



SESAR SOLUTION 02-05: COST BENEFIT ANALYSIS (CBA) FOR V3

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Abstract

This document provides the Cost Benefit Analysis (CBA) for Solution PJ02-05 “Independent Rotorcraft operations at Airports”, which aims for V3 target maturity level (S2020 wave 1).

The CBA forms part of the PJ02-05 V3 Data Pack and it's developed to:

- Identify and agree on the main elements and assumptions that have supported the development of a CBA Model;
- Identify impacted stakeholders' groups and propose options in terms of possible deployment scenario options;
- Provide an initial estimation of the potential costs and benefits of the solution.

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1 Executive Summary

This document provides the Cost Benefit Analysis (CBA) for Solution PJ02-05 “Independent Rotorcraft operations at Airports” that has been validated during validation activities at a V3 level and forms part of PJ02-05 V3 Data Pack. Its objective is to evaluate costs and benefits of deploying Solution PJ02-05 at ECAC level. Such evaluation shall support the deployment phase.

Solution PJ.02-05 addresses concepts and systems which allow the implementation of the operational concept of the Simultaneous-non-Interfering (SNI) operations for rotorcraft aimed to increase the Airport Performance using independent IFR rotorcraft procedures to/from a VFR FATO (Standard/Advanced Point In Space procedures) located at a busy airport.

The PJ02-05 CBA evaluation is furthermore, based on the use of advanced on-board avionics technologies/performances as combined with SBAS/GBAS (CAT I) procedures based on RNP 0.3 all phases of flight and Synthetic Vision System (SVS), increasing pilot situational awareness and safety meanwhile reducing ATCOs’ and Pilot’s workload. In this specific PJ02-05, it has been considered the fact that GBAS and SVS enablers are considered as “optional” to mature the AO-0316 concept, and in addition some GBAS validation activities has been cancelled from VALP. This assumption influences the way to read the CBA evaluation, better detailed in the relevant paragraphs.

To cover the objective, there is one OI step that has been validated in V3, namely AO-0316, addressing enhanced independent (parallel or convergent) IFR Rotorcraft Operations aimed to increase the airport performance:

- **AO-0316 (Increased Airport Performance through Independent (parallel or convergent) IFR Rotorcraft Operations):** using Rotorcraft specific independent IFR procedures to/from Final Approach & Take-Off areas (FATO) located at airports will remove IFR rotorcraft from active runways and allow aircraft and rotorcraft simultaneous non-interfering operations (SNI). This rotorcraft specific independent IFR procedure includes (parallel or convergent) Point-in-Space (PinS) procedure to enable access to to/depart from VFR FATO (landing location). When reaching the PinS waypoint, the pilot shall decide either to proceed to landing or to abort the approach. The PinS may result coincident with the MAPt (Missed Approach Point). In case of IFR FATO implemented for SNI IFR operations, the specific independent IFR procedure could be designed as a direct procedure (only IFR instead of a hybrid procedure IFR+VFR as is a PinS).

The results of the CBA carried out in this project are positive, given the positive results from the operational viewpoint. Nevertheless, the CBA focused, as well, on the economic aspects which encompass the determined NPV value (NPV - Net Present Value).

The result of the NPV should be interpreted as the sum of the positive (income/revenue) and negative (cost) effects of the project over time (cash flow). When a project has a positive NPV, it means that the SESAR Solution well meets the business need claimed by the Airspace Users and captured into the ATM Master Plan.

The determined NPV, after the CBA analyses is equal to **€ 3.251.957,411**

Besides, in order to measure the impact of risk which might affect the results of the CBA a sensitivity analysis was carried out. This analysis presents the change of the Net Present Value (NPV) in high/low scenarios of the most influential parameters.

2 Introduction

2.1 Purpose of the document

This document provides the Cost Benefit Analysis (CBA) for Solution PJ02-05 at V3 level. Its objective is to evaluate costs and benefits of deploying Solution PJ02-05 at an ECAC level. Such evaluation can then be utilized to support the deployment phase after achieving the V3 maturity level.

2.2 Scope

The CBA integrates costs and benefits brought by both the ground aspects and the airborne aspects of the Solution. The OI step representing these aspects is **AO-0316** (*Increased Airport Performance through Independent (parallel or convergent) IFR Rotorcraft Operations*).

The reference time considered for the CBA is a 21-year period from 2019 to 2040.

The geographical scope considered for the CBA covers the European Civil Aviation Conference (ECAC) countries. Specifically, Solution PJ02-05 targets airports classified as “primary/busy airport nodes – Very Large/Large/Medium/Small airports” with different infrastructures (from single runway to multiple runways, from limited runway exits / entries to several runway exists/entries, taxiways and apron prepared to handle from a limited number of movements to several parking bays for many traffics).

2.3 Intended readership

- AUs – EHA European Helicopters Associations;
- Other SESAR2020 Solutions:
 - (PJ.01 EAD) P.J01-06 - *Enhanced Rotorcraft operations in the TMA*.
- PJ19 - Content Integration: responsible for managing the content integration process to ensure the needed coherency (in terms of operational concept, architecture) between the different SESAR 2020 projects.
- PJ20 - Master Plan Maintenance: responsible for ATM Master Plan maintenance.
- PJ22 - Seabird: Validation and Demonstration Engineering.

2.4 Structure of the document

The structure of this CBA is as follows:

- **Section 2** (the present section) provides general information on the document.
- **Section 3** describes the scope and objectives of the CBA.
- **Sections 4 and 5** detail, respectively, the benefits and the costs.
- **Sections 6, 7 and 8** detail, respectively, the CBA model, the CBA results and sensitivity analysis.

- **Section 9** provides recommendations and next steps for the development of the V4 CBA (Deployment progresses).

2.5 Background

There is no information on previous activities in the same domain e.g. previous CBAs or economic appraisals covering the SESAR Solution or parts (precursors) of it and thus defined the input(s) to the project.

An exception is made for the Solution #113 (Low Level IFR Routes) which was part of the SESAR 1 Project 04.10 (GA and rotorcraft operations) together with the concepts of the Point in Space procedures (Standard) and SNI Operations for rotorcraft. For the Solution #113 some considerations concerning the possible cost-benefits analysis may be assessed. Solution #113 is related to the implementation of dedicated Rotorcraft Low Level IFR routes (LLR), that in solution Pj02.05 are out of the scope. The outcomes of P.04.10 within the relevant consideration about LLR are to be considered complementary and useful for CBA in TMA en-route phases.

2.6 Glossary of terms

Term	Definition	Source of the definition
Net Present Value	Net Present Value (NPV) is the sum of all discounted cash inflows and outflows during the time horizon period.	<i>Investopedia</i>
Cost Benefit Analysis	A Cost Benefit Analysis is a process of quantifying in economic terms the costs and benefits of a project or a program over a certain period, and those of its alternatives (within the same period), to have a single scale of comparison for unbiased evaluation.	COST BENEFIT ANALYSIS (CBA)

2.7 List of Acronyms

Acronym	Definition
AC	Advisory Circular
ACC	Area Control Centre
Acronym	Definition
ADD	Architecture Definition Document
ADS-C	Automatic Dependent Surveillance – Contract
AMC	Acceptable Means of Compliance
AMSL	Above Mean Sea Level

AN	Availability Note
ANSP	Air Navigation Service Provider
APCH	Approach
APV	Approach Procedure with Vertical guidance
ATCO	Air Traffic Controller
ATM	Air Traffic Management
ATM MP	Air Traffic Management Master Plan
AU	Airspace User
BADA	Base of Aircraft Data
CAA	Civil Aeronautics Authority
CAT	Commercial Air Transportation
CAT I	ILS Approach Category
CBA	Cost Benefit Analysis
CDA	Continuous Descent Approach
CDFA	Continuous Descent Final Approach
CDO	Continuous Descent Operation
CDTI	Cockpit Display of Traffic Information
CM	Context Management
CNS	Communications, navigation and surveillance
COORD	Coordinator
CPDL-C	Controller Pilot Data Link Communications
CRC	Cyclic Redundancy Check
CTR	Control Zone
DA	Decision Altitude
DA/H	Decision Altitude/ Height
DB	Database
DRA	Direct Route Airspace

DSS	Desk System Suite Hardware
EATMA	European ATM Architecture
E-ATMS	European Air Traffic Management System
ECAC	European Civil Aviation Conference
EGNOS	European Geostationary Navigation Overlay Service
EHA	European Helicopter Association
ENB	Enabler
E-OCVM	European Operational Concept Validation Methodology
ETSO	European Technical Standard Order
EU-OPS	This refers to European Union (EU) regulations specifying minimum safety and related procedures for commercial passenger and cargo fixed-wing aviation
EXE	Executive
FAF	Final Approach Fix
FAP	Final Approach Point
FAS	Final Approach Segment
FAS DB	Final Approach Segment Data Base
FATO	Final Approach & Take-Off areas
FCS	Flight Control System
FMS	Flight Management System
FNHD	Finmeccanica Helicopters Division
FPDO	Flight Procedures Design Organization
FTA	Fix Tolerance Area
GNSS	Global Navigation Satellite System
GPA	Glide Path Angle
GPS	Global Positioning System
GS	Glide Slope
HC	High complexity (airport)
HMI	Human Machine Interface

HP	Human Performance
HRP	Heliport Reference Point
I/O	Input/Output
IBP	Industrial Based Platform
ICAO	International Civil Aviation Organization
ICP	Initial Climb Procedure
IDF	Initial Departure Fix
IFR	Instrument Flight Rule
ILS	Instrument Landing System
IMC	Instrumental Meteorological Condition
INTEROP	Interoperability Requirements
IRS	Interface Requirements Specification
JRE	Java Runtime Environment
KPA	Key Performance Area
KPI	Key Performance Indicator
LC	Low complexity (airport)
LLR	Low Level IFR Routes
LNAV	Lateral Navigation
LPV	Localizer Performance with Vertical Guidance
M/M	Medium complexity / Medium density
MAHF	Missed Approach Holding Fix
MAP	Missed Approach
MAPt	Missed Approach Point
MCA	Minimum Crossing Altitude
MCDU	Multipurpose Control & Display Unit
MET	Meteorological
MLS	Microwave Landing System

MOC	Minimum Obstacle Clearance
NOTAM	Notice To AirMen
OCA	Obstacle Clearance Altitude
OCA/H	Obstacle Clearance Altitude/Height
OIS	Operational Information System
OPL	Operational Project Leader
OSD	Operational Service and Environment Definition
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations
PAR	Performance Assessment Report
PBN	Performance Based Navigation
PC	Personal Computer
PDG	Procedure Design Gradient
PFD	Primary Flight Display
PI	Performance Indicator
PinS	Point-in-Space
PIRM	Programme Information Reference Model
PRE	Predictability
QFU	Aviation Q-code for magnetic heading of a runway
R&D	Research & Development
R/C	Rotorcraft
RAIM	Receiver Autonomous Integrity Monitoring
RF	Radius to Fix
RHP	Runway Holding Point
RNAV	Area Navigation
RNP	Required Navigation Performance
RTS	Real Time Simulator
RWY	Runway

SBAS	Satellite-Based Augmentation System
SESAR	Single European Sky ATM Research Programme
SID	Standard Instrument Departure
SJU	SESAR Joint Undertaking
SME	Subject Matter Expert
SNI	Simultaneous non-interfering
SPR	Safety and Performance Requirements
SPV	Supervisor
SSR	Secondary Surveillance Radar
STAR	Standard Instrument Arrival
SUT	System Under Test
SWIM	System Wide Information Model
TAD	Technical Architecture Description
TIA	Turn Initiation Area
TMA	Terminal Manoeuvring Area
TRL	Technology Readiness Level
TS	Technical Specification
TSO	Technical Standard Order
TVALS	Transition Validation Strategy
UC	Use Case
VALP	Validation Plan
VALR	Validation Report
VALS	Validation Strategy
VFR	Visual Flight Rules
VMC	Visual Meteorological Condition
VNAV	Vertical Navigation
VP	Verification Plan

VR	Verification Report
VS	Verification Strategy
WIMS	Weather Information Management System
WL	Workload
WP	Waypoint
WPT	Waypoint
XTK	Cross Track

Table 1: List of Acronyms

3 Objectives and scope of the CBA

3.1 Problem addressed by the solution

The airport capacity was considered as a key challenge in the SESAR timeframe to overcome the full integration of rotorcraft into the ATM Network.

Nevertheless, even if rotorcraft can fly under IFR conditions (High technology available on-board), currently without the introduction of a specific operational solutions, however they would be constrained to use same approach/departure procedures than airplanes. This constraint represents a negative effect on runway arrival/departure flows (the sequencing with main line aircraft becomes difficult to achieve) because of speed differences (increasing ATCO workload as consequence).

The runway throughput (runway capacity) should be optimised at congested airports to respect this trend and create the expected and operationally appropriate ATM environment.

