



SESAR SOLUTION PJ.01-06 COST BENEFIT ANALYSIS (CBA) FOR V3

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PJ.01 EAD

ENHANCED ARRIVALS AND DEPARTURES

This Cost Benefit Analysis is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 731864 under European Union's Horizon 2020 research and innovation programme.



Abstract

This Cost Business Analysis document aims at providing an analysis of the benefits and costs of the deployment of Advanced PinS procedure using RF leg, Auto-pilot and HMD enablers at ATM level.



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1. Executive Summary

This document is the Solution PJ.01-06 relating to PJ01 Enhanced Arrival and Departures of the SESAR operational concept.

The SESAR 2020 Maturity Report states "SESAR1 Project 4.10 validated Solution PJ.01-06 (standard PinS approaches are considered as part of the baseline) covering OI step AOM-0104 to a final maturity of V3. Evidence gathered during V2 and V3 validation activities covered the "Standard PinS" concept with straight segments based on RNP APCH specifications (DOC 8168 requirements). The development of "Advanced PinS" with curved procedures in the initial, intermediate and missed approach segments, using possible new enablers (e.g. SVS, EVS) will be addressed in this solution.

In fact the OI step AOM-0104 has been split into two: The part that has achieved end of V3 (standards PinS approaches) is in fact a gap in the baseline and should be captured there. The OI step AOM-0104-B which will be covered here is V3 (new technologies and advanced PinS approaches).

The work performed in this Solution is to assess and validate the benefit of integrating piloting supporting enhanced vision systems that can increase the safety and reliability of rotorcraft operations through dedicated symbology for specific rotorcraft operations including visual segments. The objective is to assess and validated the benefit of having SBAS based navigation for advanced Point-In-Space RNP approaches and departures to/from FATO by defining the corresponding rotorcraft specific contingency procedures in case of loss of communication. As the SBAS navigation, the corresponding contingency procedures will need to comply as much as possible with profiles adapted to exploit rotorcraft performances, reduce fuel consumption and noise emission. The pilot will be supported during these operations by dedicated symbology presented on a Head Mounted Display system and/or using Auto-pilot.

This solution should impact the following KPAs:

- Safety should be improved thanks to the use of an HMD during PinS operations (facilitating the VFR-to-IFR transitions during take-off and IFR-to-VFR transitions during approach, which are usually high-workload phases for the rotorcraft pilot) and/or the use of an Auto -pilot, and through the introduction of GNSS contingency loss procedures (in particular in the final curved approach of a PinS procedure where the pilot shall maintaining safe separation during visual segment)
- Human performance should be improved thanks to the use of an HMD during PinS and SNI operations (pilot's eyes-out conformal display of the flight trajectory allows improved performance to follow precisely the allocated trajectory) and/or the use of an Auto -pilot
- Efficiency should also take benefit from the advanced PinS procedure use (optimisation of flight efficiency reducing delays)
- Access and equity for rotorcraft users to TMA and busy airfields should be improved by facilitating their use of PinS and SNI procedures or limit the interference between rotorcraft and aircraft traffic.



2 Introduction

2.1 Purpose of the document

This document provides the Cost and Benefit analysis for SESAR Solution PJ01-06 at V3 level. It describes how Head Mounted display, Auto-Pilot and FMS RF leg technology could benefit the whole ATM system based on the outcome of the exercises performed and documented in VALP and VALR.

2.2 Scope

This document provides the Cost Benefit Analysis (CBA) related to a SESAR Solution PJ01-06 at V3 level.

For all scenarios the time horizon of the CBA is 10 years following the V3 of the each enabler. No change in the regulation is expected.

2.3 Intended readership

SESAR readership

The members of solutions within PJ.01 EAD - Enhanced Arrival & Departures.

The members of the following solutions within S2020:

- PJ.02-05 Independent Rotorcraft operations at the airport
 Advanced PinS operations and all PJ01-06 enablers could be used for SNI operation (PJ.02-05) because RF legs could be used during initial, intermediate and missed approach phase of approach or departure offering to procedure designers a larger panel of solutions for the implementation. The use of more complex flight plan (using RF & TF legs) reduces the foot print of the departure/approach and limits the probability of interference with other aircraft SIDs or STARs which is essential to build a SNI procedure. Only Advanced PinS allows the use of RF leg for the approach.
 Then, by the way, the traffic can be increased and also the punctuality and predictability. All Advanced PinS enablers can be used to perform a SNI.
- PJ19 (Content Integration) is responsible for managing the content integration process to ensure the needed coherency (in terms of operational concept, architecture) between the different SESAR 2020 projects.

Further solutions and interested parties will be defined in the full version of this document.

Other readership

No other relationship reported.



2.4 Structure of the document

The document follows the template provided by SJU, by describing:

- An overview and reminder of the project objectives.
- The foreseen benefits of the technologies at ATM level
- The expected costs for the ATM stakeholders as defined in EATMA.
- The CBA model used by the partners
- The CBA results as well as a description of their significance and limitations

2.5 Background

Within SESAR 1, the project 04.10 was focused on contributing mainly to the Operational Focus Area (OFA) 02.01.01 “Optimised 2D/3D Routes” and reports its results concerning the “Standard PinS” concept. In fact, in the framework of Sesar 1 project P04.10, all the validation activities have covered the Standard PinS concept with straight segments based on RNP APCH specifications (DOC 8168 requirements) being also connected and consistent with the following projects:

- 05.06.03: Approach Procedure with Vertical Guidance (APV)
- 09.09: RNP Transition to xLS (x=G, I or M)
- 09.10: Approach with Vertical Guidance APV
- 09.49: Batch 1, 2 & 3 - Consolidated functional airborne architecture

The P04.10 activities have achieved fully V3 maturity level for the “Standard PinS” only. The development of “Advanced PinS” concept (e.g. curved procedures in the initial, intermediate, final and missed approach segments) using possible new enablers such as SVS, EVS, etc, will be addressed in these SESAR 2020 activities.

2.6 Glossary of terms

N/A

2.7 List of Acronyms

Term	Definition
ACT/FHS	Active Control Technology / Flying Helicopter Simulator
ADD	Architecture Description Document
AFCS	Automic Flight Control System



Term	Definition
AHRS	Attitude Heading Reference System
AP	Auto-pilot
AMC	Aircraft Management Computer
AMLCD	Active Matrix Liquid Crystal Display
ATM	Air Traffic Management
CC	Capability Configuration
CCP	Cockpit Control Panel
DPIFR	Dual Pilot Instrument Flight Rules
DMC	Data Management Computer
DTD	Data Transfer Device
EATMA	European ATM Architecture
E-ATMS	European Air Traffic Management System
EC	Experimental Computer
EP	Evaluation Pilot
FAA	Federal Aviation Administration
FADEC	Full Authority Digital Engine Control
FDS	Flight Display Subsystem
FLI	First Limit Indicator
FND	Flight Navigation Display
FTE	Flight Test Engineer or Flight Technical Error
FTI	Flight Test Instrumentation
GC	Graphic Computer
GECO	Generic Experimental Cockpit
HD	High Definition
HDD	Head Down Display



Term	Definition
HMD	Helmet Mounted Display
HMI	Human Machine Interface
H-TAWS	Helicopter Terrain Awareness and Warning System
IDP	Interface Display Processor
IER	Information Exchange Requirement
IESI	Integrated Electronic Stand-by Instrument
ILC	In Line Controller
IMC	Instrument Meteorological Condition
INTEROP	Interoperability Requirements
IRS	Interface Requirements Specification
ISRM	Information Services Reference Model
LNAV	Lateral Navigation
LPV	Localizer Performance with Vertical Guidance
MFD	Multi-Function Display
NAF	NATO Architecture Framework
NSOV	NAF Service Oriented View
NOV	NAF Operational View
NSE	Navigation System Error
NSV	NAF System View
NVG	Night Vision Goggle
OSED	Operational Service and Environment Definition
PDE	Path Definition Error
PIRM	Programme Information Reference Model
QoS	Quality of Service
RNAV	Required Navigation Performance Area Navigation



Term	Definition
RNP	Required Navigation Performance
RTS	Real Time Simulation
SAR	Search And Rescue
SBAS	Satellite Based Augmentation System
SDD	Service Description Document
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SoaML	Service Oriented Architecture Modelling Language
SPIFR	Single Pilot Instrument Flight Rules
SPR	Safety and Performance Requirements
SVS	Synthetic Vision System
SWIM	System Wide Information Model
TAM	Three Axis Magnetometer
TRL	Technology Readiness Level
TS	Technical Specification
UML	Unified Modelling Language
UMS	Usage Monitoring System
VFR	Visual Flight Rules
VMS	Vehicle Management System
VNAV	Vertical Navigation
V&V	Validation and Verification
WSDL	Web Services Definition Language
XSD	XML Schema Definition



3 Objectives and scope of the CBA

3.1 Problem addressed by the solution

PJ01-06 aims at assessing the interest at ATM level of new technology enabling more efficient approaches/departure and traffic segregation.

