SESAR Solution #118 - Cost Benefit Analysis (CBA) for V3

Topic: ATM Operations
Edition date: 15 May 2018
Edition: 01.00.01
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**Rejected By - Representatives of beneficiaries involved in the project**

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**Document History**

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<th>Date</th>
<th>Status</th>
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<td>28/02/2018</td>
<td>Draft</td>
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BASIC EXTENDED ATC PLANNING FUNCTION

Abstract

This document is the final version of the Cost Benefit Analysis, at V3 level, for the deployment of the SESAR Solution #118 - Basic EAP (Extended ATC Planning) function.

The basic EAP (bEAP) function consists of an automated tool supporting the basic communication between the Local DCB position and the Controllers' Work Positions to be deployed in En-route operating environments of Medium and High complexity.

The basic EAP function is expected to facilitate the implementation of ATFCM measures to better match capacity to predicted demand and to reduce the complexity of traffic presentation in order to suit available capacity.

The CBA is firstly presented at a generic individual level corresponding to an En-Route Medium/High complexity operating environment and then consolidated at the ECAC level.
# Table of Contents

Abstract .................................................................................................................. 3

1 **Executive Summary** ....................................................................................... 8

2 **Introduction** .................................................................................................. 9

2.1 Purpose of the document ................................................................................. 9

2.2 Scope ............................................................................................................... 9

2.3 Intended readership ........................................................................................ 9

2.4 Structure of the document .............................................................................. 10

2.5 Background .................................................................................................... 10

2.6 Glossary of terms .......................................................................................... 10

2.7 List of Acronyms ........................................................................................... 11

3 **Objectives and scope of the CBA** .............................................................. 12

3.1 Problem addressed by the solution ............................................................... 12

3.2 SESAR Solution description ......................................................................... 12

3.3 Objectives of the CBA ................................................................................... 14

3.4 Stakeholders’ identification .......................................................................... 15

3.5 CBA Scenarios and Assumptions ................................................................. 15

3.5.1 Reference Scenario ................................................................................... 16

3.5.2 Solution scenario ....................................................................................... 16

3.5.2.1 Solution deployed .................................................................................. 16

3.5.2.2 Timeframe considered for the CBA ..................................................... 17

3.5.2.3 Discount rate ......................................................................................... 17

3.5.2.4 Geographical scope considered for the CBA ..................................... 18

3.5.3 Assumptions ............................................................................................. 18

3.5.3.1 Timeframe for the CBA ....................................................................... 18

3.5.3.2 Discount Rate ....................................................................................... 19

3.5.3.3 The Geographical Scope .................................................................... 20

3.5.3.4 Traffic Evolution Forecast .................................................................. 22

3.5.3.5 Asset Depreciation .............................................................................. 24

3.5.3.6 Operational Organisation ................................................................. 25

3.5.3.7 Summary ............................................................................................. 25

4 **Benefits** ....................................................................................................... 26

4.1 ANSP Benefits ............................................................................................... 26

4.1.1 ATCO’s Productivity Increases Assumption ........................................... 26

4.1.2 ANSP Benefit Monetisation Process ....................................................... 27

4.2 Airspace Users’ benefits .............................................................................. 28

4.2.1 Delay Reduction Decrease Assumptions .............................................. 28

4.2.2 Benefit Monetisation Process ................................................................. 29

5 **Cost Assessment** ........................................................................................ 35
5.1 **ANSPs costs** ........................................................................................................... 35
5.1.1 ANSPs cost approach ......................................................................................... 35
5.1.2 ANSPs cost assumptions .................................................................................... 35
5.1.2.1 Implementation Costs ................................................................................... 35
5.1.2.1.1 One-off costs .......................................................................................... 35
5.1.2.1.2 Capital Cost ............................................................................................. 36
5.1.2.1.3 Transition Costs ...................................................................................... 36
5.1.2.2 Operational costs ........................................................................................... 36
5.1.3 Number of investment instances (units) ............................................................ 37
5.1.4 Cost per unit ....................................................................................................... 37
5.2 **Airport Operators Costs** ..................................................................................... 38
5.3 **Network Manager’s Costs** ................................................................................. 38
5.4 **Airspace Users’ Costs** ....................................................................................... 38
5.5 **Military Costs** .................................................................................................... 38
5.6 **Other relevant stakeholders** ............................................................................... 38
6 **CBA Model** ............................................................................................................. 39
6.1 Data sources ............................................................................................................ 39
7 **CBA Results** ........................................................................................................... 40
7.1 CBA Result at ACC Level ....................................................................................... 40
7.1.1 Cost Results ....................................................................................................... 40
7.1.2 Benefits Results ................................................................................................ 41
7.1.2.1 Air Navigation Service Provider Benefits ................................................... 41
7.1.2.2 Airspace Users Benefits .............................................................................. 41
7.1.3 CBA Result Analysis ......................................................................................... 42
7.2 CBA Result at ECAC Level ..................................................................................... 43
7.2.1 Costs Results ..................................................................................................... 44
7.2.2 Benefits Results ................................................................................................ 44
7.2.3 Result analysis ................................................................................................... 45
8 **Sensitivity and risk analysis** ................................................................................ 47
8.1 The discount rate ................................................................................................... 47
8.2 Operational organisation of the EAP function ...................................................... 48
8.3 ATCO productivity increase ................................................................................... 49
9 **Recommendations and next steps** ...................................................................... 50
10 **References and Applicable Documents** .............................................................. 51
10.1 Applicable Documents ......................................................................................... 51
10.2 Reference Documents .......................................................................................... 51
11 **Appendix** ............................................................................................................. 53

**List of Tables**
Table 1: SESAR Solution #118 Scope and related OI steps ................................................................. 14
Table 2: Related Operational and/or Human Enablers ................................................................. 14
Table 3: SESAR Solution #118 CBA Stakeholders and impacts .................................................... 15
Table 5: IFR movements Medium Term Forecast (ECAC Region) - Source STATFOR February 2017 [23] ................................................................. 23
Table 6: Forecasted annual growth rate per ACC Identified (Source STATFOR 2017) .................. 24
Table 7: Results of the benefits monetisation per KPA .................................................................. 34
Table 8: Number of investment instances - ACC ........................................................................... 37
Table 9: Cost per ACC in millions - ANSP .................................................................................... 38
Table 10: Mapping between ATM Master Plan Performance Ambition KPAs and SESAR 2020 Performance Framework KPAs, Focus Areas and KPIs ......................................................... 54

List of Figures
Figure 1: The EAP role fills the gap between ATFCM and ATC ..................................................... 13
Figure 2: Solution #118 – OIS and related enablers .................................................................... 14
Figure 3: The Solution #118 — Basic EAP (Extended ATC Planning) function SPR-Level Model ..... 18
Figure 4: En-Route complexity at ANSP Level .............................................................................. 21
Figure 5: En-Route complexity scores – Source PRR 2016 Report [26] ........................................ 21
Figure 6: Number of additional movements, 2023 vs. 2016 (Base scenario), – Source STATFOR Feb. 2017 [56] ................................................................. 23
Figure 7: ATCO productivity increase per hour ........................................................................... 27
Figure 8: ANS Productivity Cost-Saving Formula, sources [9] ........................................................ 28
Figure 9: Annual Monetised Costs of Solution #118 ................................................................. 40
Figure 10: Annual Monetised Benefit of Solution #118 related to Productivity Increase .......... 41
Figure 11: Annual Monetised Benefit of Solution #118 related to Delay decrease ................. 42
Figure 12: Annual Monetised Cash flows of Solution #118 at ACC Level .................................. 43
Figure 13: Summary Table of the CBA Result Indicators at ACC Level ..................................... 43
Figure 14: Annual Monetised Costs of Solution #118 at ACC Level ......................................... 44
Figure 15: Annual Monetised Benefit of Solution #118 related to Delay decrease ........................................ 45
Figure 16: Annual Monetised Cash flows of Solution #118 at ECAC Level ...................................................... 46
Figure 17: Table of the CBA Result Indicators at ECAC Level ................................................................. 46
1 Executive Summary

This document provides the Cost-Benefit Analysis (CBA) related to Solution #118 - Basic EAP (Extended ATC Planning) function at V3 level.

The CBA provides an analysis of the most relevant costs and benefits linked to the deployment of Solution #118 and obtain some economic metrics that demonstrate the feasibility of the project. Economic and technical assumptions are described in the document in order to be consistent in the study.

This Cost-Benefit Analysis provides results at two levels:
- Firstly, at a generic individual level, corresponding to the target Operational Environment, (En-Route, high complexity and/or demand) in support of individual deployment decisions.
- Then, consolidated at the ECAC level about the economic and financial viability of deploying the Solution #118 at the European scale.

In addition to the CBA, a sensitivity analysis has been performed to evaluate the impact of major CBA assumptions on the results, namely:
- The discount rate;
- The operational organisation of the EAP role; and
- The benefits of the ATCO productivity increase.

The CBA results and the sensitivity analysis show that, in any case, the payback period is 2021 therefore less than a year and an half after the investment.

The NPV (Net Present value) obtained is 20.4 M€ at ACC level and 220.1 M€ at ECAC level, taking into account that the Solution #118 will operate from 2020 to 2025 (six years) and the implementation will be done in the first year (2020).