In this outlook, and in the context of SESAR 2020, specifically within the Solution 02-05, the SNI concept is considered as the key factor to facilitate the integration of the rotorcraft operations in the future ATM environment. Furthermore, Rotorcraft operations are of concern when adverse weather is below the VFR minima and IFR departure and approach procedures must be used. Thus, the runway capacity played a key role in the ATM Research Programmes and it has been also enhanced by facilitating Simultaneous Non-Interfering (SNI) operations.

3.2 SESAR Solution description

This Solution 02-05 aims at improving the access into a congested¹ airport (CTR airspace Class D in a TMA airspace Class A) through the development and the publication of enhanced IFR rotorcraft procedures, “PBN based” (e.g. RNP 0.3 all phases of flight), with “Vertical Guidance” LPV (Localizer Performance with Vertical Guidance) which represent the best operational solution to allow the access of rotorcraft to the heliports (existing VFR FATOs when VMC minima not achieved) included into the airport boundaries without interfering (**SNI operations**) with already existing traffic (fixed-wing). The LPV procedures when designed as compliant with the **SNI Simultaneous Non-Interfering criteria** (SNI operations) facilitate the introduction of rotorcraft in the congested airports.

The SNI is a mode of operation for mixed IFR traffics at airport, not a specific type of procedure. It means that if an approach/departure procedure is compliant with the ICAO SNI criteria (ICAO DOC 9643 - SOIR) it can be flown simultaneously and in a non-interfering way, being strategically separated by the existing procedures.

The Solution 02-05 considers a scenario where there is new rotorcraft approach/departure SNI PinS procedures to/from a FATO located at airport and the existing SID/STAR procedures from/to runway flyable by the mainlines (fixed-wing traffic).

Dedicated IFR procedures with vertical guidance (GNSS-based e.g. APV SBAS/Baro) designed for Rotorcraft (CAT H) represent a valid means to guarantee access to FATOs (currently only VFR

¹ A dedicated IFR SNI concept can provide an alternative IFR capability **also** to small airports (in proximity of airspace class G) where the installation of traditional navigation aids is not financially viable or unfeasible due to other specific constraints. In this way any rotorcraft operations, and in particular the HEMS rotorcraft operations, will be no longer limited to VFR/VMC conditions and night operations becomes safer.

operations to FATO are allowed) and landing locations where conventional flight procedure can be result not appropriate for rotorcraft Airspace Users.

The peculiar rotorcraft capabilities of tight turns, steep climb and descent, combined to dedicated IFR procedures based on GNSS and the PBN navigation specification within low level IFR routes, is not only avoid the avoidance of the rotorcraft interaction with fixed-wing aircraft, but it is also for introducing more optimal operations in obstacle-rich urban environments and noise sensitive areas.

The scope of the Solution is linked to a several relevant Key Research and Development (R&D) needs that are grouped per Stakeholder and Key Performance Area (KPAs) in the following table. R&D needs have been defined in the Transition Validation Strategy for SESAR 2020.

Stakeholder	KPA	R&D Needs
Airspace Users	CAP	Advanced procedures making better use of rotorcraft capabilities to reduce delays, increasing capacity in low visibility conditions and enhancing accessibility at large/busy airports.
	PRD	Reduction of delays for both mainlines and rotorcraft
	SAF	Maintaining or increasing current level of safety; no increase of pilot workload in adverse weather or critical situations.
Airport Operators	CAP	Increased capacity for mainline traffic. Increase passenger traffic. ² .
	FEFF	Reduction of Noise impacts due to more appropriate Rotorcraft approach angles.
	SAF	Maintaining or increasing current level of safety thanks to separate, consistent flows of vehicles (mainlines / rotorcraft).
Passengers	CAP	Better access to busiest airports.
	PRD	Reduction of delays for both mainlines passengers and also for Rotorcraft ones.

Table 2: PJ02-05 Key R&D needs

²This concept may allow for re-invention of rotorcraft shuttle/taxi services that were suspended on some large airports in the late 1990s, e.g. between the bank towers in Frankfurt and the GAT. There is customer demand for this, but the negative impact of rotorcraft operations within the TMA so far made it impossible to offer this service again. This solution may change the situation

As input to the elaboration of CBA, the table below reports the validation targets apportioned to the SESAR Solution PJ02-05 (and related KPAs) as reported in the S2020 PJ19 Validation Targets.

KPA/Sub-OE	APT Very Large	APT Large	APT Medium	APT Small	Apt Other
PRD	0,064%	0,053%	0,077%	0,029%	N/A
FEFF	0	0	1.46	0.54	N/A

Table 3: Validation Targets APT

KPA/Sub-OE	TMA Very High Complexity	TMA High Complexity	TMA Medium Complexity	TMA Low Complexity	TMA Other
PRD	0,000%	0,000%	0,069%	0,019%	N/A
FEFF	0	0	1.30	0.35	N/A

Table 4: Validation Targets TMA

3.2.1 Additional Objectives

The main PJ.02-05 ambition is to bring to full V3 the SNI operational concept within wave 1, but there is need the formalize a proposal with the standardization of procedure design criteria for rotorcraft operations to support the creation of a pan-European operational concept for independent rotorcraft operations (parallel or convergent) to/from a (VFR) FATO located at airport.

On top of the main Solution goals, the PJ.02 Solution 5 has explored (optionally) the use of GBAS technology (GBAS GS and on-board GBAS receiver) in order to explore those cases when EGNOS signal (SBAS guidance not available) is not guaranteed (e.g. at specific latitudes as China, Russia, etc.) and the availability of a ground ATM systems as GBAS GS together with the on-board receiver can represent the best mitigation against these potential difficulties to be tackled in those locations. In so doing, it will be necessary to evaluate in depth the applicability of LPV PinS "designing criteria" to specific rotorcraft operations using the GBAS technology (e.g. criteria not existing in PANS OPS documentation), waiting the development of further new technical enablers³ which will allow exploring new operational use cases which have not assessed yet and won't be considered in S2020.

³ The perimeter of Solution PJ.02-05 was impacted by PJ.13 cancellation in terms of loss of some potential research opportunities related to the identification of new technical enablers which should have enabled the development of a largest numbers of operational situations. Considering the PJ.13 cancellation, the Solution 02-05 scope was furtherly reviewed, and this led to the decision to complete the research stream focused on the SNI Operations for rotorcraft enabled by Point In Space procedures (SBAS based) and to explore the potential benefits deriving by the use of the GBAS (GBAS exercise has been cancelled in VALP. This CBA considers anyway the future standard IFR rotorcraft configuration that will encompass also GBAS capabilities) guidance in waiting for the development of some new technical enabler which will allow exploring new operational use cases that cannot be addressed within S2020. Those enablers are the ones identified within the Project 13.

3.2.2 Validation Targets apportioned to the SESAR Solution

This section lists the validation targets for the Solution 02-05 identified based on the guidelines available in the Appendix I of SESAR TVALS [9].

They have been identified making a cross check between the KPAs and expectations, Table 5 , available in the TVALS [9] for PJ02-05 and the Validation Targets available in the PJ19_04 - D4_8 Validation Targets (2019) document [10].

KPA	Trend ⁴		Expectation (what/why)
CAP	→*	M	Increased runway throughput via dedicated procedures for rotorcraft accessing the airport: removal of R/C from the runway. Increased passenger throughput (airport capacity) thanks to more rotorcraft operations enabled. Reduction of potential go-arounds.
PRD	↗	H	Much more robust, easier to plan and to anticipate operations for both mainlines and rotorcraft.
SAF	→	M	No rotorcraft in runway traffic results in more homogeneous approach speeds and reduces the risk of longitudinal separation loss; reduction of potential go-arounds.
FEFF	→*	M	Improved flight efficiency through shortened approaches for IFR rotorcraft operations (fuel / flying time).

Table 5: Transition Performance Expectations for 02-05

3.2.3 Initial and Target Maturity levels

SESAR Solution	OI Steps	Initial Maturity level	Target Maturity level	Reused validation material from past R&D Initiatives
PJ.02-05	AO-0316 Increased Airport Performance through Independent	V2	V3	P04.10\VP-815(FTS)\VP-816(RTS)\VP-818(LT) ⁵

⁴ * Even if the expected improvements are mild, it should be considered a positive trend for the airport Capacity (and Flight Efficiency with tailored rotorcraft procedures) due to the fact that today the rotorcraft AUs are not allowed to fly to/from a busy airport unless in respecting the VFR/VMC conditions. This means that rotorcrafts are not considered in the current airport capacity evaluation. After implementing the operational solution proposed in the context of PJ:02-05 they can fly under IFR rules to/from a busy airport towards contributing in the airport capacity increase (RWYs movements + FATOs movements).

⁵ In addition to these validation in the context of P04.10 a dress rehearsal was performed in order to evaluate some contingency events and complete the scene.

SESAR Solution	OI Steps	Initial Maturity level	Target Maturity level	Reused validation material from past R&D Initiatives
	(parallel or convergent) Rotorcraft Operations.	or IFR		

Table 6: Maturity levels table

As reported in the PJ.02-05 TS/IRS V3, the Table 7 below details the solution under validation and relevant operational improvements and enablers. Please note that the “Optional” ENs are highlighted in **amber** whilst the ENs specifically covered within PJ.02-05 (purely operational) in **light blue**.

Additionally, some these ENs were already validated within SESAR 1 Projects and based on this, the Solutions 02-05 considered them (**as assumption**) as “fully matured” and integrable in the operations concerned, given that they do not need further evaluations.

SESAR Solution ID	SESAR Solution Description	OI Master or Contributing (M or C)	Contribution to the SESAR Solution short description	OI Steps ref. (from EATMA)	Enablers ref. (from EATMA)
PJ.02-05	Independent rotorcraft operations at a busy airport	M	Contribution to Capacity, Predictability, Environmental sustainability and fuel efficiency, Security, Human Performance and Safety	AO-0316 - Increased Airport Performance through Independent (parallel or convergent) IFR Rotorcraft Operations	A/C-01 Enhanced positioning for LPV/RNP based on Single Frequency SBAS A/C-02a Enhanced positioning using GBAS single frequency A/C-04 Flight management and guidance for improved lateral navigation in approach via RNP A/C-04b Flight management and guidance for RNP 0.3 (Category H(rotorcraft)) in all phases of flight, except final approach and initial missed approach A/C-06 Flight management and guidance for LPV

SESAR Solution ID	SESAR Solution Description	OI Master or Contributing (M or C)	Contribution to the SESAR Solution short description	OI Steps ref. (from EATMA)	Enablers ref. (from EATMA)
					approach based on SBAS A/C-07 Flight management and guidance for RNP transition to ILS/GLS/LPV A/C-23a Synthetic vision in low visibility conditions BTNAV-0502 Update of Minimum Performance Standard for Enhanced Vision (EV) BTNAV-0503 New ARP standard for Transport Category Airplane HUD/SVS systems BTNAV-0504 Update of Minimum Performance Standard for Airborne Synthetic Vision (SV) CTE-N07a GBAS Cat I based on Single-Constellation / Single-Frequency GNSS (GPS L1) PRO-251 ATC Procedure to handle SNI IFR rotorcraft operations using PinS REG-0521 Regulatory provisions for SNI IFR rotorcraft operations using PinS REG-0009 AMC for Curved Approaches STD-025 Harmonisation Specifications on

SESAR Solution ID	SESAR Solution Description	OI Master or Contributing (M or C)	Contribution to the SESAR Solution short description	OI Steps ref. (from EATMA)	Enablers ref. (from EATMA)
					Ground Based Augmentation System Ground Equipment to Support Category I Operations STD-043 EN 303 084, Ground Based Augmentation System (GBAS) VHF ground-air Data Broadcast (VDB) STD-067 DO-253D 'GBAS MOPS' & DO-246E 'GBAS ICD'

Table 7: SESAR Solution(s) addressed in the Validation Report

Additionally, the Table 8 shows some changes needed to update the EATMA Architecture and reflect the real situation after the Solution 02-05 work completion. Some of the listed CRs were already implemented in EATMA but other ones, already submitted, will be implemented in the next Data Set only.