Advanced PinS and associated enablers to leverage the number of approach/departure specific for GA and rotorcraft (slow traffic) and increase safety during approach phase.

3.2 SESAR Solution description

SESAR Solution ID	OI Steps ref. (coming from the Integrated Roadmap)	OI Steps definition (coming from the Integrated Roadmap)	OI step coverage	Comments on the OI step title / definition
PJ01-06 Enhanced Rotorcraft and GA operations in the TMA	AOM-0104-B	Advanced Point-in-Space RNP approaches and departures	Fully	N/A

Table 1: SESAR Solution *PJ01-06* Scope and related OI steps

Table 2 lists all required Enablers for PJ.01-06.

OI Steps ref.	Enabler ¹ ref.	Enabler definition	Enabler coverage	Applicable stakeholder	Comments on the Enabler / definition
AOM-0104-B	A/C-01	Enhanced positioning for LPV/RNP based on Single Frequency SBAS	Fully	Airspace Users	Shared enabler with PJ.02-05
AOM-0104-B	A/C-04b	Flight management and guidance for RNP 0.3 (Category H(rotorcraft)) in all phases of flight, except final approach and	Fully	Airspace Users	Shared enabler with PJ.02-05

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



		initial missed approach			
AOM-0104-B	A/C-05a	APV Barometric VNAV	Fully	Airspace Users	
AOM-0104-B	A/C-06	Flight management and guidance for LPV approach based on SBAS	Fully	Airspace Users	Shared enabler with PJ.02-05
AOM-0104-B	A/C-07	Flight management and guidance for RNP transition to ILS/GLS/LPV	Fully	Airspace Users	Shared enabler with PJ.02-05
AOM-0104-B	PRO-250	Rotorcraft procedures for IFR access to VFR FATOs	Fully	Airspace Users	

Table 2: OI steps and related Enablers

3.3 Objectives of the CBA

The objective of the V3 CBA is to provide information on the costs and benefits of deploying Solution PJ01-06, i.e. the CBA assesses the economic feasibility of the Solution. In general, the CBA will assess 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.



3.4 Stakeholders² identification

Stakeholder	The type of stakeholder and/or applicable sub-OE	Type of Impact	Involvement in the analysis	Quantitative results available in the current CBA version
ANSP	Approach	Improve the easiness approach design due to the enablers capabilities Invest, operate, enjoy benefits	Indirect involvement through PJ.02-05 Independent Rotorcraft operations at the airport	No
Airport Operators	Approach	Improve the traffic due to separated traffic in airport (SNI) and in TMA also Invest, operate, enjoy benefits	Indirect involvement through PJ.02-05 Independent Rotorcraft operations at the airport	Yes
Airport Operators	Approach	Increased operator workload due to the management of interference between traffic	Analysis not performed due to a lack of airport representability	No
Airspace users	HMD	Decreased operator workload due to the piloting symbology and increased the situation awareness providing a wide field of view (head motion) Invest, operate, enjoy benefits	Analysis performed by flight trail	Yes
Airspace users	AP	Decreased operator workload due to the autopilot pilot and	Analysis performed by flight trail	No

² 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.



		decrease the human error Invest, operate, enjoy benefits		
Network Manager	N/A	N/A	N/A	N/A
Scheduled Airlines (Mainline and Regional)	N/A	N/A	N/A	N/A
Business Aviation	N/A	N/A	N/A	N/A
Rotorcraft	Approach	Reduce number of delayed and increase the predictability due to the traffic management using SNI or reducing the time of interference	Indirect involvement through PJ.02-05 Independent Rotorcraft operations at the airport	Yes
Rotorcraft	Approach	Reduce the length of the approach regarding a A/C approach Determinist trajectory	Fuel saving or noise disturbance limitation	Yes
General Aviation IFR	Approach	Reduce number of delayed due to the traffic management using SNI	No direct or in-direct impact. The traffic is usually separated	No
General Aviation VFR	N/A	N/A	N/A	N/A
Military Airborne –	N/A	N/A	N/A	N/A
Military Ground –	N/A	N/A	N/A	N/A
Other impacted stakeholders (ground handling, weather forecast service provider, NSA....)	N/A	N/A	N/A	N/A

Table 3: SESAR Solution PJ.01-06 CBA Stakeholders and impacts



3.5 CBA Scenarios and Assumptions

As the future is uncertain with regard to technology deployment rate, the consortium has considered some different approach scenarios.

3.5.1 Reference Scenario

The reference scenarios are based on 3 current approach/departure studies in order to estimate the saving per approach and some hypothesis are taken about the deployment in Europe to estimate the global saving (*data are taken from EHA websites).

The main figures of the reference scenario are:

- Percentage of rotorcraft equipped with Advanced PinS capabilities today: 40% on 2900* (from twin engine IFR medium and heavy only) registered rotorcraft in Europe than 1160 rotorcraft for our considered operation
- Number of Airport using Advanced PinS: 300 regarding the 2000* European airports (15%)
- Deployment from 2022 to 2032
- Flight performed with a standard twin engine rotorcraft like an AH135 (Airbus Helicopter source)
- Traffic Growth assumptions ~1,9%/year (refer excel sheet for the detail)
- 500* flight per year

3.5.2 Solution Scenario

The three solution scenarios are described below.

Scenario 1: Approach/departure to EDEV (Braunschweig)

This scenario take into account the saving regarding the length of the approach compare the classical T approach.

Standard LPV approach: 13,4 NM

Advanced PinS: 11,1 NM

Saving ~2NM



Scenario 2: Approach/departure to EDPR (Donauwörth)

This scenario take into account the saving regarding the length of the approach compare the classical Y approach.

Standard LPV approach: 14 NM

Estimated saving ~2,5 NM

Scenario3: Approach to LFBO (Toulouse)

This scenario take into account the saving regarding the length of the approach compare the classical ILS approach.

Standard ILS approach: 12 NM

Advanced PinS: 9 NM

Saving ~3NM

Conclusion, in average, a saving of 2.5 NM is got (~20% of the approach/departure).

3.5.3 Assumptions

For all scenarios the time horizon of the CBA is 21 years following the V3 of the each enabler. No change in the regulation is expected.

Other assumptions included in the numbers hereafter:

- Traffic evolution
- Number of movements on secondary airports
- Number of aircrafts equipped with advanced PinS capabilities

Name	Reference
Cost of fuel [EUR/kg]	0.9€/kg
Fuel consumption [kg/min]	2.5Kg/min
Velocity in appraoch (kt)	80Kts
Average distance savingy (NM)	2.5NM
No. of flights per rotorcraft per year (BA/RA/MA)	500 flight
Average duration of flight (BA/RA/MA)	1 hour

Table 4 – Summary of inputs for CBA model



Scenario feature		Year 2027	Source
Applicability: Number of locations where Solution is deployed (# ROEs)	AOM-0104-B	300	Consortium estimation*
Impacted traffic, i.e. experiencing the benefits from the Solution(s)	IFR flights per year	40% of 2900*500 = 580 000 flights	Consortium estimation*

Table 5: SESAR Solution PJ.01-06 CBA Solution Scenario at the end of deployment



4 Benefits

The Benefits identified in [OSED] are CAP TMA (TMA Capacity), CAP APT (Airport Capacity), FEFF (Fuel Efficiency), PRD (Predictability) and PUN (Punctuality)

4.1 CAP TMA (TMA Capacity) benefit

Stakeholder	KPA	R&D Needs
TMA Operator	EFF	Increasing efficiency during approach reducing the traffic conflict between Aircraft and Rotorcraft.
TMA Operator	HP	Increasing human performance of the control during approach through the implementation of the traffic separation.
TMA Operator	SAF	Increasing safety during approach, better situational awareness through the implementation of the traffic separation avoiding human error.

