and very large airports throughout ECAC, which account for over 4.3 million departures. It is assumed that the cost reduction observed in the validation exercise, of 10.3%, will remain unchanged when extrapolated to the ECAC level. This resulted in a final expected cost reduction at ECAC level of 4.91%, which is the impact factor used in the CBA.

When it comes to the absolute costs/cost reduction expected to result from the deployment of the Solution in scope airports, the values are not available at this stage. Thus, in order to estimate them, the delay cost provided in PJ.07-W2-39 VALR Table 8 Scenario B is taken as a proxy to the total cost for the 6 airlines observed in the exercise. This cost amounts 32 €M . This value is then divided by 6 to estimate the cost per airline, which is then multiplied by 32 – the proxy of the number of airlines that are expected to benefit most from the Solution.[5] This results in a total cost of 172 €M .

It is important to consider that the initial delay cost resulting from the simulation exercise refers to only one AIRAC period. Considering that there are 13 AIRAC periods in a year, the value is multiplied by 13. Finally, knowing that the simulation exercise was run in a summer period, based on previous CBA, it is assumed that the saving over the entire year would represent approximately 50% of this value.

Finally, the value obtained is multiplied by 4.91% (see Table 9), resulting in the total operating cost that AUs are expected to save in the frame of AUC3 of approximately 55 €M per year. Please see Figure 5 for a visualisation of this calculation process.

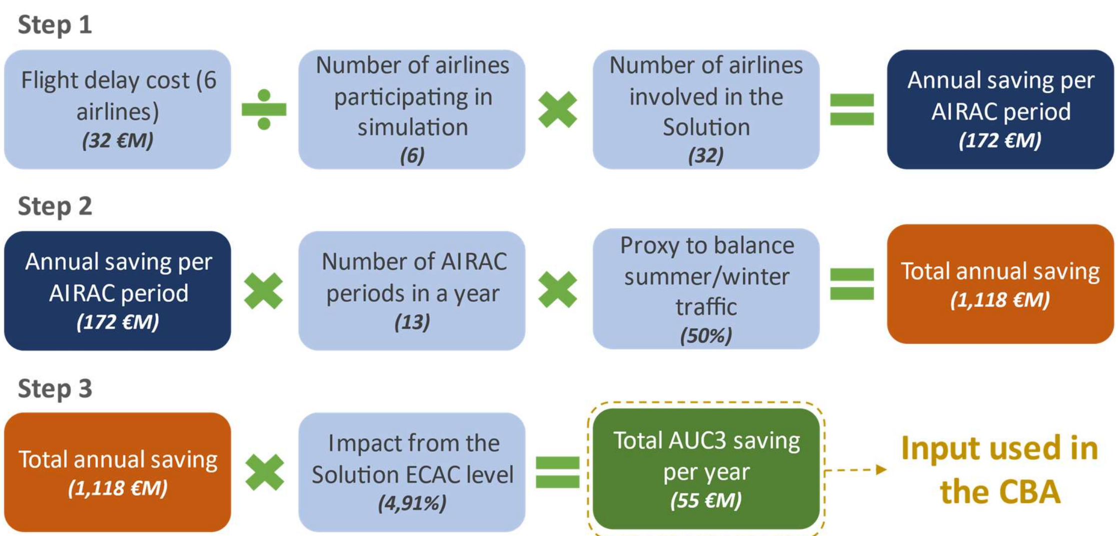

Figure 5: Detailed calculation of AUC3 yearly impact CBA input

[5] Please refer to section 4.1 for more details on the logic for the selection of 32 AUs.

EUROPEAN PARTNERSHIP
Co-funded by the European Union

These assumptions are made in order to be able to monetise the impacts in a situation where absolute costs are not available and represent a conservative approach to monetisation, with the view to not over-estimate the benefits from the Solution.

EUROPEAN PARTNERSHIP

Co-funded by the European Union

4.3 Overview of KPIs considered in the CBA

Table 10 provides an overview of the Key Performance Areas (KPAs) and KPIs that are considered in the CBA, based on the information provided in the OSED[13]. This high-level overview is followed by a more detailed description per KPI. Please note that the description of the KPIs focuses on those that are considered in the Performance Assessment Report (PAR)[12].