OI Step	OI description	Open CR
AO-0316	Increased Airport Performance through Independent (parallel or convergent) IFR Rotorcraft Operations	CR 03260 Update AO-0316 list of EN (PJ02-05)
EN code	EN description	Open CR
A/C-01	Enhanced positioning for LPV/RNP based on Single Frequency SBAS	No changes
A/C-02a	Enhanced positioning using GBAS single frequency	No changes
A/C-04a	Flight management and guidance for Advanced RNP	<i>Unlinked by AO-0316</i>
A/C-04b	Flight management and guidance for RNP 0.3 (Category H(rotorcraft)) in all phases of flight, except final approach and initial missed approach	No changes
A/C-04	Flight management and guidance for improved lateral navigation in approach via RNP	No changes
A/C-06	Flight management and guidance for LPV approach based on SBAS	No changes

A/C-07	Flight management and guidance for RNP transition to ILS/GLS/LPV	No changes
A/C-23a	Synthetic vision in low visibility conditions	No changes
AIMS-23	Enhanced digital data chain to ensure Aeronautical Information data provision to meet full 4D trajectory management requirements	<i>Unlinked by AO-0316. No i4D operations were considered within PJ.02-05 work</i>
BTNAV-0502	Update of Minimum Performance Standard for Enhanced Vision (EV)	No changes
BTNAV-0503	New ARP standard for Transport Category Airplane HUD/SVS systems	No changes
BTNAV-0504	Update of Minimum Performance Standard for Airborne Synthetic Vision (SV)	No changes
CTE-N07a	GBAS Cat I based on Single-Constellation / Single-Frequency GNSS (GPS L1)	No changes
METEO-03c	Provision and monitoring of real-time airport weather information for time-based separation and curved approaches	<i>Unlinked by AO-0316. Solution 02-05 is focused on the airport operations (last phases of approaches or initial phases of departures)</i>
METEO-04c	Generate and provide MET information relevant for Airport and approach related operations at short notice ('time to decision' between 3 minutes and 7days) including rotorcraft and RPAS	<i>Unlinked by AO-0316. Solution 02-05 is focused on the airport operations (last phases of approaches or initial phases of departures)</i>
METEO-05c	Generate and provide MET information relevant for TMA and En-route related operations at short notice ('time to decision' between 3 minutes and 7days), including for low-level IFR operations.	<i>Unlinked by AO-0316. Solution 02-05 is focused on the airport operations (last phases of approaches or initial phases of departures)</i>
REG-0009	AMC for Curved Approaches	No changes
STD-025	Harmonisation Specifications on Ground Based Augmentation System Ground Equipment to Support Category I Operations	No changes
STD-043	EN 303 084, Ground Based Augmentation System (GBAS) VHF ground-air Data Broadcast (VDB)	No changes
STD-067	DO-253D 'GBAS MOPS' & DO-246E 'GBAS ICD'	No changes
EN code	EN description	Open CR

PRO-251	ATC Procedure to handle SNI IFR rotorcraft operations using PinS	CR 03299 Update PRO-251 (AO-0316 - PJ02-05)
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Table 8: Solution PJ02-05 OI Steps, ENs and CRs (EATMA) for Data Set updates

3.3 Objectives of the CBA

The objective of the V3 CBA is to provide information on the costs and benefits of deploying Solution PJ02-05 in an ECAC-level CBA Scenario, i.e. the CBA assesses the economic feasibility of the Solution. In general, the CBA assessed whether the benefits of the deployed Solution are expected to exceed the costs over the CBA time horizon. This assessment can then be used as a basis for the decision of proceeding with the Solution to V4 phase and confirm the fully V3 achievement. While the views of individual stakeholders involved in the deployment are considered, this CBA task does not provide CBA results for specific local deployments.

3.4 Stakeholders⁶ identification of 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
ANSPs	ANSPs at deploying airports	Invest, operate, enjoy benefits	Project contributors provided inputs	Several benefits were confirmed for the ANSP qualitatively and quantitatively (e.g. more efficient runway arrivals/departures hourly distribution, increased Access & Equity, improved Predictability)
Airport Operators	Deploying airports	Invest, operate, enjoy benefits	Not involved in V3 CBA and Solution 02-05. Reviewed results	N/A
Airspace Users (Airlines & Pilots)	Airspace Users operating at	Enjoy benefits	Not directly involved in	The AUs is the RC platform used for

⁶ 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.

	deploying airports		V3 CBA but involved in the validations planned within the Solution 02-05	validation activities.
Airborne Industry (Rotorcraft)	Providers of technical solution for deploying airports	Provide technical solution	Project contributors provided inputs	The technical solutions provided confirmed quantitatively and qualitatively the benefits allowed by using of such an high-tech avionics, which resulted useless before that the operational solution in the context of PJ.02-05, be proposed.
SESAR JU	Single European Sky ATM Research Programme representative	Support operation Provide technical solution	Not directly involved in V3 CBA Reviewed results	N/A

Table 9: SESAR Solution 02-05 CBA Stakeholders and impacts

3.5 CBA Scenarios and Assumptions

This section is intended to provide a description of the scenarios that are compared in the CBA.

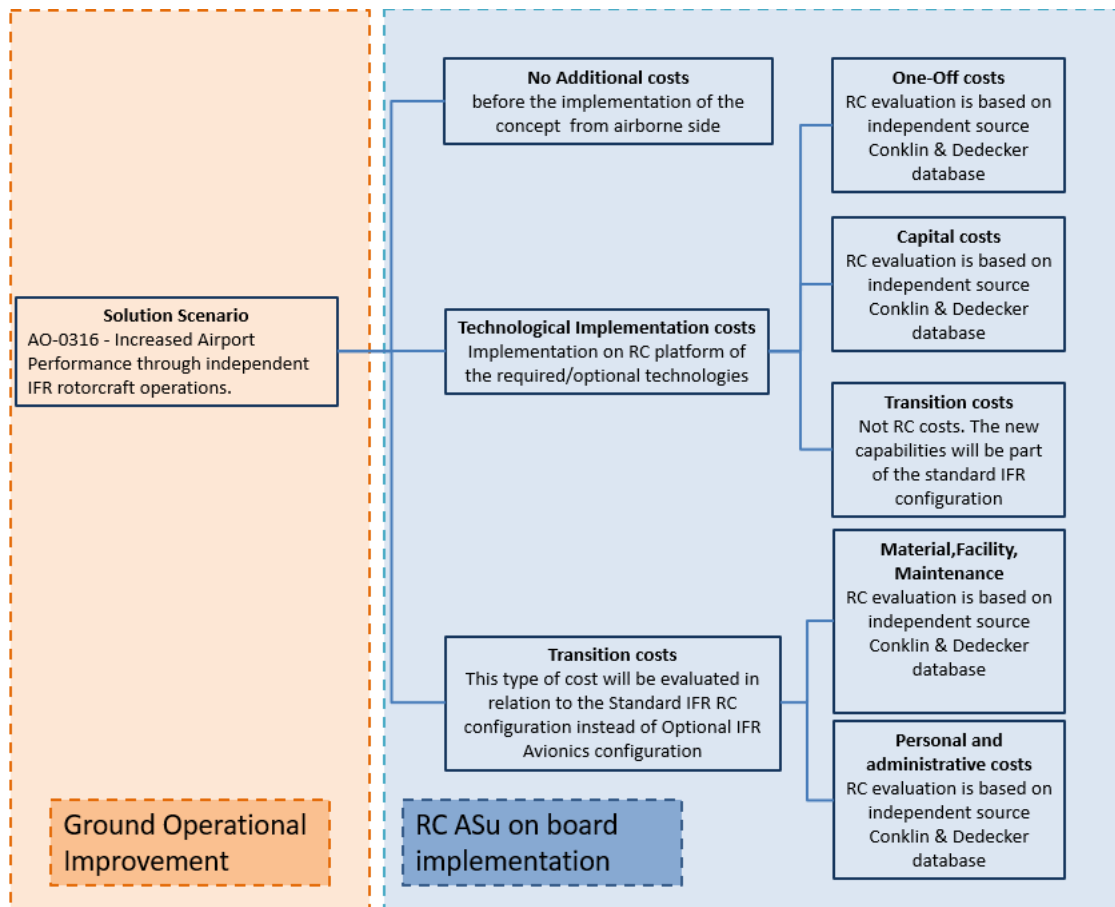


Figure 1: Scheme assumptions for Solution PJ.02-05

The Figure 1, shows how technology Costs are clustered, related to the specific OI and relative actors, from ground and airborne side.

Considering the Airborne point of view, in this solution, the Rotorcraft CBA values have been retrieved from an independent third-parties database called: Concklin&deDecker. All the evaluation and available direct and indirect costs (also called Variable or Fixed Costs) are based on this data base. The data base is available and free for consultation for any Airspace Users or actor involved in Aircraft Cost evaluation.

ANNUAL FIXED COSTS	ESTIMATED VARIABLE COSTS - Per Hour
Aircraft	Aircraft
Type of Operation	Type of Operation
Crew Salaries – Captain	Fuel
• Co Pilot • Flight Attendant • Flight Engineer/Other • Benefits	Fuel Additives
Hangar – Typical	Lubricants
Insurance – Hull	Maintenance Labor
• Single Limit Liability	Parts Airframe/Engine/Avionics
Recurrent Training	Engine Restoration
Aircraft Modernization	Thrust Reverser Allowance
Navigation Chart Service	Propeller Allowance
Refurbishing	APU Allowance
Computer Maintenance Program	Major Periodic Maintenance
Weather Service	Miscellaneous Expenses – Landing/Parking
Other Fixed Costs	• Crew Expenses • Supplies/Catering • Carbon Offset • Other
Total Fixed Cost per Year	Total Variable Cost per Hour

Figure 2: Rotorcraft costs

Hereafter is shown as the direct and indirect cost is considered and what main clusters composed each single item.

Costs are referred for any rotorcraft involved in the evaluation. The specific case of solution PJ02-05 took into consideration an average Costs value, represented by the typical flying platform used during the RTS and FT activities. Typical rotorcraft considered is a Twin-engine aircraft, dual/single IFR pilot, from 6.4 to 8.5 Tonnes MTOW, state of the art Avionic suite bay accomplished with the expected performances of this solution.

One of the main assumptions to be consider as first in to better understand this CBA evaluation, is that, any foreseen Costs spent in technological platform adaptation and integration in solution 02.05, from Manufacturer stand of view, are part of the future rotorcraft standard IFR capabilities.

In other words, the Costs evaluation of Avionics technological systems integration necessary to comply with SNI-AO-0316 (Increased Airport Performance through Independent (parallel or convergent IFR Rotorcraft Operations) have not effect on Actual and Transition costs, due to the fact that it will be part of the final rotorcraft price, comprises in the future standard IFR configuration.

Some of the specific technological systems Costs, related to specific technical enabler, are under Company restricted disclosure policy. Due to the fact that they are business oriented, they cannot be shared.

How to read the Concklin&deDecker data:

- **General Assumption:** Rotorcraft maintenance costs are estimated using an accrual method rather than a cash flow method. Our costs include an estimate of funds that should be set aside in order to pay for actual and eventual maintenance over one operational life of each of the components on the helicopter. For example, if the helicopter has a retirement item with

a life of 5,000 hours, the maintenance cost accrued per hour is equal to the cost of the item divided by its life interval of 5,000 hours. A cash flow system shows estimated costs over a fixed period based upon the typical period of an individual operator's ownership and does not reflect any maintenance costs the helicopter would experience beyond that fixed period. For more detailed information please refer to the other maintenance categories. Warranty is considered for all new helicopters, but its effect is negligible. One operational life starts with the latest model year for each helicopter type.

- **Sales Tax:** There are no sales taxes included in these costs.
- **Maintenance Assumption:** Costs has been assumed to be associated and performed by qualified service facility, unless indicated otherwise in the rotorcraft category.
- **Different type of Rotorcraft missions considered and average calculated, following that:**
 1. **Commercial (Helicopter)** - Commercial costs assume the aircraft is part of a fleet owned and operated for commercial purposes. Relative cost per hour is lower than a corporate aircraft. The aircraft is flown by a professional pilot whose primary job is pilot. Aircraft utilization is much higher than corporate. Pilot salaries are generally 20-30% lower than corporate pilots and Insurance is generally 50-100% higher than corporate. Aircraft maintenance and component overhauls are usually done in-house as opposed to sending the aircraft to a certified maintenance facility.
 2. **EMS (Helicopter)** - EMS costs assume the aircraft is owned and operated by a company solely for emergency transport of patients from an accident scene to a medical facility. The aircraft is flown by a professional pilot. These aircraft are required to maintain a very high reliability rate and are kept in excellent condition. Equipment levels are assumed to be appropriate for the transportation of people experiencing life treatments medical emergency in instrument meteorological condition (IMC-IFR)
 3. **Offshore (Helicopter)** - Offshore costs assume the aircraft is part of a fleet owned and operated for transporting personnel to offshore oil rigs. Relative cost per hour is generally lower than for a corporate aircraft. The aircraft is flown by a professional pilot whose primary job is pilot. Aircraft utilization is much higher than corporate. Pilot salaries are generally 20-30% lower than corporate pilots and insurance is generally 50-100% higher than corporate. Aircraft maintenance and component overhauls are usually done in-house as opposed to sending the aircraft to a certified maintenance facility.
 4. **Utility (Helicopter)** - Utility costs assume the aircraft is part of a fleet owned and operated for utility purposes like stringing high voltage power lines, lifting equipment and logging. The aircraft is flown by a professional pilot whose primary job is pilot. Aircraft utilization is much higher than corporate. Pilot salaries are generally 20-30% lower than corporate pilots and insurance is generally 50-100% higher than corporate. Aircraft maintenance and component overhauls are usually done in-house as opposed to sending the aircraft to a certified maintenance facility.
- **Fuel Costs:** Conklin & de Decker's fuel cost per gallon is the average of 300 Euro FBO's surveyed monthly by a third party.