For a detailed analyse please refer to the PJ.02-05 because Advanced PinS is a just enabler for SNI approach. The improvement of the capacity is performed at a higher level by implementing SNI approach.

***Nota from PJ.02-05:** Even if the expected improvements are mild, it should be considered a positive trend for the TMA 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).

4.2 CAP APT (Airport Capacity) benefit

Stakeholder	KPA	R&D Needs
Airport Operator	EFF	Increasing efficiency during approach reducing the traffic conflict between Aircraft and Rotorcraft. Specific holding zone for



		rotorcraft, capacity for rotor craft to land in airport FATO independently of the aircraft traffic. Reducing the risk of delay.
Airport Operator	HP	Increasing human performance of the control during final approach through the implementation of the traffic separation.
Airport Operator	SAF	Increasing safety during approach, better situational awareness through the implementation of the traffic separation avoiding human error.

For a detailed analyse please refer to the PJ.02-05 because Advanced PinS is a just enabler for SNI approach. The improvement of the capacity is performed at a higher level by implementing SNI approach.

****Nota from PJ.02-05:** 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).

4.3 FEF (Fuel Efficiency) benefit

Stakeholder	KPA	R&D Needs
Airspace User	EFF	Decreasing the fuel consumption by reducing the length of the approaches.

Fuel saving per year :

- Number of flight : 1160 rotorcraft * 500 flight/year = 580 000 flight * 2 (approaches/departure)
- 2,5 NM save per approach/departure -> 4630m
- 80Kts -> 41,15m/s



- Time of flight saving : 112s * 2 per flight -> 3,7minutes/flight 2,5Kg/min -> ~9 Kg saved per flight
- 0,9€/kg
- **Total saving : 5220 tonnes of fuel/year**
 - Cost saving : ~4,5M€/year

4.4 PRD (Predictability) benefit

Stakeholder	KPA	R&D Needs
Airport/TMA Operators	EFF	Increasing efficiency during approach reducing the traffic conflict between Aircraft and Rotorcraft. Air Traffic management is equivalent to 2 independent Airports or TMA using SNI and in this case it's easier to predict the traffic congestion, only a same range of speed have to be managed by controllers.

For a detailed analyse please refer to the PJ.02-05 because Advanced PinS is a just enabler for SNI approach. The improvement of the capacity is performed at a higher level by implementing SNI approach.

Nota : The table 9 data are defined by the PJ.02-05

4.5 PUN (Punctuality) benefit

Stakeholder	KPA	R&D Needs
Airport/TMA Operators	EFF	Increasing efficiency during approach reducing the traffic conflict between Aircraft and Rotorcraft and then reducing the risk of delay. Specific holding zone for rotorcraft, capacity for rotor craft to land in airport FATO independently of the aircraft traffic allowing controllers to reduce the amount of delay in case of congestion.



For a detailed analyse please refer to the PJ.02-05 because Advanced PinS is a just enabler for SNI approach. The improvement of the capacity is performed at a higher level by implementing SNI approach.

***After analyse, the PJ02-05 cannot demonstrate any saving about punctuality using SNI.

This benefit is qualitative and based on expert judgement but it could not be quantified.



Performance Framework KPA ³	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	Year N	Year N+10
Cost Efficiency							
	Airspace User Cost efficiency	/	/	/	€/year	0	0
Capacity	TMA capacity	CAP1 Increasing efficiency during approach reducing the traffic conflict between Aircraft and Rotorcraft	Refer to PJ.02-05 SNI project for the % and number of movements	Value of additional flights	0*	0*	0*
	Airport capacity	CAP2 Increasing efficiency during approach reducing the traffic	Refer to PJ.02-05 SNI project for the % and	Value of additional flights	0**	0**	0**

³ For information, the mapping to the Performance Ambition KPAs (used in the ATM Master Plan) is available in the Appendix.



Performance Framework KPA ³	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	Year N	Year N+10
		conflict between Aircraft and Rotorcraft. Specific holding zone for rotorcraft, capacity for rotor craft to land in airport FATO independently of the aircraft traffic. Reducing the risk of delay.	number of movements				
Predictability and punctuality	Airport/TMA predictability	PRD1 Air Traffic management is equivalent to 2 independent Airports or TMA using SNI and in this case it's easier to predict the traffic congestion, only a same range of speed have to be managed by controllers.	Refer to PJ.02-05 SNI project for the number of minutes saved Minutes^2	Strategic delay cost (avoided-; additional +)	TMA medium complexity 0,069% TMA Low complexity 0,019% APT Very High complexity 0,064% APT High	TMA medium complexity 0,069% TMA Low complexity 0,019% APT Very High complexity 0,064% APT High	TMA medium complexity 0,069% TMA Low complexity 0,019% APT Very High complexity 0,064% APT High



Performance Framework KPA ³	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	Year N	Year N+10
					complexity 0,053%	complexity 0,053%	complexity 0,053%
					APT medium complexity 0,077%	APT medium complexity 0,077%	APT medium complexity 0,077%
					APT Low complexity 0,029%	APT Low complexity 0,029%	APT Low complexity 0,029%
					0***	0***	0***
	Airport/TMA punctuality	PUN1 % Departures < +/- 3 mins vs. schedule due to ATM causes Specific holding zone for rotorcraft, capacity for rotor craft to land in airport FATO independently of the aircraft traffic allowing controllers to reduce the amount of delay in case of congestion	Refer to PJ.02-05 SNI project for the % (and # movements)	Tactical delay cost (avoided-; additional +)	0***	0***	0***
Flexibility	ATM System & Airport ability	/	/	/	€/year	0	0



Performance Framework KPA ³	Focus Area	KPI/PI from the Performance Framework	Unit	Metric for the CBA	Unit	Year N	Year N+10
	to respond to changes in planned flights and mission						
Environment	Fuel Efficiency	FEFF1 Average fuel burn per approach	4,5 Kg fuel per approach	Fuel Costs	€/year	4,5M€	4,5M€
Civil-Military Cooperation & Coordination	Civil-Military Cooperation & Coordination	/	/	/	€/year	0	0

Table 6: Results of the benefits monetisation per KPA

5 Cost assessment

5.1 ANSPs costs

5.1.1 ANSPs cost approach

ANSP will be impacted in two ways by the solution deployment.

1. Advanced PinS operations

As this solution aims at developing the use of Advanced PinS approaches it is expected that ANSP will have to issue an increasing number of specific approval for Advanced PinS operations. Although the approval application is performed by the airspace user, time will be needed by ANSP to assess and grant the approval operator by operator.

As no ANSP was part of the solution it was not possible to provide significant figures related to this cost increase, thus this cost will be comparable to the implementation of a SNI approach then refer to PJ.02-05.

2. ATC Workload and training for SNI Approach

The implementation of a new procedure impact the management in air traffic during approaches, then the controllers have to be train for the new procedure and perhaps the use of new tools.

The ATC workload significantly decreases during approaches due to the segregation of different traffic. In an others hand it's allow an increase of the traffic.

Nota : No additional infrastructure is required on airport or on ground..

5.1.2 ANSPs cost assumptions

A deep analysis performed in the frame of PJ.02-05 of SESAR2020 (SNI approach) and P04.10 (PinS approach) of SESAR 1 give a very good estimation of the cost for the first paragraph of the chapter 5.1.1.

The analysis below is extracted from PJ.02-05 of SESAR2020 (SNI approach) and PJ P04.10 (PinS approach) of SESAR 1 CBA and is still valid because implementing a SNI, a classical PinS or an advanced PinS or deliver an approval is roughly the same price whatever the operation.

About the SNI it's a little bit different because SNI require a specific training (perhaps tools) and the management of the traffic is different and the cost is higher.

PJ.02-05 has estimated the cost to 585 000€

5.1.3 Number of investment instances (units)

Airport			TMA			ACC		
H	M	L	H	M	L	H	M	L



0	400*	200*	0	400*	200*	15	10	0
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Table 7: Number of investment instances – ANSPs

Nota: * An estimation of two approaches per location is kept but there is no saving for the ANSP. The price to design an Advanced PinS or a classic PinS is the same

5.1.4 Cost per unit

Cost category	Airport			TMA			ACC		
	H	M	H	M	L	L	H	M	L
Pre-Implementation Costs	0	0	0	0	0	0	0	0	0
Implementation costs	0	0	0	0	0	0	585.000€.	585.000€.	585.000€.
Operating costs	0	0	0	0	0	0	0*	0*	0*

Table 8: Cost per Unit – ANSP

Nota: * Only a recurring training is identified by PJ02-05, this training is required for the ANSP and it's not specific to our PJ, therefore it is set to 0.