Over the six years of operations the CBA shows a positive return on investment indicator of around 5% for both levels.

As a conclusion of this economic study, it can be confirmed that the implementation of Solution #118 will obtain a positive NPV either at individual ACC level or at ECAC level meaning the project is feasible in economic terms. Moreover those results and the short term payback period decrease the risk level of the solution #118 for potential investors.
2 Introduction

2.1 Purpose of the document

This document provides the Cost-Benefit Analysis (CBA) related to Solution #118 - Basic EAP (Extended ATC Planning) function at V3 level.

This CBA investigates whether the benefits of the deployed Solution #118 are expected to exceed the costs over the CBA time horizon, namely 2020-2021.

The CBA results are expected to support the decision of interested stakeholders (ANSPs) to move towards operational implementation.

2.2 Scope

The benefits investigated for Solution #118 - Basic EAP (Extended ATC Planning) function are those evaluated in the scope prepared for the SESAR 1 validation exercise VP687 performed by DSNA in June 2015 in Reims UAC. To achieve a V3 maturity level, the VP687 VALR (D78) has been enriched with the outcomes from the 4ME system, a tool operationally deployed in Reims UAC since 2016, which is used as an enabler for basic EAP (to display information on CWPs).

The Cost-Benefit Analysis provides results at two levels:

- Firstly, at a generic individual level, corresponding to the target Operational Environment, (En-Route, high complexity and/or demand) in support of individual deployment decisions, despite the interested parties will have to refine the mechanisms and inputs used in this CBA and review them for adaptation to their local context.

- Then consolidated at the ECAC level about the economic and financial viability of deploying the Solution #118 at the European scale.

2.3 Intended readership

The intended audience for this CBA is:

- The key stakeholders targeted by the Solution, i.e.
  - **Airspace Users** who will be directly impacted by the deployment of the basic EAP function in En-Route airspace;
  - **ANSPs (Air Traffic Controllers)** who will benefit from a smoothed workload and less complex traffic situations thanks to the STAM or decomplexification measures enabled by the basic EAP function, especially in hotspot areas;

- SESAR 2020 PJ09.02 members:

At the time of publication of this VALR, PJ09.02 is developing a solution for the full EAP concept; and
SESAR 2020 Projects developing solutions that can benefit from the deployment of the basic EAP function.

2.4 Structure of the document
This CBA is composed of ten chapters:

- Chapter 2 presents the document purpose, scope and intended readership;
- Chapter 3 provides the general objectives and scope of the CBA;
- Chapter 4 describes the detailed analysis of the benefits of solution #118;
- Chapter 5 presents the cost assessment of solution #118;
- Chapter 6 presents the CBA model;
- Chapter 7 presents the results of the CBA;
- Chapter 8 provides the sensitivity and risk analysis;
- Chapter 9 contains the recommendations stemming from the analysis performed;
- Chapter 10 provides the list of references and applicable documents.

2.5 Background
In 2006, DSN started to work on the concept of a complementary role to the existing Flow Manager to fill the gap between the ATFCM and the ATC. This concept was deemed to be much promising in terms of safety and capacity and moreover, the R&D work to be done was estimated compliant with the SESAR timeframe.

In 2013, the Integrated Network and extended ATC Planning concept (INAP) emerged from projects P04.02 and P07.02. This concept is introducing a new role, the Extended ATC Planning (EAP) role, which is intended to fill the gap between ATFCM and ATC.

2.6 Glossary of terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>Source of the definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>HICP</td>
<td>The Harmonised Index of Consumer Prices is an indicator produced by each European Union member states to help measure their national inflation.</td>
<td></td>
</tr>
<tr>
<td>Initial Operational Capability</td>
<td>Initial Operational Capability is the state archives when a capability is available in its minimum usefully deployable form. In other words, it identifies the start of benefits and the benefit ramp-up period.</td>
<td>Wikipedia and 16.06.06-D68-New CBA Model and Method 2015-Part1 of 2</td>
</tr>
<tr>
<td>Opportunity Cost</td>
<td>Opportunity cost refers to a benefit that a person could have received, but gave up, to take another course of action. Stated differently, an opportunity cost represents an alternative given up when a decision is made. This cost is, therefore, most relevant for two</td>
<td>Investopedia</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
<td>Source of the definition</td>
</tr>
<tr>
<td>-----------------</td>
<td>---------------------------------------------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Net Present Value</td>
<td>Net Present Value (NPV) is the sum of all discounted cash inflows and outflows during the time horizon period.</td>
<td>Investopedia</td>
</tr>
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### 2.7 List of Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tr>
<td>ACC</td>
<td>Area Control Centre</td>
</tr>
<tr>
<td>ATM</td>
<td>Air Traffic Management</td>
</tr>
<tr>
<td>bEAP</td>
<td>Basic Extended ATC Planning</td>
</tr>
<tr>
<td>CWP</td>
<td>Controller Working Position</td>
</tr>
<tr>
<td>EAP</td>
<td>Extended ATC Planning</td>
</tr>
<tr>
<td>FOC</td>
<td>Full Operational Capability</td>
</tr>
<tr>
<td>HC</td>
<td>High complexity (airport)</td>
</tr>
<tr>
<td>HICP</td>
<td>Harmonised Indices of Consumer Prices</td>
</tr>
<tr>
<td>IOC</td>
<td>Initial Operational Capability</td>
</tr>
<tr>
<td>LC</td>
<td>Low complexity (airport)</td>
</tr>
<tr>
<td>LTM</td>
<td>Local Traffic Management</td>
</tr>
<tr>
<td>OE</td>
<td>Operational Environment</td>
</tr>
<tr>
<td>PIRM</td>
<td>Programme Information Reference Model</td>
</tr>
<tr>
<td>PAR</td>
<td>Performance Assessment Report</td>
</tr>
<tr>
<td>SESAR</td>
<td>Single European Sky ATM Research Programme</td>
</tr>
<tr>
<td>SJU</td>
<td>SESAR Joint Undertaking (Agency of the European Commission)</td>
</tr>
<tr>
<td>STAM</td>
<td>Short ATFCM Measure</td>
</tr>
<tr>
<td>TFV</td>
<td>Traffic Volume</td>
</tr>
<tr>
<td>TMA</td>
<td>Terminal Manoeuvring Area</td>
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3 Objectives and scope of the CBA

3.1 Problem addressed by the solution

The increase of air navigation services demand is forecasted to be up to 2.2% annually for IFR flight in Europe. This growth should lead to a total of 11 629 000 IFR flight in the European sky by 2023.

In addition, heterogeneity of the demand across the European airspace sector is not forecasted to rebalance. Currently, this disparity is illustrated in CAPA studies that highlight the Western and Eastern European situation as follows:

- The 10 biggest western European airports represent together 34% of the total passenger traffic of the region; and
- 10 eastern European airports gather 46.06% of the regional passenger traffic [22].

This demand attributes alongside other air navigation services’ characteristics have created a disequilibrium between European airspace sectors. Indeed, some sectors have higher demand and/or more complex traffic than others.

The solution #118 aims, for specific highly complex ACC’s, at:

- Increasing the quality of service provided to airspace users through reduced delays, better punctuality, fewer ATFCM regulations, while maintaining or even increasing safety.
- Increasing the ACC’s overall en-route capacity due to the positive impact of the role on the controllers’ productivity.

In addition, the basic EAP concept can be considered as a potential enabler for the deployment of functionalities such as Extended AMAN or Free Routing operations.

3.2 SESAR Solution description

Operational Concept Elements in the scope of the Solution

The SESAR Solution #118 - Basic EAP (Extended ATC Planning) function is defined in the applicable version of EATMA (Dataset 18) as follows:

Solution #118 — Basic EAP (Extended ATC Planning) function

The basic Extended ATC Planner aims at bridging the gap between Air Traffic Flow and Capacity Management (ATFCM) and Air Traffic Control (ATC) providing real-time and fine-tuning measures to solve ATFCM hotspots and to perform early measures to alleviate complexity closest to ATC activities.

The solution consists of an automated tool and associated procedures supporting the basic communication between the Local DCB position and the Controllers’ Work Positions allowing the EAP and the ATC team in identifying, assessing and resolving local complexity situations.

The basic EAP relies on a real time integrated process for managing the complexity of the traffic with capability to reduce traffic peaks through early implementation of fine-tuned solutions to solve
workload imbalances at the local level, compatible with the short term timeframe of execution phase of the flights.

Operational improvement and expected benefits

The basic EAP (Extended ATC Planning) function introduces an initial automated interface together with the related procedures that will facilitate the communication between local DCB position and the Controllers’ Work Positions through the provision of optimised solutions to solve workload imbalances compatible with the short term timeframe of execution phase of the flights.

The basic EAP concept introduces also a new role, the EAP role (Extended ATC Planning), which is intended to fill the gap between ATFCM and ATC as illustrated on Figure 1 below:

- The EAP is not an additional staff: it is a role covering a set of services/functionalities that can be assumed by different personnel of the ATSU (already existing actors, like TC or new actors like MSP or LTM);
- It is highly recommended that the EAP is holding or has held an ATCO rating in the concerned ATSUs’ airspace.