- **Lubricants:** Cost of all lubricants such as engine oil, transmission oil and hydraulic fluid. A standard percentage (3%) is used for all Helicopters.
- **Maintenance – Labor:** Maintenance labor costs for helicopters assume one full operational life of the helicopter. An aging factor is applied based on the age of the Rotorcraft.

1. What is included in Helicopter labor calculation:

- Scheduled maintenance to include all Inspections for a full-life period.
- Discrepancies found during scheduled maintenance inspections/events for the airframe and avionics (on condition).
- Routine engine maintenance not covered during engine overhaul.
- Labor for the removal/replacement of components requiring overhaul/inspection/servicing.
- Unscheduled maintenance discrepancies.
- Troubleshooting unscheduled maintenance discrepancies.
- Minor airworthiness directives and service bulletins.

2. What is not included in Helicopter labor calculation:

- Major engine maintenance covered by our estimated engine restoration costs.
- Maintenance labor required for optional equipment aircraft completion items (interior), aircraft cleaning and washing, any administrative labor, stocking of aircraft supplies or travel to repair aircraft

3. What is included in Helicopter parts calculation:

- All airframe, avionics and minor engine consumable parts required for routine scheduled line maintenance.
- Unscheduled maintenance
- On-condition maintenance
- 20% of the total components overhaul and life limited parts cost has been added to account for premature removal of these parts due to
- Parts associated with airworthiness directives and mandatory service bulletins.

➤ **Engine Restoration Cost - Helicopter**

The engine costs are estimated using an accrual system. Our costs include an estimate of the funds an operator should set aside in order to pay for engine restoration maintenance over the full operational life of the rotorcraft.

Unscheduled maintenance labor and parts are not included. We assume two cycles per hour.

- **Crew Expenses:** If shown, this is the cost incurred by the flight crew (Pilots, Flight Engineer & Flight Attendant), when away from home base, for accommodations, transportation and meals. The costs are typical of a major area of operation and use a formula that includes euro 225 per pilot per night: Hotel euro 133, Meal euro 45, Misc euro 45.
- **Crew Salaries** these are the annual Captain, Co-pilot, Flight Attendant and Flight Engineer/Other Crew salaries for each category of aircraft. Flight Attendant salaries are normally applicable only to the largest corporate aircraft. The flight attendant salary (if shown) is used for cost purposes only. Flight attendants are not included in the weight build up, or as part of the minimum crew. Salaries are obtained from a recognized salary survey unless otherwise noted. Salaries assume a Euro Based crew.
- **Hangar:** Hangar cost expenses vary by aircraft size. Yearly rental costs for all aircraft are calculated by multiplying the aircraft square footage by the Euro cost per square foot per year averaged from major business aviation airports in large metropolitan areas.
- **Recurrent Training:** There are two types of recurrent flight training, one-time and full-service contract recurrent flight training. We use the cost for onetime recurrent flight crew training using a professional, simulator-based training program (if available) or the equivalent. This cost includes travel and lodging. Full-service contract recurrent training covers training twice a year on one aircraft or once a year on one aircraft and once a year on another less expensive aircraft. The cost for full-service contract training is approximately 60% more than one-time recurrent flight training.
- **Insurance – Hull:** insurance use the all-risk category for our hull insurance cost in The Aircraft Cost Evaluator. It calculates this cost as a percentage of the aircraft hull value. The percentages we use are averaged totals obtained from major insurance underwriters. Keep in mind your insurance cost may be different as these costs are based on aircraft mission as well as pilot and flight department safety records. Exclusions include illegal use of an aircraft; using an aircraft for purposes other than that described in the policy; wear and tear; piloting the aircraft by someone not named in the policy; operating an aircraft outside stipulated geographical boundaries; and damage or destruction of an aircraft resulting from war, riots, strikes, and civil commotions, mechanical breakdown loss, structural failure loss, and conversion. The hull value includes instruments, radios, autopilots, wings, engines, and other equipment attached to or carried on the plane as described in the policy.

3.5.1 Reference Scenario

The Reference Scenario reproduces the operations within Milan TMA and to/from Milan Malpensa airport without the proposed solution. The following Table 10 describes all details about it:

Scenario	Sectors involved	Airport	Runways / FATO in use	Special Operational Procedures for Rotorcraft
<u>Reference</u>	LIMMANW LIMMANE LIMMASW	LIMC	ARR: RWY 35L DEP: RWY 35R <i>No FATO is considered</i>	TO/FROM FATO (LILK): Rotorcraft will carry out the standard departure/arrival procedures (STAR/SID) to/from active runways

Table 10: Details of Reference Scenario

3.5.2 Solution Scenario

The Solution Scenarios includes the operations within Milan TMA and Milan Malpensa airport including enhanced IFR Point in Space procedures to/from FATO with aim to enable rotorcraft Simultaneous-Non-Interfering operations. In detail, for this exercise three PinS procedures with different approaching angles/GPA have been designed. On this basis three Solutions scenarios have been identified in or to perform the analysis:

- Approach PinS to LILK(LIMC) (RNP0.3 for whole procedure) RNP310 (approaching track 310°);
- Approach PinS to LILK(LIMC) (RNP0.3 for whole procedure) RNP320 (approaching track 320°);
- Approach PinS to LILK(LIMC) (RNP0.3 for whole procedure) RNP350 (approaching track 350°)
- Departure PinS from LIMC (RNP0.3 for whole procedure).

The Live Flight Trial focused on the results of a Real Time Simulation. From the Simulation has emerged that the best procedure was the **RNP 350**, in fact during the Live Flight Trial, the SNI PinS procedures used, are:

- Cascina Costa (LILK)/LIMC SNI PinS Approach procedures **RNP350 Y / Z / W / X**;
- Cascina Costa (LILK)/LIMC SNI PinS Departure procedure MCE02.

The scenario identified was only the Solution Scenario for Flight Trials, it was Milan Malpensa Airport and Milan TMA airspace (LIMM ACC) which can be considered as High complexity/High density environment. Solution Scenario has been identified to perform the analysis as shown in Table 11:

Scenario	Sectors involved	Airports	Runways / FATO in use	Special Operational Procedures for Rotorcraft
<u>Solution Scenario</u>	LIMMANW LIMMANE LIMMASW	LIMC	Fixed-wing ARR: RWY 35L DEP: RWY 35R	TO/FROM FATO (LILK): Rotorcraft will carry out the PinS procedure RNP350X, RNP350Y, RNP350W and RNP350Z to the FATO based on SNI (Simultaneous Non-Interfering Operations);

Table 11: Details of Solution Scenario

3.5.3 Assumptions

Please take into consideration that additional overall solution assumptions (e.g. where the PJ.02-05 concept will be implemented, foreseen fleet mix, etc.) is reported in the Section §5.4, so for detailed info refer to that section.

In the previous sections 3.1.5.1 and 3.5.2 was provided a detailed description of reference and solution scenarios simulated in the performed V3 Real Time Simulation and tested in the Live Trial, to evaluate the benefits brought by the implementation of concept Simultaneous Non-Interfering operations (SNI). The unmatched rotorcraft capabilities to fly at very low altitude with low flight speed allow

designing procedure with a steep approach (more than conventional 3° used by fixed wing) and thigh corridor (RNP 0.3 all phases of flight).

The deployment of the simultaneous non-interfering operations between fixed-wing aircraft and rotorcraft under IFR, with the main scope not to interfere at all, neither the existing runway traffic nor the existing flight procedures for fixed-wing and at the same time reducing reliance on the weather conditions is the main achieved outcomes in terms of CBA benefits.

It's important to underline the fact that from ANSP point of view the impossibility to considering the right aggregation parameters at ECAC level, led to making very important considerations and assumptions such as:

- Not matches or mix up parameters between Rotorcraft and fixed wing Flights available data have been considered. It is not correct to consider at ECAC level, data referred to fixed wing operation, and then compared or considered equivalent to rotorcraft operations. Rotorcrafts operations are peculiar and completely distinctive. In this CBA from AUs point of view some European IFR fleet and related flight hours have been properly considered and projected into the future, in order to have a clearer vision of benefits in late 2030.
- To date no rotorcraft SNI concept of operation has still implemented in any ECAC environment/airport, available to release any type of cost/operative benefits.
- The medium/high complexity and medium/high density TMA in Milano area, considering a congested and busy airport such as Milano Malpensa, in which the SNI concept applied to specific Rotorcrafts operation have been tested and evaluated for the first time; have given a valuable example of tangible benefits.
- Having in mind that solution 02-05 have recognised and pointed out the quantitative and qualitative Cost Benefits in terms of Fuel/Distance/Time saved through the application of PInS APCH/DEP in SNI environment, from CBA concrete benefits, the outcomes could be considered as the starting point of precise data available for future statistic elaboration or costs evaluation.

4 Benefits

This section provides an early rough estimation of the monetised benefits deriving from the potential implementation of the solution under analysis.

A first overview of the main expected benefits in terms of Key Performance Areas (KPAs) and Key Performance Indicators (KPIs) may be found in the Benefit Mechanism defined within the PJ.02-05 V3 Validation Plan [12].

Some of such benefits have been measured during the validation activity and are going to be monetised here, where possible, following a two-stage process as presented in the picture below. First, the performance results from the validation exercises reported in the VALR were aggregated per each KPA and KPIs in the PAR. In a second stage, the relevant KPIs performance figures from the PAR were translated in compliance with PJ19 guidelines, into monetary values in this CBA.

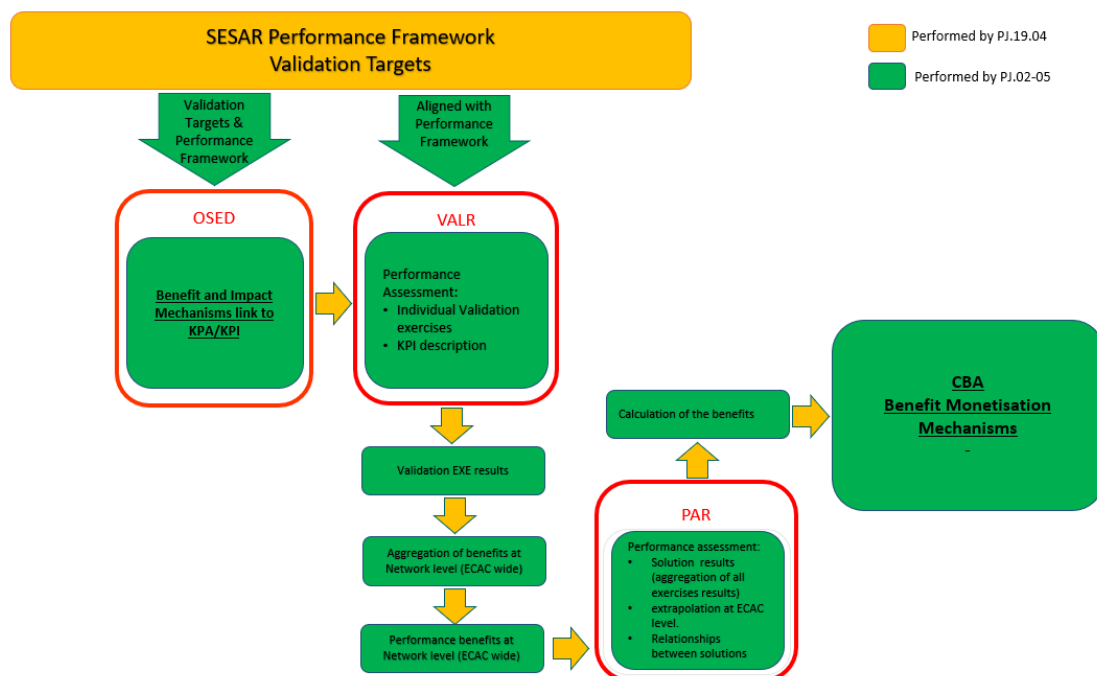


Figure 3: CBA logic calculation

The CBA Benefit Monetisation mechanism, the “CBA Model” used for translating validations results into monetary benefits is the CBA spreadsheet derived from the PJ19 S2020 CBA and embedded in the following Section 6.