Detail of the 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: 260.01 euros per hour in 2024 based on **Error! Reference source not found.**
- 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 **Error! Reference source not found.**

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, will 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) 585.000€.

Usually the TMA is an airspace under responsibility of an authority which is part of an ACC. In other words, the TMA is usually made up of one or more sectors under the responsibility of an ACC, placed physically in the ACC control room as well, so the investments in the TMA are located into an ACC.

The global cost for the implementation is : $(15 + 10) * 585\ 000€ = 14,625M€$ (excel sheet AOM-104-B cell H8).

5.2 Airport operators costs

5.2.1 Airport operators cost approach

The implementation of a new procedure impact the management in air traffic during approaches, then the controllers have to be train for the new procedures and perhaps the use of new tools.

5.2.2 Airport operators cost assumptions

Refer to PJ02-05



5.2.3 Number of investment instances (units)

Airport		
H	M	L
0	0	0

Table 9: Number of investment instances - Airports

The PJ02-05 didn't identify any extra investment for the airport

5.2.4 Cost per unit

Cost category	Airport		
	H	M	L
Pre-Implementation Costs	0	0	0
Implementation costs	0	0	0
Operating costs	0	0	0

Table 10: Cost per Unit - Airport

5.3 Network Manager costs

There is consensus within the solution team that Network Manager costs will not be increased in the frame of PJ01-06. Therefore they are not considered in the document.

5.3.1 Network Manager cost approach

N/A

5.3.2 Network Manager cost assumptions

N/A

5.3.3 Network Manager cost figures

Cost category	Network Manager		
	HC	HS	LC
Pre-Implementation Costs	0	0	0
Implementation costs	0	0	0
Operating costs	0	0	0

Table 11: Cost per Unit - NM



5.4 Airspace User costs

5.4.1 Airspace User cost approach

Most of the cost will be supported by airspace users, sharing between investments at rotorcraft level and pilot training.

PJ01-06 is technology oriented. HMD, FMS with RF capability, 4 axes Autopilot ... are disruptive technology requiring a huge long-term investment. Development costs must not be neglected as industry has also a ROI to consider... This cost could be directly transferred to airline when buying the equipment shipset for the shipset installation in forward or retrofit.

Today a large majority of IFR rotorcraft embed a GPS TSO, a LPV capacity, a 4 axis autopilot and a FMS with RNP APCH capacity required as basis for the implementation of Advanced PinS enablers described hereafter (regarding Airbus helicopter information 90% of the fleet is equipped).

5.4.2 Airspace User cost assumptions

As the costs for airspace users, the following aspects are considered:

Equipment

- Installation of forward fit (initial estimated numbers)
- HMD equipment: 100 000 € equipment price for 10% of the fleet (Not equipped with a four axis auto-pilot)
- FMS with VNAV, RNP 0.3 and RF capacity : 25 000 € equipment price (2 equipment are required) price for 10% of the fleet (Not equipped with a four axis auto-pilot and a dual FMS)
- A four axes autopilot is considered to be installed in this kind of rotorcraft (90% of the fleet)

Numbers above are initial estimated numbers but final values will depend on many factors.

Additional costs linked with operation and maintenance:

- Pilots training costs 30 000 €
- Maintenance costs 20 000 €
- Consecutive training is 5% of the initial training costs



5.4.3 Number of investment instances (units)

Scheduled Airlines (SA-M) Mainline		Scheduled Airlines (SA-R) Regional		General Aviation (GA)		Business Aviation (BA)		Rotorcraft	
Ground locations (e.g. FOCs)	Airborne (air vehicles)	Ground locations (e.g. FOCs)	Airborne (air vehicles)	Ground IFR vehicles	Airborne VFR vehicles	Ground locations	Airborne (air vehicles)	Ground locations	Airborne (air vehicles)
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1160

Table 12: Number of investment instances - AUs

5.4.4 Cost per unit

Cost category	Scheduled Airlines (SA-M) Mainline		Scheduled Airlines (SA-R) Regional		General Aviation (GA)		Business Aviation (BA)		Rotorcraft	
	Ground locations (e.g. FOCs)	Airborne (air vehicles)	Ground locations (e.g. FOCs)	Airborne (air vehicles)	IFR	VFR	Ground	Airborne	Ground	Airborne
Pre-Implementation Costs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
Implementation costs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	170 000
Operating costs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8500

Table 13: Cost per unit - AUs

5.5 Military costs

There is consensus within the solution team that Military costs are not impacted by the solution will not be increased in the frame of PJ03a-04. Therefore they are not considered in the document.

5.5.1 Military cost approach

N/A

5.5.2 Military cost assumptions

N/A



5.5.3 Military cost figures

N/A

Cost category	Military		
	HC	HS	LC
Pre-Implementation Costs	0	0	0
Implementation costs	0	0	0
Operating costs	0	0	0

Table 14: Cost per Unit – NM

5.6 Total costs

Total Cost	ANSP	Airspace user
Pre-Implementation Costs	0	0
Implementation costs basic scenario	14,625M€	40,6 M€
Implementation costs alternative scenario 1	14,625M€	20,88 M€
Implementation costs alternative scenario 2	14,625M€	87 M€
Operating costs for scenarios basic and 2	0	9,86 M€
Operating costs for scenarios 1	0	8,87M€

Table 15: Total cost per stakeholders– M€



6 CBA Model

6.1 Data sources

Overall assumptions

The consortium agreed with PJ.02-05 teams the CBA model:

- A fleet of 1160 rotorcraft (40% on 2900 from twin engine IFR medium and heavy only) is considered for the Advanced PinS scenario.
- The horizon for the analysis is 18 years from 2022 to 2040
- Number of Airport using Advanced PinS : 300 regarding the 2000* European airports (15%)
- Flight performed with a standard twin engine rotorcraft like an AH135

The CBA model takes into account the following data.

Name	Reference
Cost of fuel [EUR/kg]	0.9€/kg (refer excel sheet for details)
Fuel consumption [kg/min]	2,5Kg/min
Velocity in approach (kt)	80Kts
Average distance saving (NM)	2,5NM
No. of flights per rotorcraft per year (BA/RA/MA)	500 flight
Average duration of flight (BA/RA/MA)	1 hour

Table 16 : CBA Fuel costs

Input	Updated value	Source	Note
HMD	100 000 €	Thales marketing	
FMS	50 000 €	Thales marketing	2 equipment required

Table 17: Equipment costs

The training and maintenance is considered at two levels – the 1st year (initial) and recurrent. Please, see the respective values in Table 18: Training and maintenance.



Input	Updated value	Source	Note
Training 1 st year	20 000 EUR	Expert opinion	
Regular training 5%	1000 EUR	Expert opinion	
Maintenance/year 5%	7 500 €/year	Expert opinion	

Table 18: Training and maintenance

6.2 Basic scenario

The implementation cost per unit for the basic scenario is:

- For 90% of the IFR rotorcraft (with 4 axis auto-pilot and FMS): $(1\,160 * 0,9) * 20\,000 = 20\,880\,000\text{€}$
- For 10% of the IFR rotorcraft (w/o 4 axis auto-pilot and FMS): $(1\,160 * 0,1) * (150\,000 + 20\,000) = 19\,720\,000\text{€}$

Then the global cost for the first year is: 40,6M€ (excel sheet AOM-104-B cell N8).

The operating cost per unit is 1 000 + 7 500 per year, multiply by the number of rotorcraft 1 160. Therefore, the global operating cost is 9 860 000€ per year (excel sheet AOM-104-B cell E29).

The fuel saving are computed for 100% of the 40% of the IFR fleet (excel sheet ECAC traffic cell B17 & C17).

6.3 Scenario 1

The implementation cost per unit for the alternative scenario 1 with 90% of the 40% of the fleet fitted with 4 axis auto-pilot, FMS and no HMDs is:

- For 90% of the IFR rotorcraft (with 4 axis auto-pilot and FMS) : $(1\,160 * 0,9) * 20\,000 = 20\,880\,000\text{€}$

Then the global cost for the first year is : 20,88M€ (excel sheet AOM-104-B cell N8).

