INDUSTRIAL RESEARCH

SESAR SOLUTION 38: COST BENEFIT ANALYSIS (CBA) FOR V3

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PJ07-W2-OAUO

OPTIMISED AIRSPACE USERS OPERATIONS

This CBA 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 Solution PJ.07-W2-38 Enhanced integration of Airspace User (AU) trajectory definition and network management processes. It considers the deployment of this Solution's main OI steps (*AUO-0208 Use of Simple AU Preferences in DCB Processes and AUO-0219 Use of Enriched DCB Information and Enhanced What-Ifs to Improve AU Flight Planning)* 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. The deployment of each OI step is considered separately, since they can be deployed as standalone, as well as a joint deployment is touched.

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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-W2-38.** Its aim is to provide a view on the costs and benefits of deploying this Solution at the ECAC level for all stakeholders involved, as well as to show the expected outcomes from the deployment in monetary terms.

PJ.07-W2-38 Enhanced integration of AU trajectory definition and network management processes aims at reducing the impact of Air Traffic Management (ATM) planning on Airspace Users' (AU) costs of operations, by providing them a better access to ATM resource management and allowing them to better cope with ATM constraints. This is done through the implementation of the Solution's two Operational Improvement (OI) steps:

- **AUO-0208 – Use of simple AU preference in DCB processes:** as part of Collaborative Decision Making (CDM) processes, the AU can provide preferences information even before the publication of Demand Capacity Balancing (DCB) constraints. This information is considered in the DCB to define or refine measures to reduce the impact on the AU costs, when possible. Simple preferences refer more specifically to light information, such as proactive flight delay criticality indicators that can be considered by Network Management Function (NMF) human operators and systems - either at regional, sub-regional or local levels - to avoid Air Traffic Flow and Capacity Management (ATFCM) delay (e.g. slot exemption or level capping/re-routing proposal to avoid an ATFCM regulation) for critical flights.
- **AUO-0219 - Use of enriched DCB information and enhanced what-ifs to improve AU flight planning:** within the scope of this OI step, the provision of enriched DCB information, such as protection hotspots, which NMF can declare to protect an airspace from undesired rerouted flights, will be available. Those protection hotspots will follow the same publication rules as the current (resolution) hotspots and have similar attributes. The protection hotspot information is provided to the AU, mainly in the context of what-if functions, to be used prior to their decision to change a flight plan. It does not intend to trigger the change of trajectories for flights already planned in the hotspot.

It is expected that each OI step can be deployed separately and, therefore, the CBA analysis was conducted based on this working assumption, while also looking into the sum results of a deployment of both OI steps. The Key Performance Indicators (KPIs) monetised in the CBA are the following:

- **FEFF1 – Fuel efficiency:** due to greater automation of DCB processes and the fact that NMF will propose to AUs to adapt their planned trajectory to take their preferences into account, a possible increase of reroutings to mitigate the impact of DCB measures could increase the fuel burnt. On the other hand, protection hotspots can avoid significant number of inefficient refilings allowing a fuel burn decrease. This KPI applies to both OI steps.
- **PUN1 – Punctuality:** a reduction in the average departure delay per flight and the consequent optimisation of flight trajectories is expected to lead to an improved departure punctuality and the corresponding savings for the AUs. This KPI applies mainly to AUO-0219.
- **AUC3 – Airspace User Cost efficiency:** a reduction in the average departure delay allows the AUs to optimise their flight trajectories and consequently improve their punctuality and reduce indirect costs associated with flight delays. This KPI applies mainly to AUO-0208.

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Regarding the deployment scope, it was considered that PJ.07-W2-38 would be deployed across ECAC, focussing on AUs that declare critical operations. A proxy used to estimate the number of such AUs, based on the discussions with NM, is 40 airlines which represent about 62% of traffic. The Flight Operations Centres (FOC) of these AUs are expected to invest into the system that would allow them to use the functionalities offered by PJ.07-W2-38.

The Network Manager is another entity that is expected to invest in the deployment by developing and implementing a system that would then be put at the disposal of Air Navigation Service Providers (ANSPs) / Flow Management Positions (FMPs) across ECAC allowing them to participate without the need for any investments.

Regarding the timeline of the CBA, according to what is specified in the eATM Portal, the start of deployment is expected in 2025, end of deployment and full operational capability in 2034, with the benefits starting to be generated as of 2028. The analysis runs until 2043.

Based on these considerations, the CBA model was run to provide the following results, per OI step.

AUO-0208:

Net Present Value (NPV), which represents the cumulated discounted net benefits expected from the deployment of PJ.07-W2-38 AUO-0208, is expected to amount **769 M€** between 2022 and 2043, showing that this is an economically viable investment. This corresponds to **undiscounted cumulative benefits of 2,485 M€** for the same period.

Payback period of 3 years, which means that the benefits from the implementation of this OI step are expected to overcome its costs as soon as 2028.

AUO-0219:

An **NPV of about 558 M€** is expected to be generated, meaning that, which this OI step is expected to bring a smaller net benefit than the previous one, it remains an economically viable investment. In terms of **undiscounted cumulative benefits,** it corresponds to about **1,837 M€.**

Payback period for this OI step is equally 3 years, and the benefits are expected to overcome the costs by 2028.

Deployment of AUO-0208 and AUO-0219:

Assuming that there will be no additional efficiency gains from a joint deployment of both OI steps, it is expected that the deployment of both OI steps will result in an **NPV of 1,327 M€** between 2022 and 2043, and **undiscounted cumulated net benefits amounting 4,321 M€** over the CBA timeline. This shows that the deployment of both OI steps is expected to bring a higher monetary impact and, above everything, it would allow to obtain the maximum benefits from the deployment of PJ.07-W2-38 (i.e. both PUN1 and AUC3 benefits).

The **payback period** remains unchanged with relation to the deployment of each OI step separately: **3 years.**

There are **two main limitations** to this CBA:

- The first one is linked to the uncertainty regarding the real deployment scope of the Solution. As previously mentioned, it is assumed that about 40 biggest airlines will be investing in PJ.07-W2-38 deployment, representing about 62% of all traffic, according to the Network Manager (NM) estimates. However, it is possible that a different number of AUs will be involved in the deployment. To account for this uncertainty, **a sensitivity analysis was performed, showing that the OI step that is significantly affected by such changes is AUO-0208**, where an increase or a decrease in the number of deployment instances by 50% can result in an increase or a decrease of 50% in NPV. Although highly sensitive, this remains an economically viable investment, since despite this fluctuation, the NPV remains positive and a relatively small number of additional deployment instances (i.e. 20 airlines) can bring significant benefits.
- The second one is also linked to a key uncertainty concerning AUO-0208. Quantified benefits in terms of AU cost efficiency are derived from the estimation of the number of extra critical flights NMOC and FMPs can treat per day and the average ATFCM delay cost for critical flights. The uncertainty related to this estimation has been highlighted by the operational experts. To account for this uncertainty, **a sensitivity analysis was performed, applying a** 2/3 reduction of benefits per flight for the AU cost efficiency KPI. This revealed that a decrease of about 67% in the cost reduction per flight will lead to a proportional reduction in the outcome, leading to an NPV of 254 M€ for AUO-0208.

Given all the above, **three main recommendations** can be made. Firstly, given the higher monetary benefits from its implementation, it is recommended to prioritise the deployment of AUO-0208. It brings significant monetary benefits linked to the AU cost savings (AUC3) from prioritisation of critical flights. Secondly, AUO-0219 brings higher benefits in terms of delay (PUN1) than AUO-0208 (which is not expected to significantly impact PUN1). Therefore, the implementation of this OI step would be beneficial from the point of view of delay reduction. Finally, the deployment of both OI steps together is expected to result in an NPV that is a sum of both individual ones (1,327 M€ over the CBA timeline) and allow the users to benefit fully from the two key benefits enabled by PJ.07-W2-38: PUN1 and AUC3. Given this, the deployment of both OI steps is recommended.

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 Solution PJ.07-W2-38.The key aim of this V3 CBA is to provide a view on the costs and benefits of deploying the Operational Improvement (OI) steps included in Solution PJ.07-W2-38 ECAC level for all stakeholders involved, as well as to show the expected outcomes from the Solution deployment in monetary terms. The V3 validation activities have produced evidence to show that the solution concept is feasible, however, some educated assumptions had to be made during the production of this CBA, to cover some information gaps. All assumptions used are specified in relevant sections of the document.

2.2 Scope

The scope of this document is the V3 CBA for PJ.07-W2-38 and it builds on the V2 CBA of SESAR Solution PJ.07-01: Airspace Users Processes for Trajectory Definition.

The Solution focuses on **two Operational Improvement (OI) steps:**

- AUO-0208 — Use of simple AU preference in DCB processes
- AUO-0219 — Use of enriched DCB information and enhanced what-ifs to improve AU flight planning

This V3 CBA estimates the costs and benefits of deploying AUO-0208 and AUO-0219 separately and together across ECAC, representing the geographical scope of the CBA. The timeline of the analysis covers the period between 2022 and 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 acronyms

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)

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

As explained in the PJ.07-W2-38 OSED[8], many programs, projects and initiatives have contributed to the domain of business trajectory management. Previous work on Flight and Flow Information for a Collaborative Environment (FF-ICE) Planning Service has mainly been performed by ICAO and related Research and Development (R&D) within the framework of SESAR 1.

4D Trajectory information exchange concepts have been developed by the ICAO Air Traffic Management Requirements and Performance Panel (ATMRPP) and are included in the *Manual on Flight and Flow Information for a Collaborative Environment (FF-ICE)*, which was released in 2012 as ICAO Doc 9965 [7].

In preparation for FF-ICE/1 (FF-ICE Planning) implementation, the Panel developed ICAO flight planning provisions referred as FF-ICE provisions. These provisions include the definition of the FF-ICE Planning Service, Extended Flight Plans (eFPLs) and eFPL updates, and trial requests to evaluate a possible alternative or change to preliminary flight plans or to eFPLs.

To support these provisions, R&D work related to the FF-ICE Planning Service was done in SESAR 1 project 07.06.02 Step 2, with the main concept developed being the process of submission of the Airspace User's 4D business trajectory to the Network Management Function (NMF) for accommodation in the ATM network during the Business Trajectory Short Term Planning Phase.

SESAR 1 project 07.06.02 Step 1 has also analysed the FF-ICE Planning, and in particular as an evolution of the Extended Flight Plan processes to align with the FF-ICE Provisions.

To give proper continuity, also during SESAR 1 (WP11.1, EXE 713) the eFPL concept was developed and validated reaching a V3 maturity level. This development constitutes the supporting element for the eFPL concept mentioned previously.

More recently, other initiatives were also developed in SESAR 2020 W1 (Solution PJ.07-01). This is the case, for example, of Aircraft Operator What-If-Reroute (AOWIR) development; this development is strongly related to the trial request mentioned above.

The validation activities for AOWIR allowed:

1. concerning the concept clarification, to confirm that this improvement supported efficiently both AU-driven and Flow Management Position (FMP)-driven decision processes as mentioned below:

    - AUs monitoring their fleet and re-optimising their flight trajectories taking into account DCB constraints and information.
    - Improved Collaborative Decision Making (CDM) process in the context of DCB cherry-picking measures. AUs use enriched DCB information and what-if functions to decide to either accept FMP/NM proposals or propose effective counter proposals.

2. regarding the performance assessment, to demonstrate that the use of enhanced what-if (together with enriched DCB) in the context of the flight planning:

    - should improve departure punctuality (only applicable winter period), and
    - has not a negative impact on Equity.

Also, according to the FF-ICE Provisions, "A Preliminary Flight Plan communicates the operator's best estimate of their current intended route/trajectory and serves as the basis for Air Traffic Flow Management (ATFM) Planning before a Filed Flight Plan is submitted; this R&D work about PFP concept was foreseen to be validated during this W2, but the subject will not be addressed due to the effort reduction resulting from CORONA crisis. However, some references to PFP were kept for a better process comprehension (e.g. Flight Planning Milestones).

