SESAR JOINT UNDERTAKING

PROPOSAL ON THE CONTENT OF A PILOT COMMON PROJECT

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In response to the mandate received from the European Commission on 2 August 2012, this document contains the SESAR Joint Undertaking's proposal for a Pilot Common Project (PCP) and outlines the main steps and drivers to move from the implementation view in the ATM Master plan to a business view identifying the main deployment requirements.

SUMMARY OF CONTENTS

EXECUTIVE SUMMARY

In response to the mandate received from the European Commission ("the Commission") on 2 August 2012, this document contains the SESAR Joint Undertaking's proposal for a Pilot Common Project (PCP) and outlines the main steps and drivers to move from the implementation view in the ATM Master plan to a business view identifying the main deployment requirements.

Content of the proposal

This PCP proposal combines coherent technological improvements aiming to enhance the performance of the European Air Traffic Management system in the short to medium term. It builds on the Interim Deployment Programme and focuses on technological improvements that are mature enough to start deployment in 2014-2020 and require a synchronised implementation among the key investors and in particular Air Navigation Service Providers (ANSPs), Airspace Users, Military, Network Manager, Airports and Meteorological (MET) Service Providers. It also fosters the implementation of key ground-ground and air-ground infrastructural building blocks for future Common Projects while leveraging to the greatest extent possible and further building upon the present aircraft capabilities, thereby delivering early benefits whilst keeping additional investment requirements under strict control.

The technological deployments proposed constitute a balanced and coherent set of six "ATM Functionalities" (AFs), as per the Commission's draft implementing Regulation on common projects[1], consisting in logical groupings of essential operational / technical changes identified in the European ATM Master Plan. They address ATM deficiencies and required performance improvements including safety, in all flight segments, at en route, approach / terminal and also airport levels. In an optimal scenario, the six AFs should be implemented as a package, achieving maximum benefits within the set time frame as described in the Cost Benefit Analysis (CBA), and should also ensure a well-reasoned transition towards the next common projects and deployment decisions.

A global positive Cost Benefit Analysis

The proposed ATM functionalities show an overall positive CBA. Together they bring substantial and measurable performance improvements and also pave the way towards building the ATM infrastructure of the future. The ATM functionalities proposed in this PCP are a first selection from the larger list of essential operational changes defined as Step 1 in the European ATM Master Plan. They were selected for their technological, operational and economical maturity for implementation, their significant contribution to performance, and the added value of their synchronised deployment. Some are mere initial steps towards more advanced technological solutions that will deliver more performance improvements. Such is the case of the Trajectory Exchange, a first step towards the implementation of the i4D trajectory concept.

These first initiatives of the PCP towards common standardised and interoperable infrastructure should be followed by adequate deployment decisions in the future common projects. This would allow for an effective and efficient deployment of these ATM functionalities, unleashing their full potential in terms of benefits to the network.

The Commission is therefore invited to use the proposals of this PCP, not only for short-term deployment decisions, but also as a stepping stone for the future common projects or any other deployment related activities.

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[1] Draft Commission implementing Regulation "on the definition of common projects, the establishment of governance and the identification of incentives supporting the implementation of the European Air Traffic Management Master Plan", which received a positive opinion from the Single Sky Committee in its 49th meeting on 7 March 2013

Proposal on the content of a Pilot Common Project

To facilitate the Commission's decision-making and the future wok of the Deployment Manager, the selected ATM functionalities are also presented in a way which allows for independent assessment. They are proposed with their separate CBA/impact assessment with details per stakeholder category, performance improvement evaluation, geographical scope definition, timing, and as appropriate, recommendations with regards to standardisation and regulatory actions. The components of the PCP proposal aiming at building the foundations for the ATM infrastructure of the future, seen in isolation and in the time span of the pilot common project, show an initial negative business case. However, their relevance is strong and their deployment is recommended as they are indispensable to enable other components of the proposal as well as future Common Projects. Negative CBAs were also identified for some categories of stakeholders due to the nature of their business model.

For these reasons the proposal includes an assessment of the potential risks that would hinder the implementation of the PCP and recommends appropriate mitigation measures, such as incentive mechanisms, in particular to address specific local/individual negative business cases.

Finally, the high level definition of the deployment architecture was not fully addressed as part of this mandate and decision to choose between, "local", "non-local" or centralised deployment and operations of some of the ATM functionalities would probably have an impact on their cost-benefit analyses. This will be further addressed as part of the extension to this mandate and as part of the initiation sequence of the deployment.

A performance driven content definition

Overall, the PCP proposal aims to achieve the following performance improvements:

- An improved predictability of the ATM system through enhanced exchange of planning and execution data between all ATM stakeholders;
- Optimised arrival trajectories including the reduction of airborne holdings at congested airports through the introduction of Extended Arrival Management (Extended-AMAN) and Performance Based Navigation (PBN), supported by enhanced navigation capability and air traffic control tools. This is combined with investments at the airports to improve throughput, reduce delays and improve safety for surface movements;
- An improvement of fuel efficiency and emissions in the en route segments of flights through the network-wide introduction of Free Route at Network level supported by the upgrade of flight processing systems and based on enhancements of European En-route Air Traffic Centres;
- Enhanced demand/capacity balancing at Network Level through the implementation of new capabilities for the Network Manager to work in a collaborative manner with all ATM stakeholders, resulting in significant delay reduction;
- A commensurate improvement of the "passenger experience", meaning a better quality of service provided in terms of punctuality, safety and sustainability of the flights;
- Building the foundation for the ATM infrastructure of the future, through:

  1. Laying down the technological foundation of an ATM information management system to rationalise the ground-ground ATM system architecture in order to foster potential efficiency improvements by the ANSPs.

2. Laying down the foundation for an exchange of trajectory between aircraft and ground systems to achieve gradual enhancements in air-ground integration which is core to the SESAR concept of operations.