The operating cost per unit is 1 000 + 7 500 per year, multiply by the number of rotorcraft $1\,160 * 0,9$. Therefore, the global operating cost is 8 874 000€ per year (excel sheet AOM-104-B cell E29).

The fuel saving are computed for only 90% of the 40% of the IFR fleet (excel sheet ECAC traffic cell B17 & C17).

6.4 Scenario 2

The implementation cost per unit for the alternative scenario 2 with 40% of the fleet fitted with HMDs is:

Founding Members





- For 50% of the IFR rotorcraft (with 4 axis auto-pilot and FMS) : $(1\,160 * 0,5) * 20\,000 = 11\,600\,000\text{€}$
- For 40% of the IFR rotorcraft (with 4 axis auto-pilot and FMS) with an optional HMD : $(1\,160 * 0,4) * (20\,000 + 100\,000) = 55\,680\,000\text{€} +$
- For 10% of the IFR rotorcraft (w/o 4 axis auto-pilot and FMS) : $(1\,160 * 0,1) * (150\,000 + 20\,000) = 19\,720\,000\text{€}$

Then the global cost for the first year is : 87M€ (excel sheet AOM-104-B cell N8).

The operating cost per unit is 1 000 + 7 500 per year, multiply by the number of rotorcraft 1 160. Therefore, the global operating cost is 9 860 000€ per year (excel sheet AOM-104-B cell E29).

The fuel saving are computed for 100% of the 40% of the IFR fleet (excel sheet ECAC traffic cell B17 & C17).

6.5 CBA model description

The principle of the CBA model for approach/departure phase of flight includes briefly two main parts.

The first part is cost side where all costs related to solution acquisition, maintenance, operation costs etc. are considered.

The second part is benefit side including all benefits relevant to suggested solution under conditions. The conditions are determined by the current rotorcraft fleet, the prediction of airports deployment and the prevision of number of flights.

The model considers increasing number of rotorcraft equipped by appropriate technology during expected time horizon with average number of flight per aircraft per year. Benefits generally consist in savings generated by reduction of fuel consumption, emission, diverted and cancelled flights etc...

The Excel files including the CBA Model are embedded here.



PJ01-06 CBA Basic
scenario.xlsx



PJ01-06 CBA
Alternative scenario 1.



PJ01-06 CBA
Alternative scenario 2.



7 CBA Results

This section provides the results of the PJ.01-06 CBA at V3 Level. The CBA has been built gathering the following information:

- The Investments costs (pre-implementation and implementation costs) and Operating Costs;
- Benefits have been estimated and monetised in the CBA Model using the information available from the PJ.02-05 and from the fuel saving defined in the PJ.01-06

The figure hereafter presents the PJ.01-06 cumulated costs and benefits for the period 2019-2040. There is no ROI for the airspace user, the fuel saving does not cover the recurrent training and maintenance cost but the operational availability and the safety are increased.

7.1 Basic scenario

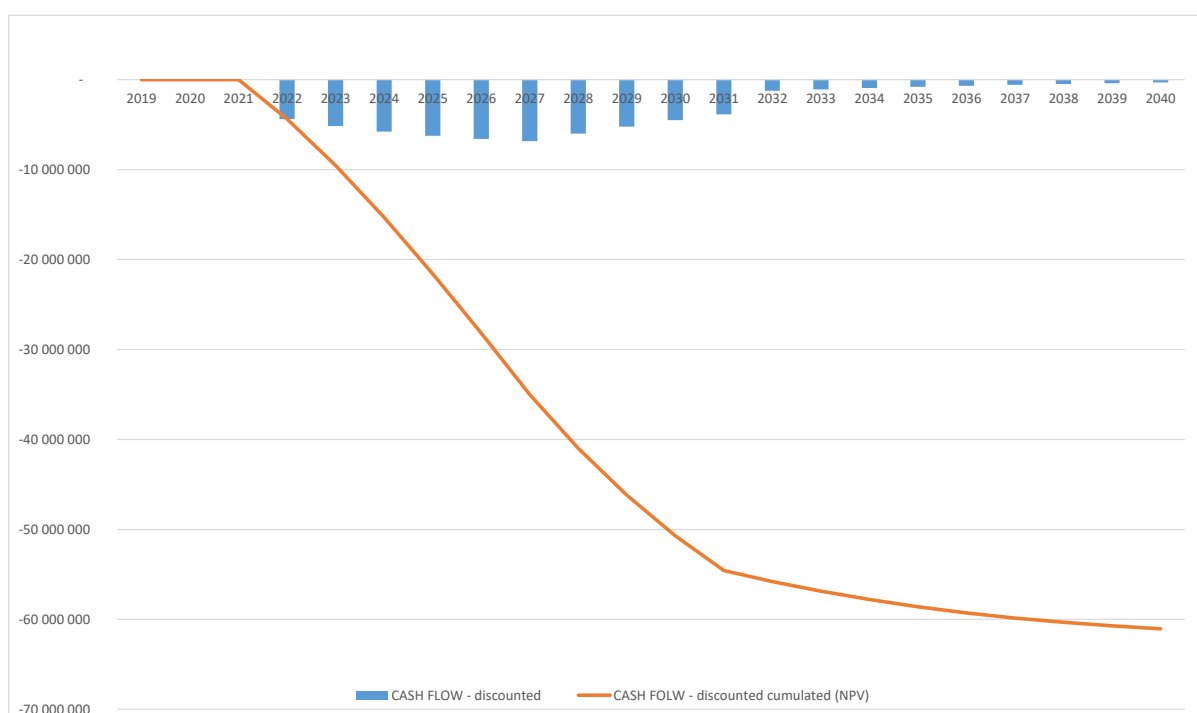


Figure 1: Cash flows for basic scenario (in EUR)

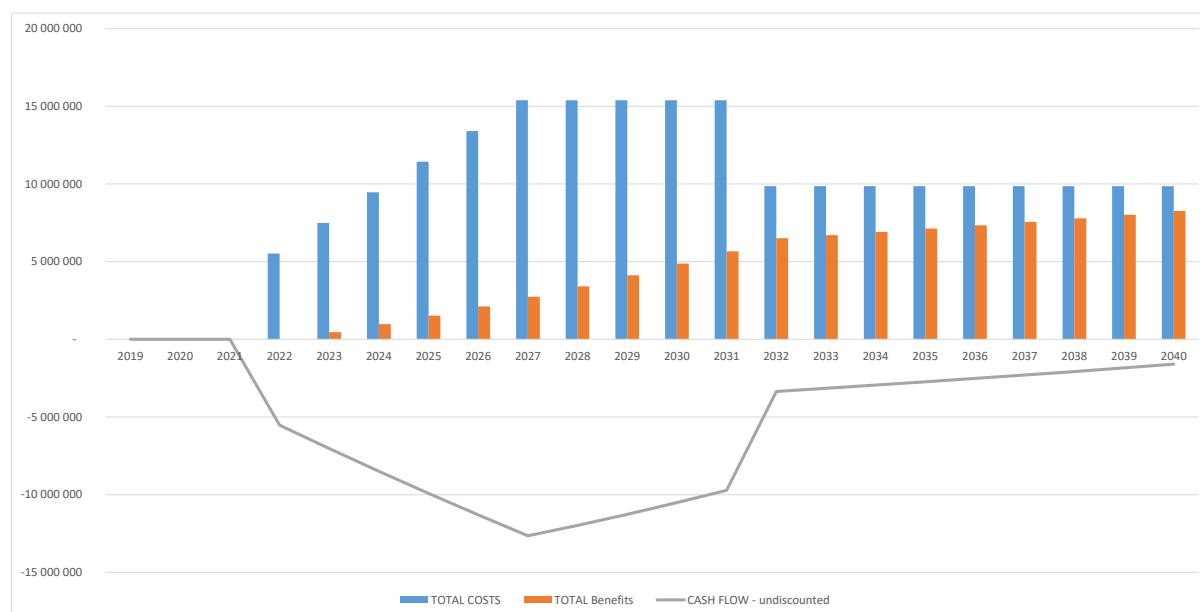


Figure 2: Total costs and benefits for basic scenario (in EUR)