R&D work related to the criticality of some flights given by the AU has been developed in SESAR 1 W1 under the Flight Delay Criticality Indicator (FDCI) concept. This FDCI information was identified by the AU as an efficient mechanism to notify critical flights to NM/FMP; by sharing this information via the Network Operations Plan (NOP) significantly increased the situational awareness for all stakeholders.

The *Manual on Flight and Flow Information for a Collaborative Environment* (FF-ICE) also refers to the possibility given to the AU to provide an indication of the relative priority of a flight within an operator's set of flights (i.e. Operator flight priority).

To conclude, although the purpose of the FF-ICE Planning Service was to "facilitate ATM and operator planning for flights in airspaces where significant constraints exist, and/or where air traffic demand at times exceeds, or is expected to exceed, the declared capacity of the air traffic control services concerned", other research activities will also provide the appropriate services that will complement such FF-ICE Planning Service; these complementary services being not part of the FF-ICE Planning Service are aligned with the ICAO environment and in some cases provide additional research improvements.

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2.6 Glossary of terms

Term	Definition	Source of the definition
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
Discount rate	The opportunity cost of capital and is valued as the loss of income from an alternative investment with a similar risk profile, or as an opportunity cost for society as a whole. It takes into account the time value of money, for example the idea that money available now is worth more than the same amount of money in the future.	EC DG REGIO Guide to Cost-Benefit Analysis of Investment Projects
FDCI	FDCI is a parameter provided by the Airspace User to indicate the importance for the flight to progress on time.	OSED
Hot Spot	A local demand/capacity imbalance on the day of operations, which may result from a complex traffic situation or a short period of high demand. A hotspot is created to raise awareness of the situation and may act as a precursor to solving the imbalance (STAM or ATFM regulation).	OSED
Key Performance Area	A way of categorising performance subjects related to high level ambitions and expectations. ICAO Global ATM Concept sets out these expectations in general terms for each of the 11 ICAO defined KPAs.	EUROCONTROL ATM Lexicon
Key Performance Indicator	Current/past performance expected future performance (estimated as part of forecasting and performance modelling), as well as actual progress in achieving performance objectives is quantitatively expressed by means of indicators (sometimes called Key Performance Indicators, or KPIs). To be relevant, indicators need to correctly express the	ICAO Doc 9883 Performance Framework

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

Table 1: Glossary of terms

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2.7 List of Acronyms

Acronym	Definition
ACC	Area Control Centre
ANSP	Air Navigation Service Provider
AOWIR	Aircraft Operator What-If-Reroute
ATC	Air Traffic Control
ATFCM	Air Traffic Flow and Capacity Management
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
AU	Airspace User
CAPEX	Capital Expenditure
CBA	Cost-Benefit Analysis
CDM	Collaborative Decision Making
DCB	Demand Capacity Balancing
ECAC	European Civil Aviation Conference
eFPL	Extended Flight Plan
FDCI	Flight Delay Criticality Indicator
FF-ICE	Flight and Flow Information for a Collaborative Environment
FMP	Flow Management Position
FOC	Full Operational Capability
ICAO	International Civil Aviation Organisation
IOC	Initial Operational Capability
KPA	Key Performance Area
KPI	Key Performance Indicator
NM	Network Manager
NMF	Network Management Function
NMOC	Network Manager Operations Centre
NOP	Network Operations Plan
NPV	Net Present Value
OE	Operational Environment
OI	Operational Improvement
OPEX	Operating Expenditure
PAR	Performance Assessment Report
PJ	Project

Acronym	Definition
R&D	Research and Development
SESAR	Single European Sky ATM Research Programme
TMA	Terminal Manoeuvring Area

Table 2: List of acronyms

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3 Objectives and scope of the CBA

3.1 Problem addressed by the solution

In today's situation, when regulations are applied, there is no consideration of the preferences of the airspace users. For example, AUs may prefer to prioritise a flight with many connecting passengers so that those connections are successfully completed as this avoids the costs and effort associated with re-planning the journeys of passengers who miss their connections, compensation, etc. However, in the current situation, this preference is not proactively communicated to the Network Manager, who will allocate delays to flights based on other criteria.

PJ.07-W2-38 responds to the need to accommodate individual airspace user business needs and priorities without compromising optimum Air Traffic Management (ATM) system outcome and the performances of all stakeholders.

Moreover, currently, the ATFM system at central (NM) and local levels (Air Traffic Control (ATC) units through Flow Management office) use historic data, AU schedule information, airport slot information and statistical analysis in order to predict traffic flow and hotspots. The filed ATC flight plans are taken and used to better predict traffic flow but often too late to optimise the ATM capacity especially in medium/high complexity areas. An interactive exchange of schedule and trajectory information between the different stakeholders, as proposed by this Solution, is expected to have a direct effect in the AUs operations and onto the ATFCM scenarios analysed by the NMF representatives.

3.2 SESAR Solution description

According to what is described in the solution's OSED[8], the objective of PJ.07-W2-38 is to reduce the impact of ATM planning on Airspace Users' costs of operations, by providing them a better access to ATM resource management and allowing them to better cope with ATM constraints. This shall improve Airspace Users' flight planning and network management through improved Flight Operations Centre (FOC) participation into the ATM network collaborative processes.

PJ.07-W2-38 is expected to reach its objective through the implementation of its two OI steps, as described hereafter. These OI steps can be implemented separately, and their joint implementation is not expected to bring additional added value *vis-à-vis* the individual implementation.

AUO-0208 – Use of simple AU preference in DCB processes

As part of CDM processes, the AU can provide preferences information even before the publication of DCB constraints. This information is considered in the DCB to define or refine measures to reduce the impact on the AU costs, when possible. Simple preferences refer more specifically to light information, such as proactive flight delay criticality indicators that can be considered by NMF human operators and systems - either at regional, sub-regional or local levels - to avoid ATFCM delay (e.g. slot exemption or level capping/re-routing proposal to avoid an ATFCM regulation) for critical flights.

AUO-0219 - Use of enriched DCB information and enhanced what-ifs to improve AU flight planning

Whitin the scope of this OI step, the provision of enriched DCB information, such as protection hotspots, which NMF can declare to protect an airspace from undesired rerouted flights, will be available. Those protection hotspots will follow the same publication rules as the current (resolution) hotspots and have similar attributes. The protection hotspot information is provided to the AU, mainly in the context of what-if functions, to be used prior to their decision to change a flight plan. It does not intend to trigger the change of trajectories for flights already planned in the hotspot.

Table 3 and Table 4 provide an overview of OI steps associated to the implementation of PJ.04-W2-38 and the corresponding enablers.

SESAR Solution ID	OI Steps ref.	OI Steps definition	Source reference
Enhanced integration of AU trajectory definition and network management processes	AUO-0208	Use of Simple AU Preferences in DCB Processes	DS 23a (EATMA)
	AUO-0219	Use of Enriched DCB Information and Enhanced What-Ifs to Improve AU Flight Planning	DS 23a (EATMA)

Table 3: SESAR PJ.07-W2-38 Scope and related OI steps

OI Steps ref.	Enabler[1] ref.	Enabler definition	Applicable stakeholder	Source reference
AUO-0208	AOC-ATM-28 (R)	Enhance AU flight planning systems to integrate the proactive flight criticality data	Airspace User – Civil - Civil Flight Operations Centre	DS 23a (EATMA)
	NIMS-72 (R)	Enhance NM flight planning and DCB functions to integrate the proactive flight criticality data	Network Manager	DS 23a (EATMA)
	NIMS-78 (R)	Enhance local ATFCM system to integrate the proactive flight criticality data	Air Navigation Service Provider – Civil - Civil ATS Approach Service Provider - Civil ATS En-Route Service Provider	DS 23a (EATMA)
AUO-0219	AOC-ATM-24 (R)	Integration of the DCB constraint data to the flight planning functions	Airspace User – Civil - Civil Flight Operations Centre	DS 23a (EATMA)
	AOC-ATM-26 (R)	Integration of the enriched DCB constraint data to the flight planning functions	Airspace User – Civil - Civil Flight Operations Centre	DS 23a (EATMA)
	HUM-19 (R)	New task to analyse the DCB impact and decide on the next action for the flight plan	Airspace User – Civil - Civil Flight Operations Centre	DS 23a (EATMA)

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

OI Steps ref.	Enabler[1] ref.	Enabler definition	Applicable stakeholder	Source reference
	NIMS-58 (R)	Enhance the regional DCB functions to provide the enriched DCB data for a flight trajectory	Network Manager	DS 23a (EATMA)
	NIMS-61 (R)	Enhance the regional DCB functions to provide the DCB constraint data for a flight trajectory	Network Manager	DS 23a (EATMA)
	NIMS-77 (R)	Enhanced local DCB traffic monitoring functions	Air Navigation Service Provider – Civil - Civil ATS Approach Service Provider - Civil ATS En-Route Service Provider	DS 23a (EATMA)

Table 4: OI steps and related Enablers

3.3 Objectives of the CBA

The aim of V3 CBA is to provide an assessment of the economic interest of the deployment of PJ.07-W2-38 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 through an analysis of the Net Present Value 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 for each OI step separately, as a sum of deployment of both OI steps, 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 and uncertainties.

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 consider the local environment/situation (e.g. current operational systems, their lifespan(s), replacement timing, etc.).

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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 CBA analysis	Quantitative results available in the current CBA version
ANSP	All FMP in ECAC handling medium, high, and very high complexity en-route and terminal airspace	**Costs:** No expected costs since they will adopt local DCB solutions based on the one provided by NM **Benefits:** Increased capacity due to more reliable prediction of demand using pre-flight intentions and a more efficient usage of available capacity within the area of responsibility they manage Expect a reduction in the number of tactical interventions	Provided considerations (e.g. costs, benefits, main assumptions) to the CBA	No benefits or costs have been identified for ANSPs
Network Manager	Network Manager	**Costs:** Implementation of appropriate tools and procedures to support collaborative and	Provided cost inputs to the CBA and feedback on main assumptions used	Quantification of costs available

[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.

Stakeholder	The type of stakeholder and/or applicable sub-OE	Type of Impact	Involvement in the CBA analysis	Quantitative results available in the current CBA version
		coordinated Network management activities throughout planning phase **Benefits:** Effective cooperation between all the stakeholders to optimise Network usage Availability of appropriate tools and procedures to support collaborative and coordinated Network management activities throughout planning phase	Reviewed the CBA report	
Scheduled Airlines (Mainline and Regional)	FOC	**Costs:** Investment in enablers necessary for the implementation of the Solution **Costs:** Improved punctuality and cost efficiency since they will be included in the DCB process (FF-ICE)	Provided cost inputs to the CBA and feedback on main assumptions used	Quantification of costs and benefits
Business Aviation	FOC	**Costs:** Investment in enablers necessary for the implementation of the Solution **Costs:** Improved punctuality and cost efficiency since they will be included in the DCB process (FF-ICE)	Provided inputs to the CBA	For the purpose of this CBA merged with Scheduled Airlines
Airport Operators	No involvement	No involvement	No involvement	No involvement

Stakeholder	The type of stakeholder and/or applicable sub-OE	Type of Impact	Involvement in the CBA analysis	Quantitative results available in the current CBA version
Rotorcraft	No involvement	No involvement	No involvement	No involvement
General Aviation	No involvement	No involvement	No involvement	No involvement
Military	No involvement	No involvement	No involvement	No involvement
Other impacted stakeholders (ground handling, weather forecast service provider, NSA….)	No involvement	No involvement	No involvement	No involvement

Table 5: SESAR PJ.07-W2-38 CBA Stakeholders and impacts

3.5 CBA Scenarios and Assumptions

This CBA considers the deployment of Solution PJ.07-W2-38. 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 PJ.07-W2-38 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).