Figure 1: The EAP role fills the gap between ATFCM and ATC

OI Steps and Operational Enablers under the scope of the Solution

Table 1 below summarizes the relevant OI Steps under the scope of the Solution #118 as defined in the applicable version of EATMA.

<table>
<thead>
<tr>
<th>SESAR Solution ID</th>
<th>OI Steps ID ref.</th>
<th>OI Steps Title</th>
<th>OI Step Coverage</th>
<th>Comments on the OI step title</th>
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<tr>
<td>Solution #118</td>
<td>CM-0106</td>
<td>Initial support to INAP: basic EAP (Extended ATC Planning) function</td>
<td>Fully covered</td>
<td>N/A</td>
</tr>
<tr>
<td>Basic EAP (Extended ATC Planning) function</td>
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<td></td>
<td></td>
</tr>
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</table>

Founding Members

EUROPEAN UNION

EUROCONTROL
Table 1: SESAR Solution #118 Scope and related OI steps

Table 2 summarizes the relevant Operational and/or Human Enablers under the scope of the SESAR Solution according to the applicable version of EATMA.

<table>
<thead>
<tr>
<th>OI Steps ref.</th>
<th>Enablers ID ref.</th>
<th>Enablers Definition</th>
<th>Enablers Coverage</th>
<th>Applicable stakeholder</th>
<th>Comments on the Enabler / definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM-0106</td>
<td>ER-ATC-164</td>
<td>ATC tools to re-organize traffic flows to reduce complexity in the execution phase</td>
<td>Full</td>
<td>ANSP</td>
<td>N/A</td>
</tr>
<tr>
<td>PRO-220a</td>
<td></td>
<td>ATC Procedures related to Detection and Resolution of Complexity, Density and Traffic Flow Problems</td>
<td>Partial – Limited to the execution phase</td>
<td>ANSP</td>
<td>N/A</td>
</tr>
<tr>
<td>PRO-220b</td>
<td></td>
<td>FCM procedures to describe how detection and resolution of complexity, density or traffic flow issues are managed.</td>
<td>Partial – Limited to the execution phase</td>
<td>ANSP</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 2: Related Operational and/or Human Enablers

Figure 2 below illustrates OIS and related enablers linked to Solution #118.

3.3 Objectives of the CBA

The Cost Benefit Analysis aims at monetising the solution’s cost and benefit in order to determine if the technical effectiveness of the project, presented in the VALR [10], is profitable in the long term for an ANSP and for the overall European Network (ECAC Level).
Therefore the Cost-Benefit Analysis will provide results at two levels:

- Firstly, at a generic individual level, corresponding to the target Operational Environment, (En-Route, high complexity and/or demand) in support of individual deployment decisions, despite the interested parties will have to refine the mechanisms and inputs used in this CBA and review them for adaptation to their local context.

- Then consolidated at the ECAC level about the economic and financial viability of deploying the Solution #118 – basic EAP at the European scale.

In order to answer to SESAR 2020 expectation regarding the CBA in V3, this CBA should include all the evidence gathered in terms of impacts, benefits and costs of a solution. The output should be the NPV overall and per stakeholder group, sensitivity and risk analysis, CBA model report and recommendation.

### 3.4 Stakeholders’ identification

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>The type of stakeholder and/or applicable sub-OE</th>
<th>Type of Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSP</td>
<td>European High Complexity ACCs</td>
<td>Invest in the tool (purchase, implementation, training cost and non-monetized costs such as increase of the FMP workload)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Enjoy the non-monetized benefits such as a complexity decrease or an ATCO workload decrease</td>
</tr>
<tr>
<td>Scheduled Airlines</td>
<td>All airlines that are using high complexity Airspace</td>
<td>Enjoy monetized benefit such as cost reduction through airborne and ground delays decrease</td>
</tr>
<tr>
<td>(Mainline and Regional)</td>
<td></td>
<td>Not involved in the analysis</td>
</tr>
</tbody>
</table>

Table 3: SESAR Solution #118 CBA Stakeholders and impacts

### 3.5 CBA Scenarios and Assumptions

This section presents a brief description of the reference scenario and of the Solution #118 implementation scenario. In addition this section presents and argues the different general assumptions used to create the solution’s framework for the CBA analysis.
3.5.1 Reference Scenario

The Reference Scenario reflects the situation at the start of implementation, with assumptions about what enablers are deployed and how deployment is likely to evolve without the Solution #118 during the time horizon of the CBA.

The reference scenario of the CBA is based on the current situation of an ACC: it considers that the organisation of the control room is as follows:

- One FMP which executes its role during the ATFCM Horizon
- Two controllers (one planner and one organic) per position that manage the traffic during the ATC Horizon

This scenario takes as an assumption that all other elements of the ACC environment are being equal. Therefore, the reference scenario considers that no investments are made during the timeframe of the CBA in ATCO productivity or ATCO workload.

In addition, it is considered that the forecast of STATFOR is realistic, consequently the traffic will increase during the CBA timeframe.

Therefore, the reference scenario will result in a non-optimal situation with for example an increase of ATFCM Delays.

3.5.2 Solution scenario

This section presents the Solution Scenario i.e. the scenario corresponding to the deployment of the Solution #118 — Basic EAP (Extended ATC Planning) function.

A “delta” approach is followed to describe the Solution Scenario: only the differential elements implied by the Solution Scenario over the Reference are included in this analysis which establishes the framework used for the CBA.

This section addresses successively:

- The description of the solution deployed;
- The timeframe considered for the CBA;
- The analysis of the appropriate discount rate; and
- The Geographical scope considered for the CBA.

3.5.2.1 Solution deployed

The deployment of Solution #118 is based on both:

- The implementation of an automated tool supporting the basic communication between the Local DCB position and the Controllers’ Work Positions; and
- The implementation of the new EAP role, which is an intermediary role between the ATFCM and the ATC Horizons.

The EAP role is expected to improve the efficiency of the procedures related to detection and resolution of complexity, density and traffic flow problems thanks to more up-to-date information.
For the CBA, it is assumed that this new role will be supported by the FMP and therefore the new organisation of an ACC would be described as follows:

- One FMP which executes its role during the ATFCM Horizon and the EAP role;
- Two controllers (one Planning Controller and one Executive/Tactical Controller) per position that manage the traffic during the ATC Horizon.

The EAP role will be supported by the implementation of two types of equipment one for the EAP agent and another one for the CWP. Both types of equipment will be linked to support the communication between the EAP and the controllers’ work-positions.

The solution scenario addresses the following OIS and Enablers:

- OI Step CM-0106 Initial support to INAP: basic EAP (Extended ATC Planning) function
- ER-ATC-164: ATC tools to re-organize traffic flows to reduce complexity in the execution phase
- PRO-220a: ATC Procedures related to Detection and Resolution of Complexity, Density and Traffic Flow Problems
- PRO-220b: FCM procedures to describe how detection and resolution of complexity, density or traffic flow issues are managed.

It is worth noting that whilst the OI Step CM-0106 and ER-ATC-164 are fully covered by the solution #118, PRO-220a and PRO-220b are only covered for the execution phase.

### 3.5.2.2 Timeframe considered for the CBA

It is assumed that the timeframe to be retained for the CBA of Solution #118 has to be relatively short given that a pre-industrial prototype has already been developed by DSNA/DTI and is in operation since 2016 based on simple equipment (tablets).

On the other hand, in the perspective of a deployment at the ECAC level, it is also necessary to consider the time required by an industrial supplier to develop a commercial solution similar to the tool deployed by DSNA.

Consequently, for the CBA, it is assumed that Solution #118 would be available by 2020 at the earliest for any ACCs which would have chosen to invest in it.

In addition, the lifespan of the solution is estimated to be approximately five (5) to seven (7) years.

Therefore the timeframe retained for the CBA of Solution #118 is 2020-2025. The detail of this analysis is presented in the section 3.5.3.1.

### 3.5.2.3 Discount rate

The analysis of the appropriate discount rate for the CBA of Solution #118 is based on the following inputs:

- The forecasted European inflation rate;
- The short solution’s time frame and its limited geographical scope; and
- The Eurocontrol’s standard discount rate.

The calculation and the assumption used to determine the aggregated discount rate of 4.48% are detailed in section 3.5.3.2.
3.5.2.4 Geographical scope considered for the CBA

The operational environment of the Solution #118 present in the OSED [10] has detailed that the geographical scope of the solution is defined for En-route operating environments of Medium and High complexity. It is however necessary to specify further this geographical scope to provide the CBA results at ECAC scale.

As the main monetized benefits expected from the deployment of the basic EAP function are due to the decrease of Airspace Users’ costs related to En-Route delay, it has been decided that the geographical scope will focus on the En-Route ACCs, managing Medium or High complexity traffic flow, which have high En-Route delays caused by ATC Capacity.

The details of this argument and the list of the ACC identified are presented in the section 3.5.3.3 of this document.

3.5.3 Assumptions

3.5.3.1 Timeframe for the CBA

The technical solution recommended for the basic EAP support tool is not fully integrated into the operational equipment and systems deployed in an ACC as illustrated on the figure below.

![Diagram](image_url)

Figure 3: The Solution #118 — Basic EAP (Extended ATC Planning) function SPR-Level Model

Indeed, the basic EAP support tool is based on software used to fulfil communication needs between the EAP role and the CWPs, therefore it does not necessarily require to be integrated in the existing operational environment and hence will not require expensive and time-consuming safety studies.