2019-2040				
Discounted	NPV (M€)	Costs (discounted)	Benefits (discounted)	Discount rate
	ANSP	-13,455	13,455	0,0
	Airspace			
	User	-78,851	182,491	103,640
	Overall	-92,306	195,946	103,640

Table 19: CBA results for PJ.01-06 Basic Scenario, discounted values, M€

2019-2040			
Undiscounted	Net Benefits (M€)	Costs (undiscounted)	Benefits (undiscounted)
	ANSP	-14,625	14,625
	Airspace		
	User	-94,720	198,360
	Overall	-109,345	212,985

Table 20: CBA results for PJ.01-06 Basic Scenario, undiscounted values, M€



7.2 Alternative scenario 1

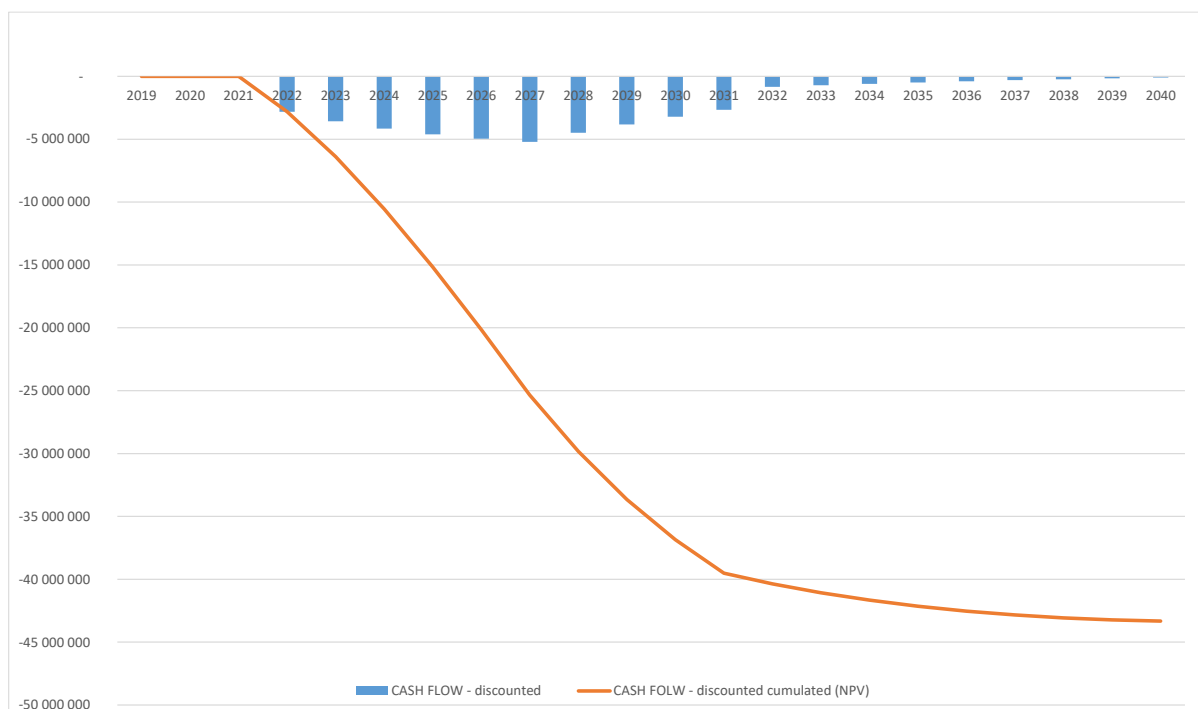


Figure 3: Cash flows for alternative scenario 1 (in EUR)

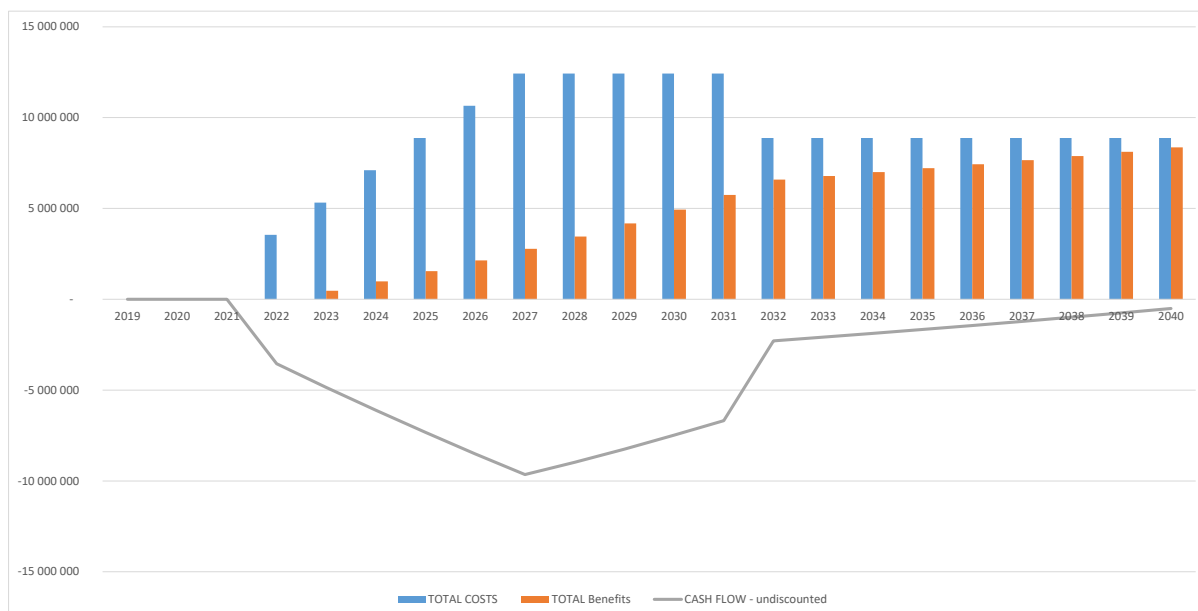


Figure 4: Total costs and benefits for alternative scenario 1 (in EUR)



2019-2040					
Discounted		NPV (M€)	Costs (discounted)	Benefits (discounted)	Discount rate
	ANSP	-13,455	13,455	0,0	8%
	Airspace				
	User	-56,558	149,834	93,276	8%
	Overall	-70,013	163,289	93,276	
Discounted					

Table 21: CBA results for PJ.01-06 Scenario 1, discounted values, M€

2019-2040				
Undiscounted		Net Benefits (M€)	Costs (undiscounted)	Benefits (undiscounted)
	ANSP	-14,625	14,625	0,0
	Airspace			
	User	-69,588	162,864	93,276
	Overall	-84,213	177,489	93,276
Undiscounted				

Table 22: CBA results for PJ.01-06 Scenario 1, discounted values, M€

7.3 Alternative scenario 2

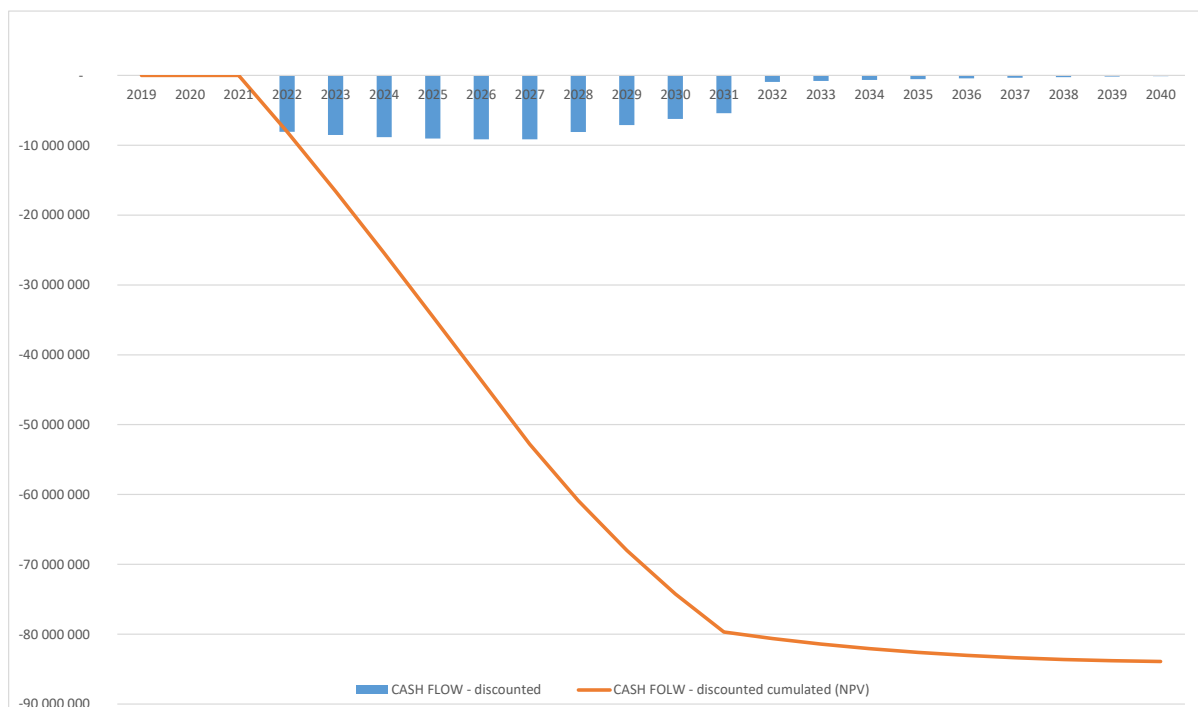


Figure 5: Cash flows for alternative scenario 2 (in EUR)