Performance Framework KPA[6]	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	2043
Cost Efficiency	ANS Cost efficiency	**CEF2** Flights per ATCO-Hour on duty	Nb	ATCO employment Cost change	€/year	N/A
				Support Staff Employment Cost Change	€/year	N/A
				Non-staff Operating Costs Change	€/year	N/A
		CEF3 Technology cost per flight	EUR / flight	G2G ANS cost changes related to technology and equipment	€/year	N/A
	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	55 €M

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

EUROPEAN PARTNERSHIP
Co-funded by the European Union

Performance Framework KPA[6]	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	2043
		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	N/A
		AUC5 Overhead costs for an airspace user	EUR / flight	Impact on overhead costs. Examples: dispatchers, training, IT infrastructure, sales.	€/year	N/A
Capacity	Airspace capacity	**CAP1** TMA throughput, in challenging airspace, per unit time	% and # movements	Tactical delay cost (avoided-; additional +)	€/year	N/A
			% and # movements	Strategic delay cost (avoided-; additional +)	€/year	N/A
		CAP2 En-route throughput, in challenging airspace, per unit time	% and # movements	Tactical delay cost (avoided-; additional +)	€/year	N/A
			% and # movements	Strategic delay cost (avoided-; additional +)	€/year	N/A
	Airport capacity	**CAP3** Peak Runway Throughput (Mixed mode)	% and # movements	Value of additional flights	€/year	N/A
	Resilience	**RES4a** Minutes of delays	Minutes	Tactical delay cost (avoided-; additional +)	€/year	N/A
		RES4b Cancellations	% and # movements	Cost of cancellations	€/year	N/A

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Performance Framework KPA[6]	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	2043
		Diversions	% and # movements	Cost of diversions	€/year	N/A
Predictability and punctuality	Predictability	**PRD1** Variance of Difference in actual & Flight Plan or RBT durations	Minutes^2	Strategic delay cost (avoided-; additional +)	€/year	N/A
	Punctuality	**PUN1** % Departures < +/- 3 mins vs. schedule due to ATM causes	% (and # movements)	Tactical delay cost (avoided-; additional +)	€/year	18 €M
Flexibility	ATM System & Airport ability to respond to changes in planned flights and mission	**FLX1** Average delay for scheduled civil/military flights with change request and non-scheduled / late flight plan request	Minutes	Tactical delay cost (avoided-; additional +)	€/year	N/A
						N/A
Environment	Time Efficiency	**FEFF3** Reduction in average flight duration	% and minutes	Strategic delay: airborne: direct cost to an airline excl. Fuel (avoided-; additional +)	€/year	N/A
	Fuel Efficiency	**FEFF1** Average fuel burn per flight	Kg fuel per movement	Fuel Costs	€/year	N/A
	Fuel Efficiency	**FEFF2** CO2 Emissions	Kg CO2 per movement	CO2 Costs	€/year	N/A
Civil-Military Cooperation & Coordination	Civil-Military Cooperation & Coordination	**CMC2.1a** Fuel saving (for GAT operations)	Kg fuel per movement	Fuel Costs	€/year	N/A

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Performance Framework KPA[6]	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	2043
		CMC2.1b Distance saving (for GAT operations)	NM per movement	Time Costs	€/year	N/A

Table 10: Results of the benefits monetisation per KPA

5 Cost assessment

This section presents an assessment of costs that are expected to be borne by the different stakeholders in order to implement Solution PJ.07-W2-39. These include the capital expenditure (CAPEX) associated with the implementation of the Solution enablers (e.g. system development and integration, personnel training, certification, etc.), as well as any changes in the recurrent operating costs (OPEX), such as continuous personnel training, system maintenance, etc.

The table below presents summary of the enablers per OI and per stakeholder that are required for the implementation of PJ.07-W2-39, as specified on eATM portal. Please note that, in the table, NIMS-46 is an enabler that, although required, is use only (i.e. does not require to develop any system by the stakeholders concerned).

OI code	Enabler code	Enabler title	Stakeholders concerned
AUO-0110	AOC-ATM-18	Flight Operations Centre adaptation to support UDPP	AU
AUO-0110	NIMS-44	Evolution of NIMS to support management of UDPP, inclusion of user preferences and priority as part of SBT	AU NM
AUO-0110	NIMS-46	Integrated local DCB working position	ANSP APT NM
AUO-0110	NIMS-46b	Interface to the integrated local DCB working position	ANSP NM

Table 11: Overview of enablers per stakeholder

5.1 ANSPs costs

As mentioned in section 4.3, there are no investment costs expected on the side of ANSPs. In fact, the ANSPs are expected to benefit from the system put in place by NM and, therefore, do not have any additional costs related to the Solution.

5.2 Airport operators costs

There are no investment costs expected on the side of Airports.

5.3 Network Manager costs

5.3.1 Network Manager cost approach

The cost estimations for the Network Manager were derived form a standard value for NM new functionality deployment used in the previous versions of the CBA and through expert judgement.