Anyway, the SESAR studies, the ANSP’s decision periods and the software development by an industrial stakeholder need to be taken into account in the CBA timeframe. Even if the basic
Extended ATC Planning software is not complex, because the traffic analysis would still be done on the CHMI, the time required by the industry to develop a commercial solution has to be taken into account.

Taking account of all of these constraints it is assumed that the operational implementation of the basic EAP function should be possible from early 2020 and onwards. This analysis allows concluding that the timeframe up to the Initial Operational Capability (IOC) should be relatively short. It is also assumed that the Full Operational Capability (FOC) should occur the same year.

Finally, considering the fact that the basic Extended ATC Planning is only an intermediate solution that will provide a short-term support to the communication function between the FMP and the CWP, before being fully integrated in the FMP operational tool, the lifespan of the Solution #118 is estimated to be 5 Years.

In conclusion, the assumptions regarding the timeframe to consider for the CBA of the Solution #118 are the following:

- Deployment and implementation period: 2020
- IOC=FOC: 2020
- The end of the operational period of the bEAP Tool: End of 2025

3.5.3.2 Discount Rate

The discount rate refers to the interest rate used in discounted cash flow analysis to determine the present value of future cash flows [18].

In order for the chosen discount rate to be coherent with the CBA needs and the Solution #118 characteristics the 4% standard discount rate proposed by Eurocontrol [17] was taken into account. This value is composed of three different inputs:

- A basic, risk-free, time of money (TFVM)-traditionally of the order of 2.5%
- Compensation for the erosion of the principal by inflation- not taken into account in the standard rate
- A premium for the risk- 1.5% in the standard rate

Nevertheless, the short time frame up to IOC along with the limited geographical scope characteristics of the Solution #118 — Basic EAP (Extended ATC Planning) function, have persuaded us to diminish the premium for the risk to 0.5%.

However, the recent OECD economic outlook report has forecasted the growth of the euro area’s economy and of the inflation rate which is expected to increase up to 1.7% by 2019.

This raise represents 2.125 times the HICP of 2016. In order to be coherent with this report and the recent growth of European economies, the inflation rate was taken into account in our nominal discount rate for the Solution #118’s CBA.

Therefore the following nominal discount rate is:

\[(1 + n) = (1 + r) \times (1 + i)\]
With:
- \( n \): nominal discount rate
- \( r \): real discount rate; with \( r = \text{basic risk free rate} + \text{the risk premium rate} \)
- \( i \): inflation rate

\[
(1 + n) = [1 + (0.005 + 0.025)] \times (1 + 0.017) \\
(1 + n) = 1.04751 \\
\text{n \approx 4.48\%} 
\]

The nominal discount rate used in the CBA to determine the present value of future cash flows is 4.48\%.

This assumption on the discount rate is strong and could be considerably affected by multiple non-measurable external factors. It highlights that an error term could be present. That is why this element should be analysed in the sensitivity analysis of the CBA, section 8.1.

3.5.3.3 The Geographical Scope

The Solution #118 - Basic EAP (Extended ATC Planning) function is defined for En-route operating environments of Medium and High complexity, with the aim to decrease the traffic complexity level and cope with high level traffic demand through the assessment and resolution of local complexity situations.

In the PRR 2013 [24], these operating environments are defined according to complexity and traffic volume by a traffic complexity score which is as follows:

- En-Route **High Complexity**: traffic complexity score higher than 6
- En-Route **Medium Complexity**: traffic complexity score higher than 2 but lower than 6.

This complexity indicator is therefore representative of the level and characteristics of the traffic demand in the airspace and the need for Enhanced DCB including Complexity Management at regional/sub-regional/local level and/or Enhanced Conflict Management and Automation at local level.

The complexity analysis provided in the PRR 2014 [25] illustrates the complexity score computed per ANSPs on Figure 4 below.
Figure 2.10: Structural complexity and adjusted density at ANSP level [2014]

Figure 4: En-Route complexity at ANSP Level

From the figure above it can be observed that the validation results obtained for the bEAP function in the Reims ACC (score between 7 and 8) correspond to a high complexity En-route environment.

In order to properly extend these results at ECAC level, it is necessary to consider a geographical scope for the CBA that will encompass the ACCs managing traffic of similar complexity. Hence the geographical scope of the CBA will focus on high complexity and/or high demand ACCs.

The map below illustrates how the traffic complexity scores, computed by the PRU for 2016, are allocated to the different European airspaces.

Traffic complexity score 2016

Figure 5: En-Route complexity scores – Source PRR 2016 Report [26]
From the above map it can be observed that most of the upper airspace and the lower airspace of the core area are potentially concerned by the basic EAP function. In these airspaces, all flights operating under GAT IFR rules area eligible to the measures managed by the basic EAP function.

However this preliminary analysis does not allow to precisely selecting the ACCs that would highly benefit from the implementation of the Basic EAP function and that could be in the scope of the CBA to extrapolate benefits at ECAC level.

The analysis of the Monthly Annual Network Operations Reports [19] and of the Performance Result Report [20] has highlighted the 12 ACCs with the highest delays.

From this analysis it has been possible to establish the following list of ACCs that will represent the geographical scope of the CBA for benefits’ extrapolation and costs’ calculation. This list is presented in Table 4 below.

<table>
<thead>
<tr>
<th>Geographical scope of the CBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATHINAI &amp; MACEDONIA</td>
</tr>
<tr>
<td>BARCELONA</td>
</tr>
<tr>
<td>BREST UACC</td>
</tr>
<tr>
<td>KARLSRUHE UAC</td>
</tr>
<tr>
<td>LANGEN ACC</td>
</tr>
<tr>
<td>LISBOA ACC UAC</td>
</tr>
<tr>
<td>MAASTRICHT UAC</td>
</tr>
<tr>
<td>NICOSIA ACC</td>
</tr>
<tr>
<td>PARIS ALL ACC</td>
</tr>
<tr>
<td>REIMS UACC</td>
</tr>
<tr>
<td>WARSZAWA ACC</td>
</tr>
<tr>
<td>ZAGREB ACC</td>
</tr>
</tbody>
</table>

Table 4: Geographical Scope based on Monthly Network Operation Report of 2015 [19]

### 3.5.3.4 Traffic Evolution Forecast

The traffic evolution of the solution scenario is based on the STATFOR analysis of published in February 2017 [23]. According to this Medium-term traffic forecast [23], the most-likely of the 3 scenarios forecast for 2023 is 11.6 million annual IFR flight movements in Europe, which represents 17.2% more than in 2015.
Table 5: IFR movements Medium Term Forecast (ECAC¹ Region) - Source STATFOR February 2017 [23]

In this forecast all IFR flights, including military and general aviation flights operating under GAT IFR rules, are included.

As illustrated on Figure 6 above it is still the busiest States (France, Germany, Spain, UK and Italy) which will see the greatest number of extra flights per day in 2023 (compared to 2016) which is consistent with the distribution of En-Route Medium and High Complexity airspaces shown on Figure 5 and the selection of ACCs presented in Table 4 that defines the geographical scope of the CBA.

¹ The European Civil Aviation Conference (ECAC) is an intergovernmental organization which was established by ICAO and the Council of Europe. ECAC now totals 44 members, including all 28 EU, 31 of the 32 EASA member states, and all 41 EUROCONTROL member states.
The table below presents the forecasted annual growth rate for the 12 ACCs that define the geographical scope of the CBA.

<table>
<thead>
<tr>
<th>Geographical Scope</th>
<th>STATFOR annual growth forecast (2017-2023)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATHINAI &amp; MACEDONIA</td>
<td>3.2%</td>
</tr>
<tr>
<td>BARCELONA</td>
<td>3%</td>
</tr>
<tr>
<td>BREST U ACC</td>
<td>1.8%</td>
</tr>
<tr>
<td>KARLSRUHE UAC</td>
<td>1.7%</td>
</tr>
<tr>
<td>LANGEN ACC</td>
<td>1.7%</td>
</tr>
<tr>
<td>LISBOA ACC UAC</td>
<td>2.5%</td>
</tr>
<tr>
<td>MAASTRICHT UAC</td>
<td>1.4%</td>
</tr>
<tr>
<td>NICOSIA ACC</td>
<td>4.4%</td>
</tr>
<tr>
<td>PARIS ALL ACC</td>
<td>1.8%</td>
</tr>
<tr>
<td>REIMS U ACC</td>
<td>1.8%</td>
</tr>
<tr>
<td>WARSZAWA ACC</td>
<td>3.0%</td>
</tr>
<tr>
<td>ZAGREB</td>
<td>2.6%</td>
</tr>
</tbody>
</table>

Table 6: Forecasted annual growth rate per ACC identified (Source STATFOR 2017)

Nevertheless, the available STATFOR annual growth traffic forecast is a only 7-year-long estimation of the evolution of the traffic in Europe which does not cover the full timeframe of the CBA.

Hence it assumed that the STATFOR figures are reliable and stable over time and can be extended until the end of the CBA’s timeframe.