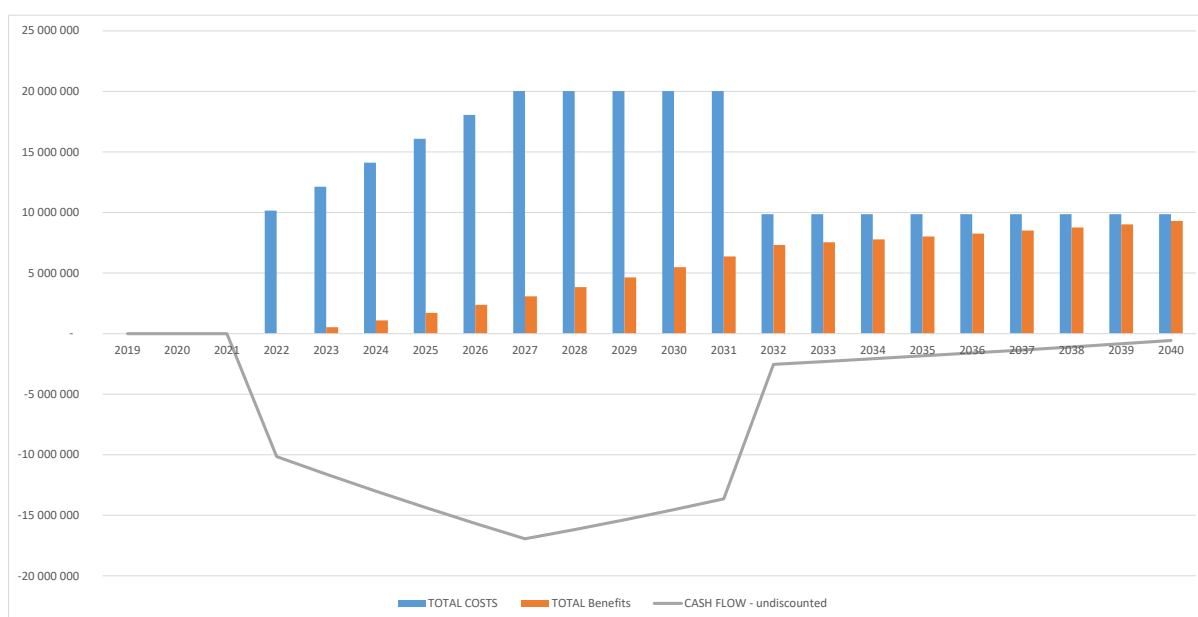


Figure 6: Total costs and benefits for alternative scenario 2 (in EUR)



2019-2040					
Discounted		NPV (M€)	Costs (discounted)	Benefits (discounted)	Discount rate
	ANSP	-13,455	13,455	0,0	8%
	Airspace				
	User	-121,539	225,179	103,640	8%
	Overall	-134,994	238,634	103,640	
Discounted					

Table 23: CBA results for PJ.01-06 Scenario 2, discounted values, M€

2019-2040					
Undiscounted		Net Benefits (M€)	Costs (undiscounted)	Benefits (undiscounted)	Undiscounted
	ANSP	-14,625	14,625	0,0	
	Airspace				
	User	-141,120	244,760	103,640	
	Overall	-155.745	259.385	103.640	

Table 24: CBA results for PJ.01-06 Scenario 2, discounted values, M€

In conclusion, the value of the solution is not ink to the SESAR saving for the Advanced PinS operation but the solution allows a separation between aircraft and rotorcraft traffic for the departure/approach but also for en-route using NP 0.3 capability. Then the saving are indirectly perform on the traffic management and mainly on the overall impact of the solution on aircraft-traffic by reducing the potential conflicts:

- Resilience in terms of reduction of aircraft delays,
- Resilience in term of air traffic management for the aircraft punctuality
- Additionally and independently of the SESAR project, Advanced PinS could be used by ANSP in mountain area where the implementation of a standard PinS is not possible
- For the operator, the solution give also a capability to access to helipads everywhere in low visibility condition (ex : EMS, VIP ...)



8 Sensitivity and risk analysis

There are a number of uncertainties behind the assumptions considered in this analysis.

Traffic growth

The expected growth of air traffic depends on a number of traditionally variables factors including fuel price and geopolitical environment. The advent of Shame-To-Fly contestation may also negatively impact the air traffic growth in the coming years. It's also difficult to estimate the traffic growth of EMS helicopter because it depends also on political decisions and health policy.

Traffic growth

The expected deployment of Advanced PinS procedure is also a variable factor, the ANSP level of investment is directly link to the traffic growth or requirement of availability (for example EMS).

Performances/acquisition cost:

The technology is always moving and a technologic breakthrough may appear and have a strong impact on actual cost and have a positive impact on the result.

Therefore the results presented in this document have to be considered with care.

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

8.1 Basic scenario

NPV sensitivity analysis				
Base case NPV (in EUR)	- 61 045 382			
Sensitivities	Low value	High value		Difference
Traffic values (Fragmented world / Global growth)	-64 259 436	-55 504 802		8 754 634
Discount rate (4% / 12%)	-45 551 191	-84 344 389		-38 793 198
Total costs (-50% / +50%)	-36 025 726	-106 877 950		-70 852 224

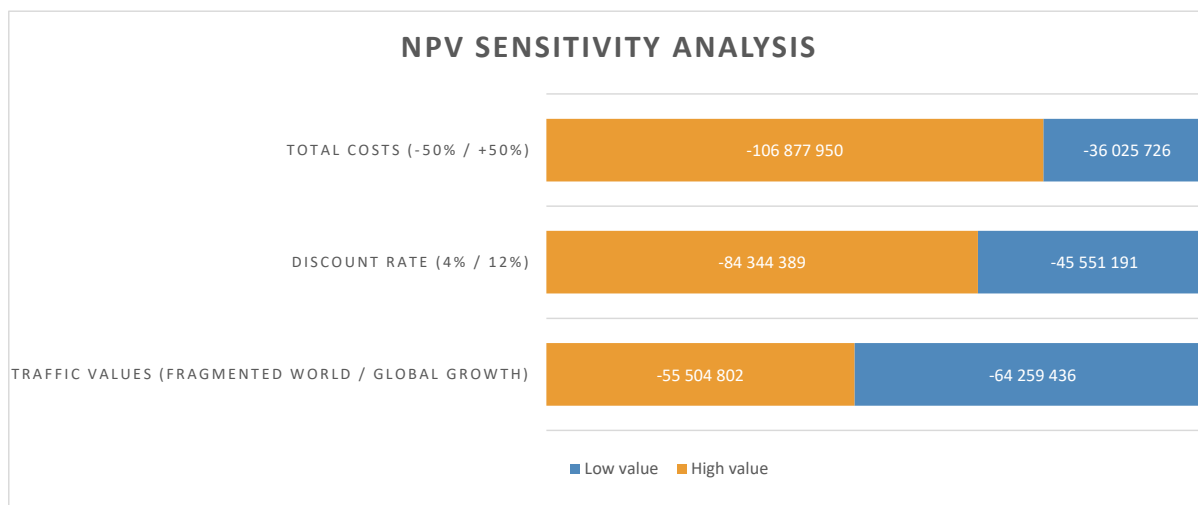


Figure 7: NPV Sensitivity Analysis for basic scenario

8.2 Alternative scenario 1

Base case NPV (in EUR)	-	43 328 565		
Sensitivities	Low value	High value		Difference
Traffic values (Fragmented world / Global growth)	-46 582 795	-37 718 728		8 864 067
Discount rate (4% / 12%)	-32 469 951	-59 434 305		-26 964 354
Total costs (-50% / +50%)	-22 624 426	-80 494 098		-57 869 672