The human dimension and the need to carefully manage the changes generated by the implementation of the various components of this PCP are fully acknowledged and taken into account in the deployment schedules proposed. This dimension should also be considered by the Deployment Manager when setting up the implementation projects.

A proposal for an incremental approach

This PCP proposal constitutes the first materialisation of the notion of common project described in Article 15a paragraph 1 of the amended service provision Regulation adopted by the European Parliament and the Council on 21 October 2009[2]. It will be used as input to support the preparation of a call for interest for the selection of the Deployment Manager (Level 2), as well as the implementation projects (Level 3). It therefore breaks new grounds and, with the expectation that it will be favourably received by the Commission, Member States and aviation stakeholders, may set a standard and pave the way for the future common projects.

For these reasons the underlying philosophy of the proposal is to be both ambitious so as to make a real difference against a “business as usual” approach, and realistic in the sense that it minimises the risk of identifying changes that are not mature enough to deliver significant benefits when implemented.

This balanced approach, which builds on the deployment baseline capabilities, is fully in line with the incremental steps defined within ICAO’s Global Air Navigation Plan and the notion of Aviation System Blocks Upgrades.

This proposal is therefore expected to open the series of common projects with a success, giving a positive signal for a sustainable and performance-driven SESAR deployment.

[2] Regulation (EC) No 1070/2009 of 21 October 2009, published on 14 November 2009, OJEU L300/34

1 INTRODUCTION

1.1 Purpose of the pilot common project

In accordance with the mandate received from the Commission on 2 August 2012, this document contains the proposal of the SESAR Joint Undertaking (SJU) for a PCP.

This PCP is the first materialisation of the setting up of the governance of SESAR deployment, aiming to coordinate and synchronise the implementation of the most relevant ATM functionalities developed by SESAR, moving from the implementation view of the European ATM Master Plan to a business view.

It aims to propose the coordinated and synchronised deployment of six selected "ATM functionalities" (AFs).

This first common project is of specific importance as it will:

- serve as a basis for launching SESAR deployment;
- paves the way to the future common projects, and
- be used to support a call for interest for the selection of the Deployment Manager referred to in Article 9 of the draft implementing Regulation on "*the definition of common projects, the establishment of governance and the identification of incentives supporting the implementation of the European Air Traffic Management Master plan*".

For these reasons, the proposal is presented in a way to: firstly, facilitate the Commission's assessment and adoption of the proposal and, secondly, efficiently frame the work of the future Deployment Manager:

- Chapter 2 describes the approach to the proposal and in particular the respect of the assessment criteria and the involvement of stakeholders in all phases and at all levels of the work, as requested in the mandate. It also explains how, among the Essential Step 1 operational changes outlined in the European ATM Master Plan, "candidates" are gradually identified, selected, grouped with Technology Changes and assembled into ATM functionalities (AFs). This materialises the subsequent transfer from the implementation view of the European ATM Master Plan to a business view facilitating investment decision as well as traceability. This approach also aims to facilitate future work of the Deployment Manager.
- In addition, this Chapter maps the "candidates" with the essential operational changes identified in the European ATM Master Plan, establishes the links with ICAO's ASBUS and highlights potential prerequisites and risks with the Deployment Baseline covered in the Interim Deployment Programme (IDP).
- Chapter 3 contains the summary of the global cost-benefit analysis, demonstrating the overall added value of the "package" contained in the proposal. The full CBA, performed by an external and independent consultant, is to be found in Appendix C of this proposal. Individual CBAs for each AFs are to be found in Chapter 5.
- Chapter 4 describes the conditions for successful deployment and identifies the incentive schemes needed to support the timely and synchronised deployment of the PCP proposal.
- Chapter 5 contains the detailed description of each ATM Functionality (AF) broken down as follows:
    - Description of the AF ("What": Technological changes / enablers and "why": the performance gains / the maturity / the network impact, etc…)

- Geographical scope of implementation and associated time frames: "Where" and "Who" (geographical scope / stakeholders - entities concerned) and "When" (synchronisation planning with identification of sub scenarios as appropriate to differentiate the stakeholder categories and description of start / end of deployment and start of benefit / full benefit achieved). Further details with regards to the geographical scope can be found in Appendix D.
- Identification of possible regulatory and standardisation needs. Further details with regards to the regulatory and standardization needs can be found in Appendix E.
- Alignment with safety requirements.
- Cost-Benefit Analysis, with differentiation per stakeholder category.

- Chapter 6 contains a table recapitulating the high-priority risks identified.
- Chapter 7 describes the next steps and proposed Commission actions.

As requested by the Commission, the detailed methodology followed, lessons learned, recommendations for the next common projects and recommendations on R&D needs are provided in a separate document.

1.2 Background

SESAR (the Single European Sky ATM Research programme) is the technological pillar of the SES II package. All five SES pillars[3] jointly contribute to achieving "*more sustainable and performing European aviation*"[4] whilst enhancing safety.

The European ATM Master Plan[5] constitutes the roadmap agreed by all stakeholders to bring the operational and technological changes developed and validated by SESAR to their successful deployment / implementation phase.

Deployment of ATM system changes (for simplicity, in this document reference to "technology" shall cover both operational and technological changes) is to be performance-driven and substantiated by robust Cost-Benefit Analyses. In other words, ATM system changes shall be deployed only if and when they bring demonstrated benefits substantially exceeding their implementation costs.

On 30 March 2009, the Council of Ministers of the European Union adopted a Resolution requesting the Commission to present "*precise proposals* (…) *for the preparation and transition to the SESAR deployment phase emphasising its governance and its adequate and, if appropriate, for some stakeholders, innovative funding mechanisms*".