5.3.2 Network Manager cost assumptions

Based on the discussions with project partners, it was agreed that the Network Manager, together with the AUs, will be the one implementing the functionality that will be used as a core of PJ.07-W2-39, allowing all the actors involved to interact with it with the view to optimise the arrival management.

EUROPEAN PARTNERSHIP
Co-funded by the European Union

5.3.3 Network Manager cost figures

It is expected that NM will be responsible for the implementation of NIMS-44, NIMS-46 and NIMS-46b. Furthermore, it is expected that NM will have only the CAPEX associated to PJ.07-W2-39 deployment, and no additional operating expenses nor pre-implementing costs. Given this, the table below presents the expected delta cost for the implementation of PJ.07-W2-39 by NM. This cost is estimated based on previous CBAs and expert judgement and refer to a standard NM cost for a new functionality.

Cost category	Network Manager
Pre-Implementation Costs	Not applicable
Implementation costs	5 €M
Operating costs	Not applicable

Table 12: Cost per Unit - NM

5.4 Airspace User costs

5.4.1 Airspace User cost approach

The expected costs for the Airspace Users were estimated based on the information used in previous versions of the CBA and expert judgement.

5.4.2 Airspace User cost assumptions

The AUs are expected to implement PJ.07-W2-39 at their Flight Operations Centre, which will represent a certain cost (CAPEX). Once the Solution is implemented, the operating expenses related to its running are expected to be insignificant or non-existent and, therefore, it is assumed that no OPEX is expected to be associated to this stakeholder.

Through discussion with the Solution partners, and as shown in section 5.4.3, it is assumed that only the airlines that have major operations in the scope airports will be implementing the Solution, limiting the implementation costs to these airlines. Therefore, considering that there is a total of 32 large and very large airports in the scope of the Solution, it is assumed that there will be 1 airline per airport implementing PJ.07-W2-39. This assumption allows the CBA to remain conservative in terms of the scope of implementation, and it goes in line with the assumptions made during the previous CBAs performed.

5.4.3 Number of investment instances (units)

As mentioned above, it was agreed that only airlines with significant operations in the in-scope airports will be considered for the implementation of the Solution (i.e. 1 per airport). The estimated numbers of these airlines for selected airports[7] are presented in the table below.

[7] Please refer to the PAR for a detailed list of in-scope airports and the rationale behind their selection.

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Scheduled Airlines (SA)	
Ground locations (e.g. Flight Operations Centres)	Airborne (air vehicles)
32 Flight Operations Centres (i.e. one per airport)	No airborne investment expected

Table 13: Number of investment instances – AUs

When looking at these numbers it is important to note that, in reality, the situation may vary. In some airports there may be more than only the hub airline investing in the Solution, while in others it is possible that no airlines will choose to invest. Prior to the implementation of the Solution, the AUs are advised to perform their own assessment of the costs and benefits related to the implementation of the Solution based on their specific case.

5.4.4 Cost per unit

The table below presents an overview of the expected costs to be borne by the Airspace Users.

Cost category	Scheduled Airlines (SA)	
	Ground locations (e.g. Flight Operations Centres)	Airborne (air vehicles)
Pre-Implementation Costs	No pre-implementation costs are expected	No airborne investment is expected
Implementation costs	€ 500,000 per Flight Operations Centre	
Operating costs	No significant additional operating costs are expected	

Table 14: Cost per unit – AUs

The number presented in the figure (i.e. € 500,000 initial investment per Flight Operations Centre) is equally a result of discussions with the Solution partners and represents an estimation of an average cost per airline. Having said this, it is important to note that this cost will greatly vary from one airline to another, depending on their starting point, as well as the specific conditions during the Solution implementation.

5.5 Military costs

As mentioned in section 4.3, there are no military costs expected for the implementation of this Solution.

EUROPEAN PARTNERSHIP

Co-funded by the European Union

6 CBA Model

The model used for the elaboration of this CBA is the CBA Model 7.4.1, made available on Stellar PJ.19. Please find attached below the model with the monetisation of impacts related to PJ.07-W2-39.

D3.1.011-PJ.07-W2-39-V3-CBA_model.xl:

6.1 Data sources

The data regarding the costs related to the Solution implementation was provided by the Solution partners during online exchanges.

The information on the quantification of benefits expected form the Solution is derived from the Performance Assessment Report [12] section on ECAC extrapolation.

The data sources for the specific parameters used in the CBA model, other than the above, are specified in the Excel file next to the relevant parameters and identified as “Source”.

EUROPEAN PARTNERSHIP

Co-funded by the European Union

7 CBA Results

The sections below present the main outcomes form the running of the CBA model with the values and assumptions outlined previously in this report.