3.5.3.5 Asset Depreciation

Depreciation is an accounting method of allocating the cost of a tangible asset over its useful life, which allows a company to write off the value of an asset over time [18]. The bEAP concept is based on two types of assets that have specific useful life described as follows:

- EAP and CWP Tablets are electronic equipment which has a lifespan of approximately 3 years. Therefore, the tablet cost will occur twice during the Solution #118 lifespan.
- EAP software will be licenced annually and this licence cost should include the maintenance and update. An overall upgrade should be done every three years to upgrade the software.
3.5.3.6 Operational Organisation

As presented in the Solution #118 — Basic EAP (Extended ATC Planning) function description, the role should be taken in charged by the FMP. However, risk that this operational organisation might not be the choice of every ANSP which invest in the Solution #118 has to be underlined.

This assumption is strong and could highly affect the cost results and structure of the CBA. That is why this element should be analysed in the sensitivity analysis of the CBA section 8.2.

3.5.3.7 Summary

This section is a summary of all the scenario main assumptions and parameters affecting the CBA results. The additional assumptions on the costs and the benefits are presented in section 4 and section 5 of this document.

<table>
<thead>
<tr>
<th>Scenario feature</th>
<th>Year N</th>
<th>Year N+2</th>
<th>Year N+5</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>The discount rate</td>
<td>4.48%</td>
<td>4.48%</td>
<td>4.48%</td>
<td>3.5.3.2</td>
</tr>
<tr>
<td>The Geographical scope (in Nb of ACC)</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>3.5.3.3</td>
</tr>
<tr>
<td>The average of the annual forecasted traffic growth in the ACC identified</td>
<td>2.41%</td>
<td>2.41%</td>
<td>2.41%</td>
<td>[14]</td>
</tr>
</tbody>
</table>
4 Benefits

This section of the document will describe the monetised benefits from the implementation of the Solution #118 — Basic EAP (Extended ATC Planning) function scenario presented in the previous section. However, for accurate purposes several assumptions to elaborate our analytic framework were used.

In order to remain consistent with the cost assessment section (§5), the presentation of the monetized benefits has also been split per stakeholder.

The generic results of the monetized benefits are presented in the Table 5 of this section and they will be detailed and analysed in the CBA results section 7 of this document.

4.1 ANSP Benefits

This section will detail the assumptions, the formula and the input used to monetise the benefit for the ANSP.

4.1.1 ATCO’s Productivity Increases Assumption

The benefits for the CBA are based on the VALR inputs acquired during the Reims live trial which studied the KPA of ATCO productivity. The result of this one-week exercise was a positive increase of 2% of the ATCO productivity compared to the reference scenario.

However, the SESAR validation context has led to an over-investment in human resources in order to compensate the novelty factor of the role and the tool for both the FMP and the ATCO. Consequently, the assumption on the 2% ATCO productivity increase is a long-term goal result for the bEAP was taken into account.

In addition, we have to take into account that the experience and the knowledge acquirement of the EAP role and tool will take time as it modifies working both FMP and ATCO working method. The other element to take into account in order to be as close as possible to the operational context is the threshold effect. Indeed, the implementation of a new tool in an operational environment does not lead to a continuous increase of productivity. That is why we take as an assumption that the productivity indicator will follow a concave function which leads to a quick growth during the first years of the tool’s implementation and then this increase will slowly diminish to reach its maximum of 2% ATCO productivity increase as presented in the following graph:
In conclusion, for the CBA the following assumption regarding the ATCO productivity will be used:

- **First year:** 0.75% productivity increase compared to the base year
- **Second year:** 1.25% productivity increase compared to the base year
- **Third year:** 1.5% productivity increase compared to the base year
- **Fourth year:** 1.75% productivity increase compared to the base year
- **Fifth year:** 2% productivity increase from the base year

These assumptions on the productivity index’s evolution are strong and could be considerably affected by multiple non-measurable external factors. Therefore the probability that an error term could be present has to be underlined. That is why this element should be analysis in the sensitivity analysis of the CBA.

### 4.1.2 ANSP Benefit Monetisation Process

The monetisation of the Solution #118 — Basic EAP (Extended ATC Planning) function is based on the New CBA Models and Method Part 1 of 2 SESAR document [9] which provides the following formula to assess the ANS Productivity Cost Saving:
As presented in the previous subsection, it has been taken as an assumption that the 2% productivity increases will be reached during the fifth year of the solution implementation therefore the monetised ATCO productivity increase should be maximised at this period. However, the benefits materialise as soon as the Solution #118 is implemented. That is why the ANSP benefits increases between the first year of implementation and stabilised at the fifth.

The inputs used during for the benefit monetisation are the VALR Results and the standard input of ATCO cost per hour based on the ATM Cost effectiveness benchmarking report 2014 with 2015-2019 outlook [21]. For accuracy purposes, the cost data year by year were recomputed according to the realised and forecasted inflation rate at each specific period.

4.2 Airspace Users’ benefits

This section will detail the assumptions, the formula and the input used to monetise the decrease of airborne delay.

4.2.1 Delay Reduction Decrease Assumptions

The benefit calculation of the Solution #118 — Basic EAP (Extended ATC Planning) function is based on the input acquired during Reims live trial presented in the VALR. During this exercise, the STAM proposed by the EAP to the CWP, which resulted in a reduction of delay, were proposed on airborne flight. This result specifies has constrained us to take as an assumption that the delay reduction at ECAC Levels would be airborne delays.

However, in order to deduce the annual airline’s benefit in an operational environment we had to determine when the VALR result would materialise. To answer this requirement, the 2015 annual traffic based on the different monthly Network Operation Report [19] has been analysed. This analysis has allowed us to determine that the European traffic had an important seasonality period which based on the most containing ACC in terms of En-Route delays last on average 14 weeks. As the solution aims at decreasing En-Route delays, it has been taken as an assumption that the basic
EAP delays reduction benefit would appear only during the high season, in other words, 14 weeks per year.

This assessment has also highlighted that the En-Route delay causes were numerous; however the bEAP solution has an impact only on the ATC Capacity delay. Therefore, in order to determine the operational benefit of the Solution #118, the average the percentage of delay due this specific cause had to be determined. To compute how much of the VALR delay reduction should be credited to the bEAP role and tool, the Performance Results Report published in 2016 was used and underlined that 55% of the En-Route delays were caused by ATC Capacity.

In addition, the results in terms of delay reduction in the VALR [10] were presented for the base week scenario with and without the impacts of the 2F regulation on day 6. This specificity highlights that not all of the delay reduction of the solution scenario could be generalized at a national or ECAC operational level. That is why in this CBA, it has been decided to use the data from the base week without the regulation impacts on the total of delays.

In conclusion, to assess the monetised benefit of the Solution #118 — Basic EAP (Extended ATC Planning) function in the operational environment the following assumptions were used:

- The delays reduction in minutes represents only airborne delays.
- The VALR results are representative for 14 weeks per year.
- 55% of the En-Route delays are due to ATC Capacity.

These assumptions on the characteristics of tactical delay are strong and could be considerably affected by multiple non-measurable external factors. It highlights that an error term could be present. That is why this element should be analysed in the sensitivity analysis of the CBA.

### 4.2.2 Benefit Monetisation Process

The monetisation of the Solution #118 — Basic EAP (Extended ATC Planning) function is based on the New CBA Models and Method Part 1 of 2 SESAR document [9] which provides the following formula to assess the ATFM delay reduction:

![Formula Diagram]

As presented in the previous subsection, the operational benefit's analysis for the airline takes only into account a portion of the total delay reduction presented in the VALR [10]. In addition, it has
been taken into account that the ATCO productivity and the airborne delay reduction are correlated; therefore the delay reduction should follow the ATCO productivity increase concave function.

The inputs used for the monetisation of the airlines benefit are based on the VALR results and the cost of ATFM delay based on EUROCONTROL’s Standard Input for CBA [17]. For accuracy purposes the cost data year by year were recomputed according to the realised and forecasted inflation rate at each specific period.
<table>
<thead>
<tr>
<th>Performance Framework KPA²</th>
<th>Focus Area</th>
<th>KPI/PI from the Performance Framework</th>
<th>Unit</th>
<th>Metric for the CBA</th>
<th>Unit</th>
<th>Year</th>
<th>Year</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost Efficiency</td>
<td>ANS</td>
<td>Cost efficiency</td>
<td>Nb</td>
<td>ATCO employment Cost change</td>
<td>Thousand€/year</td>
<td>20</td>
<td>38</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CEF2</td>
<td></td>
<td>Support Staff Employment Cost Change</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Non-staff Operating Costs Change</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CEF3</td>
<td>EUR/flight</td>
<td>G2G ANS cost changes related to technology and equipment</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td>Airspace User Cost efficiency</td>
<td>AUC3</td>
<td>Direct operating costs for an airspace user</td>
<td>EUR/flight</td>
<td>Impact on direct costs related to the aeroplane and passengers. Examples: fuel, staff expenses, passenger service costs, maintenance and repairs, navigation charges, strategic delay, landing fees, catering</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AUC4</td>
<td>EUR/flight</td>
<td>Impact on operating costs that don’t relate to a specific flight. Examples: parking charges, crew and cabin salary, handling prices at Base Stations</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
</tbody>
</table>