Accordingly, the Commission initiated reflection and consultation on the issue, resulting in a Commission communication in December 2011 and "DG MOVE orientations" on 9 July 2012, initiating formal discussions between the Commission and Member States, as well as stakeholders, on draft Guidance material on common projects and the governance of SESAR deployment. After consultation, further discussion with stakeholders and the Single Sky Committee and a number of adjustments to the proposal, an agreement was secured and the draft implementing Regulation on "*the definition of common projects, the establishment of governance and the identification of*

[3] The other four pillars are: the Legislative pillar (a set of four basic Regulations completed by Commission implementing Regulations, including notably the performance scheme, a strengthening of Functional Airspace Blocks (FAB), as well as a central network management function fostering an increased efficiency of the network), the safety pillar (the extension of EASA competences to ATM and airports), the airport pillar (with the observatory on airport capacity) and the human factor pillar, also defined as the overarching pillar taking into account the human dimension of the SES initiative

[4] Communication from the Commission to the EP, the Council, the EESC and the Committee of Regions on SES II (COM(2008) 389/2 of 25 June 2008)

[5] Edition 2012 released in October 2012

incentives supporting the implementation of the European Air Traffic Management Master plan" received a positive opinion from the Single Sky Committee on 7 March 2013, allowing formal adoption by the Commission and publication in the Official Journal of the European Union. Such adoption will strengthen the entire common project concept and provide a firm basis for the present proposal.

Common projects are the main vehicle to drive a timely, synchronised and cost-efficient deployment of the essential operational changes identified in the European ATM Master Plan that will bring substantial performance improvement to the European network.

In order to initiate a first concrete operation of deployment of relevant SESAR technology without further ado and thus enable the selection of a Deployment Manager, the Commission mandated on 2 August 2012 the SESAR Joint Undertaking to draft "*a proposal on the content of a pilot common project"*.

1.3 Legal basis

Common projects are based on:

- Recitals 7 and 8 of Regulation (EC) No 1070/2009 of the European Parliament and of the Council of 21 October 2009, amending the four basic Regulations[6] of the SES I package and constituting the basis for the SES II package.
- Article 15a of Regulation (EC) No 550/2004 of the European Parliament and of the Council on the provision of air navigation services in the Single European Sky (the service provision Regulation).
- The PCP is based more specifically on Paragraph 1 of this Article (to "*assist the successful implementation of the ATM Master Plan*" and "*improve the performance of the European aviation system*").

Common projects are referred to in:

- Article 11.3 (c), Annex II Point 2 and Annex IV Point 1(e) of the draft Commission Regulation laying down a performance scheme for air navigation services and network functions (the performance Regulation), repealing Commission Regulation (EU) No 691/2010, which received a positive opinion from the Single Sky Committee on 8 March 2013;
- Articles 6.4, 16.2, Annex II and Annex VII of the draft Commission Regulation laying down a common charging scheme for air navigation services (the charging Regulation), repealing Commission Regulation (EC) No 1794/2006, which received a positive opinion from the Single Sky Committee on 8 March 2013;

Common projects are detailed in the draft implementing Regulation on "the definition of common projects, the establishment of governance and the identification of incentives supporting the implementation of the European Air Traffic Management Master plan", which received a positive opinion from the Single Sky Committee on 7 March 2013 (hereafter referred to as "the Regulation on common projects").

1.4 Organisation of work

In line with the mandate received from the Commission, the SESAR JU ensured "the involvement of the relevant stakeholders, and also liaised with EASA, PRB, Staff Associations and the military". Involvement was secured at all working levels, and maximum levels of transparency were ensured in all phases of work:

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[6] The framework Regulation (EC) No 549/2004, the service provision Regulation (EC No 550/2004), the airspace Regulation (EC No 551/2004), the interoperability Regulation (EC No 552/2004)

- The Steering Group (SG), supporting the SJU in executing the mandate and supervising the execution of the technical work, was composed of one representative per stakeholder category (Network Manager, airspace users, air navigation service providers, airports, ground industry, airborne industry and military - EDA).
- The Support & Validation Office (S&VO), providing the secretarial, administrative and technical assistance required for the execution of the mandate benefited from the assistance of EUROCONTROL/DSS experts, including in the performance review and civil-military units.
- The Expert Groups (EGs), which provided the content required for the technological and/or operational changes, were chaired in a balanced way by stakeholders and Network Manager representatives. All stakeholder categories were represented in each Expert Group, to secure the buy-in of the results of the work. More than 70 experts, nominated by all stakeholder categories, participated in this task.

In addition, permanent coordination and frequent bilateral meetings were organised by the Chairman of the PCP Steering Group with the military and all stakeholder categories not directly involved in the work (EASA, staff associations) as well as the Commission and EUROCONTROL. These meetings aimed to keep all interested parties informed on the progress of the work, collect feedback so as to reorient / refocus work where and when necessary, and more generally to ensure that all stakeholders were able to contribute to the elaboration of the proposal.

This permanent coordination was organised as follows:

- **With the military:**

  Because of its large variety of missions for homeland security, training purposes as well as cross-border operations (such as recent operations in Libya and Mali) the military have a vital need to have access to airspace at very short notice. The military is therefore a key stakeholder for the success of the PCP proposal. The European Defence Agency (EDA) joined the PCP Steering Group as representative of the military needs and interests. Out of the six AFs, AFs # 3, (Flexible Airspace Management and Free Route), 4 (Network Collaborative Management) and 5 (iSWIM) are identified as being of specific importance for the military.

  In this context, EDA first conducted several meetings with the Member States to better define what contribution the military could bring to the PCP process. With the support of national and EUROCONTROL/DSS experts, the Agency subsequently kept the Member States informed through dedicated communications to report on the progress of work and proposing actions when necessary, such as during the Cost Benefit Analysis. The SESAR JU and EDA organised an information session for Member States and NATO for them to get a deeper knowledge of the PCP process, the content of the AFs and the way forward. Information was also provided to non-EU States and international organisations through the Military ATM Board (MAB/11 and MAB/12) and the SES/SESAR Military Implementation Forum.