7.1 Discounted results

This section shows the outcomes of the CBA over the entire period of time discounted to 2022 values using a discount rate of 8%.

Stakeholder	Benefits	Costs	NPV[8]
ANSP	€ 0	€ 0	€ 0
Airports	€ 0	€ 0	€ 0
Network Manager	€ 0	- 3 €M	- 3 €M
Business Aviation	€ 0	€ 0	€ 0
Scheduled Aviation	327 €M	- 8 €M	319 €M
Total	**327 €M**	**- 11 €M**	**316 €M**

Table 15: Overview of discounted CBA results per stakeholder

It can be observed in the table that, according to what has been described in section 5.3, the Network Manager is the one stakeholder that is expected to invest in the deployment of the Solution, without having clear monetary benefits (please refer to the PAR for more detailed information). It is expected that the discounted deployment costs for the Network Manager will amount 3 €M in total.

Airspace Users is another stakeholder that is expected to be impacted by the Solution. It is expected that the 32 AUs in scope will invest a total of approximately 8 €M during the first years after the start of Solution deployment and will count about 327 €M in total discounted benefits over the entire timeline (i.e. up to 2043).

The remaining stakeholders, as explained in OSED and PAR, are not expected to have any significant costs or benefits form PJ.07-W2-39 deployment.

The total NPV from PJ.07-W2-39 deployment is expected to reach 316 €M between 2023 and 2043.

Error! Reference source not found. shows the evolution of discounted cashflows (i.e. costs and benefits) from PJ.07-W2-39 deployment over the CBA timeline.

[8] Please note that in the CBA model Excel file the results you will find will look slightly differently: the NPV will remain the same, but benefits will be lower and costs will be higher. This is linked to the fact that, due to specificities of the model, AUC3 is monetised as operating cost saving and, in the model, it shows as a positive value among the costs, driving the cost down. In the report, since it is a cost **saving**, it is added as part of the benefits, for clarity of reading. However, the final result will remain the same.

EUROPEAN PARTNERSHIP

Co-funded by the European Union

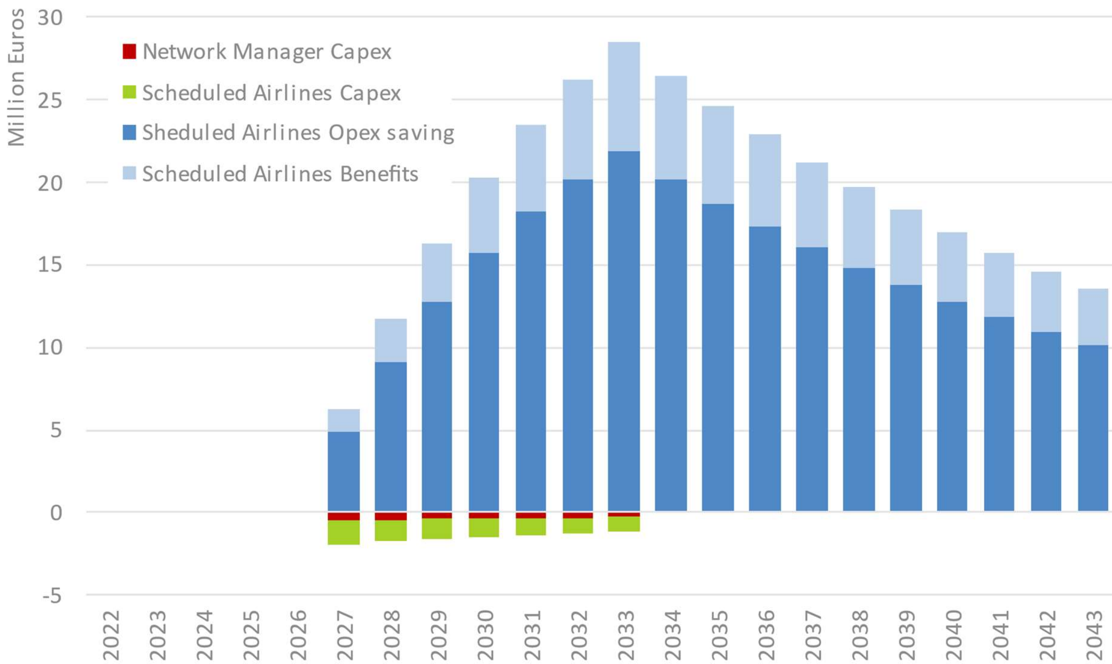

Figure 6: Evolution of discounted cashflows over time

It can be observed in the figure that the costs of PJ.07-W2-39 are focused between 2027 (i.e. start of deployment) and 2033 (i.e. FOC), as explained in Figure 2. This means also that all the enablers will be put in place and all the stakeholders would have invested by that time, after which the Solution can generate the full benefits.