Performance Framework KPA ^[1]	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	2019	2028	2040
	ANS Cost efficiency	CEF2 Flights per ATCO-Hour on duty	Nb	ATCO employment Cost change	€/year	N/A	N/A	N/A
				Support Staff Employment Cost Change	€/year	N/A	N/A	N/A
				Non-staff Operating Costs Change	€/year	N/A	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	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	No variation. It's based on annual variable operating growth cost, not related to the OI-0316 – SNI concept	No variation. It's based on annual variable operating growth cost, not related to the OI-0316 – SNI concept	No variation. It's based on annual variable operating growth cost, not related to the OI-0316 – SNI concept

Performance Framework KPA ^[1]	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	2019	2028	2040
		AUC5 Overhead costs for an airspace user	EUR / flight 430 euro by flight	Impact on overhead costs. Examples: dispatchers, training, IT infrastructure, sales.	€/ year	430 * 500 ifr/h = 215.000 euro per year by single RC	260.000 euro per year by single Rotorcraft	327.000 euro per year by single Rotorcraft
	Airspace capacity	CAP1 TMA throughput, in challenging airspace, per unit time	% and # movements	Tactical delay cost (avoided-; additional +)	€/ year	N/A	N/A	N/A
			% and # movements	Strategic delay cost (avoided-; additional +)	€/ year	N/A	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	N/A
			% and # movements	Strategic delay cost (avoided-; additional +)	€/ year	N/A	N/A	N/A
	Airport capacity	CAP3 Peak Runway Throughput (Mixed mode)	% and # movements	Value of additional flights	€/ year	N/A	N/A	N/A
	Resilience	RES4a Minutes of delays	Minutes	Tactical delay cost (avoided-; additional +)	€/ year	N/A	N/A	N/A
		RES4b Cancellations	% and # movements	Cost of cancellations	€/ year	N/A	N/A	N/A

Performance Framework KPA ^[1]	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	2019	2028	2040
		Diversions	% and # movements	Cost of diversions	€/year	N/A	N/A	N/A
	Predictability	PRD1 Variance of Difference in actual & Flight Plan or RBT durations	Minutes^2	Strategic delay cost (avoided-; additional +)	€/year	N/A	N/A	N/A
	Punctuality	PUN1 % Departures < +/- 3 mins vs. schedule due to ATM causes	% (and # movements)	Tactical delay cost (avoided-; additional +)	€/year	N/A	N/A	N/A
	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	N/A
						N/A	N/A	N/A
	Time Efficiency	FEFF3	% and minutes	Strategic delay: airborne: direct cost to	€/year	0	562.873.698 €	653.353.414 €

Performance Framework KPA ^[1]	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	2019	2028	2040
		Reduction in average flight duration		an airline excl. Fuel (avoided-; additional +)				
	Fuel Efficiency	FEFF1 Average fuel burns per flight	Kg fuel per movement	Fuel Costs	€/year	0	3.679.787 €	5.349.331 €
	Fuel Efficiency	FEFF2 CO2 Emissions	Kg CO2 per movement	CO2 Costs	€/year	0	53.086 €	61.619 €
	Civil-Military Cooperation & Coordination	CMC2.1a Fuel saving (for GAT operations)	Kg fuel per movement	Fuel Costs	€/year	N/A	N/A	N/A
		CMC2.1b Distance saving (for GAT operations)	NM per movement	Time Costs	€/year	N/A	N/A	N/A

Table 12: Results of the benefits monetisation per KPA

5 Cost assessment

The goal of the CBA is to monetise the costs and benefit in order to determine if the solution is profitable for a specific investor and for the airspace users. In order to answers to both of those needs, it has been decided to use generic aggregated European data to monetize the costs. **ANSPs costs**

5.1.1 ANSPs cost approach

The goal of the CBA is to monetise the costs and benefit in order to determine if the solution is profitable for a specific investor and for the airspace users. In order to answers to both of those needs, it has been decided to use generic aggregated European data to monetize the costs.

5.1.2 ANSPs cost assumptions

As the time horizon and the time frame of the project presented in section 3, the implementation costs are supposed be generated from 2022 to 2026 and the operating cost should materialise from 2023 to the end of 2040.

5.1.2.1 One-off costs

Initial Training: The cost evaluation for the initial training is based on the following inputs:

- The training period related to the implementation and the operational use of the rotorcraft procedures involves both TWR and TMA (APP or ACC) ATCOs:
 - 1 day of theory for both TWR and TMA's ATCOs;
 - 2 days of simulation for each TWR's ATCOs (with a focus on contingencies, missed-approach management in a simultaneous scenario and new ground movement management in light of a forecast rotorcraft's growth);
 - 1 day of simulation for TMA's ATCOs (including the ACC Supervisor who in charge of sector configuration).
- The opportunity cost of those training sessions based on the cost of the ATCO hour's standard input and the number of controllers trained: 265,21 euros per hour in 2024 based on [11]
- The training fees requested by the training entity: 1 000 euros per training days. However, for accuracy purposes it has been considered that the training session should include a maximum of 20 controllers. It is assumed that on average number of TMA ATCO is 30 per ACC\APP and 40 ATCO per TWR (e.g. Very Large airport) within several training sessions.

In the end, assuming a daily training cost of 1000€ per 1 Day per 100 ATCOs (among TWR and TMA\ACC's ATCOs), the estimated costs for training are 280.000 euros;

Project Management: The estimate of the overall project management cost is 100 000 euros for each ANSP that chooses to invest in this SESAR Solution. It means that if this Solution is implemented in several ACC this cost will only appear once for a given ANSP. This envelope includes the project definition, programme management and support, planning costs, procurement management, meeting and travelling costs, processes and documentation costs that are related to the

implementation of procedures in the airport environment. This cost is spread equally across the pre-implementation period, therefore in 2022 and 2023.

Administrative costs: The introduction of the rotorcraft procedure concept impacts the existing operational procedure. Nevertheless, as it relies on existing operational working methods, it follows the best effort rule. The administrative costs are assumed to be very low and for this CBA it is set to zero.

Installation and commissioning: It's worth noting that a map's on ATC system's architecture update (ATCO's CWP) shall be calculated. If it's not part of ANSP and his industry party agreement, estimated costs: 5000 euros as described in the Section 5.1.2.2.

Validation and certification costs: The validation test and evolution of the product is the most important subsection of this one-off cost component. Indeed, before deploying the product operationally each ANSPs that have chosen to invest in this Solution, have to conduct validation exercises and live trials in order to certify the solution operationally. Those exercises are costly due to the number of staffs involved in the process. The overall cost for this validation and certification is estimated 200.000 euros.

So, considering these assumptions the costs relating to ANSP are (280.000, 100.000, 100.000, 155.000) 635.000€.

5.1.2.2 Capital costs

Equipment & Systems:

No costs for Equipment & Systems were identified. Nevertheless, it's worth noting that a map's update on ATC system's architecture (ATCO's CWP) shall be calculated (If it's not part of ANSP and his industry party agreement). The estimated costs for this update, assuming that 0.5 person-mouth will be necessary, are 5000 euros.

5.1.2.3 Transition costs

Neither transition staff costs nor transition nor transition investment cost were identified.

5.1.3 Operational costs

Personnel and training: In lights of a potential increasing in airport capacity and number of movements (fixed wing on the active runways + helicopters on the FATO), the TOWER layout (number of ATCOs) may need to be increased in terms of personnel to be allocated to the airport management. However, these costs are not quantifiable at the moment because that are based on specific assumptions. Anyhow, it's a fact that the implementation of this additional role and its impact on the operation do lead to an increase of the ATCO training (for both sides TWR and TMA\ACC). The estimation on this cost is 0.5 day of training for ATCO per year.

5.1.4 Number of investment instances (units)

The number of investment instances in unit in terms of ACC is presented in the following table:

Airport	TMA	ACC
---------	-----	-----

HC	HS	LC	LS	H	M	L	H	M	L
N/A							15	10	4

Table 13: Number of investment instances - ANSPs

5.2 Airport operators' costs

Even if this is not interest of this CBA (Cost Benefit Analysis) we firmly believe that, the implementation for this Solution will impact mainly the Airport Operators' costs (e.g. new parking positions to accommodate the new AUs, preferential taxiways to roll-out/in from/to the FATO, dedicated terminals, dedicated handling services, etc.).

5.3 Network Manager costs

N/A for Solution PJ.02.05 **Airspace User costs**

The airspace User costs relate to solution 02-05 is here referred generally to Airborne. With "Airborne" definition, is intended all the costs and relative data connected to flying platform. This distinction is necessary since in order to make calculation more general as possible, the evaluation has been based on values coming from independent third parties Concklin&deDecker database. Specifically, if had been considered the prototype flying platform used during the RTS and FT activities, the costs values would have been falsified and not real, for a Customer/Operator/Airspace Users. Airborne data have been calculated based on different assumptions, listed in chapter 3.5 and in Chapter 5.4.2.

The main expected costs from airborne side, in order to achieve the aim of OI-0316, have been expected to come from Avionics platform integration and adaptation.

The Costs evaluation of Avionics technological systems integration necessary to comply with SNI-AO-0316 (Increased Airport Performance through Independent - parallel or convergent IFR Rotorcraft Operations) have not effects on Actual and Transition costs, due to the fact that the new capabilities/performances are part of the final rotorcraft price, comprises in the future standard IFR configuration.

Some of the specific technological systems Costs, related to specific technical enabler, are under Company restricted disclosure policy. **Airspace User cost approach**

The airborne Costs approach has been based on some assumptions and clear solution definitions on what planned and used in PJ02.05 exercise activities.

First it essential to distinguish the difference between a general air space user (intended as final services user) and the airborne technical/operational evaluation made during the research activities. This is come out in the consideration of prototype flying platform that is by design, different in its characteristics respect a production one.

In addition, a clear view on what is intended as IFR flight in the European rotorcraft field of operation were necessary, considering the solution scope.

The assumptions were based on rotorcraft IFR flights and flight hour's data available through the kind involvement of EHA- European Helicopter Association.

The Cost evaluation criteria may contain information that are confidential and proprietary to Leonardo Helicopters, and is supplied on the express condition that it may not be disclosed to any third party, or reproduced in whole or in part, or used for manufacture, or used for any purpose other than for which it is supplied, without the prior written consent of the Company. Due to Company restricted policy in sharing specific business costs, some calculation has been based on third independent source, like the Concklin&deDecker aircraft cost summary. The use of Concklin&deDecker does not remove Rotorcraft specificity and accuracy of calculation for final costs outcomes.

Additional specific data, values, growth rate and percentages have been applied in accordance to expert actors involved during the document preparation. **Airspace User cost assumptions**

In addition to the assumptions reported in Chapter 3.5; taking into consideration the European Helicopter IFR flight hours, and European Helicopter IFR fleet, the necessary value and data required to calculate and populate Table 12: “Results of the benefits monetisation per KPA” in chapter 4, has been based on the following assumptions:

- 1) In order to identify the Helicopters IFR flight hours in Europe, the helicopter fleet has been analysed considering the following field of operations:
 - Emergency medical service operations
 - Offshore operations
 - Corporate operations
 - Utility operations

and the “numbers” included in the document: EUROPEAN HELICOPTER IFR FLEET ANALYSIS, prepared by EHA (dtd 18.06.2013 and later updates).

- 2) Europe and East Europe helicopters IFR flight hours assumptions:

➤ Flight Duration assumptions:

- Short flight/short distance = VFR
- IFR = long distance (600km max – about 2 or 3 hours of flying)
- Many IFR flights take 60 – 90 minutes

➤ Emergency Medical Service assumptions:

HEMS, normally 600-700 flight hours per RC per year, average flight duration: 20 –40mins per flight

- 20% IFR today
- 45% IFR in 2040
- HEMS operator data from EHA (2007) – Italian CAA data

➤ Offshore Operations assumptions:

- Offshore, normally 1.000-1.500 flight hrs per RC per year

- 80% IFR today
- 87% IFR in 2040

➤ Corporate Operations assumptions:

Mainly not scheduled – normally 300-600 flight hours per year

- 70% IFR today
- 85% IFR in 2040

3) Traffic Growth assumptions

- The number of IFR flights will increase in the next future:

		Flights growth sharing			
		Today		2040	
		IFR	VFR	IFR	VFR
Fleet	Off-shore	80%	20%	87%	15%
	HEMS	20%	80%	45%	60%
	Corporate	70%	30%	85%	20%

4) Calculation\assumptions:

- The maximum number of flight hours per year interval and per field of operation is considered
- The Total flight hours related to the number of helicopters per geographical area (Ref: EUROPEAN HELICOPTER IFR FLEET ANALYSIS) are calculated taking into consideration IFR estimated percentages as indicated in the above table.
- The number of IFR helicopters fleet in 2028/2040 is based on a forecast of IFR fleet growth rate of 1,8% , over the next twenty years (2040 manufactures data)
- It is estimated that in Europe there are around 750.000 IFR helicopter flights per year of which, in average, a flight lasts less than one hour up to one a half.

5) The estimation of total IFR Rotorcraft flight hours today and in 2040, passing through 2028 is:

Europe (ECAC)	Today	2028	2040
TOT. FT/hrs	512.400	587.360	632.190

6) It's worthy to underline the additional assumption on what is the meaning of: "Flying IFR".