- **With EASA:**

  Continuous contact has been maintained with EASA and two working sessions were held with the Agency in order to obtain its input in three main fields:

  1. The determination of regulatory and standardisation needs, their alignment with the EASA Rulemaking Plan and the feasibility of the dates foreseen for the availability of related norms.

2. The analysis, from an Authority point of view, of the technical documentation describing the PCP.
3. The assessment of the tools developed by the SJU to obtain from the different Expert Groups the relevant information on the status of the Safety Assessment Reports, and the correlation of these documents with the relevant applicable regulations (namely Regulation No 1034/2011 and Regulation No 1035/2011).

In close cooperation with the SJU and under the Letter of Agreement between the two entities, EASA will continue reviewing the different Safety Assessment Reports associated to the PCP as they are finalised by the projects.

These regulatory and standardisation needs affect the technical and operational aspects of PCP. These needs are captured in the impact assessment of each individual ATM functionality, and more details, including expected dates of availability, can be found in Appendix E.

- **With Staff associations:**

  Five professional staff associations are involved in SESAR work packages under an SJU Professional Staff Framework contract. These associations are IFATCA, IFATSEA, ECA, ATCEUC and ETF and represent the full spectrum of European and global pilots, controllers and air traffic engineers. An informal consultation of the staff on the PCP has been organised in the framework of this contract, using regular staff meetings at quarterly intervals to discuss issues and SESAR progress. The following milestones can be noted:

  - First presentation of draft scope of PCP at the staff quarterly meeting
  - Presentation of the updated scope and discussion at a dedicated meeting.
  - Receipt of staff written comments.

  The overall feedback from the staff has been open and constructive and no ‘red flags’ have been raised so far. Some of the detailed operational comments have been useful in refining the documentation. In general, they report that the logic of the PCP work is sound and the documentation provides a good description of what is to be expected. However, some risk areas were also identified. These can be summarised into the four following categories:

  - Transition (Training, parallel operations, staffing)
  - New roles, tasks, tools (Regulatory requirements, technical requirements, training requirements)
  - Financial provisions (Transition and new roles and tasks)
  - Acceptance by operational staff (It has been identified that, if new tools or procedures are being implemented in current operations, there is a need to address the change).

  On a more general note, other issues related to the identification of the baseline for a synchronised or a-synchronised deployment have been flagged, in particular on regulatory issues, airborne equipment, forward-fitting of airborne and ground infrastructure.

- **With the broader stakeholder community:**

  The SESAR Operational Performance Partnership (SPP) was used as a single forum for consensus-driven coordination for the broader stakeholder community.

Interests from the following stakeholders are represented at the SPP: civil airspace users (AEA, IATA, ELFAA, ERA, IACA, EBAA, and IAOPA), ANSPs (CANSO), airports (ACI), staff associations (IFATCA, IFATSEA, and ECA) and the military.

In order to provide maximum level of transparency throughout PCP activities, the SPP working arrangements were strengthened through the doubling of plenary meetings frequency and monthly briefing sessions.

A wide range of constructive improvement recommendations were collected from SPP members and taken into consideration in the elaboration of the PCP proposal.

This organisation of work and permanent coordination allowed stakeholders to maximise their involvement in the elaboration of the present proposal. It has to be understood as a way to secure the buy-in of those stakeholders and to de-risk the subsequent formal consultation.

2 APPROACH TO THE PROPOSAL

2.1 Assessment criteria

Work was driven by the key elements of the Commission's draft implementing Regulation on common projects, and in particular Article 4:

- The general aim of common project is "to deploy in a timely, coordinated and synchronised way ATM functionalities that will achieve the essential operational changes".
- Common projects have a strong link with the performance scheme. As the Commission repeatedly made the point, deployment must be performance-driven and common projects are to "be consistent with and contribute to the European Union- wide performance targets".
- Maturity: The ATM functionalities proposed for deployment should have "reached the appropriate level of industrialisation" and be "mature for implementation". Furthermore, "The maturity of ATM functionalities shall be demonstrated, inter alia on the basis of the results of validation carried out by the SESAR Joint Undertaking, the status of standardisation and certification processes and an assessment of their interoperability, also in relation to the ICAO Global Air Navigation Plan and relevant ICAO material".
- Synchronisation: Common project should propose ATM functionalities that require synchronised deployment. This is to be assessed on the basis of:

  "(a) a definition of their geographical scope and planning, including deployment target dates;

  (b) an identification of the operational stakeholders required to deploy them;

  (c) transitional measures for their progressive deployment."
- a positive business case: "based on an independent cost-benefit analysis, and identify(ing) any potential local or regional negative impact for any specific category of operational stakeholders";

In addition, common projects should:

- *"(b) identify incentives for deployment, referred to in Section 3 of Chapter III, in particular to mitigate negative impacts on a specific geographical area or category of operational stakeholders" (according to Article 13 in this Section 3 of Chapter III, incentives include Union funding);*
- *(c) refer to the implementing rules for interoperability and safety under Regulation (EC) No 552/2004 of the European Parliament and of the Council8 and Regulation (EC) No 216/2008 of the European Parliament and of the Council9. In particular, reference shall be made to Community specifications under Regulation (EC) No 552/2004 of the European Parliament and of the Council and to acceptable means of compliance and certification specifications under Regulation (EC) No 216/2008 of the European Parliament and of the Council;*
- *(d) identify any need for new implementing rules for interoperability and safety, Community specifications and civil standards to support their deployment and their applicability to the military taking into consideration civil and military systems' equivalence; and*
- *(e) take account of the relevant deployment elements specified in the Network Strategy Plan and the Network Operations Plan of the Network Manager."*

2.2 Selecting the "candidates": from an open approach to a robust and concise list of Essentials extracted from Step 1 of the European ATM Master Plan

2.2.1 Focus on performance, need for synchronised deployment and maturity

In full compliance with the criteria contained in the draft Commission implementing Regulation on common projects and the mandate given to the SESAR JU, the package of Essentials selected from the European ATM Master Plan's Operational Focus Areas (OFAs) or groupings of OFAs, constitute a coherent and balanced set of mature ATM functionalities (i.e. within SESAR releases 1 to 4), aiming to improve global network performance and safety within the next decade. One of the key drivers of the work was to identify and select candidates with IOC dates within 2014 and 2020, corresponding to the second performance reference period (RP2).