The benefits continue growing up until 2033, after which the discounted benefits seem to decrease on the figure. In reality, and as was shown in Figure 8, the benefits continue a slight growth, despite of significantly slowing down their yearly growth. The apparent decrease in discounted benefits starting from 2034 is a result of the money devaluation after that period as compared to today (i.e. result of discount to today's values).

In Figure 7 is shown the evolution of cumulative discounted net benefits from the deployment of PJ.07-W2-39 over the years.

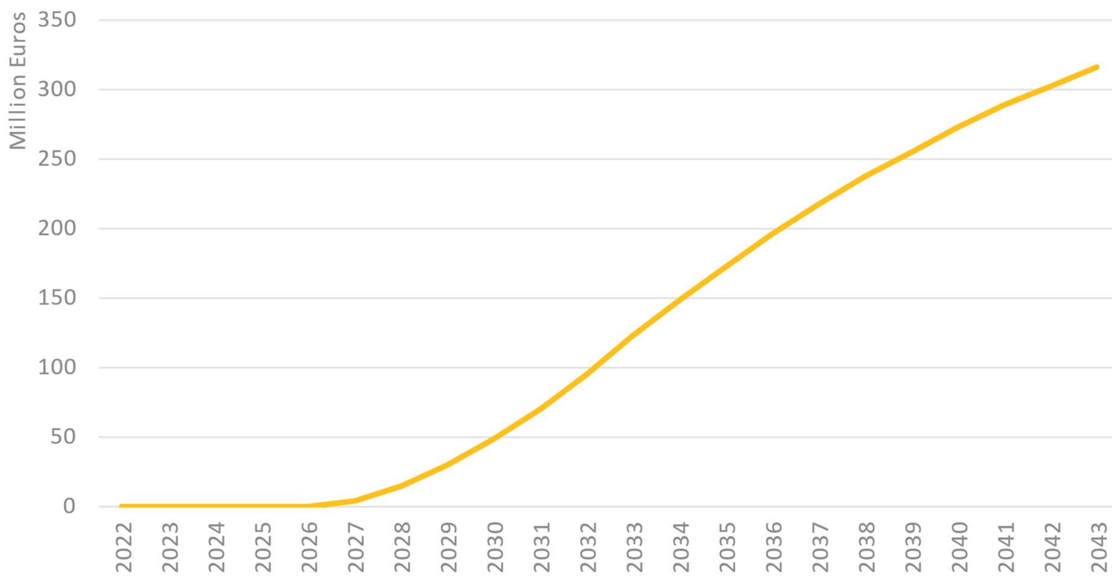

Figure 7: Evolution of discounted cumulative benefits over time

The cumulative benefits, as can be observed in the figure, continue their growth over the entire CBA timeline, showing the expected increase in net benefits, to reach just over 300 €M in 2043. The payback period for PJ.07-W2-39 is of 1 year, meaning that the benefits outgrow the costs in the first year of Solution deployment.

EUROPEAN PARTNERSHIP

Co-funded by
the European Union

7.2 Undiscounted results

The undiscounted results show the outcomes of the CBA per year before applying the yearly discount rate to account for the effects of inflation. Thus, they represent the yearly cash flows expected form the Solution deployment, without bringing them to today's money. Table 16 shows an overview of the total undiscounted results per stakeholder.

Stakeholder	Benefits	Costs	Net benefits[9]
ANSP	€ 0	€ 0	€ 0
Airports	€ 0	€ 0	€ 0
Network Manager	€ 0	- 5 €M	- 5 €M
Business Aviation	€ 0	€ 0	€ 0
Scheduled Aviation	1,014 €M	- 16 €M	998 €M
Total	**1,014 €M**	**- 21 €M**	**993 €M**

Table 16: Overview of undiscounted CBA results per stakeholder

Following a similar logic as in section 7.1, the Network Manager, will be the stakeholder that will invest in the deployment of PJ.07-W2-39, alongside the AUs, and is expected to bear investment costs associated to this. These costs are expected to amount 5 €M in undiscounted values. The Scheduled Airlines, by their turn, are expected to have an investment of about 16 €M and undiscounted benefits amounting 1,014 €M between 2023 and 2043. The remaining stakeholders, as explained in OSED and PAR, are not expected to have any significant costs or benefits form PJ.07-W2-39 deployment.