² For information, the mapping to the Performance Ambition KPAs (used in the ATM Master Plan) is available in the Appendix.
<table>
<thead>
<tr>
<th>Performance Framework KPA²</th>
<th>Focus Area</th>
<th>KPI/PI from the Performance Framework</th>
<th>Unit</th>
<th>Metric for the CBA</th>
<th>Unit</th>
<th>Year N</th>
<th>Year N+2</th>
<th>Year N+5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>AUC5</td>
<td>EUR / flight</td>
<td>Impact on overhead costs. Examples: dispatchers, training, IT infrastructure, sales.</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Capacity</td>
<td>CAP1</td>
<td>% and # movements</td>
<td>Tactical delay cost (avoided; additional +)</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CAP2</td>
<td>% and # movements</td>
<td>Tactical delay cost (avoided; additional +)</td>
<td>Millions€/year</td>
<td>1.9</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CAP3</td>
<td>% and # movements</td>
<td>Value of additional flights</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Resilience</td>
<td>RES4a</td>
<td>Minutes</td>
<td>Tactical delay cost (avoided; additional +)</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RES4b</td>
<td>% and # movements</td>
<td>Cost of cancellations</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Diversions</td>
<td>% and # movements</td>
<td>Cost of diversions</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td>Performance Framework KPA(^2)</td>
<td>Focus Area</td>
<td>KPI/PI from the Performance Framework</td>
<td>Unit</td>
<td>Metric for the CBA</td>
<td>Unit</td>
<td>Year N</td>
<td>Year N+2</td>
<td>Year N+5</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------------------------</td>
<td>---------------------------------------</td>
<td>-----------------------</td>
<td>---------------------------------------------</td>
<td>------</td>
<td>--------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>Predictability and punctuality</td>
<td>Predictability</td>
<td>PRD1</td>
<td>Minutes(^2)</td>
<td>Strategic delay cost (avoided; additional +)</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td>Punctuality</td>
<td>PUN1</td>
<td>% Departures &lt; +/- 3 mins vs. schedule due to ATM causes</td>
<td>% (and # movements)</td>
<td>Tactical delay cost (avoided; additional +)</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td>Flexibility</td>
<td>ATM System &amp; Airport ability to respond to changes in planned flights and mission</td>
<td>FLX1</td>
<td>Minutes</td>
<td>Tactical delay cost (avoided; additional +)</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td>Environment</td>
<td>Time Efficiency</td>
<td>FEFF3</td>
<td>% and minutes</td>
<td>Strategic delay: airborne: direct cost to an airline excl. Fuel (avoided; additional +)</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td></td>
<td>Fuel Efficiency</td>
<td>FEFF1</td>
<td>Kg fuel per movement</td>
<td>Fuel Costs</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td></td>
<td>Fuel Efficiency</td>
<td>FEFF2</td>
<td>Kg CO2 per movement</td>
<td>CO2 Costs</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td>Performance Framework KPA²</td>
<td>Focus Area</td>
<td>KPI/PI from the Performance Framework</td>
<td>Unit</td>
<td>Metric for the CBA</td>
<td>Unit</td>
<td>Year N</td>
<td>Year N+2</td>
<td>Year N+5</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------</td>
<td>---------------------------------------</td>
<td>------</td>
<td>--------------------</td>
<td>------</td>
<td>--------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Civil-Military Cooperation &amp; Coordination</td>
<td></td>
<td>CMC2.1a Fuel saving (for GAT operations)</td>
<td>Kg fuel per movement</td>
<td>Fuel Costs</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CMC2.1b Distance saving (for GAT operations)</td>
<td>NM per movement</td>
<td>Time Costs</td>
<td>€/year</td>
<td>[N/A]</td>
<td>[N/A]</td>
<td>[N/A]</td>
</tr>
</tbody>
</table>

Table 7: Results of the benefits monetisation per KPA
5 Cost Assessment

The Solution #118’s description has underlined that the costs of the EAP role and tool will be entirely supported by the ANSPs that will choose to invest in the solution to optimise their operations. Therefore this section will only focus on the costs borne by the ANSPs.

5.1 ANSPs costs

This section aims at identifying the ANSPs’s Solution #118 cost and the assumptions used in order to monetize them in the CBA model.

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 overall network. 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 in 2020/2021 and the operating cost should materialise from 2020 to the end of 2025. This specificity forces us, for accuracy purposes, to take into account the realised and the forecasted annual inflation rate for all the cost inputs. The calculations are presented in the CBA excel model.

5.1.2.1 Implementation Costs

5.1.2.1.1 One-off costs

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

- The training period duration for the EAP role implementation and the operational use of the bEAP tool: 3 days for the CWP and 5 days for the FMP.

- The opportunity cost of those training sessions based on the cost of the ATCO hour’s standard input and the number of controllers trained: 107, 03 euros per hour in 2020 based on [21] (EUROCONTROL, ATM Cost effectiveness benchmarking report 2014 with 2015-2019 outlook).

- The training fees requested by the training entity: 800 euros per training days. However, for accuracy purposes it has been taken into account that the training session should include a maximum of 20 controllers. Therefore a total of 23 days of training for 350 CWP and 5 FMP per ACC.

Project Management: The estimate of the overall project management cost is 500,000 euros for each ANSP that chooses to invest in the SESAR Solution #118 — Basic EAP (Extended ATC Planning) function meaning that if the Solution #118 is implemented in several ACC this cost will only appear once. This envelope includes the project definition, programme management and support, planning costs, procurement management, meeting and travelling costs, processes and documentation costs.

Administrative costs: The bEAP solution does not highly impact the operational procedure. Indeed, as it is an extended ATFCM tool it follows the best effort rule. The administrative costs are therefore very low and for this CBA we will take as an assumption that there will be equal to zero.
Installation and commissioning: The initial 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 the SESAR Solution #118, will have to conduct implementation exercises and live trials in order to certify the solution operationally. And those exercises are costly due to the number of staff involved in the process. In the cost analysis the inputs of Reims live trial were used as standard inputs and the overall cost of this exercise validation was **100 000 euros**.

In addition to this amount it was taken into account the installation costs that should be relatively low due to the separation of the operational architecture and the basic EAP architecture presented in the SPR-INTEROP/OSED [10]. The installation fees should not go over 50 000 euros per ACC that chooses to invest in the Solution #118 — Basic EAP (Extended ATC Planning) function.

Validation and certification costs: As presented in the OSED [10], the impact of the solution on the operational systems and architecture is non-existent. This allows us to take as an assumption that this component of the cost analysis is equal to zero.

### 5.1.2.1.2 Capital Cost

**Equipment & Systems:** The Solution #118 — Basic EAP (Extended ATC Planning) function is based on two main components: the HMI, a tablet or a 4ME screens, and the bEAP software.

- The cost analysis of this CBA used a benchmark to determine the costs of the tablet which have shown that the cost per unit is around 1 500 euro for the CWP positions and 3 000 euros for the FMP position. This price difference is based on the distinct technical hardware requirement of the EAP and the CWP software.

- The second component of the solution is software which, as presented in the third section of the document, will be proposed as an annual licence per user account. Therefore, the cost of the software included in this implementation cost will be the initial implementation cost and the licenced keys requested by the ANSP according to their needs. The price determination of this initial fee is based on the solution’s development period which is forecasted to take 100 days and the industrial daily fee of 2 500 euros. Which represents an overall cost initial cost of the software is: 250 000 euros.

The asset life of a tablet is 3 years and the software important evolution should be around 3 years also; therefore we will have to take into account these costs twice during the project lifespan.

**Integration costs:** As presented in the OSED [10], the functional architecture of the Solution #118 does not require any integration on the existing operational systems and architecture. This allows us to take as an assumption that this component of the cost analysis is equal to zero.

### 5.1.2.1.3 Transition Costs

As the Solution #118 — Basic EAP (Extended ATC Planning) function is not impacting operational system or tools there are not transition cost that applies in this CBA.

### 5.1.2.2 Operational costs

**Raw Material:** As presented in the previous section one of the solution’s technical components is the bEAP software which relies on annual licences. The cost of this annual fee should be around 2 500 euros per CWP and 3 700 euros per FMP. This price difference is based on the distinct
technical hardware requirement of the EAP and the CWP software. This cost includes software maintenance and update.

Personnel and training: As the Solution #118 does not include any increase in the ANSPs staff, the personnel costs and support staff subsection are equal to zero. However, as explained in the previous section, the licencing software includes annual update on which the EAP and the controllers should be trained. The estimation on this cost is three days of training for the FMP and a day for the CWP per year.

Maintenance and repairs: The Solution #118 represents a small investment that will not impact the maintenance and repair annual cost of the ANSP therefore this cost component will be equal to 0 in the bEAP’s CBA.

5.1.3 Number of investment instances (units)

The Solution #118 — Basic EAP (Extended ATC Planning) function was developed and tests only in En-Route environment that is why it has been taken as an assumption that the Sub Operating Environment of Airport and TMA were not applicable to this study.

The geographical scope assumptions have identified that 12 ACC would highly benefit from the solution implementation due to the important amount of En-Route delay which they generate. In the Cost analysis the based scenario in terms of investments units relies on the geographical assumption which is equal to 12 specific ACC.