Further selection was made on the basis of functionalities that require synchronised deployment. For this reason, functionalities, that may be both mature and delivering performance, were left out of the proposal because their deployment does not require synchronisation and pertains mainly to local investment decisions. Furthermore, the PCP does not aim to describe all the deployment needs for the next five years in an exhaustive manner, only the activities matching the PCP mandate criteria and in particular the need for synchronisation were considered.

Another criterion was the reference to European ATM Master Plan Step 1 Essentials as "the ATM master plan shall be the key SES instrument for the seamless operation of the EATMN and the timely, coordinated and synchronised SESAR deployment" (Article 3 of draft implementing Regulation on Common Projects).

2.2.2 An incremental approach

The approach to the work was as follows:

1 Top-down approach by stakeholder category,

2 Application of implementing rule's assessment criteria,

3 Gradual rejection of candidates / essentials not complying with cumulative criteria,

4 High-level grouping of the remaining Essentials,

5 Rejection of Essentials where no performance gains were validated yet or with IOC date beyond the PCP time window

This approach and its results are described in further detail in the following paragraphs.

As a starting point, each stakeholder category representative was invited to adopt a top-down approach and take a fresh look at what they would deem important to integrate in the PCP. This first exercise resulted in a preliminary list of 34 potential "candidates". The list was brought down to 30 after removal of pure enablers and logical aggregation of several sub-proposals.

Applying the draft implementing rule's assessment criteria, several iterations and discussions then allowed the PCP Steering Group to achieve a gradual selection of the candidates. The following steps where implemented in a chronological way:

- Assessment of expected performance gains, this being understood as identifying:
    - High potential resulting from a positive CBA, including safety aspects;

- Successful deployment implying benefit transfer to the airspace users ;
- Maximisation of SESAR contribution to RP2 performance targets;
- Possibilities to make optimal use of existing modern aircraft capabilities;
- Specific benefits in terms of fuel efficiency, quality of service and ANS cost-efficiency;
- Solutions to identified network performance deficiencies;
- Provision of short term network performance benefits in support of Step 1.

- Assessment of the need for synchronisation of deployment, meaning:
  - Building on existing mandates (e.g. Datalink);
  - Bringing solutions leading to standardisation and further automation;
  - Preparing infrastructure for the future;
  - Identifying the need for synchronisation of the different operational investors;
  - Identifying the existence of a high potential for optimisation through synchronisation.
- Verification of the link of the candidates with the European ATM Master Plan Essentials.

This task led to the gradual rejection of twelve candidates / essentials that did not comply with these cumulative criteria, as follows:

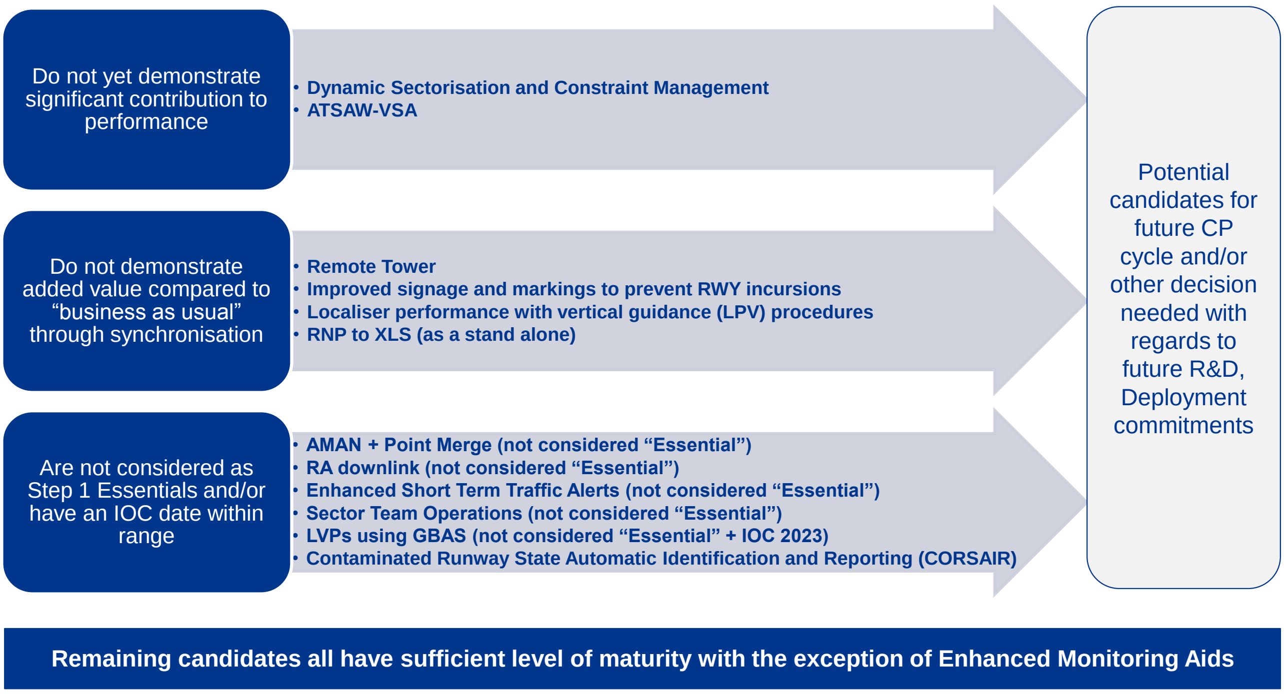


Figure 1: Candidates not complying with selection criteria

Following this step, the SJU then referred to the European ATM Master Plan to carry out a high-level grouping of the remaining Essentials, and finally applied the maturity criterion, which was interpreted as follows:

- Tangible results need to be demonstrated from validation exercises, taking into account SESAR releases 1 & 2 results together with the most up to date plans for Releases 3 and 4.
- Reliable deadlines must be identified in terms of materialising the benefits based on confirmed maturity (end of V3) and IOC target dates (including industrialisation), as per European ATM Master Plan Step 1 Essentials to be acknowledged as being within the 2014-2020 (mainly corresponding to the time frame of RP2).
- Selected Essentials must allow for an incremental approach, considering the deployment baseline prerequisites for the Step 1 selected priorities.

In this process, two more Essentials were removed (A-CCD because of its probable transfer to SESAR Step 2 and enhanced monitoring aids because of the poor general quality of the case in relation to the other topics).

On the other hand, a number of good Essentials were identified as promising but were rejected because either performance gains were not yet validated in a sufficiently robust manner or their IOC date was beyond the PCP time window. They should however be considered as first contenders for the next Common Project:

- i4D + CTO/CTA for all flights (building on the “CTOT and TTA” candidate and paving the way towards 4D trajectory) ;
- Dynamic sectorisation and constraint management;
- Sector Team Operations (currently not identified as an “essential” in the European ATM Master Plan);
- Improved surface management.

The table below shows the result of this incremental approach and highlights how the PCP Essentials were identified, selected and extracted from the list of European ATM Master Plan step 1 Essentials:

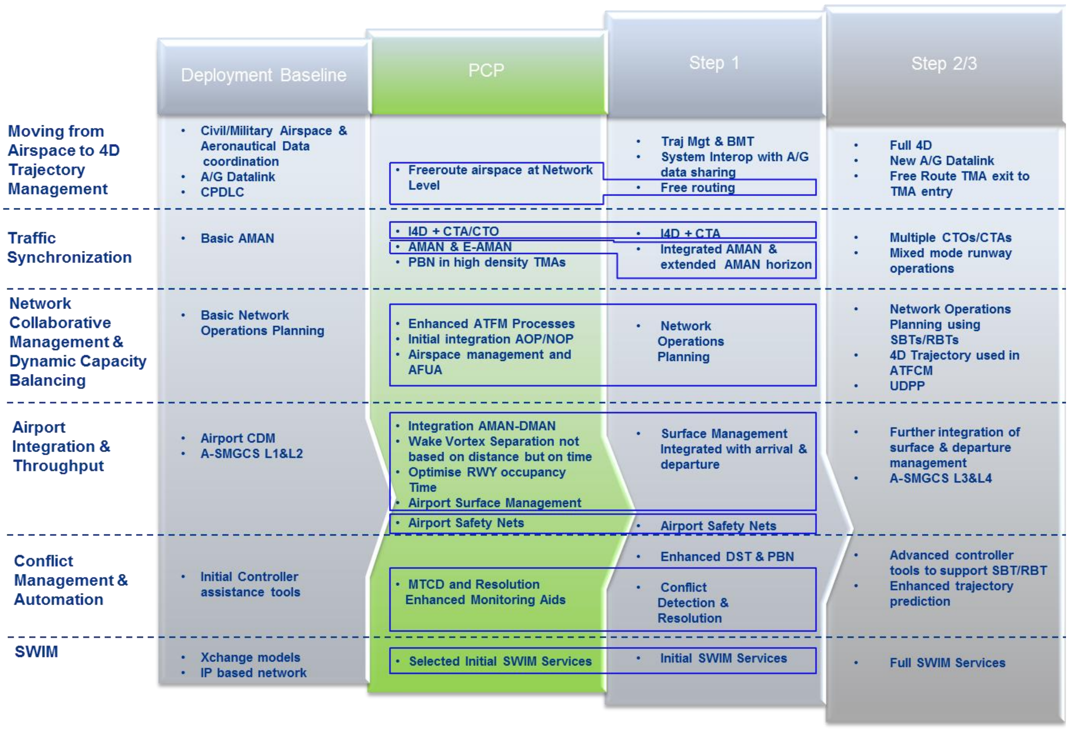


Figure 2: PCP scope in relation to Essential Operational Changes identified in the European ATM Master Plan

This process highlights how the PCP content was defined, but also allows the identification of those essential operational improvements that should be considered as priorities for the next deployment decisions building on an incremental approach of common projects. This should be prolonged as well by an ongoing incremental approach to monitor and confirm the maturity of the PCP solutions. The PCP implementation progress should be reviewed every 2-3 years, and its content amended if necessary, should the assumed deployment baseline (IDP) not be available in time, the results from future validation activities in Releases 3 and 4 necessitate a change, or regulatory and standardisation needs not be resolved in time.

2.2.3 Result; list of twelve Essentials selected for the pilot common projects

As a result, the final list of twelve Essentials selected for the PCP is as follows:

- Free routing at network level
- CTOT and TTA
- Integration AMAN-DMAN
- AMAN & E-AMAN
- Initial integration AOP/NOP
- Enhanced ATFCM Processes
- Airspace management and AFUA
- Initial SWIM Services
- Wake Vortex Separation based on time
- Airport Safety Nets
- Medium Term Conflict Detection and Resolution
- PBN in high density TMAs

A description of all these essentials can be found in Appendix A. The following high-level description can be made:

Free routing at network level: Free route (FRA) operations Users may freely plan a route between a defined entry and a defined exit point with the possibility of routing via intermediate waypoints, without reference to the ATS route network, subject to airspace availability. Within this airspace, flights remain subject to air traffic control.