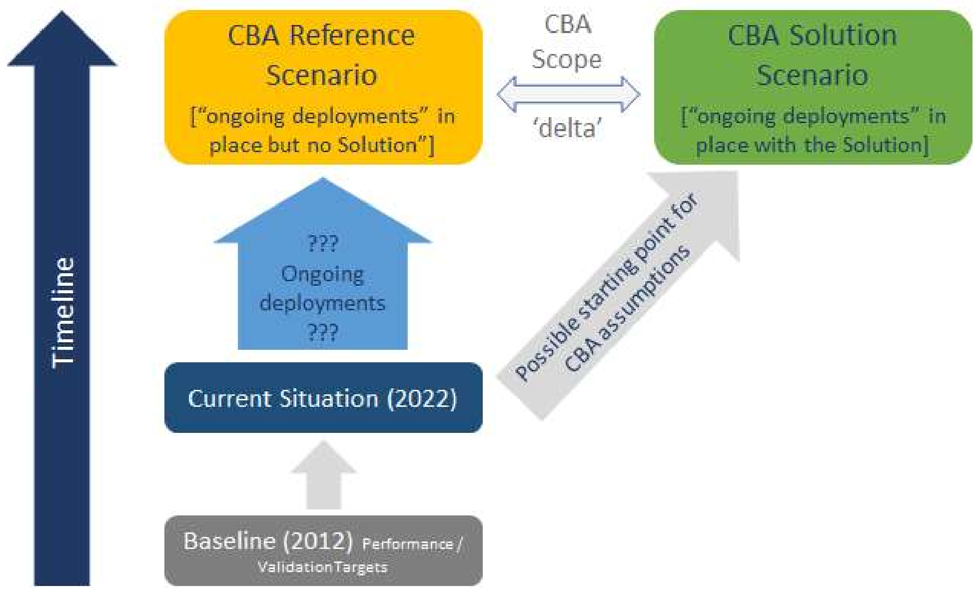

Figure 1: CBA Scenario Overview

3.5.1 CBA Reference Scenario

The CBA Reference Scenario correspond to the situation without the solution and it is assumed that the situation does not change significantly during the CBA scope. Furthermore, based on the discussion with key experts, it was agreed that there are no prerequisites for the implementation of PJ.07-W2-38. It is expected that it can be implemented in the current operating mode via the implementation of specific Solution-related enablers.

3.5.2 CBA Solution Scenario

The CBA Solution Scenario considers deployment of the relevant enablers by relevant stakeholders (i.e. Airspace Users, ANSPs and Network Manager) (see Table 4) in the applicable listed sub-Operating Environments (sub-OE). In terms of deployment scope, the following sub-OE are considered: medium, high, and very high complexity en-route and terminal airspace.

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. Please note that, as explained in the Solution OSED Part I, AUO-0219 can be considered as complementary as far as DCB information to Airspace Users is concerned [8].

Figure 2 below presents an overview of the expected timeline for PJ.07-W2-38, highlighting its key investment moments and benefit generation stages. These constitute the timeline of the CBA. Please note that:

- **Start of deployment** date represents the start of investments for the first deployment location
- **End of deployment** date shows the end of the investments for the final deployment location
- **Initial Operating Capability (IOC)** stands for 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
- **Final Operating Capability (FOC)** represents the moment when maximum benefits from the full deployment of the Solution at applicable locations can be reached. Investment costs are considered to end here, although any operating cost impacts would continue

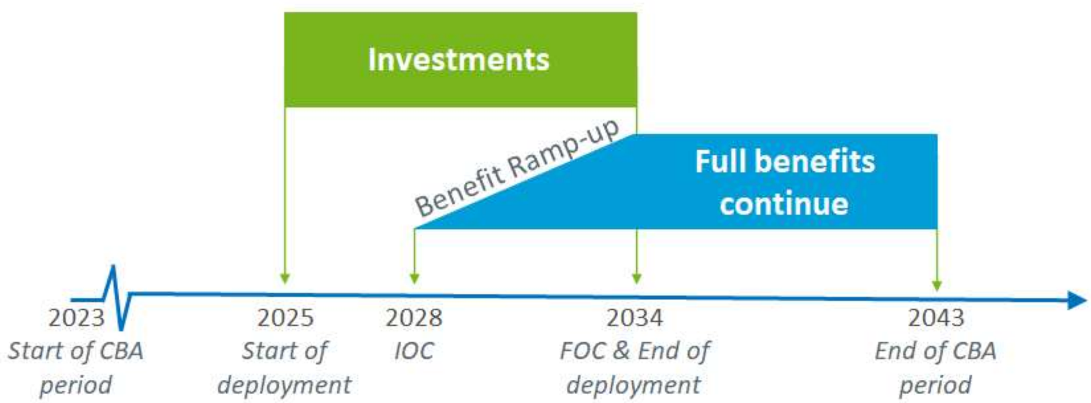

Figure 2: Overview of S38 CBA timeline

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 until the end of the CBA timeline (i.e. 2043).

4 Benefits

The Solution is expected to generate benefits in a two-fold way:

- on the one hand, by allowing the Airspace Users to proactively provide their preferences in terms of flight prioritisation **(proactive- FDCI),** which would allow NMF to propose DCB measures and negotiate trajectories with the Airspace Users **(AUO-0208).**
- on the other hand, by systematically providing the Airspace Users with enriched DCB information **(e.g. protection hotspots),** which would not only allow them to better plan their flights, but also to automate the information exchanges in a CDM environment **(AUO-0219).**

This is expected to improve AUs' flight planning and network management through improved FOC participation into the ATM network collaborative processes. Please note that in this report only the benefits that have a significant quantitative impact as described in the Performance Assessment Report [9].

4.1 FEFF1 Fuel efficiency

Within the frame of PJ.07-W2-38, fuel efficiency is expected to be impacted in the case of both OI steps, as explained below. For more detailed information please refer to the Performance Assessment Report [9].

In the context of **AUO-0208 (proactive-FDCI),** it is expected that allowing Airspace Users to proactively provide preferences on their critical flights will improve DCB processes and minimise the impact on airline scheduling. This will allow for departure times to be closer to the optimum and for an optimised flight trajectory. Optimised critical flight trajectories would, in turn, result in optimal fuel consumption.

It is also important to note that a change in the fuel burn during a flight naturally leads to a variation in the CO_2 emissions from the same flight. Thus, together with the estimation of fuel efficiency, some calculations on the expected emissions reduction were made, as shown further down. In the CBA model, the changes in CO_2 emissions are calculated automatically as a consequence of fuel efficiency indicators, not constituting a separate benefit nor requiring a separate input.

The quantification values provided by the Performance Assessment Report for this KPI, and this OI are presented in the table below.

Indicator	Value
Expected absolute impact at ECAC level	0.02 kg/flight (negative impact)
Expected delta fuel consumption from the Solution	0.001% (negative impact)
Expected consequent impact on the CO_2	0.07 kg/flight (negative impact)
Expected delta decrease in emissions	0.001% (negative impact)

Table 6: Overview of performance elements used in the CBA for FEFF1 (AUO-0208)

Looking into **AUO-0219 (protection hotspots)**, a greater automation of DCB processes and the fact that NMF will propose to AUs to adapt their planned trajectory to take their preferences into account, a possible increase of reroutings to mitigate the impact of DCB measures could increase the fuel burnt. On the other hand, protection hotspots can avoid significant number of inefficient refilings allowing a fuel burn decrease.

The following data is provided in PAR regarding the extrapolation of impacts to ECAC region with regard to this KPI.

Indicator	Value
Expected absolute impact at ECAC level	0.67 kg/flight (negative impact)
Expected delta fuel consumption from the Solution	0.01% (negative impact)
Expected consequent impact on the CO_2	2.11 kg/flight (negative impact)
Expected delta decrease in emissions	0.01% (negative impact)

Table 7: Overview of performance elements used in the CBA for FEFF1 (AUO-0219)

In the CBA model this KPI is monetised as presented in Figure 3. In order to monetise the benefits, the model relies on the data provided in PAR as presented in the tables above. This is applicable to both OI steps, however, in the case of AUO-0208 the traffic concerned will be focussing on critical flights within the scope region. Please note that, as explained in section 5.4.3, it is expected that approximately 40 airlines, representing about 62% of traffic in 2022, will be deploying PJ.07-W2-38. Therefore, considering that FEFF1 benefit is expected to impact the flights directly concerned by the Solution (i.e. those of AUs implementing PJ.07-W2-38), in order to remain conservative in the calculation of FEFF1 benefit, the inputs in the model will be scaled down to 62% of the ones reported in Table 7 and Table 6, to reflect the expected traffic affected.

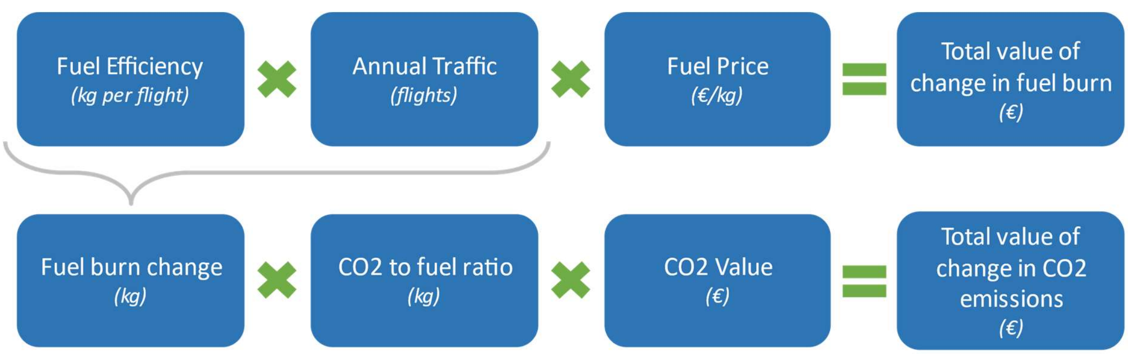

Figure 3: Monetisation of FEFF1 KPI

4.2 PUN1 Punctuality

The Punctuality KPI represents the average departure delay due to reactionary delays, ATM, and weather-related delay causes. In the case of Solution PJ.07-W2-38, a reduction in the average departure delay per flight and the consequent optimisation of flight trajectories is expected to lead to an improved flight punctuality and the corresponding savings for the AUs. This impact relates solely to **AUO-0219 (protection hotspots)** (please refer to PAR [9] for more details).

This benefit is monetised following the formula below.

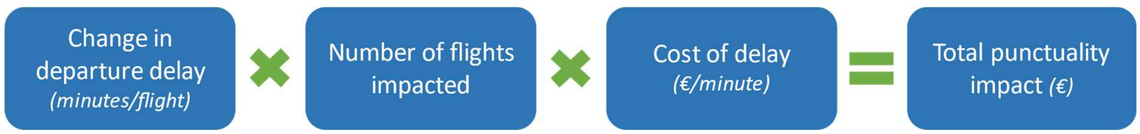

Figure 4: Monetisation of PUN1 KPI

In order to monetise the benefits, the model relies on the inputs calculated in the PAR, extrapolated to the ECAC level, that are presented in the table below. For detailed information on the calculations please refer to the Performance Assessment Report [9].

Indicator	Value
Delta absolute delay per rerouted flight (ECAC-wide)	**0.24 min/flight**

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

The implementation of the Solution at the ECAC level is expected to result in an improvement of 0.24 minutes per flight, which is used in the CBA model to calculate the total monetised benefit.

4.3 AUC3 Airspace User cost efficiency

PJ.07-W2-38 is expected to generate cost savings for the Airspace Users by allowing them to better plan/re-plan their flights due to the provision of an accurate DCB information. As explained more in detail in [8] and [9], trajectory negotiation with an enriched DCB information would enable AUs to re-route their flights with an awareness of the evolving situation in surrounding sectors which is expected to reduce their cost/delay and avoid the need for additional regulations.

Moreover, an increased number of automatic flight plan changes is expected to further contribute to the optimisation of the planned trajectory without additional AU operator workload, while fewer late flight plan changes are expected to reduce AU operator's workload, since they typically require coordination with the flight crew. Finally, improving task allocation between Human and Machine and supporting Human by technical systems will allow to reduce AU operator's workload, also contributing to the AU cost efficiency improvement.