It is expected that the 32 Airspace Users falling within the scope of PJ.07-W2-39 will invest a total of approximately 16 €M in undiscounted terms (i.e. € 500,000 per AU) during the first years after the start of Solution deployment and will count over 1,014 €M in total undiscounted benefits over the entire CBA timeline (i.e. up to 2043).

The remaining stakeholders, as previously explained, are not expected to have any significant costs or benefits form PJ.07-W2-39 deployment.

The total undiscounted net benefit from the Solution is expected to reach 993 €M by 2043.

The figure below shows the distribution of undiscounted costs and benefits between 2023 and 2043.

[9] Please note that in the CBA model Excel file the results you will find will look slightly differently: the net benefits will remain the same, but benefits will be lower and costs will be higher. This is linked to the fact that, due to specificities of the model, AUC3 is monetised as operating cost saving and, in the model, it shows as a positive value among the costs, driving the cost down. In the report, since it is a cost **saving**, it is added as part of the benefits, for clarity of reading. However, the final result will remain the same.

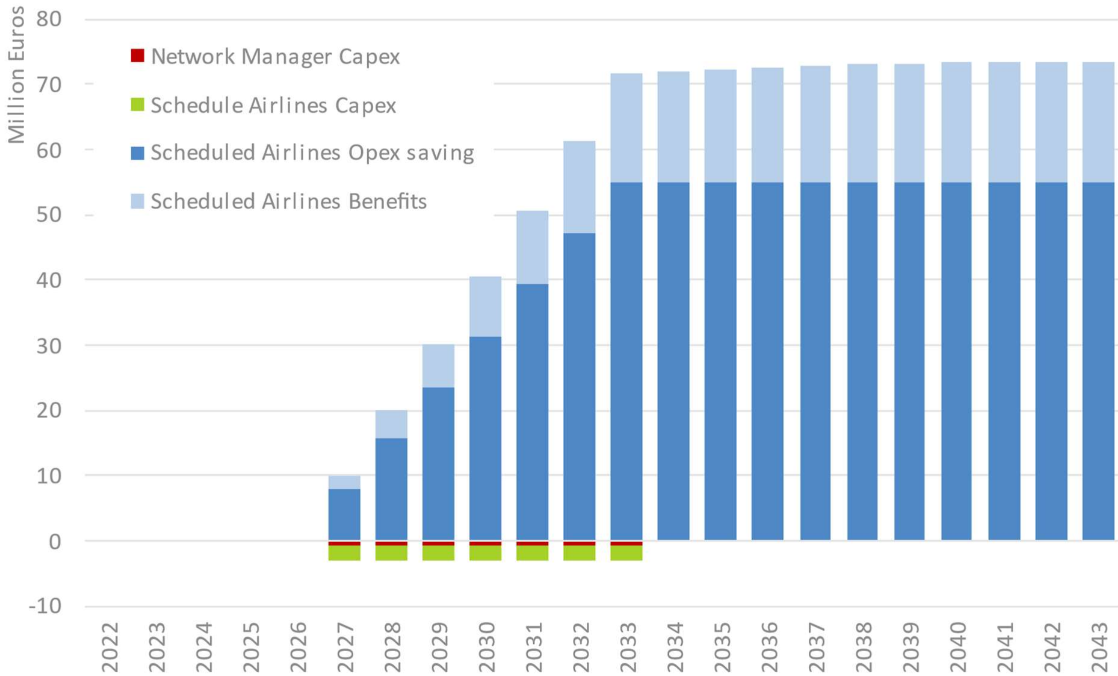

Figure 8: Evolution of undiscounted cashflows over time

It can be observed in the figure that the investment expenses take place between 2027 and 2033 included. This corresponds to the Solution investment period. Starting from 2027 it also is possible to observe the start of benefit generation that happens progressively as the Solution is being deployed in an increasing number of locations.

The benefit distribution follows a growing trend, growing more steadily during the years of Solution deployment, since the benefits here are related to the level of operability of the Solution. Once FOC is reached in 2033, the benefits start growing slower, remaining relatively stable over time. The Scheduled Airlines' OPEX saving will reach a plateau because a stable amount of savings per year was considered for this model. The remaining benefits (i.e. PUN1) are expected to continue a slight annual growth, following the change in traffic, etc.

EUROPEAN PARTNERSHIP

Co-funded by
the European Union

8 Sensitivity and risk analysis

The subsections below provide an overview of the CBA results when different sensitivity scenarios are applied. The sensitivity analysis is performed for the most uncertain metrics of the model. Please see each section for more information.