CTOT and TTA: Improved predictability will bring increased confidence in traffic and workload forecasts, reducing the need and magnitude of ATFCM measures. This will be achieved by moving from a pure CTOT (Calculated Take Off time) mechanism to the use of Target time of Arrival.

Integration AMAN-DMAN: The integration of AMAN and Departure MANager (DMAN) functions at a given airport is intended to improve resource planning for the turn-around time of a flight by taking into account the local constraints that can impact the arrival or the departure traffic flows therefore improving accuracy of arrival and departure times.

AMAN & E-AMAN: Extended AMAN consists of Arrival Management Extended to en route Airspace, limited to the extension of AMAN to 180-200NM and Arrivals Management including Multiple Airports.

Initial integration AOP/NOP: The linking of Airport Operating Plan (AOP)/Network Operating Plan (NOP) parameters optimises the network and airport management by timely and simultaneously updating AOP and NOP providing Network and Airport Managers with a commonly updated, consistent and accurate plan.

Enhanced ATFCM Processes: Improving the ATC-ATFCM-Airport operations interaction will improve traffic predictability and provides the cornerstone for delivering traffic flows to downstream ATC sectors in a ‘shape’ (rate, sequence, complexity) that allows best use of available resources.

Airspace management and AFUA: The enhanced en route airspace structure addresses the multiple route options, modular temporary airspace structures and reserved areas, improvements to the route network including cross-border sectorisation and the initial steps towards flexible sectorisation management.

Initial SWIM Services: SWIM will introduce a change in how information is managed throughout its lifecycle across the whole European ATM system. SWIM consists of standards, infrastructure and governance, enabling the management of ATM information and its exchange between qualified parties via interoperable services. Initial SWIM functionality (iSWIM) consists of a set of services that are delivered and consumed through IP-based network by SWIM enabled systems.

Wake Vortex Separation based on time: The application of time based wake turbulence radar separation rules on final approach (TBS) provides consistent time spacing between arriving aircraft in order to maintain runway approach capacity independently of any headwind component.

Airport Safety Nets: The ground systems detect potential conflicts/incursions involving mobiles with other mobiles or obstacles on runways, taxiways and in the apron area.

Medium Term Conflict Detection and Resolution: Conflict Detection Tools in the planning phase of the traffic are used by the Planning Controller (PC) as a first filter in identifying trajectories potentially in conflict.

PBN in high density TMAs: Performance Based Navigation (PBN) capabilities offer a greater set of routing possibilities. PBN in high density TMAs focuses on the development and implementation of fuel efficient and/or environmental friendly procedures for arrival/departure and approach.

2.3 Moving from an implementation to a business view: from European ATM Master Plan “candidates” to ATM Functionalities (AFs)

Once agreed, the Essentials extracted from the European ATM Master Plan essential requirements were transposed and grouped in a set of ATM Functionalities (AFs), as defined in Article 2(3) and further detailed in Article 4 of the draft Regulation on common projects. The aim in doing this was to move from the European ATM Master Plan implementation view to a business view, aligned with the Commission draft Regulation and facilitating investment decision-making and allowing their traceability.

The principles of this transposition are depicted in the figure below:

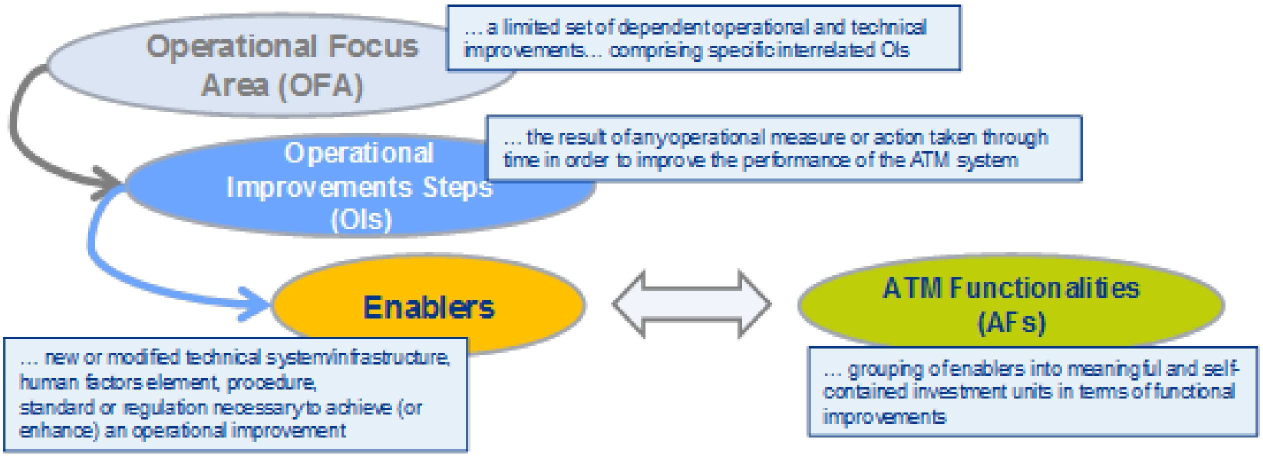


Figure 3: From the European ATM Master Plan "candidates" to ATM Functionalities

- AFs are derived from the essential operational changes of the European ATM Master Plan Level 1: they are defined as a cluster of enablers (procedural, system, …) and mapped to Operational Improvements (OIs) on the operational side;
- AFs support an investment-oriented approach to decisions on deployment;
- The grouping of enablers is based upon the commonalities and similar scope of the enablers. Particular attention is paid to multi-stakeholder synchronisation needs;
- Enablers are grouped into meaningful and self-contained investment units, in terms of bringing functional improvements.