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It doesn't mean, that all the flight is under IFR or that both landing, and take-off location are IFR.

For that reason, the total amount of IFR hours and related flight (e.g. 750.000 IFR helicopter flights/ 512.400 Hrs) must be considered properly. The SNI concept of operation is expected that it will be implemented in all IFR landing/take-off location considered, and in the last future all the above amount would be considered for entire.

Based on the above assumptions and value, it has been considered an average value of 500 IFR Flight hours per year by a single rotorcraft that will "use the SNI concept" at airport. The SNI concept represents the 60% of airport IFR rotorcraft flights in Europe in the incoming future. The expectation for late future is attested around 85%.

This flight hour's number has been used to initialize the Concklin&deDecker calculation of the relevant Rotorcraft direct and indirect cost per year.

5.4.3 Number of investment instances (units)

The expected investments instances made by an AUs, foreseen in 2028 and in the future 2040 is the replacement of elder rotorcraft that don't comply with the future standards and performances requirements. The new Rotorcrafts capabilities/performances are the requisite to support a certain type of operation, like to perform AO-0316. The Future standard IFR rotorcraft configuration will comprise those new capabilities.

5.4.4 Cost per unit

The SNI concept implemented at airport, supported by the specific rotorcraft avionics technologies, has been evaluated in terms of: Pre-Implementation Costs, Implementation costs and Operating costs.

As per previously assumptions, from airborne evaluation, it can be said that, no Pre-Implementation Costs are considered or took into consideration, due to the fact that SNI concept was not implemented.

The SNI on board enablers/capabilities will be part of the latest standard IFR configuration, so no implementation costs are foreseen. These new Navigation and Avionics capabilities in terms of assured performances are the future standards to which comply.

On the other hands, the Operating Costs, can be evaluated, through the available database and assumptions, making and average calculation on the actual Operating Costs and the expected future ones, applying a percentage growth rate of 5%.

Cost category	Rotorcraft	
	Ground	Airborne
Pre-Implementation Costs	N/A	Not Applicable

Implementation costs	N/A	are part of Standard IFR Avionics configuration
Operating costs	N/A	3350 €/Hr (Average source) Concklin&deDecker

Table 14: Cost per unit - AUs

5.5 Military costs

N/A for PJ02.05

5.6 Other relevant stakeholders

N/A for PJ02.05

6 CBA Model

The Excel file including the CBA Model is embedded here.



PJ.02-05_CBA_(D4.1.
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6.1 Data sources

The model uses the following data sources:

- SESAR 2020, PJ02-05 SPR-INTEROP/OSED for V3 – Part I
- SESAR 2020, PJ02-05 SPR-INTEROP/OSED for V3 – Part IV
- SESAR 2020, PJ02-05 SPR-INTEROP/OSED for V3 – Part V
- EATMA Dataset 19
- Common assumptions
- STATFOR Challenges of Growth 2018
- Standard Inputs for EUROCONTROL Cost-Benefit Analyses vol. 8.0

7 CBA Results

This section provides the results of the PJ.02-05 CBA at V3 Level. The CBA has been built gathering the following information:

- The Investments costs (pre-implementation and implementation costs) and Operating Costs have been identified for the main stakeholders impacted;
- Benefits have been estimated and monetised in the CBA Model using the information available from the PJ.02-05 Performance Assessment Report and Validation Report as input

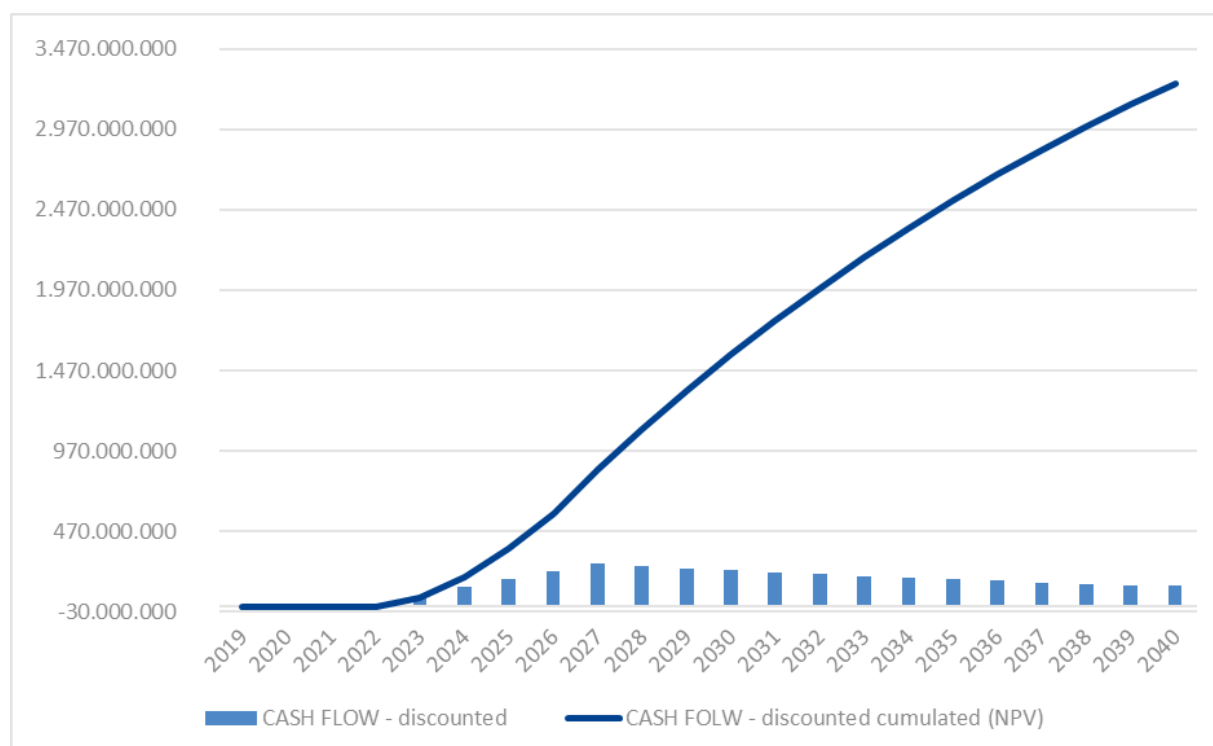


Figure 4 (and Figure 5) presents the PJ.02-05 cumulated costs and benefits for the period 2019-2040, overall and for the viewpoint of every impacted stakeholder. Costs and Benefits are estimated at ECAC level in according to the Scenario.

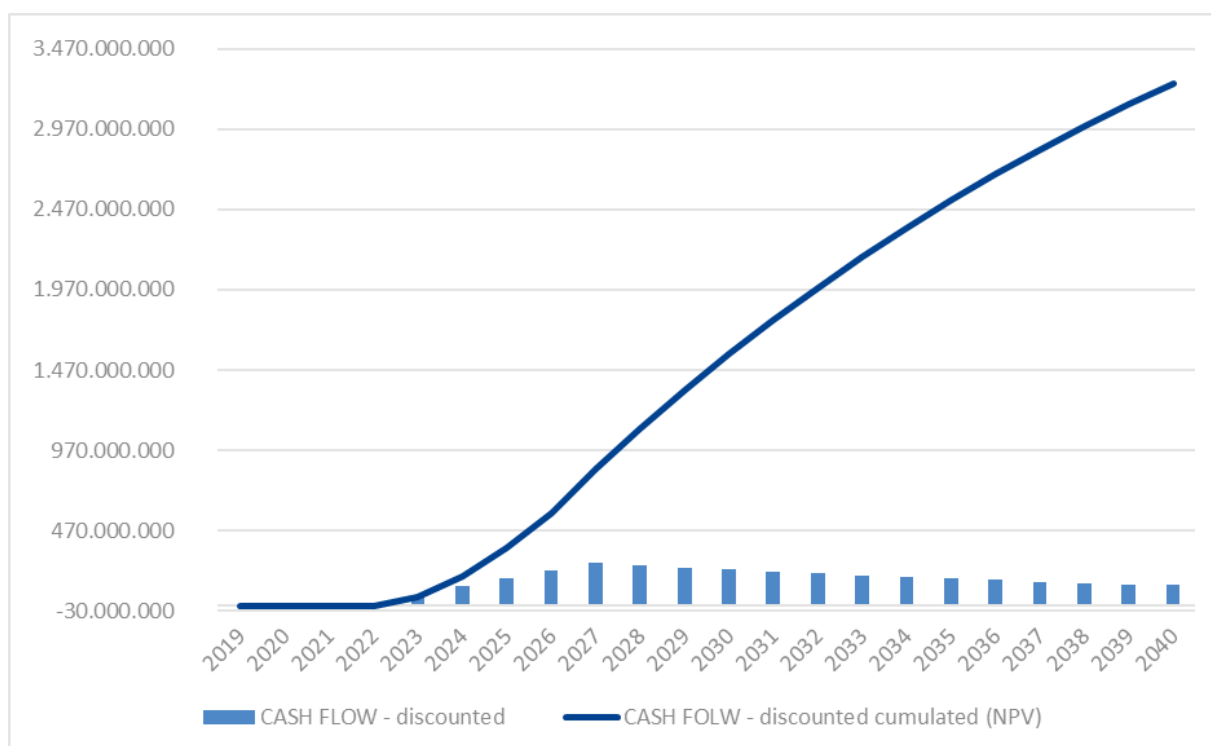


Figure 4: Cash flows (in EUR)

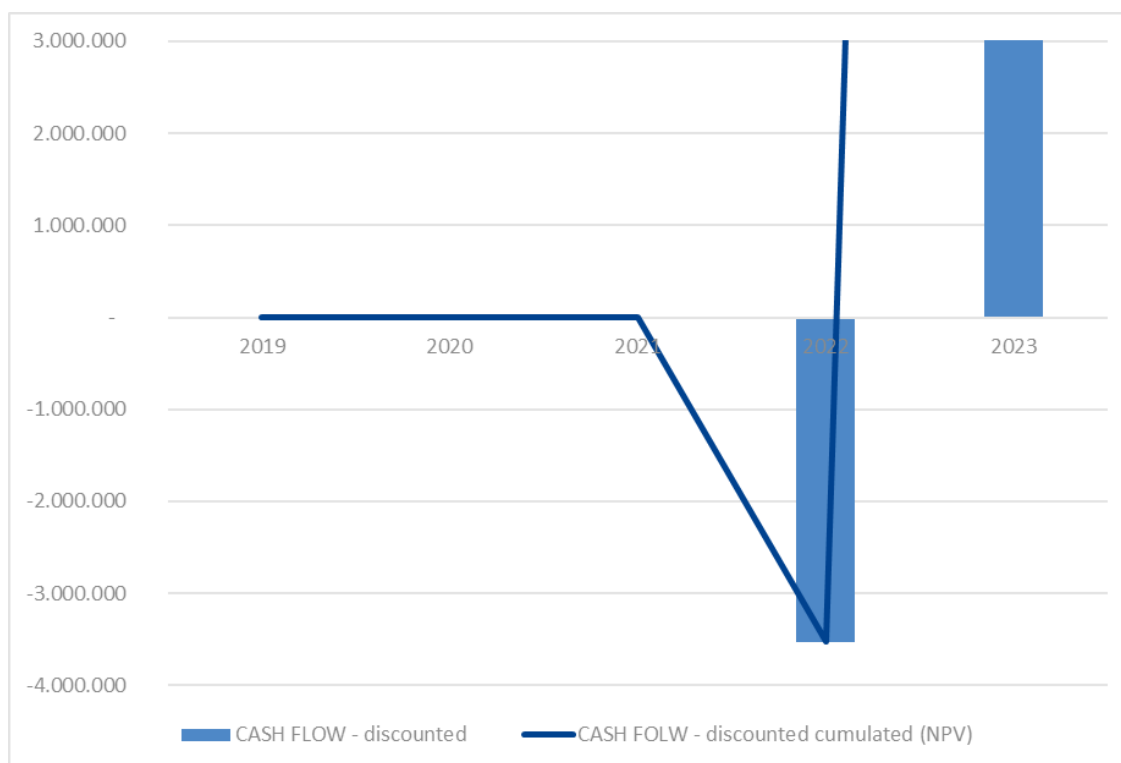


Figure 5: Cash flows (in EUR) - 2019 to 2023 details (zoom)