8.1 Costs and benefits sensitivity

Some of the most uncertain aspects in the present CBA are:

- Uncertainty about the number of deployment locations: it was assumed that one major AU per in-scope airport will be deploying the Solution, resulting in 32 airlines investing.
- Per-unit deployment cost for the AUs: in the baseline calculations it was assumed that each AU Flight Operations Centre will invest € 500,000 to implement the Solution.

Given the above, this sensitivity analysis will look into the results of the CBA if more AUs will deploy the Solution and if the per airline investment cost will increase, as summarised in Table 17.

Parameter	Value in baseline calculations	Value in sensitivity
Number of AUs deploying the Solution	1 per airport (32)	2 per airport (64)
Per-unit deployment cost	€ 500,000	€ 1,000,000

Table 17: Cost sensitivity scenario

Based on the assumptions above, and keeping all the rest stable,[10] the sensitivity results in terms of NPV change are presented below, taking into account separately the increase in the number of locations (i.e. number of AUs deploying the Solution) and in the deployment cost per AU.

Stakeholder	Baseline NPV	Sensitivity NPV (cost)	Change	Sensitivity NPV (locations)	Change
ANSP	€ 0	€ 0	0%	€ 0	0%
Airports	€ 0	€ 0	0%	€ 0	0%
Network Manager	- 3 €M	- 3 €M	0%	- 3 €M	0%
Business Aviation	€ 0	€ 0	0%	€ 0	0%
Scheduled Aviation	319 €M	311 €M	-2%	311 €M	-2%
Total	**316 €M**	**308 €M**	**-3%**	**308 €M**	**-3%**

Table 18: Cost sensitivity analysis results

[10] Please note that this is purely a sensitivity analysis based on the CBA inputs and it does not take into consideration any productivity gains that result from a wider deployment, as this would require a separate validation exercise.

EUROPEAN PARTNERSHIP
Co-funded by the European Union

As can be observed in the table above, keeping everything else stable, doubling the number of deployment locations and the per-unit deployment cost is expected to decrease the total net benefit by 3%. This shows that an increase in either the number of deployment locations or the price per unit will result in a higher cost increase than in benefit increase, making it less interesting, from the financial perspective to increase any of these two metrics.

The figure below presents a tornado diagram which shows the variation in the CBA results, per impact, when the costs and benefits are changed by 10%.