In the CBA, this benefit refers to **AUO-0208 (proactive-FDCI),** since this is the OI step that focuses on critical flights and, hence, is expected to yield the cost savings, and is monetised as a reduction in operating costs for the Airspace Users.

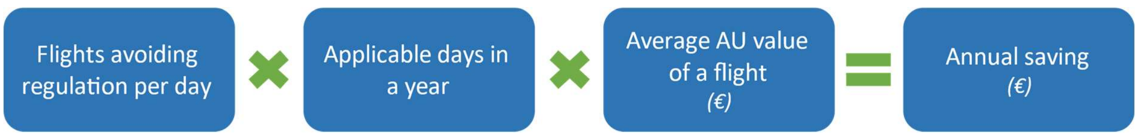

Figure 5: Monetisation of AUC3 KPI

The table below presents the expected total absolute benefit in terms of cost savings for the AUs per year across ECAC. This value represents the expected cost savings for the Airspace Users per year after the full operational capability has been reached (i.e. 2034). Before this time, this benefit will follow the benefit ramp-up, as shown in Figure 2. Please refer to the PAR [9] for further details on the calculation of this benefit.

Indicator	Value
Absolute expected performance benefit ECAC-wide (per year)	€ 191,625,000

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

4.4 Overview of KPIs considered in the CBA

Performance Framework KPA[3]	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	2043 (AUO-0208)	2043 (AUO-0219)
Cost Efficiency	ANS Cost efficiency	**CEF2** Flights per ATCO-Hour on duty	Nb	ATCO employment Cost change	€/year	N/A	N/A
				Support Staff Employment Cost Change	€/year	N/A	N/A
				Non-staff Operating Costs Change	€/year	N/A	N/A
		CEF3 Technology cost per flight	EUR / flight	G2G ANS cost changes related to technology and equipment	€/year	N/A	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	191 M€	N/A
		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	N/A

[3] For information, the mapping to the Performance Ambition KPAs (used in the ATM Master Plan) is available in the **Error! Reference source not found.**.

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Performance Framework KPA[3]	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	2043 (AUO-0208)	2043 (AUO-0219)
		AUC5 Overhead costs for an airspace user	EUR / flight	Impact on overhead costs. Examples: dispatchers, training, IT infrastructure, sales.	€/year	N/A	N/A
Capacity	Airspace capacity	**CAP1** TMA throughput, in challenging airspace, per unit time	% and # movements	Tactical delay cost (avoided-; additional +)	€/year	N/A	N/A
			% and # movements	Strategic delay cost (avoided-; additional +)	€/year	N/A	N/A
		CAP2 En-route throughput, in challenging airspace, per unit time	% and # movements	Tactical delay cost (avoided-; additional +)	€/year	N/A	N/A
			% and # movements	Strategic delay cost (avoided-; additional +)	€/year	N/A	N/A
	Airport capacity	**CAP3** Peak Runway Throughput (Mixed mode)	% and # movements	Value of additional flights	€/year	N/A	N/A
	Resilience	**RES4a** Minutes of delays	Minutes	Tactical delay cost (avoided-; additional +)	€/year	N/A	N/A
		RES4b Cancellations	% and # movements	Cost of cancellations	€/year	N/A	N/A
		Diversions	% and # movements	Cost of diversions	€/year	N/A	N/A

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Performance Framework KPA[3]	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	2043 (AUO-0208)	2043 (AUO-0219)
Predictability and punctuality	Predictability	**PRD1** Variance of Difference in actual & Flight Plan or RBT durations	Minutes^2	Strategic delay cost (avoided-; additional +)	€/year	Neutral	N/A
	Punctuality	**PUN1** % Departures < +/- 3 mins vs. schedule due to ATM causes	% (and # movements)	Tactical delay cost (avoided-; additional +)	€/year	N/A	156 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	**TEFF1** Reduction in average flight duration	% and minutes	Strategic delay: airborne: direct cost to an airline excl. Fuel (avoided-; additional +)	€/year	Neutral	N/A
	Fuel Efficiency	**FEFF1** Average fuel burn per flight	Kg fuel per movement	Fuel Costs	€/year	- 0.2 M€	- 6.1 M€
	Fuel Efficiency	**FEFF2** CO_2 Emissions	Kg CO_2 per movement	CO_2 Costs	€/year	- 0.0003 M€	- 0.01 M€

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Performance Framework KPA[3]	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	2043 (AUO-0208)	2043 (AUO-0219)
Civil-Military Cooperation & Coordination	Civil-Military Cooperation & Coordination	**CMC2.1a** Fuel saving (for GAT operations)	Kg fuel per movement	Fuel Costs	€/year	N/A	N/A
		CMC2.1b Distance saving (for GAT operations)	NM per movement	Time Costs	€/year	N/A	N/A

Table 10: Results of the benefits monetisation per KPA

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5 Cost assessment

This section presents an assessment of costs that are expected to be borne by the different stakeholders to implement PJ.07-W2-38. These include the capital expenditure (CAPEX) associated to 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. All the inputs on costs are a result of discussions with the project partners and constitute an approximation of the costs expected to be borne by the different stakeholders.

The table below presents summary of the enablers per OI and per stakeholder that are required for the implementation of PJ.07-W2-38, as specified on EATMA portal.

OI code	Enabler code	Enabler title	Stakeholders concerned
AUO-0208	AOC-ATM-28	Enhance AU flight planning systems to integrate the proactive flight criticality data	AU
AUO-0208	NIMS-72	Enhance NM flight planning and DCB functions to integrate the proactive flight criticality data	NM
AUO-0208	NIMS-78	Enhance local ATFCM system to integrate the proactive flight criticality data	ANSP
AUO-0219	AOC-ATM-24	Integration of the DCB constraint data to the flight planning functions	AU
AUO-0219	AOC-ATM-26	Integration of the enriched DCB constraint data to the flight planning functions	AU
AUO-0219	HUM-019	New task to analyse the DCB impact and decide on the next action for the flight plan	AU
AUO-0219	NIMS-58	Enhance the regional DCB functions to provide the enriched DCB data for a flight trajectory	NM
AUO-0219	NIMS-61	Enhance the regional DCB functions to provide the DCB constraint data for a flight trajectory	NM
AUO-0219	NIMS-77	Enhanced local DCB traffic monitoring functions	ANSP

Table 11: Overview of enablers per stakeholder

After the discussion with the Solution partners, it became clear that ANSPs will not be required to invest in PJ.07-W2-38 implementation, they will instead be able to benefit, without investing, from the system put in place by the Network Manager, while any training costs associated with the deployment of a new tool/process are expected to be part of the regular training which would happen independently from PJ.07-W2-38 deployment. Thus, no costs for ANSPs will be monetised in the CBA.

5.1 ANSPs costs

As mentioned in the previous section, after a discussion with the Solution partners it became clear that ANSPs will use the system implemented by NM and, hence, will not be required to make any investments.

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5.2 Airport operators costs

Airport Operators are not required to invest for this solution.

5.3 Network Manager costs

5.3.1 Network Manager cost approach

The cost figures for Network Manager as presented in the sections below were provided by the partners from NM and they reflect the numbers specific to the enablers relative to PJ.07-W2-38 deployment.

5.3.2 Network Manager cost assumptions

The main assumption related to the costs of implementation of Solution PJ.07-W2-38 for the Network Manager is that this will be the stakeholder implementing the functionality and making it available to the ANSPs. Furthermore, no additional training costs are expected for this stakeholder, as any training needs will be embedded in the periodic training activities.

5.3.3 Network Manager cost figures

The table below presents the expected costs to be borne by the Network Manager for the implementation of the enablers related to each of their enablers (see Table 4). These include the costs associated to the system development, installation and/or integration. As mentioned in section 5.3.1, these costs were provided by NM regarding the implementation of the specific enablers for PJ.07-W2-38, as listed in Table 11.

Cost category	AUO-0208	AUO-0219	
	NIMS-72	*NIMS-58*	*NIMS-61*
Pre-Implementation Costs	Not applicable	Not applicable	
Implementation costs	3.5 M€	7 M€	
Operating costs	Not applicable	Not applicable	

Table 12: Cost per Unit - NM

5.4 Airspace User costs

5.4.1 Airspace User cost approach

The cost information provided by the different partners were put together to estimate a unique cost for the implementation of PJ.07-W2-38.

5.4.2 Airspace User cost assumptions

One of the main assumptions taken during the elaboration of the CBA is that the AUs will be investing in an internal development of the new tool. This assumption is based on the data available provided by the Airspace Users and constitutes a conservative approach to cost estimation.

Another important assumption that was made to estimate the number of AUs that will be involved in PJ.07-W2-38 deployment is that these will be the airlines that declare flight critical operations. This influences greatly the investment instances below.

Finally, it is assumed that the unit costs for Scheduled and Business Aviation will be the same. For this reason and considering the lack of information regarding the proportion of Scheduled vs. Business aviation that will be deploying the Solution, the costs for these two AU segments are monetised together under Scheduled Aviation.

5.4.3 Number of investment instances (units)

The table below provides an overview of the investment instances (i.e. the number of airlines that will be deploying PJ.07-W2-38). It relies on the assumption that the airlines that will be investing in the Solution are those that declare flight critical operations. According to the inputs provided by NM, the top 40 airlines, representing around 62% of the traffic at the network level, would constitute a proxy for the number of airlines that will be deploying PJ.07-W2-38, with the view to remain conservative in the calculations. These airlines include both, scheduled and business aviation, and exclude military traffic which is not targeted by PJ.07-W2-38.

Total	
Ground locations (e.g. FOCs)	Airborne (air vehicles)
40	Not applicable

Table 13: Number of investment instances - AUs

5.4.4 Cost per unit

Table 14 presents the expected unit costs that will be borne by the Airspace Users to implement and use PJ.07-W2-38. The figures are provided per year and per Airspace User.

Cost category	AUO-0208 (Ground)	AUO-0219 (Ground)			
	AOC-ATM-28	*AOC-ATM-24*	*AOC-ATM-26*	*HUM-019*	*Total*
Pre-Implementation Costs	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Implementation costs	€ 17,500	€ 38,500	€ 19,500	€ 22,000	€ 80,000
Operating costs	Not applicable	€ 16,800			

Table 14: Cost per unit – AUs

In the table above, the implementation costs include any costs related to the development and implementation of PJ.07-W2-38, such as the development, installation, and certification of the system, related administrative and project management costs, initial personnel training, etc. Operating costs (OPEX), on the other hand, represent essentially any maintenance or other operating costs that are expected on the Airspace User side. These costs were estimated by the AUs involved in the project for the different cost elements (i.e. deployment, training, etc.) of each enabler involved in PJ.07-W2-38, as presented in Table 11.

5.5 Military costs

Military stakeholders are not required to invest for this solution.

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5.6 Other relevant stakeholders

Not applicable.

6 CBA Model

The model used for the elaboration of this CBA is the CBA Model 7.4.1 produced by PJ19.04. Please find attached below the model with the monetisation of impacts related to PJ.07-W2-38.

D2.1.010-PJ.07-W2-38-V3-CBA_model.xls

6.1 Data sources

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

The information on the quantification of benefits expected from the Solution is derived from the Performance Assessment Report [9] section on extrapolation to ECAC.

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”.

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7 CBA Results

In the sub-sections below are presented the outcomes of the CBA analysis per OI step, taking into consideration the assumptions and values outlined previously in this report.

7.1 AUO-0208

7.1.1 Discounted results

Table 15 shows the outcomes of the CBA over the entire period discounted to 2023 values using a discount rate of 8% as specified in SESAR Common Assumptions [4], namely the costs, benefits and the Net Present Value (NPV). The outcomes represent the present value of future cashflows related to the implementation of AUO-0208 (proactive-FDCI).