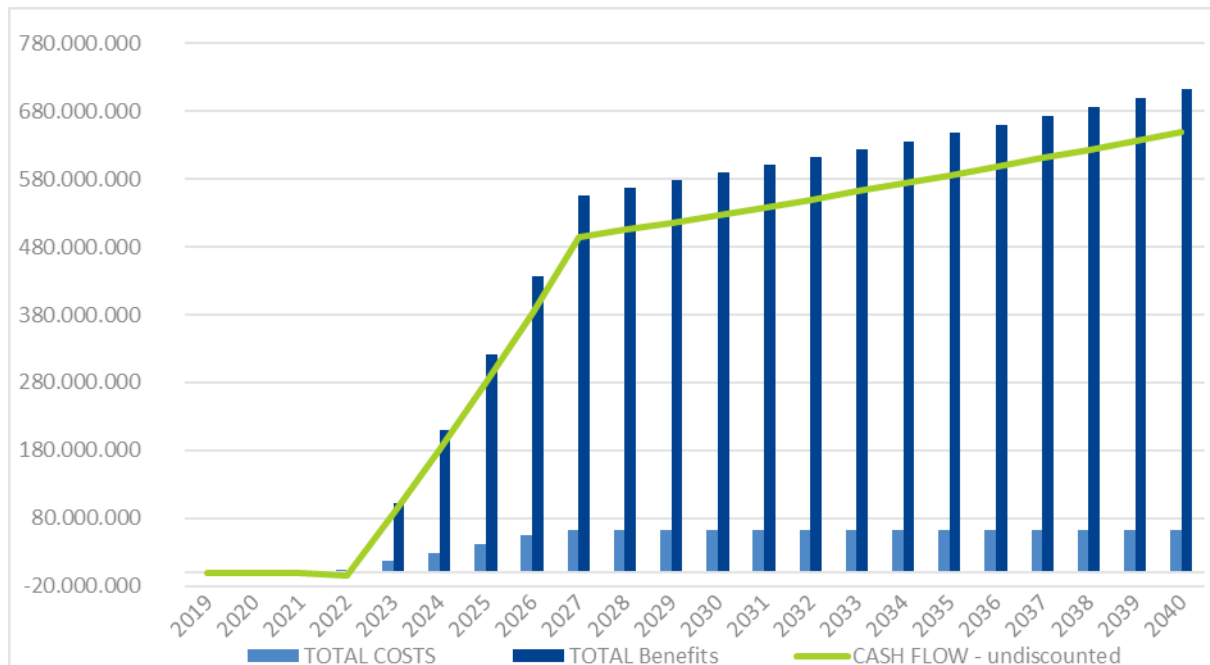


Figure 6 shows the cumulative cash flow of the PJ.02-05 and correlated benefits. The (little) light blue bars below the horizontal axis represent the different yearly costs incurred by the concerned stakeholders. The dark blue columns over the horizontal axis show the yearly benefits. The costs of Deployment (Pre-Implementation and Implementation Costs) last until the end of 2040. The model data shows that as from 2023 the solution starts delivering benefits.

In 2027, when all OI considered in this CBA are expected to be fully deployed and in operation, the yearly benefits start to exceed the yearly costs. In the

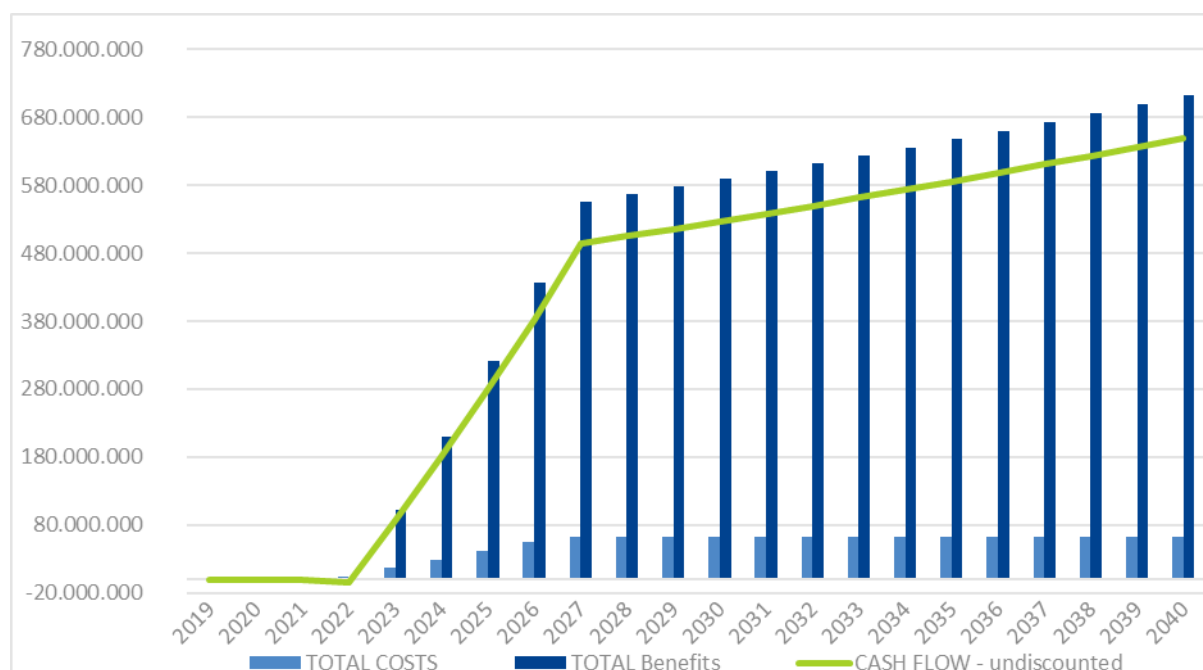


Figure 6 this is translated into a positive slope for the cumulative benefits until the end of the timeline

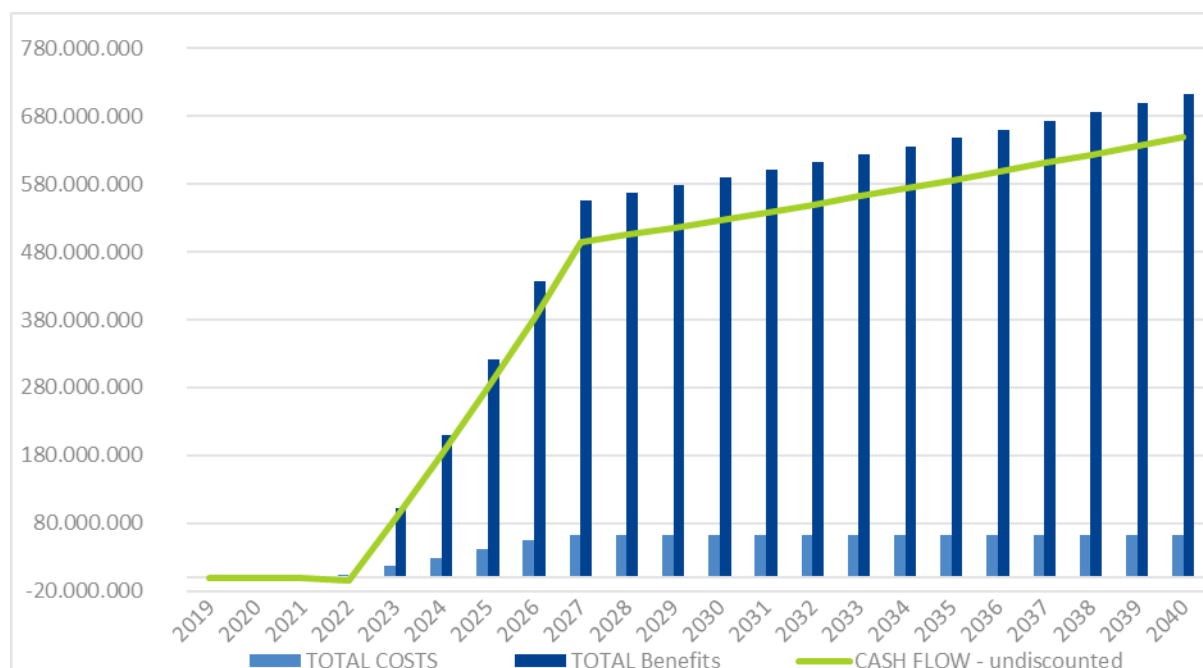


Figure 6: Total costs and benefits (in EUR)

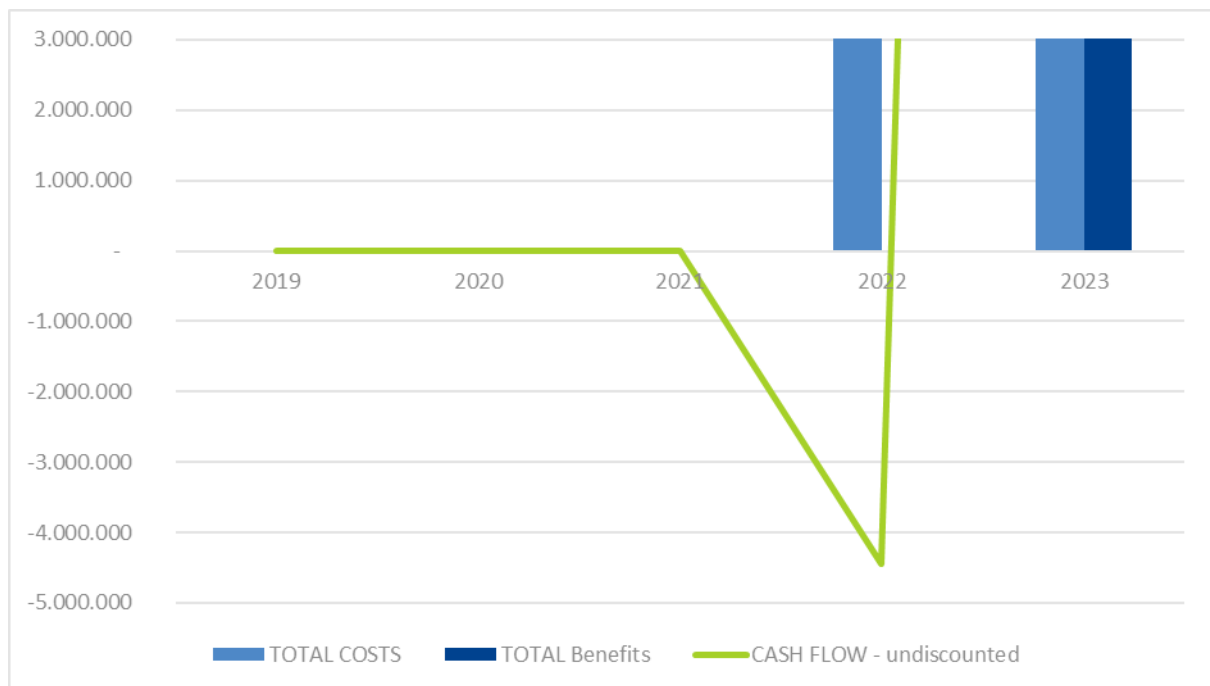


Figure 7: Total costs and benefits (in EUR) - 2019 to 2023 details ([zoom](#))

8 Sensitivity and risk analysis

The Sensitivity Analysis has been useful to test the robustness of the results of the model in the presence of emulated uncertainty. It has contributed to increase the understanding of the relationships between input and output variables in the CBA.

This section provides an initial analysis of the impact of the main uncertainties identified when designing the PJ.02-05 CBA Model and calculating the final NPV. This analysis intends to depict the global impact in the results of the CBA. The level of confidence in the results is good as:

- potential benefit estimations are coming from the Real Time Simulation and Live Flight Trial;
- the parameters that were used in the benefits quantification and the benefit mechanisms were consolidated and allow the extrapolation at ECAC level.

In order to measure the impact of risk which might affect the results of the CBA a sensitivity analysis has been carried out. The

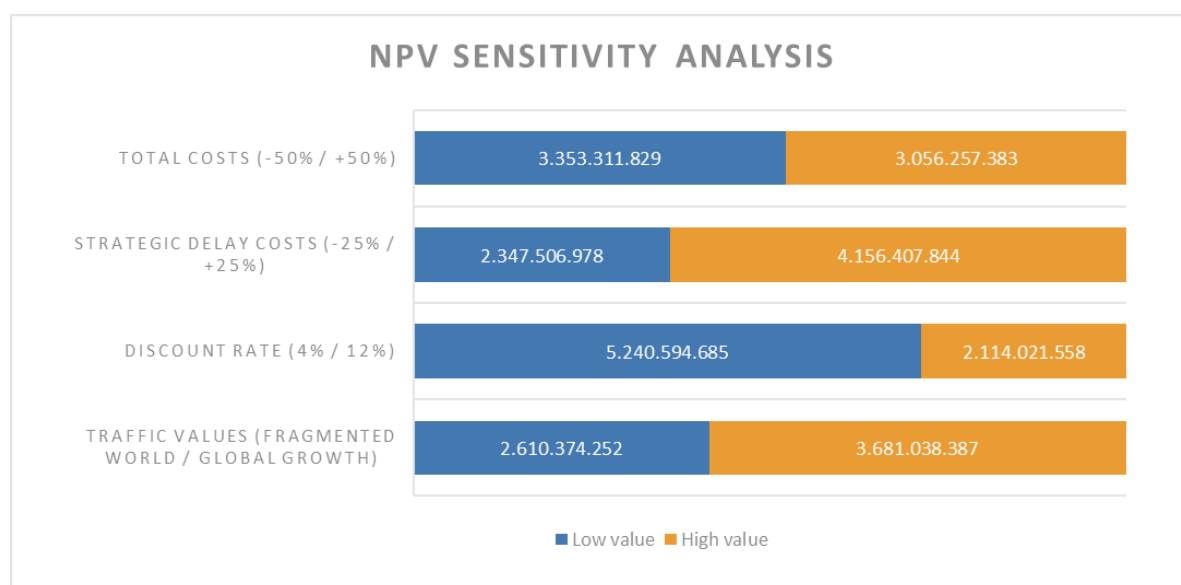


Figure 9 below presents the change of the Net Present Value (NPV) in high/low scenarios of the most influential parameters.