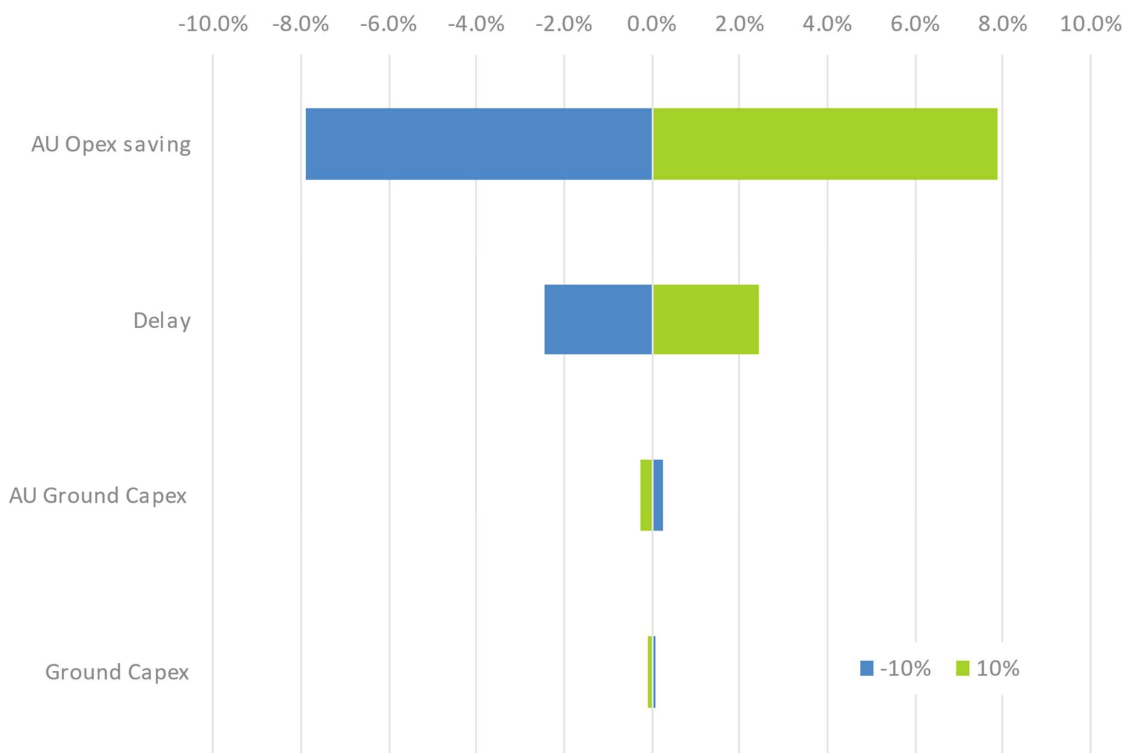

Figure 9: Variation in NPV when inputs vary by 10%

It can be observed in the figure that AU cost saving (AUC3) and delay reduction (PUN1) are the two KPIs that suffer the highest change if the inputs are changed by 10%, showing their high sensitivity to any changes.

EUROPEAN PARTNERSHIP

Co-funded by
the European Union

8.2 Discount rate sensitivity

The discount rate used for the baseline calculations within this CBA is 8%, which corresponds to the recommendations set out in SESAR Common Assumptions [9]. The figure below presents the expected change in the NPV of this CBA when different discount rates are applied.

Figure 10: NPV sensitivity to changing discount rate

EUROPEAN PARTNERSHIP
Co-funded by the European Union

9 Recommendations and next steps

Considering the largely positive outcome from this CBA, the main conclusion that can be drawn is that PJ.07-W2-39 is interesting to deploy in large and very large airports across ECAC.

The sensitivity analysis showed that an increase in the number of deployment locations would lead to a decrease in the overall NPV of roughly 3%. While this shows that a wider adoption would not be justified, it is important to keep in mind that this is a sensitivity analysis purely based on the costs and benefits considerations and a wider assessment of any underlying multiplication effects (e.g. the possibility of a wider deployment by the same AUs to drive down the costs, etc.) is recommended to be studied prior to any decision to widen the scope of deployment.

Furthermore, as was described more in detail throughout the report, for this CBA it was assumed that the ANSPs will not directly invest in PJ.07-W2-39 deployment but will rather use the system put in place by the Network Manager. It would, however, be interesting, if not already done, to explore more in-depth the systems currently in place in the ANSPs/ACCs that would deploy the Solution to understand how to best take advantage from all the systems and understand whether there could be some possibilities for cost savings, as well as to assess the real costs of deployment by ANSPs that deploy the Solution on their own without relying on the NM system. Same recommendation can be applied to any existing systems in use by the Airspace Users.

EUROPEAN PARTNERSHIP

Co-funded by
the European Union

10 References and Applicable Documents

10.1Applicable Documents

[1] SESAR Project Handbook

[2] Guidelines for Producing Benefit and Impact Mechanisms

[3] Methods to Assess Costs and Monetise Benefits

[4] SESAR Cost-Benefit Analysis Model[11]

[5] Cost Benefit Analyses – Standard Input

[6] Cost Benefit Analyses – Method to assess costs

[7] ATM CBA Quality checklist

[8] Methods to Assess Costs and Benefits for CBAs

10.2 Reference Documents

[9] SESAR 2020 Common assumptions. Ed.01.00.00 released on 16 September 2019

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

[11] PJ19-W2: Performance Framework. Ed.00.01.01 released on 31 May 2019

[12] SESAR Solution PJ.07-W2-39 SPR-INTEROP/OSED for V3 - Part V - Performance Assessment Report (PAR). Ed.00.01.01 released on 3 May 2023

[13] SESAR PJ.07-W2-39 OSED-SPR-INTEROP for V3 - Part I. Ed.00.05.01 released on 7 July 2021

[14] SESAR 2020 VALR for PJ07-W2 PJ.07-W2-S39. Ed.00.01.01 released on 31 January 2023

[11] This reference is no more accessible from Programme library but it is now available in ATM Performance Assessment Community of Practice.

EUROPEAN PARTNERSHIP

Co-funded by the European Union

11 Appendix A Mapping of ATM Master Plan KPAs and SESAR KPAs

Mapping between ATM Master Plan Performance Ambition KPAs and SESAR Performance Framework KPAs, Focus Areas and KPIs, source reference *[11]*.

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		Variance of actual and reference business trajectories	PRD1	Variance of differences between actual and flight plan or Reference Business Trajectory (RBT) durations

EUROPEAN PARTNERSHIP

Co-funded by the European Union

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
	flights actually arriving at gate				
	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 CO2 emissions			(FEFF2)	CO2 Emissions
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 19: Mapping between ATM Master Plan Performance Ambition KPAs and SESAR Performance Framework KPAs, Focus Areas and KPIs

EUROPEAN PARTNERSHIP

Co-funded by the European Union

-END OF DOCUMENT-