Stakeholder	Benefits	Costs	NPV[4]
ANSP	€ 0	€ 0	€ 0
Network Manager	€ 0	- 2 M€	- 2 M€
Airspace Users	772 M€	- 400 K€	771 M€
Total	**772 M€**	**- 3 M€**	**769 M€**

Table 15: Overview of discounted CBA results per stakeholder (AUO-0208)

It can be observed in the table that, as explained in Chapter 5, NM and AUs are the two stakeholders that are expected to bear the costs associated with the implementation of PJ.07-W2-38 with a total discounted cost of 2 M€ and 400 K€ respectively. The Airspace Users are also expected to be the stakeholder benefitting from the Solution, counting with about 772 M€ benefits over the entire CBA timeline. The remaining stakeholders, as explained in OSED[8] and PAR[9], are not expected to have any significant costs or quantifiable benefits from PJ.07-W2-38 deployment.

The total **NPV from the implementation of AUO-0208 is expected to reach 769 M€** between 2022 and 2043, representing the net benefit, in 2023 euros, that the implementation of this OI step is expected to bring. This shows that the deployment of AUO-0208 is a viable investment where the benefits are expected to significantly overweight the costs. And Figure 6 below shows that this investment is particularly interesting from the point of view of AU cost saving, since this OI step is the one that will have the benefits related to AU OPEX savings.

[4] 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.

Figure 6 shows the evolution of discounted costs and benefits related to the deployment of AUO-0208, representing a detailed look into the yearly evolution of the numbers in Table 15.

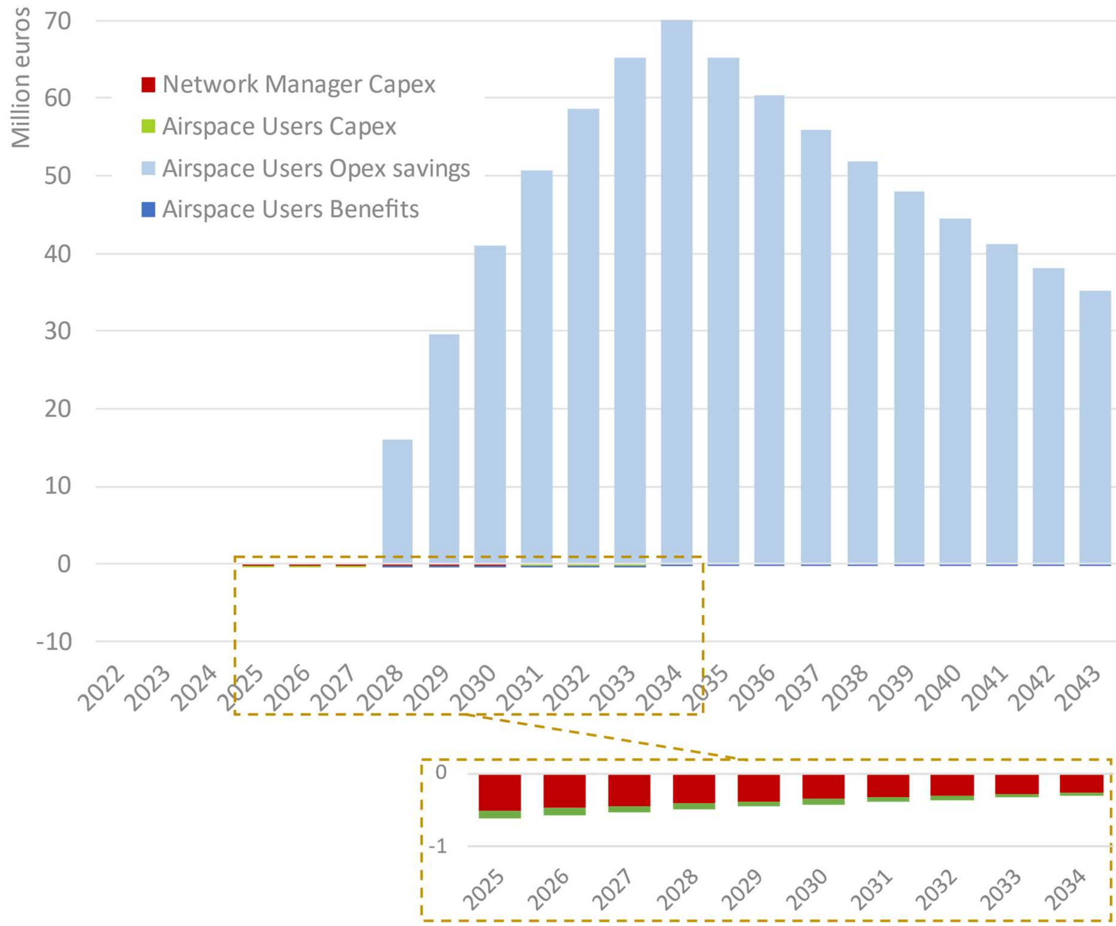

Figure 6: Evolution of discounted cashflows over time (AUO-0208)

It can be observed in Figure 6 that in the first years of PJ.07-W2-38 deployment, the stakeholders are expected to bear the Solution deployment costs, with the benefits starting to be generated as of 2028. The benefits are expected to increase in the first years, following the progressive implementation of PJ.07-W2-38. Once the benefits reach their full capacity in 2034, they appear as decreasing starting from 2035, which in reality reflects the impact of the discount rate of 8% yearly on the values. A similar situation is observed on the costs side, mainly due to the discount rate application. The costs are expected to be distributed between 2025 and 2034, which corresponds to the investment period of the Solution (see Figure 2).

It can be observed in Figure 6 that the biggest expected benefit is the AU OPEX saving related to AUO-0208. As explained in Section 4.3 and detailed in [9], this is linked to the expected reduction in ATFCM delay, which would improve the punctuality of critical flights, and indirectly all other flights in the rotation, and hence generate significant savings for the Airspace User.

Figure 7shows the cumulated discounted net benefits evolution over time and should be read as a complement to Figure 6.

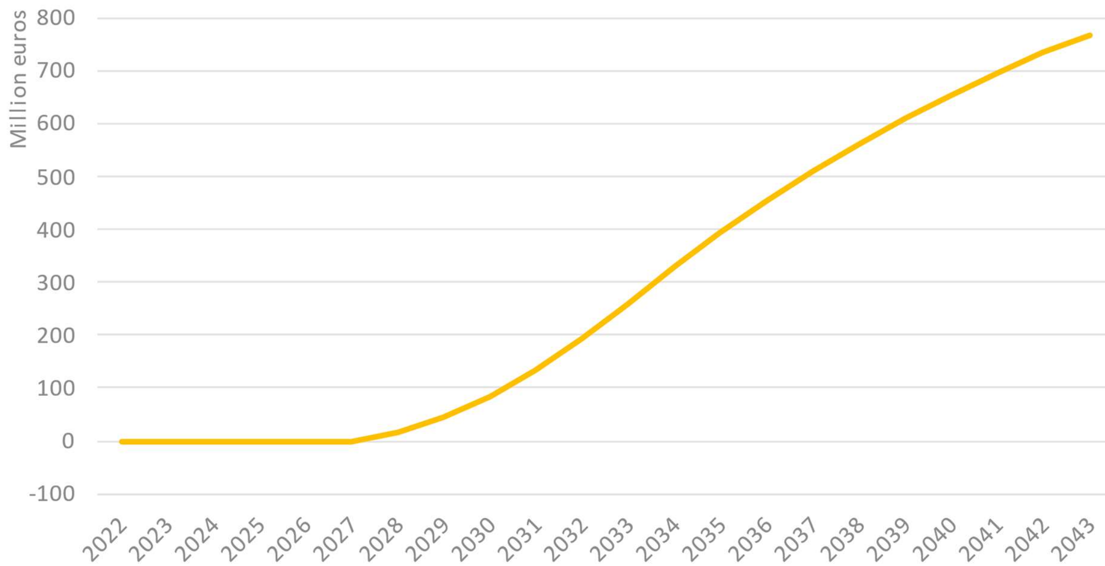

Figure 7: Evolution of discounted cumulative benefits over time (AUO-0208)

As can be observed in the figure above, the cumulative discounted net benefits from the implementation of AUO-0208 (proactive-FDCI) continue their growth over the entire timeline, showing the expected increase in net benefits, to reach 769 M€ in 2043. The payback period for the deployment of this OI step is rather short: the benefits outgrow the costs already in 2028, representing a payback period of 3 years.

7.1.2 Undiscounted results

The undiscounted results show the outcomes of the CBA before applying the yearly discount rate to account for the effects of inflation. Thus, they represent the yearly and total cash flows expected from the AUO-0208 deployment, without bringing them to today's money. Table 16 shows an overview of the total undiscounted results per stakeholder related to the deployment of AUO-0208 (proactive-FDCI).

Stakeholder	Benefits	Costs	Net benefits[5]
ANSP	€ 0	€ 0	€ 0
Network Manager	€ 0	- 3.5 M€	- 3.5 M€
Airspace Users	2,489 M€	- 700 K€	2,488 M€
Total	**2,489 M€**	**- 4 M€**	**2,485 M€**

Table 16: Overview of undiscounted CBA results per stakeholder (AUO-0208)

It can be observed in the table above that the deployment of AUO-0208 is expected to bring an **undiscounted net benefit of about 2,485 M€.** This is mainly linked to the expected high AUC3 impact, which represents an estimated saving of more than 191 M€ per year at the ECAC level. In this frame, Airspace Users are expected to be the stakeholder category benefitting the most from the implementation of the enablers relative to this OI step.

Network Manager, by its turn, is expected to have a cost of 3.5 M€, which represents the costs associated with the development of the system that will be used in the frame of PJ.07-W2-38. NM is not, however, expected to have significant quantifiable benefits arising from this investment (please refer to PAR [9] for more details).

When it comes to the specific KPIs, Table 17 presents an overview of the expected undiscounted cumulated benefits associated to each KPI monetised in the CBA for the period 2022-2043.

KPI	Expected benefit
FEFF1 Fuel efficiency	- 2 M€
PUN1 Punctuality	€ 0
AUC3 Airspace User cost efficiency	2,491 M€

Table 17: Cumulative undiscounted benefits per KPI (AOU-0208)

[5] 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.

Table 17 shows that, as described in section 4, for AUO-0208 (proactive-FDCI), AUC3 is the KPI that is expected to be the most impacted by OJ.07-W2-38, since it would allow the Airspace Users to better adapt their operations to their needs. PUN1, on the other hand, is not expected to bring any monetary value through the deployment of AUO-0208, since it is fully linked to AUO-0208 deployment.

Figure 8 shows the distribution of yearly undiscounted cashflows over the entire CBA timeline (i.e. 2022-2043) for AUO-0208 (proactive-FDCI).