As the basic Extended ATC Planning has been developed and tested by the DSNA, it has been taken as an assumption that in the worst scenario case the three French most constraining ACC identified in the geographical scope would invest in the Solution #118.

In the best case scenario the 20 most constraining European ACC in terms of En-Route Delays should invests in the SESAR Solution#118.

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

<table>
<thead>
<tr>
<th>Airport</th>
<th>TMA</th>
<th>ACC</th>
</tr>
</thead>
<tbody>
<tr>
<td>HC</td>
<td>HS</td>
<td>LC</td>
</tr>
<tr>
<td>[N/A]</td>
<td>[N/A]</td>
<td></td>
</tr>
</tbody>
</table>

Table 8: Number of Investment Instances - ACC

5.1.4 Cost per unit

This section will detail the total cost of the Solution #118 per ACC unit. As presented in the Excel CBA model the Solution #118 cumulated amount of costs is 4 081 824 euro discounted in 2020 euros. This amount represents an annual average of 680 304 euros.

The Low and High ranges of costs monetisation are related to the uncertainty rate related which was computed at 20%. The results of this uncertainty element are presented in the following table:
### Cost category

<table>
<thead>
<tr>
<th>Cost category</th>
<th>Airport</th>
<th>TMA</th>
<th>ACC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HC</td>
<td>HS</td>
<td>LC</td>
</tr>
<tr>
<td>Pre-Implementation</td>
<td>[N/A]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implementation costs</td>
<td>[N/A]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 9: Cost per ACC in millions - ANSP

### 5.2 Airport Operators Costs
[N/A]

### 5.3 Network Manager’s Costs
[N/A]

### 5.4 Airspace Users’ Costs
[N/A]

### 5.5 Military Costs
[N/A]

### 5.6 Other relevant stakeholders
[N/A]
6 CBA Model

6.1 Data sources

Model: Excel CBA
BEAS.xlx
7 CBA Results

As presented in the introduction of the document the result will be presented as follows:

- Firstly, at a generic individual level, corresponding to the target Operational Environment, (En-Route, high complexity and/or demand) in support of individual deployment decisions, despite the interested parties will have to refine the mechanisms and inputs used in this CBA and review them for adaptation to their local context.

- Then consolidated at the ECAC level about the economic and financial viability of deploying the Solution #118 — Basic EAP (Extended ATC Planning) function at the European scale.

7.1 CBA Result at ACC Level

This section will present the CBA generic results at an individual ACC Level.

7.1.1 Cost Results

The cost analysis has highlighted that the total cost are evenly distributed between the CAPEX costs (48%) and the OPEX costs (52%) for the Solution #118. However, we have to underline that the One-off costs driven by the initial training and staffing subsection represents around 72% of the total CAPEX and 35% of the total 2020 cost of the Solution #118. In addition, the assumption on the software licence and the continuous training of the controllers has impacted the OPEX materialize each year. The annual monetised costs of the solution are presented in the following graph.

![Solution #118 Cost Evolution (ACC Level)](image)

Figure 9: Annual Monetised Costs of Solution #118
7.1.2 Benefits Results

7.1.2.1 Air Navigation Service Provider Benefits

This following graph presents the monetized benefit due to the increase of ATCO productivity.

![Solution #118 ANSP Benefit Evolution](image)

**Figure 10: Annual Monetised Benefit of Solution #118 related to Productivity Increase**

The results show in the graph underline that the ATCO productivity increase has a relatively marginal impact on the total monetized benefit the Solution #118. However, the VALR results were not sufficient to analyse the ACC Capacity increase. Therefore, all the ANSP benefit derived from the productivity increase could not be monetised in this CBA.

7.1.2.2 Airspace Users Benefits

This following graph presents the monetized benefit due to the decrease of ATC Delays:
The monetisation of airline cost saving due to Solution #118 performance of the delay reduction is increasing annually to reach a total of 5,400,653 euros (discounted) in 2025. These results underline the economic efficiency of the solution implementation for the airspace users.

### 7.1.3 CBA Result Analysis

The annual cash flow evolution graph presented below highlights that the Solution #118 — Basic EAP (Extended ATC Planning) function is a very profitable solution for the airlines as it allows them to decrease their costs of delay in a specific constraining ACC. In addition, the CBA results discounted, with a rate of 4.48%, shows that the payback period should be at the end of 2021, therefore approximately less than a year and a half after the Solution #118 implementation.
The CBA results are presented in the following table are showing that the Solution #118 — Basic EAP (Extended ATC Planning) function is very profitable solution with a net present value (NPV) of 20 377 391 €. Indeed, the return on investment (ROI) indicator underlines that the investment in the Solution #118 is 5 times more profitable than not investing.

<table>
<thead>
<tr>
<th>Payback Period</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return on Investment (ROI)</td>
<td>4.99</td>
</tr>
<tr>
<td>Net Present Value (NPV)</td>
<td>20 377 391.62 €</td>
</tr>
</tbody>
</table>

However, the fact that the stakeholder that invests in the Solution #118 is not the one that benefits from the monetised benefit has to be underlined. Indeed, the costs are supported by the ANSP and only the airline benefit from the solution. That is why in order to be profitable to the stakeholder who invests in the Solution #118 — Basic EAP (Extended ATC Planning) function; the costs should be transferred to the airline to stimulate the investment of the ANSPs.

### 7.2 CBA Result at ECAC Level

This section presents the results of the CBA at ECAC Level which takes into account that all the ACC identified in the geographical scope invest in the Solution #118 by 2020.
7.2.1 Costs Results

The cost analysis has highlighted that the total cost are evenly distributed between the CAPEX costs (46%) and the OPEX costs (54%) for the Solution #118. However, we have to underline that the One-off costs driven by the initial training and staffing subsection represents around 69% of the total CAPEX and 32% of the total 2020 cost. In addition, the assumption on the software licence and the continuous training of the controllers has impacted the OPEX materialize each year. The difference of proportion compared to the local level proportion is due to the decrease of project management cost because as presented in the cost assumption section they are generated once for each national ANSP. The annual monetised costs of the Solution #118 are presented in the following graph.

![Solution #118 Cost Evolution (ECAC Level)](image)

Figure 14: Annual Monetised Costs of Solution #118 at ACC Level.

7.2.2 Benefits Results

The result of the productivity increases benefit monetisation at an ACC Level has underlined that this aspect of the Solution #118 is negligible. That is why it has been chosen not to analyse it at the ECAC level.

This following graph presents the monetized benefit due to the decrease of ATC Delays:
Solution #118 AU Benefit Evolution

![Graph showing the annual benefit evolution for Solution #118 at ECAC level.](image)

**Figure 15: Annual Monetised Benefit of Solution #118 related to Delay decrease**

The monetisation of airline cost saving due to Solution #118 performance of the delay reduction is increasing annually to reach a total of 55,023,944 euros (discounted) in 2025. These results underline the economic efficiency of the solution implementation at ECAC Level.

### 7.2.3 Result analysis

The annual cash flow evolution presented in the following graph, highlights that the Solution #118 is a very profitable solution for the airlines as it allows them to decrease their costs of delay in several specific constraining ACC. In addition, the CBA results discounted, with a rate of 4.48%, shows that the payback period should be at the end of 2021, therefore approximately less than a year and a half after the Solution #118 implementation.
The CBA results are presented in the following table are showing that the Solution #118 — Basic EAP (Extended ATC Planning) function is very profitable solution with a net present value (NPV) of 220 132 253 euros. Indeed, the return on investment (ROI) indicator underlines that the investment in the Solution #118 is 4, 64 times more profitable than not investing.

<table>
<thead>
<tr>
<th>Payback Period</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return on Investment (ROI)</td>
<td>4,64</td>
</tr>
<tr>
<td>Net Present Value (NPV)</td>
<td>220 132 253,88 €</td>
</tr>
</tbody>
</table>

However, the fact that the stakeholder that invests in the Solution #118 — Basic EAP (Extended ATC Planning) function is not the one that benefits from the monetised benefit has to be underlined. Indeed, the costs are supported by the ANSP and only the airline benefit from the solution. That is why in order to be profitable to the stakeholder who invests in the Solution #118; the costs should be transferred to the airline to stimulate the investment of the ANSPS.
8 Sensitivity and risk analysis

The sensitivity analysis aims at highlighting the impact of major CBA assumptions on the results. For the Solution #118, the sensitivity analysis focuses on:

- The discount rate;
- The operational organisation of the EAP role; and
- The benefits of the ACTO productivity increase.

8.1 The discount rate

As presented in the section 3.5.3.2, the discount rate taken into account in the CBA was: 4.48%. To analyse the impact of this element on the CBA results, the discount rate has been increased by 1%. This assessment computed the following evolution:

At a Local CBA level:

<table>
<thead>
<tr>
<th>Discount analysis</th>
<th>rate sensitivity</th>
<th>4.48%</th>
<th>5.48%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payback period</td>
<td>2021</td>
<td>2021</td>
<td></td>
</tr>
<tr>
<td>ROI</td>
<td>4.99</td>
<td>5.02</td>
<td></td>
</tr>
<tr>
<td>NPV</td>
<td>20 377 392 euros</td>
<td>20 218 651 euros</td>
<td></td>
</tr>
</tbody>
</table>

These results underline that the CBA local results are not highly impacted by the increase of the discount rate. Indeed, the NVP decreases of 0.77% while the ROI increased in the same proportion. The divergent evolution highlights that the increase of the discount rate leads to a decrease of the total benefits of the CBA in terms of euro, however, the return on investment is higher when the discount rate increases of one percentage.