NPV sensitivity analysis				
Base case NPV (in EUR)		3.251.957.411		
Sensitivities	Low value	High value	Difference	
Traffic values (Fragmented world / Global growth)	2.610.374.252	3.681.038.387	1.070.664.135	
Discount rate (4% / 12%)	5.240.594.685	2.114.021.558	-3.126.573.127	
Strategic delay costs (-25% / +25%)	2.347.506.978	4.156.407.844	1.808.900.866	
Total costs (-50% / +50%)	3.353.311.829	3.056.257.383	-297.054.446	

Figure 8: Excerpt from CBA Model (XLS embedded in section §6)

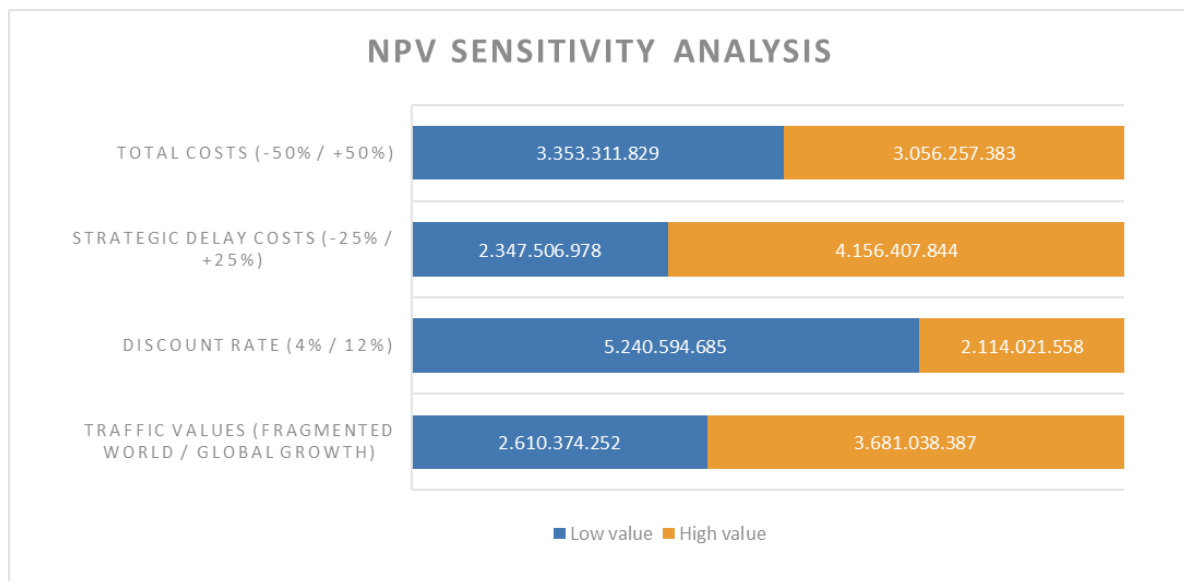


Figure 9: NPV Sensitivity Analysis

9 Recommendations and next steps

The purpose of next steps is transition from research to deployment in an operational environment, by further development of operational concepts.

It is also necessary to validate that all concurrently developed concepts and supporting enablers (procedures, technology and human performance aspects) can work coherently together and can deliver the required benefits.

The overall positive result of the CBA supports the decision of proceeding with the Solution to next phase. In fact, in the next phase further validation scenarios will have to be performed where they may shine light on HP and SAF requirements that influence overall KPA investigated.

The benefit assessment and cost estimates should be covered all areas of benefit of the solution and, in the next phase, providing more robust qualitative and quantitative complete assessments.

In conclusion the several recommendations stemming from the CBA to be considered when planning the next phase are the following:

- KPIs – upon planning the next phase validations more emphasis should be put on strict adherence to SESAR 2020 KPIs and a delivery of quantifiable results;
- Operating environment – Operating environment - during the deployment phase (outside the SESAR factory) more work will be required to develop operational systems, new standards and, of course, the regulatory framework in which this solution (rotorcraft IFR SNI operations) can operate. Due to the fact that the PinS IFR approaches and departure procedures in SNI airport environment are to be considered as the operative solution that allows rotorcraft to land **in airport** on (existing) VFR FATOs, making “free” fixed wing operation on main runway, the ATCOs’ recommendation are:
 - a. Even if the IFR SNI PinS are strategically separated (by designing criteria) from the surrounding routes network, the ATCOs suggest identifying a Limit Clearance Point (LCP) in some specific cases where a FATO is located in airport environment (Class D) close to the main runway, in order to fully satisfy the SNI concept and ATM statements.
 - b. Differentially, when the IFR landing location (FATOs) is considered totally IFR, in airport environment, the problem of separation issue responsibility will be overcoming. In this specific case, the ATCO prefer an independent IFR rotorcraft procedure (to/from FATO located at airport) procedure **completely IFR**, till the FATO lift off and landing area.
- Costs – it is advisable that more stakeholders are consulted on costs estimations in to provide much more reliable costs breakdown structure and more accurate values.

10 References and Applicable Documents

10.1 Applicable Documents

- [1] SESAR 2020 Project Handbook
- [2] SESAR 16.06.06-D26_04, Guidelines for Producing Benefit and Impact Mechanisms, Edition 03.00.01
- [3] SESAR 16.06.06-D26_03, Methods to Assess Costs and Monetise Benefits for CBAs, Edition 00.02.02

10.2 Reference Documents

- [4] Common assumptions for CBAs as maintained by Pj19 (provisionally the ones included in the 16.06.06- D68_Part 1, New CBA Model and Methods 2015, Edition 00.01.01 can be used)
- [5] European ATM Master Plan Portal <https://www.atmmasterplan.eu/>
- [6] SESAR C.02-D110, Updated D02 after MP Campaign, Edition 00.01.00
- [7] SESAR 2020 D108, Transition Performance Framework, Edition 00.06.00
- [8] SESAR 2020 D86, Guidance on KPIs and Data Collection – Support to SESAR2020 transition
- [9] Transition VALS SESAR 2020 - Consolidated deliverable with contribution from Operational Federating Projects
- [10] PJ19_04 - D4_8 Validation Targets (2019)
- [11] ATM Cost-Effectiveness (ACE) 2017 Benchmarking Report with 2018-2022 outlook
- [12] SESAR2020, PJ.02-05 VALP for V3 (FINAL);
- [13] SESAR 2020, PJ.02-05 SPR-INTEROP/OSED V3 (FINAL);
- [14] SESAR 2020, PJ.02-05 TS/IRS V3 (FINAL);

11 Appendix A

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

ATM Master Plan SESAR Performance Ambition KPA	ATM Master Plan SESAR Performance Ambition KPI	Performance Framework KPA	Focus Area	#KPI / (#PI) / <Design goal>	KPI definition
Cost efficiency	PA1 - 30-40% reduction in ANS costs per flight	Cost efficiency	ANS Cost efficiency	CEF2	Flights per ATCO hour on duty
				CEF3	Technology Cost per flight
Capacity	PA7 - System able to handle 80-100% more traffic	Capacity	Airspace capacity	CAP1	TMA throughput, in challenging airspace, per unit time
				CAP2	En-route throughput, in challenging airspace, per unit time
	Airport capacity		CAP3	Peak Runway Throughput (Mixed Mode)	
			Capacity resilience	<RES1>	% Loss of airport capacity avoided
	PA6 - 5-10% additional flights at congested airports	Capacity resilience	<RES2>	% Loss of airspace capacity avoided	
			PA4 - 10-30% reduction in departure delays	Predictability and punctuality	Departure punctuality

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
Operational Efficiency	PA5 - Arrival predictability: 2 minute time window for 70% of flights actually arriving at gate		Variance of actual and reference business trajectories	PRD1	Variance of differences between actual and flight plan or Reference Business Trajectory (RBT) durations
	PA2 - 3-6% reduction in flight time	Environment	Fuel efficiency	(FEFF3)	Reduction in average flight duration
	PA3 - 5-10% reduction in fuel burn			FEFF1	Average fuel burn per flight
Environment	PA8 - 5-10% reduction in CO2 emissions			(FEFF2)	CO2 Emissions
Safety	PA9 - Safety improvement by a factor 3-4	Safety	Accidents/incidents with ATM contribution	<SAF1> see section 3.4	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 15: Mapping between ATM Master Plan Performance Ambition KPAs and SESAR 2020 Performance Framework KPAs, Focus Areas and KPIs

12 Appendix B

12.1 FEFF Extrapolation to ECAC wide:

The following table shows the results of the Flight Trials for Fuel Efficiency

Flight Efficiency Analysis for Fuel Benefits Terminal & Approach							
	Reference	Solution 1 RNP 310/320	Solution 2 RNP 350	Δ Kg x AC Ref vs Sol 1 & 2	Δ Kg x AC Ref vs Sol 3	Δ % x AC Ref vs Sol 1 & 2	Δ % x AC Ref vs Sol 3
FEFF1 (kg Fuel Reduction)	163	150	132	-13.10	-30.63	-8.03%	-18.79%
FEFF2 (CO2 Reduction)	513	472	417	-41.25	-96.45		
FEFF3 (TIME mm:ss)	0:31:22	00:24:42	00:22:59	06:40	08:23		

In order to extrapolate this results to ECAC wide, the following approach explained in D4-0-1 PJ19 SESAR 2020 Common Assumptions 2017 has been used.

FEFF1:

Assumptions:

1. Validation Results as in the table
2. Average Fuel burn for flight = 4800Kg
3. High-density Airport = 59.5%

Calculation:

As the common assumption for average fuel burn per flight is of 4800kg, a saving of 30.63kg represents 0.64% of fuel consumption reduction per flight ($30.63 \text{ kg} / 4800 \text{ kg} \times 100\% = 0.64\%$).

Considering only high-density airports and consequently 59.5% of the ECAC traffic (common assumption of high-density airport representativeness), the result is **0.38 %** of fuel reduction ($0.64\% \times 59.5\% = 0.38\%$).

The same approach has been used for a fuel saving of 13.10kg resulting in a **0.16%** at ECAC level.

Finally, an arithmetic mean between the two results obtained has been done. The result is: **0.27%**.

FEFF2:

Assumptions:

4. Validation Results as in the table
5. Average Fuel burn for flight = 4800Kg

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6. CO₂/fuel ratio = 3.15
7. High-density Airport = 59.5%

Calculation:

$(41.25\text{Kg}/4800\text{Kg}) / 3.15 = 0.27\%$. The result is **0.16%** at ECAC level ($0.27\% \times 59.5\% = 0.16\%$).

The same approach has been used for the other result of 96.45kg resulting in a **0.38%** at ECAC level.

Finally, an arithmetic mean between the two results obtained has been done. The result is: **0.27%**.

FEFF3:

Assumptions:

1. Validation Results as in the table
2. Fuel burn rate as in Common Assumption = 500Kg/h = 8.33Kg/minute
3. High-density Airport = 59.5%

Calculation:

$(13.1 \text{ Kg} / 8.33\text{Kg/minute}) = 1.57$. The result is **0.94** at ECAC level ($1.57\% \times 59.5\% = 0.94$).

The same approach has been used for the other result of 30.63kg resulting in a **2.19** at ECAC level.

Finally, an arithmetic mean between the two results obtained has been done. The result is: **1.6**.

12.2PRD1 Extrapolation to ECAC wide:

The following table shows the results of the Flight Trials for Predictability:

Flight Efficiency Analysis for Fuel Benefits PRD1					
	Reference	Solution 1 RNP 310/320	Solution 2 RNP 350	Δ % AC Ref vs Sol 1 & 2	Δ % AC Ref vs Sol 3
TIME hh:mm:ss (to "fly" each Arrival Leg & Final Approach Procedure)	00:31:22	00:24:42	00:22:59	-21.25%	-26.73%

Assumption:

1. Validation Results as in the table
2. High-density Airport = 59.5%.

Calculation:

$21.25\% \times 59.5\% = 12.64\%$ at ECAC level.

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The same approach has been used for the other result of 26.73% resulting in a **15.90%** at ECAC level.

Finally, an arithmetic mean between the two results obtained has been done. The result is: **14.27%**.

-