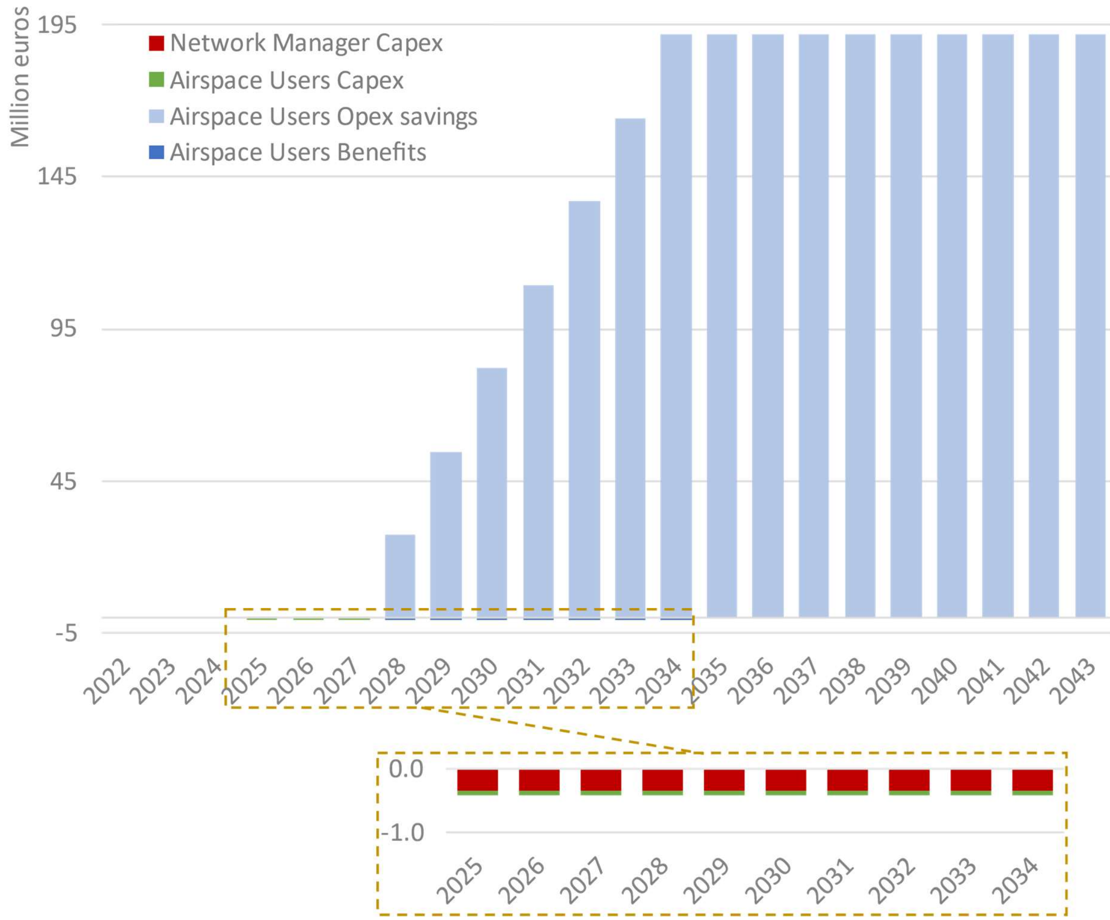

Figure 8: Evolution of undiscounted cashflows over time (AUO-0208)

It can be observed in the figure that the costs associated to the implementation of AUO-0208 (i.e. NM and AU capital expenditure (CAPEX)) are expected to incur between 2025 (i.e. start of deployment) and 2034 (i.e. FOC). After 2034 all enablers are expected to be in place and the Solution is expected to generate full benefits.

The benefit distribution follows a growing trend, steeper during the years of PJ.07-W2-38 deployment and slower after full deployment. This happens because the benefits are related to the level of operability of the Solution: during the first years the benefits are linked to the number of stakeholders that adopted the Solution, growing proportionally. Once FOC is reached in 2034, the benefits start growing slower, remaining relatively stable over time, reflecting the traffic growth in the model. The AU OPEX saving are expected to reach a plateau because a stable amount of savings per year was considered for this model.

7.2 AUO-0219

7.2.1 Discounted results

Table 18 shows the outcomes of the CBA over the entire period (i.e. 2022-2043) discounted to 2023 prices using a discount rate of 8%, as specified in SESAR Common Assumptions [4]. The outcomes represent the present value of future cashflows related to the implementation of AUO-0219 (protection hotspots).

Stakeholder	Benefits	Costs	NPV[6]
ANSP	€ 0	€ 0	€ 0
Network Manager	€ 0	- 4 M€	- 4 M€
Airspace Users	564 M€	- 2 M€	562 M€
Total	**564 M€**	**- 6 M€**	**558 M€**

Table 18: Overview of discounted CBA results per stakeholder (AUO-0219)

Similarly to what happens for AUO-0208, NM and AUs are re expected to bear the majority of costs associated with the deployment of AUO-0219 (protection hotspots), representing a total undiscounted cost of 6 M€ (4 M€ for NM and 2 M€ for the AU). The Airspace Users are, however, also expected to be the ones benefitting from the implementation of AUO-0219, amounting 564 M€ in NPV over the entire timeline. The remaining stakeholders, as explained in OSED and PAR, are not expected to have any significant costs or benefits from PJ.07-W2-38 deployment.

Thus, the total **NPV from the implementation of AUO-0219 is expected to reach 558 M€** between 2022 and 2043. This reflects the net benefit, in 2023 euros, that the implementation of this OI step is expected to bring, showing that the deployment of this OI step is an investment that will bring benefits significantly higher than its cost of implementation, making it an interesting investment.

Figure 9 shows the evolution of discounted cashflows related to the deployment of AUO-0219.

[6] 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.

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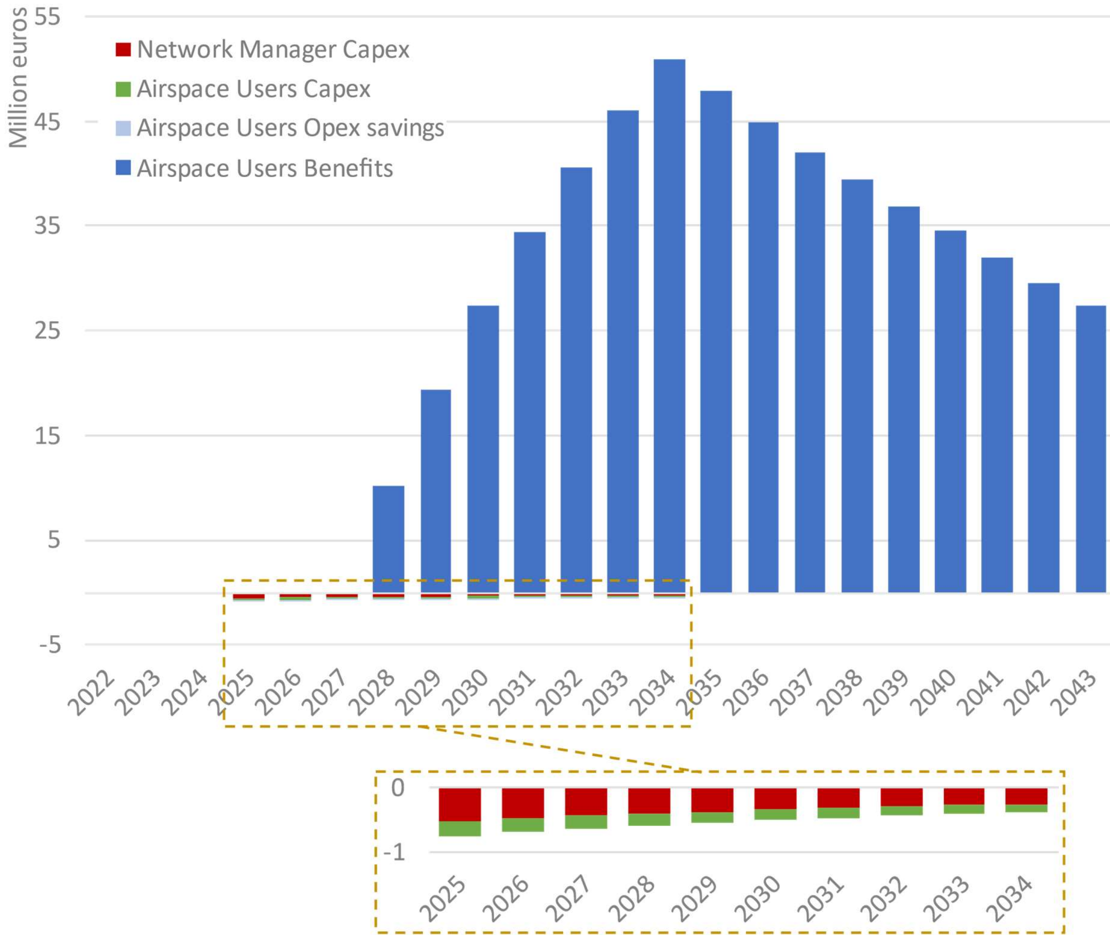

Figure 9: Evolution of discounted cashflows over time (AUO-0219)

It can be observed in the figure above that the yearly cashflows from AUO-0219 (protection hotspots) deployment are expected to increase in the first years, following the progressive implementation of PJ.07-W2-38. Once the Solution reaches its full implementation in 2034, the benefits appear as decreasing starting from 2035. In reality, this reflects the impact of the discount rate of 8% yearly on the values.

While the yearly discounted benefits are shown above, the related cumulated discounted benefits over the years are presented in Figure 10.

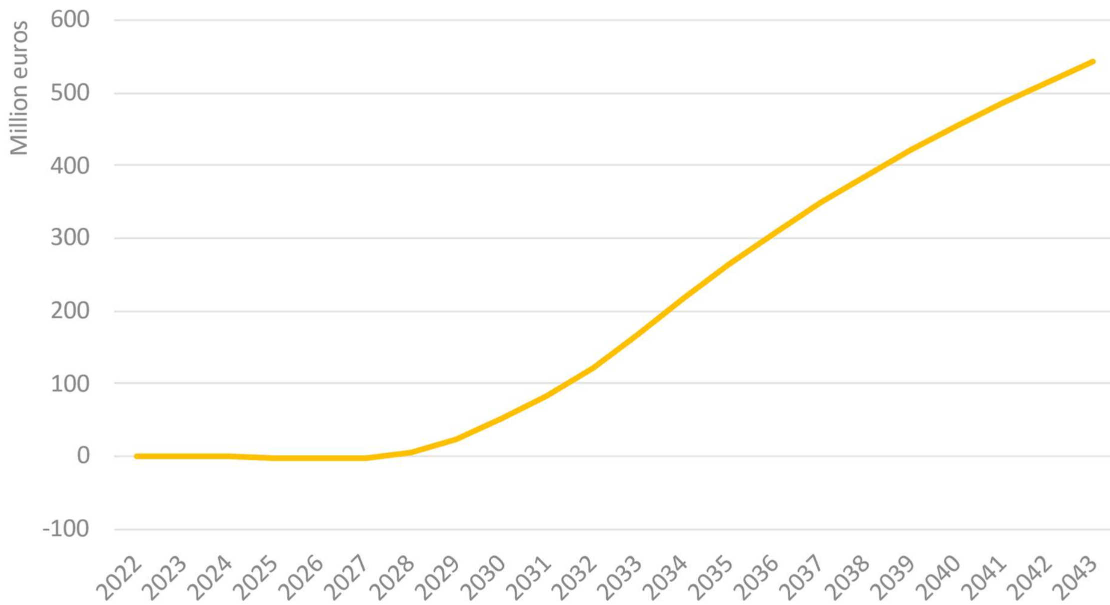

Figure 10: Evolution of discounted cumulative benefits over time (AUO-0219)

As shown in Figure 10, the discounted cumulated net benefits from the implementation of AUO-0219 (protection hotspots) increase over the entire CBA timeline, to reach 558 M€ by 2043. The payback period for the implementation of this OI step is of 3 years: the benefits outgrow the costs already in 2028.

7.2.2 Undiscounted results

In Table 19 is presented an overview of the total undiscounted results per stakeholder related to the deployment of AUO-0219 (protection hotspots).

Stakeholder	Benefits	Costs	Net benefits
ANSP	€ 0	€ 0	€ 0
Network Manager	€ 0	- 7 M€	- 7 M€
Airspace Users	1,847 M€	- 3 M€	1,844 M€
Total	**1,847 M€**	**- 10 M€**	**1,837 M€**

Table 19: Overview of undiscounted CBA results per stakeholder (AUO-0219)

As shown in the table above, the deployment of AUO-0219 is expected to bring an **undiscounted net benefit of about 1,837 M€** between 2022 and 2043**.** This reflects the expected impact from the PUN1 KPI, which strongly outweighs the slightly negative fuel impact that is expected from the implementation of PJ.07-W2-38 (see section 4.1 for more details).

To deploy this OI step, the Network Manager is expected to bear an undiscounted cost of 7 M€, which represents the costs associated with the development of the system that will be used in the frame of the Solution implementation. NM is not expected to have significant benefits arising from this investment (please refer to PAR [9] for more details). The AUs are also expected to invest in the development and implementation of the necessary systems in their flight operations centres, amounting an expected cost of about 6 M€ over the entire timeline.