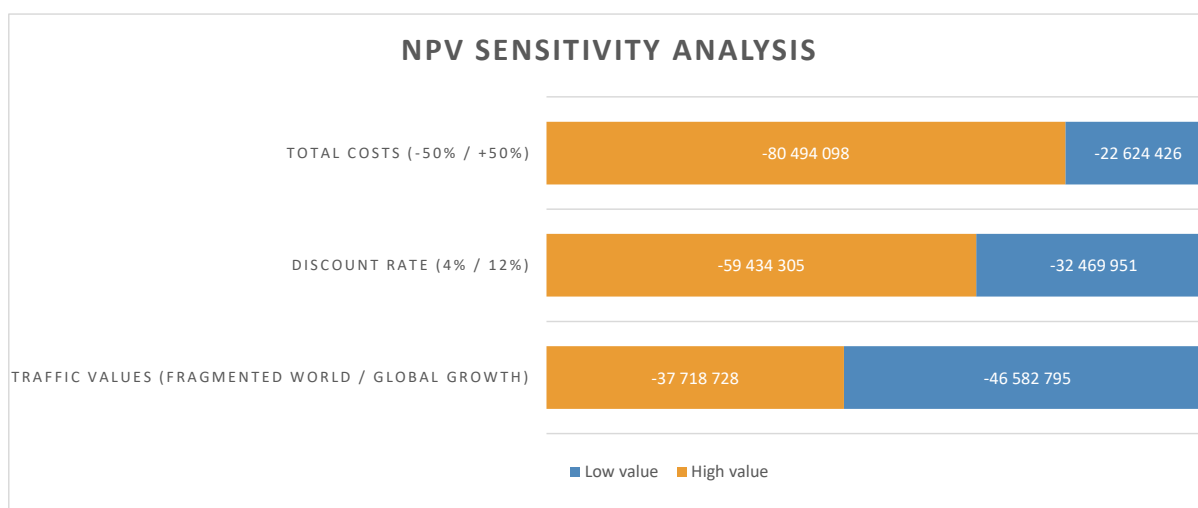


Figure 8: NPV Sensitivity Analysis for alternative scenario 1

8.3 Alternative Scenario 2



Base case NPV (in EUR)	- 83 910 960		
Sensitivities	Low value	High value	Difference
Traffic values (Fragmented world / Global growth)	-87 526 777	-77 677 814	9 848 963
Discount rate (4% / 12%)	-64 083 353	-112 663 019	-48 579 666
Total costs (-50% / +50%)	-52 218 046	-143 090 061	-90 872 015

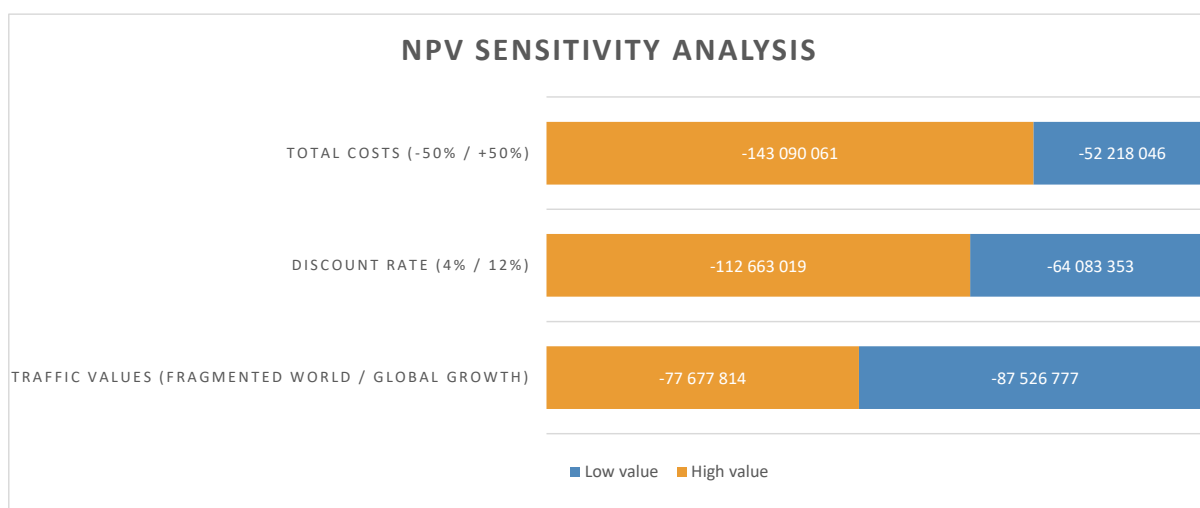


Figure 9: NPV Sensitivity Analysis for alternative scenario 2



9 Recommendations and next steps

The solution partners recommend verifying the data of the current document by proposing VLDs on different airport in order to verify the theoretical data.

Additionally, SJU have to quantify the indirect impacts on Aircraft traffic growth capability, punctuality and availability in LVC for EMS or VIP.

For the moment the VLDs are difficult to deploy due to the limited number of implementation, on board or on airport.



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] SESAR SOLUTION 02-05: COST BENEFIT ANALYSIS (CBA) FOR V3 – Rev 00.01.00

10.3 Other references

- [10] Standard Inputs for EUROCONTROL Cost-Benefit Analyses
Edition Number: 8.0
Edition Date: January 2018
- [11] EHA website : <http://www.eha-heli.eu/>

11 Appendix

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	Fuel efficiency	FEFF1	4 Kg of fuel consumption reduction per approach
Capacity	PA7 - System able to handle 80-100% more traffic	Capacity	TMA capacity	CAP1	Increasing efficiency during approach and departure reducing the traffic conflict between Aircraft and Rotorcraft
	PA6 - 5-10% additional flights at congested airports		Airport capacity	CAP2	Increasing efficiency during approach and departure reducing the traffic conflict between Aircraft and Rotorcraft. Specific holding zone for rotorcraft, capacity for rotor craft to land in airport FATO independently of the aircraft traffic. Reducing the risk of delay.
			Capacity resilience	N/A	N/A



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
	PA4 - 10-30% reduction in departure delays	Predictability and punctuality	Airport/TMA	PUN1	% of Flights departing (Actual Off-Block Time) within +/- 3 minutes of Scheduled Specific holding zone for rotorcraft, capacity for rotor craft to land in airport FATO independently of the aircraft traffic allowing controllers to reduce the amount of delay in case of congestion
Operational Efficiency	PA5 - Arrival predictability: 2 minute time window for 70% of flights actually arriving at gate		Airport/TMA	PRD1	Air Traffic management is equivalent to 2 independent Airports or TMA using SNI and in this case it's easier to predict the traffic congestion, only a same range of speed have to be managed by controllers
	PA2 - 3-6% reduction in flight time	Environment	Fuel efficiency	FEFF1	The time saving is negligible and not considered
	PA3 - 5-10% reduction in fuel burn			FEFF1	4 Kg of fuel consumption reduction per approach
Environment	PA8 - 5-10% reduction in CO2 emissions			FEFF1	The CO2 Emissions saving are negligible and not considered



ATM Master Plan SESAR Performance Ambition KPA	ATM Master Plan SESAR Performance Ambition KPI	Performance Framework KPA	Focus Area	#KPI / (#PI) / <Design goal>	KPI definition
Safety	PA9 - Safety improvement by a factor 3-4	Safety	Accidents/incidents with ATM contribution	/	The safety is increase but in other hand the traffic is growing then is not possible to separate the both variable in order to get a robust safety status.
Security	PA10 - No increase in ATM related security incidents resulting in traffic disruptions	Security	Self- Protection of the ATM System / Collaborative Support	N/A	N/A
				N/A	N/A
				N/A	N/A
				N/A	N/A

Table 25: Mapping between ATM Master Plan Performance Ambition KPAs and SESAR 2020 Performance Framework KPAs, Focus Areas and KPIs

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Founding Members