At an ECAC Level:

<table>
<thead>
<tr>
<th>Discount analysis</th>
<th>rate sensitivity</th>
<th>4.48%</th>
<th>5.48%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payback period</td>
<td>2021</td>
<td>2021</td>
<td></td>
</tr>
<tr>
<td>ROI</td>
<td>4.64</td>
<td>4.56</td>
<td></td>
</tr>
<tr>
<td>NPV</td>
<td>220 132 253 euros</td>
<td>213 473 957 euros</td>
<td></td>
</tr>
</tbody>
</table>

These results underline that the CBA local results are impacted by the increase of the discount rate. Indeed, the NVP decreases of 30% while the ROI decreases 1.7%. The divergent evolution highlights
that the increase of the discount rate leads to an important decrease of the total benefits of the CBA in terms of euro; however, the return on investment stays relatively stable.

### 8.2 Operational organisation of the EAP function

The Solution #118’s CBA cost model relied on the assumption that the Extended ATC Planning was a function and not an additional agent. Because, this assumption depends on each ANSP internal organisation it has been decided to analyse its impact on the CBA results. The sensitivity analysis presented in the following table is showing the increase of 5 additional agents to cover the EAP role annually.

#### At a Local Level:

<table>
<thead>
<tr>
<th></th>
<th>EAP Function</th>
<th>EAP Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payback period</td>
<td>2021</td>
<td>2021</td>
</tr>
<tr>
<td>ROI</td>
<td>4.99</td>
<td>1.96</td>
</tr>
<tr>
<td>NPV</td>
<td>20 377 392 euros</td>
<td>16 184 033 euros</td>
</tr>
</tbody>
</table>

These results are showing that the assumption on the EAP role is impacting highly the results of the CBA. Indeed, the scenario analysed in the sensitivity analysis has underlined a decrease of the return on investment of the solution of 61% and a decrease of net present value of 21%. This highly negative impact is due to the important increase of the OPEX cost.

However, even in this case the Solution #118 has a positive result and that the payback period is remaining 2021.

#### At an ECAC Level

<table>
<thead>
<tr>
<th></th>
<th>EAP Function</th>
<th>EAP Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payback period</td>
<td>2021</td>
<td>2021</td>
</tr>
<tr>
<td>ROI</td>
<td>4.64</td>
<td>1.74</td>
</tr>
<tr>
<td>NPV</td>
<td>220 132 253 euros</td>
<td>169 811 954 euros</td>
</tr>
</tbody>
</table>

These results are showing that the assumption on the EAP role is impacting highly the results of the CBA. Indeed, the scenario analysed in the sensitivity analysis has underlined a decrease of the return on investment of the solution of 63% and a decrease of net present value of 23%. This highly negative impact is due to the important increase of the OPEX cost.

However, even in this case the Solution #118 has a positive result and that the payback period is remaining 2021.
8.3 ATCO productivity increase

The ATCO productivity element of the benefit model has been chosen for the sensitivity analysis because it impacts both the ANSP and the AU monetized benefits. To analyse the impact of this assumption on the benefits it has been chosen to set the ATCO productivity increase to 1% instead of 2%. The results are presented in the following tables:

At a Local Level:

<table>
<thead>
<tr>
<th></th>
<th>2% Productivity Increase</th>
<th>1% Productivity Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payback period</td>
<td>2021</td>
<td>2021</td>
</tr>
<tr>
<td>ROI</td>
<td>4,99</td>
<td>2,28</td>
</tr>
<tr>
<td>NPV</td>
<td>20 377 392 euros</td>
<td>9 318 424 euros</td>
</tr>
</tbody>
</table>

These results are showing that the assumption on the ATCO productivity increase is impacting highly the results of the CBA. Indeed, the scenario analysed in the sensitivity analysis has underlined a decrease of 54% for both the return on investment and net present value of the Solution #118. It underlines that this assumption is the most impacting one on the NPV.

At an ECAC Level

<table>
<thead>
<tr>
<th></th>
<th>2% Productivity Increase</th>
<th>1% Productivity Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payback period</td>
<td>2021</td>
<td>2021</td>
</tr>
<tr>
<td>ROI</td>
<td>4,64</td>
<td>2,08</td>
</tr>
<tr>
<td>NPV</td>
<td>220 132 253 euros</td>
<td>98 820 139 euros</td>
</tr>
</tbody>
</table>

These results are showing that the assumption on the ATCO productivity increase is impacting highly the results of the CBA. Indeed, the scenario analysed in the sensitivity analysis has underlined a decrease of 55% for both the return on investment and net present value of the Solution #118. It underlines that this assumption is the most impacting one on the NPV.
9 Recommendations and next steps

This CBA report has provided positive results and return on investment for both the base scenario and the three sensitivity analysis.

However, it has to be taken into account that the CBA results are based on the VALR live trial which consisted on a two-week long exercise only, with a limited list of KPA/KPI investigated.

It would be therefore recommended to evaluate additional indicators in order to obtain metrics that would allow integrating new benefits or costs for the Basic EAP function for the different stakeholders (e.g., if relevant, Fuel burn, Airspace capacity, human performance...).
10 References and Applicable Documents

10.1 Applicable Documents


[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)


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


[10]SESAR Solution#118 – SPR/INTEROP/ISED V3 – Basic EAP - Part I Edition 01.00.01, 15/05/2018

[11]SESAR Solution#118 – SPR/INTEROP/ISED V3 - Basic EAP - Part IV - HPAR Edition 01.00.01, 15/05/2018

[12]SESAR Solution#118 – SPR/INTEROP/ISED V3 - Basic EAP - Part V - PAR- Edition 01.00.01, 15/05/2018

[13]SESAR Solution #118 Final VALR V3 - Edition 01.00.00, 28/02/2018

[14]04.07.08 - D78 - Validation Report VP-687, Edition 00.01.02, 23/03/2016

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[17]EUROCONTROL Standard input for CBA

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[23] EUROCONTROL Seven-Year Forecast – February 2017, Flight Movements and Service Units 2017-2023, STATFOR Team, Edition 17/01/02-100


[26] PRR 2015 - Performance Review Report, An Assessment of Air traffic Management in Europe during the Calendar Year 2015

[27] PRR 2016 - Performance Review Report, An Assessment of Air traffic Management in Europe during the Calendar Year 2016, June 2017
11 Appendix

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

<table>
<thead>
<tr>
<th>ATM Master Plan SESAR Performance Ambition KPA</th>
<th>Performance Framework KPA</th>
<th>Focus Area</th>
<th>KPI definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost efficiency</td>
<td>Cost efficiency</td>
<td>ANS Cost efficiency</td>
<td>CEF2 Flights per ATCO hour on duty</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CEF3 Technology Cost per flight</td>
</tr>
<tr>
<td>Capacity</td>
<td>PA7 - System able to handle 80-100% more traffic</td>
<td>Capacity</td>
<td>CAP1 TMA throughput, in challenging airspace, per unit time</td>
</tr>
<tr>
<td></td>
<td>PA6 - 5-10% additional flights at congested airports</td>
<td></td>
<td>CAP2 En-Route throughput, in challenging airspace, per unit time</td>
</tr>
<tr>
<td></td>
<td>PA4 - 10-30% reduction in departure delays</td>
<td>Capacity resilience</td>
<td>&lt;RES1&gt; % Loss of airport capacity avoided</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;RES2&gt; % Loss of airspace capacity avoided</td>
</tr>
<tr>
<td>Operational Efficiency</td>
<td>Predictability and punctuality</td>
<td>Departure punctuality</td>
<td>PUN1 % of Flights departing (Actual Off-Block Time) within +/- 3 minutes of Scheduled Off-Block Time after accounting for ATM and weather related delay causes</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>PRD1 Variance of differences between actual and flight plan or Reference Business Trajectory (RBT) durations</td>
</tr>
<tr>
<td>ATM Master Plan SESAR Performance Ambition KPA</td>
<td>ATM Master Plan SESAR Performance Ambition KPI</td>
<td>Performance Framework KPA</td>
<td>Focus Area</td>
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<td></td>
<td>PA2 - 3-6% reduction in flight time</td>
<td>Environment</td>
<td>Fuel efficiency</td>
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<td>PA3 - 5-10% reduction in fuel burn</td>
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<tr>
<td>Environment</td>
<td>PA8 - 5-10% reduction in CO2 emissions</td>
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<tr>
<td>Safety</td>
<td>PA9 - Safety improvement by a factor 3-4</td>
<td>Safety</td>
<td>Accidents/incidents with ATM contribution</td>
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<tr>
<td>Security</td>
<td>PA10 - No increase in ATM related security incidents resulting in traffic disruptions</td>
<td>Security</td>
<td>Self- Protection of the ATM System / Collaborative Support</td>
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</tbody>
</table>

[28] Table 10: Mapping between ATM Master Plan Performance Ambition KPAs and SESAR 2020 Performance Framework KPAs, Focus Areas and KPIs