Looking specifically at different KPIs, Table 20 presents the cumulative undiscounted benefits per KPI and for all stakeholders from the implementation of this OI step.

KPI	Expected benefit
FEFF1 Fuel efficiency	- 75 M€
PUN1 Punctuality	1,922 M€
AUC3 Airspace User cost efficiency	€ 0

Table 20: Cumulative undiscounted benefits per KPI (AOU-0219)

As can be observed in the table, the PUN1 KPI is the one that is expected to be the most impacted by the implementation of AUO-0219, bringing about 1,922 M€ in cumulated undiscounted benefits between 2022 and 2043. FEFF1, as discussed in section 4.1, is expected to represent a loss amounting about 75 M€. AUC3 is a KPI that is not expected to bring any monetary value through the deployment of AUO-0219, since this KPI is linked to AUO-0208 deployment.

Figure 11 represents the distribution of yearly undiscounted cashflows over the entire CBA timeline (i.e. 2022-2043) for AUO-0219 (protection hotspots).

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Figure 11: Evolution of undiscounted cashflows over time (AUO-0219)

Figure 11 shows that the yearly benefits from the implementation of AUO-0219 increase over time, with a stronger yearly growth during the years of deployment and slower after full deployment is reached. This is due to the fact that the benefits are related to the level of operability of the Solution: during the first years the benefits are linked to the number of stakeholders that adopted the Solution, growing proportionally. Once FOC is reached in 2034, the benefits start growing slower, remaining relatively stable over time, reflecting the traffic growth in the model.

When it comes to the costs, these are expected to incur between 2025 (i.e. start of deployment) and 2034 (i.e. FOC). After 2034 all enablers are expected to be in place and the Solution is expected to generate full benefits.

7.3 Combined solution (AUO-0208 & AUO-0219)

This section presents the CBA results if both OI steps (AUO-0208 and AUO-0219) are implemented together. Please note that for the purpose of this CBA and based on discussions with Solution partners it is assumed that no additional efficiency gains will be associated to the joint implementation of both OI steps, hence **these results represent the sum of impacts from each OI step individually.**

7.3.1 Discounted results

Table 21 shows the outcomes of the CBA over the entire period discounted to 2023 prices using a discount rate of 8%. The outcomes represent the present value of future cashflows related to the implementation of PJ.07-W2-38 (both OI steps).

Stakeholder	Benefits	Costs	NPV[7]
ANSP	€ 0	€ 0	€ 0
Network Manager	€ 0	- 6 M€	- 6 M€
Airspace Users	1,335 M€	- 2 M€	1,333 M€
Total	**1,335 M€**	**- 8 M€**	**1,327 M€**

Table 21: Overview of discounted CBA results per stakeholder (AUO-0208 & AUO-0219)

Similarly to what happens for each OI step individually (see sections 7.1.1 and 7.2.1), AUs is the stakeholder that is expected to benefit the most from the implementation of PJ.07-W2-38, with an expected NPV of 1,327 M€ between 2022 and 2043. This benefit stems mainly from AUC3, but also from PUN1. NM is expected to invest in the development and deployment of the PJ.07-W2-38 without having quantifiable benefits, thus sustaining an NPV of -6 M€.

The total **NPV from the implementation of PJ.07-W2-38 is expected to reach 1,327 M€** over the entire timeline. This shows that the benefits from the deployment of both OI steps are expected to bring benefits that, in monetary terms, and much higher than the expected costs of implementation. However, it is important to note here that this represents a sum of benefits and costs from the deployment of each OI step separately and any additional efficiency gains from joint deployment should be analysed separately if such an analysis becomes necessary.

Figure 12 shows the evolution of discounted cashflows related to the deployment of PJ.07-W2-38 both OI steps, the sum of which is shown in Table 21 above.

[7] 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.

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Figure 12: Evolution of discounted cashflows over time (AUO-0208 & AUO-0219)

As shown in Figure 12, the yearly cashflows from the deployment of both OI steps of PJ.07-W2-38 are expected to increase in the first years, following the progressive implementation of PJ.07-W2-38, visibly decreasing once it reaches its full implementation in 2034. This visual decrease reflects the impact of the discount rate of 8% yearly on the values. Figure 13 shows the cumulated discounted net benefits evolution over time. It can also be observed that both, AU OPEX savings (representing AUC3) and AU benefits (representing PUN1) have a strong presence in terms of monetary impacts. This shows that each of the OI steps has its strengths in terms of benefits (AUC3 for AUO-0208 and PUN1 for AUO-0219) and the deployment of both OI steps would bring different benefits to the Airspace Users.

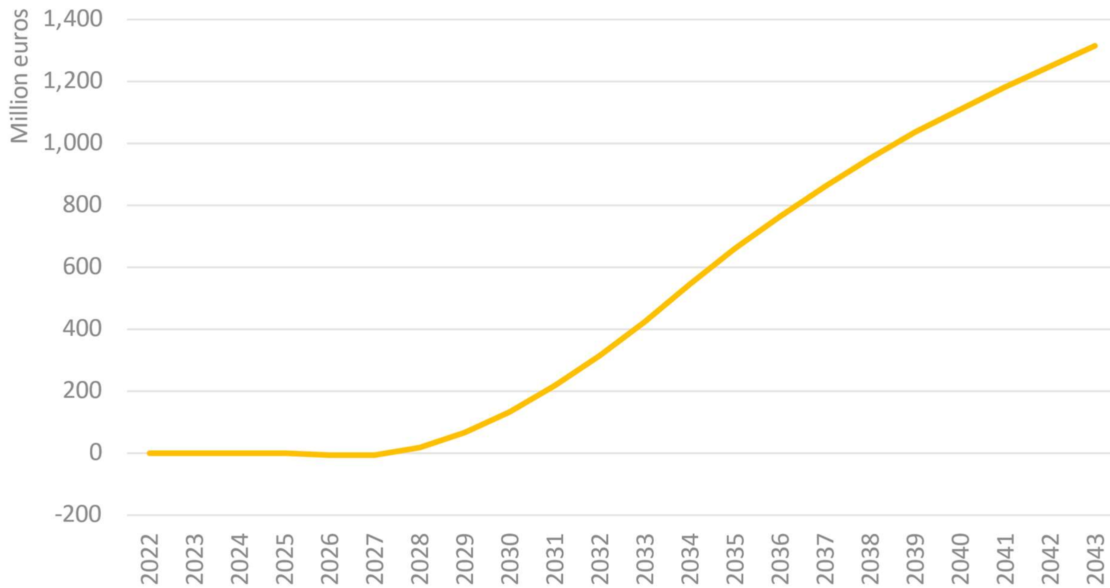

Figure 13: Evolution of discounted cumulative benefits over time (AUO-0208 & AUO-0219)

The cumulative discounted net benefits from the implementation of PJ.07-W2-38 are expected to increase over the entire CBA timeline, to reach 1,327 M€ by 2043. The payback period for the implementation of PJ.07-W2-38 is of 3 years, with the benefits outgrowing the costs by 2028.

7.3.2 Undiscounted results

Table 22 shows the overview of the total undiscounted results per stakeholder related to the deployment of PJ.07-W2-38 (both OI steps).

Stakeholder	Benefits	Costs	Net benefits[8]
ANSP	€ 0	€ 0	€ 0
Network Manager	€ 0	- 11 M€	- 11 M€
Airspace Users	4,336 M€	- 4 M€	4,332 M€
Total	**4,336 M€**	**- 15 M€**	**4,321 M€**

Table 22: Overview of undiscounted CBA results per stakeholder (AUO-0208 & AUO-0219)

The deployment of PJ.07-W2-38 is expected to bring an **undiscounted net benefit of about 4,321 M€** between 2022 and 2043, reflecting the expected benefits form the separate implementation of each OI step. Similarly to what happens for the individual OI steps (see sections 7.1.2 and 7.2.2), AUs are expected to benefit the most from the Solution, while NM is the stakeholder that is expected to invest in the Solution deployment, without having major quantifiable benefits. Please refer to OSED[8] and PAR [9] for more details.

Table 23 shows the cumulative undiscounted benefits per KPI and for all stakeholders from the implementation of PJ.07-W2-38.

KPI	Expected benefit
FEFF1 Fuel efficiency	- 177 M€
PUN1 Punctuality	1,922 M€
AUC3 Airspace User cost efficiency	2,491 M€

Table 23: Cumulative undiscounted benefits per KPI (AUO-0208 & AUO-0219)

As a result of joint implementation of the two OI steps described previously in this report, PUN1 and AUC3 remain the KPIs that are expected to be the most impacted by the implementation of PJ.07-W2-38, with the latter one expected to bring a higher monetary return than the former one, while FEFF1 is expected to sustain a negative impact.

Figure 14 represents the distribution of yearly undiscounted cashflows over the entire CBA timeline (i.e. 2022-2043) for PJ.07-W2-38 (both OI steps).

[8] 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.

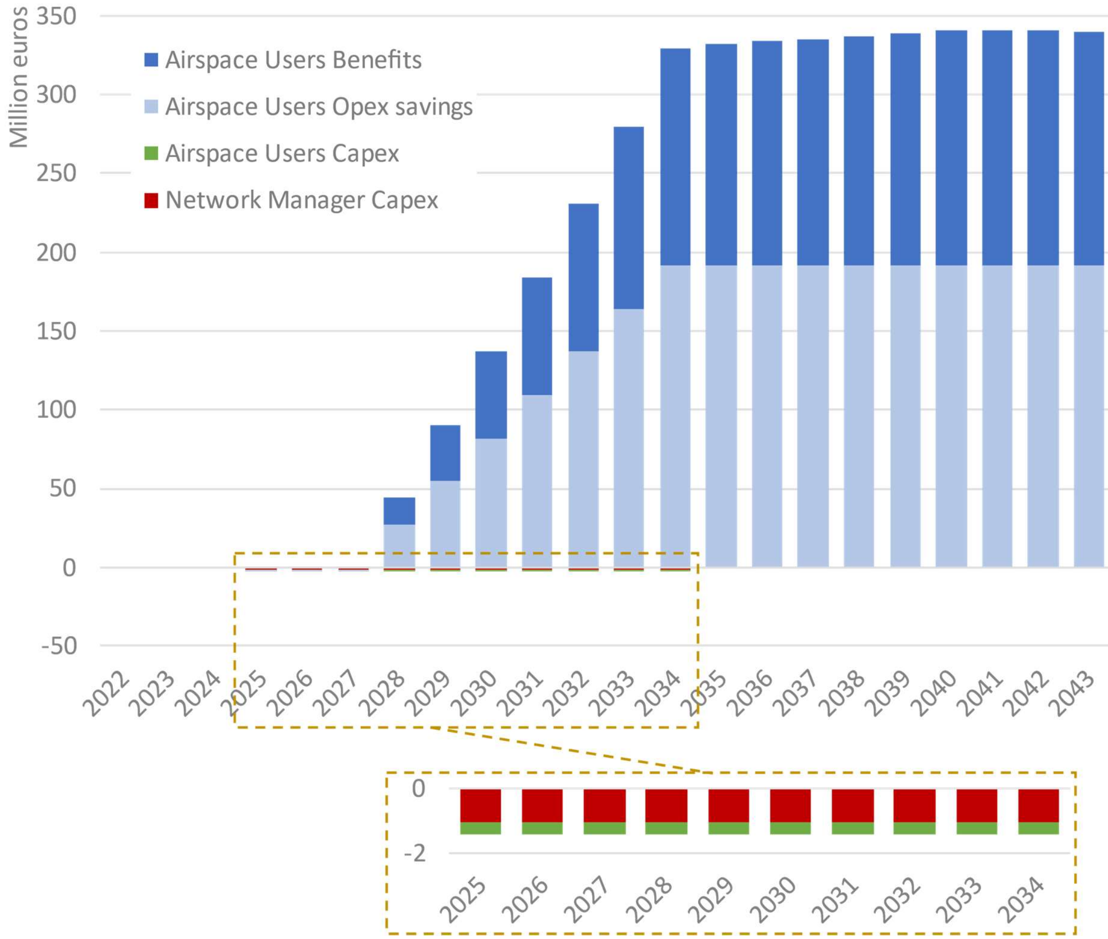

Figure 14: Evolution of undiscounted cashflows over time (AUO-0208 & AUO-0219)

Similarly to what happens for individual OI steps, the yearly benefits from the implementation of PJ.07-W2-38 are expected to grow over time, with a stronger yearly increase during the years of deployment and slower after full deployment is reached. This is linked to the fact that the benefits are related to the level of operability of PJ.07-W2-38 and, hence, during the first years they follow the number of stakeholders that implemented the Solution. Once FOC is reached in 2034, the benefits remain relatively stable over time, reflecting the traffic growth in the model.

When it comes to the costs, these are expected to incur between 2025 (i.e. start of deployment) and 2034 (i.e. FOC). After 2034 all enablers are expected to be in place and the Solution is expected to generate full benefits.

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 on the most uncertain metrics of the model. Please see each section for more information.

8.1 Costs and benefits sensitivity

One of the most uncertain aspects of this CBA is the number of AUs that will be deploying the Solution. As explained in section 5.4, it is assumed that 40 airlines are expected to invest in PJ.07-W2-38 deployment, which represents about 62% of traffic in NM area. This is a proxy of the expected number of investment instances used for the purpose of this CBA. Thus, to account for variations in the number of investment instances, a sensitivity analysis was conducted to observe the change in the CBA results if the number of AUs deploying a solution increase and decreased by 50%.

The impact of this change on the NPV of the Solution is presented in the table below.

Stakeholder	Baseline NPV	Sensitivity NPV (+50% AUs)	Change	Sensitivity NPV (-50% AUs)	Change
AUO-0208					
ANSP	€ 0	€ 0	0%	€ 0	0%
Network Manager	- 2 M€	- 2 M€	0%	- 2 M€	0%
Airspace Users	771 M€	1,157 M€	50%	385 M€	-50%
Total	**769 M€**	**1,155 M€**	**50%**	**383 M€**	**50%**
AUO-0219					
ANSP	€ 0	€ 0	0%	€	0%
Network Manager	- 4 M€	- 4 M€	0%	- 4 M€	0%
Airspace Users	562 M€	561 M€	-0.2%	563 M€	+0.2%
Total	**558 M€**	**557 M€**	**-0.2%**	**559 M€**	**+0.2%**

Table 24: Cost sensitivity analysis results (AUO-0208 & AUO-0219)

As can be observed in the table, when varying the number of AUs implementing PJ.07-W2-38 , the change in results in terms of NPV greatly varies from one OI step to another: while AUO-0219 does not suffer major changes (about 0.2% variation), AUO-0208 changes by about 50% in each direction. This shows that AUC3 is the most sensitive among all KPIs considered and a small variation in the input can cause big variations in the output for this KPI.

Another key uncertainty concerns AUO-0208. The quantified benefits in terms of AU cost efficiency are derived from the estimation of the number of extra critical flights Network Manager Operations Centre (NMOC) and FMPs can treat per day and the average ATFCM delay cost for critical flights. The uncertainty related to this estimation has been highlighted by the operational experts. To account for this uncertainty, a sensitivity analysis was performed, applying a 2/3 reduction of benefits for the AU cost efficiency KPI, the results of which are presented in Table 25.

Stakeholder	Baseline NPV	Sensitivity NPV	Change
ANSP	€ 0	€ 0	0%
Network Manager	- 2 M€	- 2 M€	0%
Airspace Users	771 M€	254 M€	-67%
Total	**769 M€**	**254 M€**	**-67%**

Table 25: AU cost sensitivity result (AUO-0208)

As can be observed in the table, a decrease in the expected per flight cost saving for Airspace Users of about 67% (i.e. 2/3) results in a proportional decrease in the total AUC3 benefit, leading to an expected NPV for the implementation of AUO-0208 of 254 M€.

Figure 15 presents a tornado diagram which shows the variation in the CBA results, per KPI, when the costs and benefits vary by 10%.

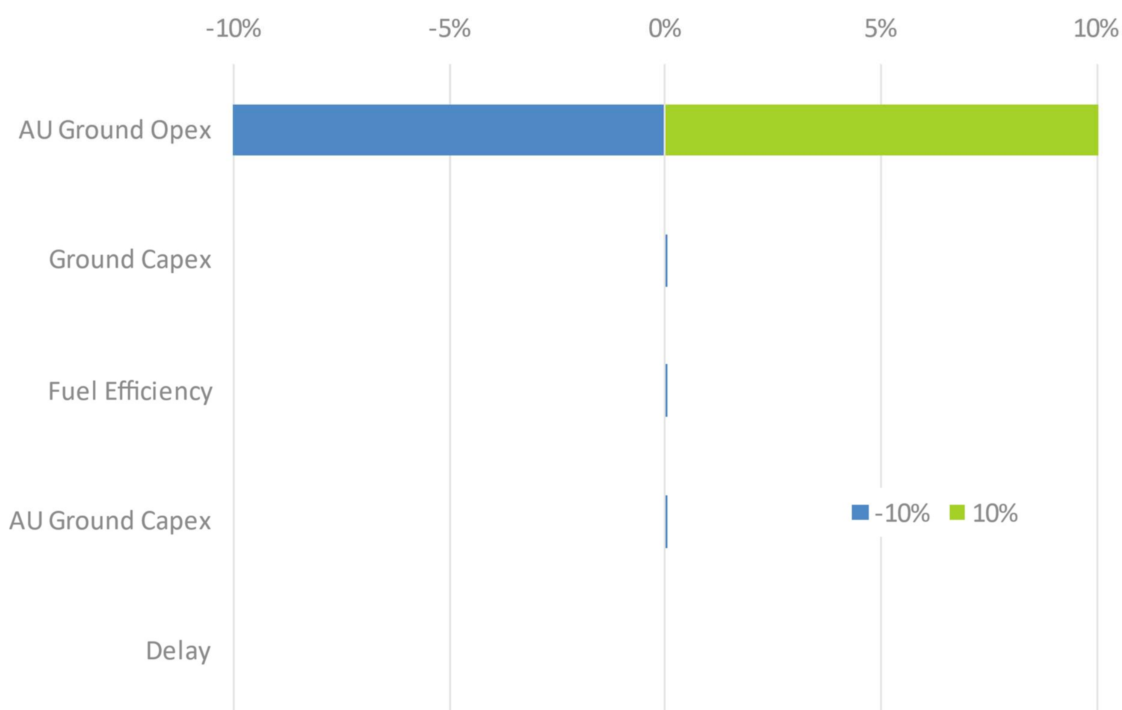

Figure 15: Variation in NPV when inputs vary by 10% (AUO-0208 & AUO-0219)

It can be observed in the figure that AU cost saving (AUC3), as already mentioned above, is the KPI that suffers the highest change if the inputs are changed by 10%, showing its high sensitivity to any changes in PJ.07-W2-38 deployment or operation.

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 [4]. The figure below presents the expected change in the NPV of this CBA (both OI steps) when different discount rates are applied.

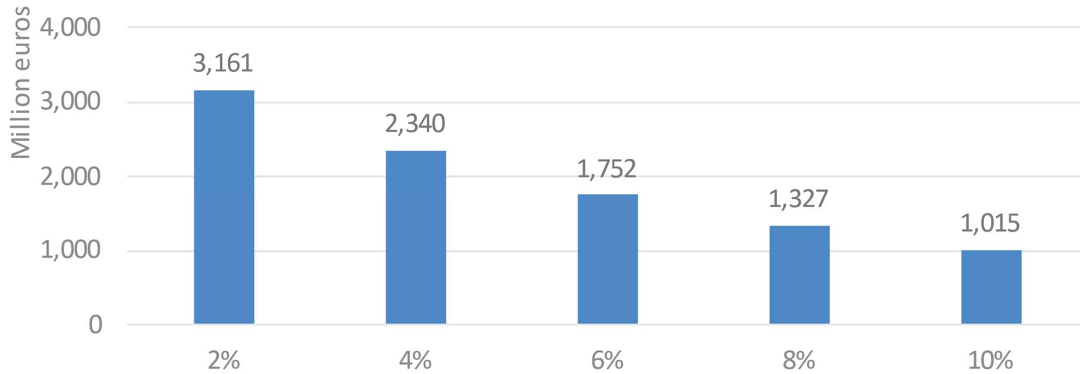

Figure 16: NPV sensitivity to changing discount rate (AUO-0208 & AUO-0219)

9 Recommendations and next steps

Below are summarised the main CBA results regarding the deployment of each OI steps separately and together:

- **AUO-0208: NPV,** which represents the cumulated discounted net benefits expected from the deployment of PJ.07-W2-38, is expected to amount **769 M€** between 2022 and 2043, showing that this is an economically viable investment.
- **AUO-0219:** an **NPV of about 558 M€** is expected to be generated, meaning that, which this OI step is expected to bring a smaller net benefit than the previous one, it remains an economically viable investment.
- **AUO-0208 and AUO-0219:** assuming that there will be no additional efficiency gains from a joint deployment of both OI steps, it is expected that such a deployment will result in an **NPV of 1,327 M€** between 2022 and 2043, which represents the sum of the benefits from the implementation of each OI step separately.

When looking at the results of the CBA analysis summarised above, three main conclusions can be drawn.

On the one hand, the biggest monetary benefit from PJ.07-W2-38 implementation is the cost savings for the Airspace Users from prioritisation of their flights, with the focus on critical flights but also a spillover effect on remaining ones. This is reflected in the NPV of AUO-0208 (i.e. the OI step in which this benefit is expected), which higher than AUO-0219, that does not account for this benefit, by over 200 M€. Therefore, and considering that the investment expected for the implementation of AUO-0208 is lower than for AUO-0219, from a monetary perspective, the implementation of AUO-0208 is recommended to be prioritised.

On the other hand, AUO-0219 is expected to generate significant benefit in terms of delay management (PUN1), making it interesting from the point of view of delay reduction. Since the difference in NPV for both OI steps is of about 200 M€, and considering the significant punctuality benefit stemming from AUO-0219 deployment, the deployment of AUO-0219 is also recommended to be considered.

Finally, when looking at the Solution-wide results, the joint implementation of the two OI steps, albeit not increasing the individual OI step benefits, results in a joint NPV of 1,327 M€ over the considered timeline. This is essentially a sum of the two OI steps' benefits and therefore, each OI step can bring part of these benefits individually. However, it is recommended to consider the deployment of both OI steps as the joint monetary impact is higher and this allows to obtain the maximum benefits from the deployment of PJ.07-W2-38 (i.e. both PUN1 and AUC3 benefits).

10 References and Applicable Documents

10.1 Applicable Documents

[1] SESAR 2020 Project Handbook, edition 02.02.00, 08 June 2020Guidelines for Producing Benefit and Impact Mechanisms

[2] SESAR Cost-Benefit Analysis Model[9]

[3] EUROCONTROL, Standard Inputs for EUROCONTROL Economic Analyses, Edition 9, December 2020

10.2 Reference Documents

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

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

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

[7] ICAO Doc 9965 Manual on Flight and Flow – Information for a Collaborative Environment (FF-ICE) First Edition 2012

[8] SESAR PJ.07-W2-38 OSED-SPR-INTEROP for V3 - Part I. Ed.00.01.03 released on 5 March 2021

[9] SESAR Solution PJ.07-W2-38 SPR-INTEROP/OSED for V3 - Part V - Performance Assessment Report (PAR). Ed.00.00.09 released on 20 March 2023

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

Appendix A Mapping of ATM Master Plan and SESAR KPAs

Mapping between ATM Master Plan Performance Ambition KPAs and SESAR Performance Framework KPAs, Focus Areas and KPIs, source reference *[6]*

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

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

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