Subsequently, the AFs contained in this proposal are:

AF # 1: Extended AMAN and PBN in high density TMAs

AF # 2: Airport Integration and Throughput Functionalities

AF # 3: Flexible Airspace Management and Free Route

AF # 4: Network Collaborative Management (Flow & NOP)

AF # 5: iSWIM: Ground-ground integration and aeronautical data management and sharing

AF # 6: Initial Trajectory Information Sharing: air-ground integration towards i4D with enhanced Flight Data Processing performances

A detailed mapping of the AFs with the European ATM Master Plan can be found in Appendix B.

2.4 Global interoperability and coherence of the PCP Essentials with ICAO's Global Air Navigation Plan and Aviation System Block Upgrades (ASBUs)

The ICAO framework is set through the Global Air Navigation Plan (Doc 9750), which comprises the "Aviation System Block Upgrades" (ASBU) initiative, developing a set of ATM solutions or upgrades that exploits current equipage, establishes a transition plan and enables global interoperability. ASBUs comprise a suite of modules organised into flexible and scalable building blocks where each module represents a specific, well bounded improvement.

The ASBU initiative describes a way to apply the concepts defined in the ICAO Global Air Traffic Management Concept (Doc 9854) with the goal of implementing regional performance improvements.

The PCP approach is fully aligned with the European ATM Master Plan and considered as 100% compatible with the "Aviation System Block Upgrades" (ASBU) initiative. The mapping between Step 1 SESAR essential operational changes considered for the PCP and ICAO's ABSU initiative is highlighted in the following figure:

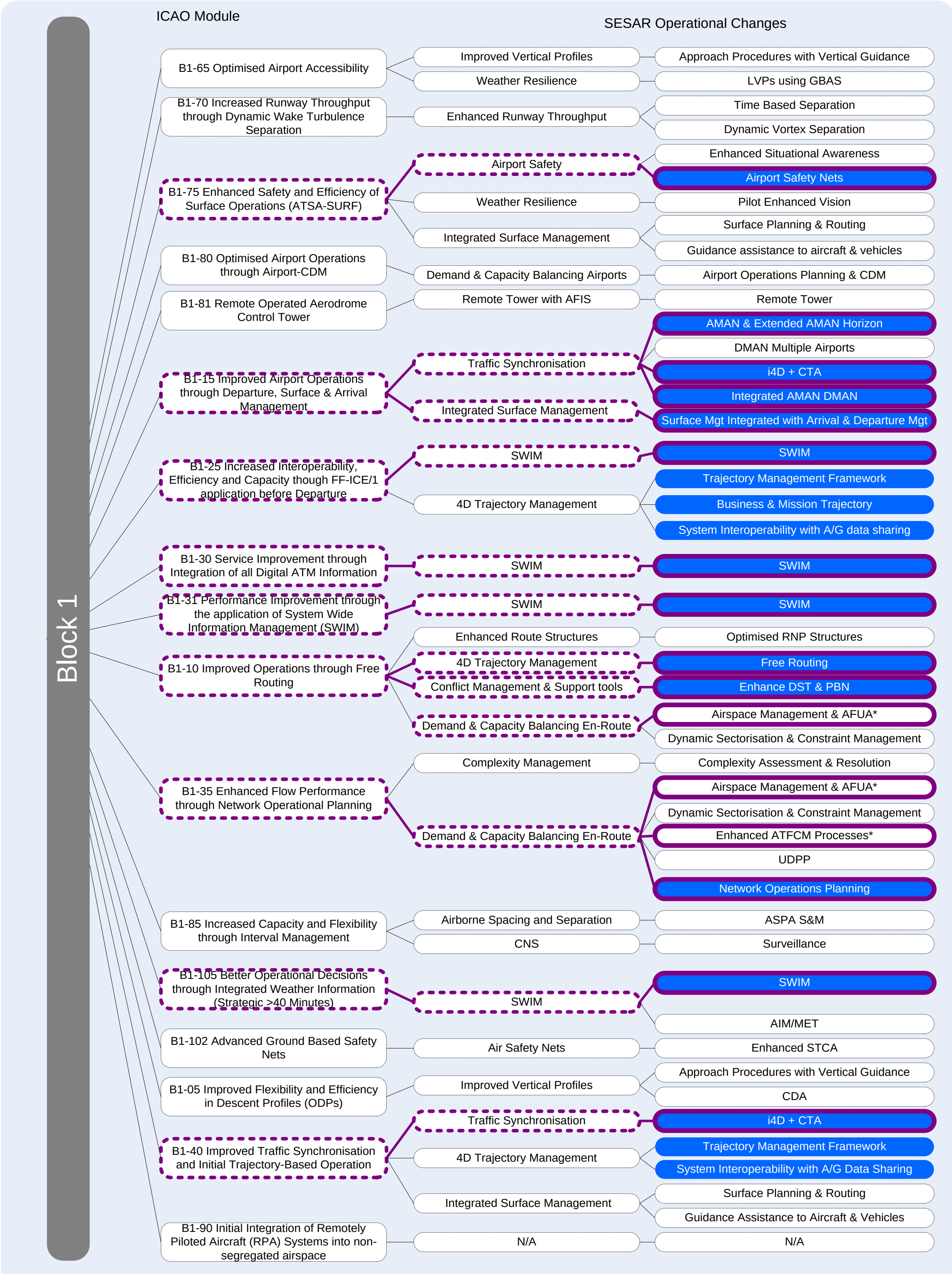


Figure 4: Mapping between Step 1 SESAR essential operational changes considered for the PCP and ICAO's ABSU initiative

2.5 Identification of the Interim Deployment Programme prerequisites conditioning a successful deployment of the ATM Functionalities of the PCP

Based on expert judgement, all the prerequisites considered essential for the successful implementation of the Deployment Baseline Scenario of the PCP were identified. The Essential prerequisites were also mapped with the Interim Deployment Programme (IDP) and the ESSIP objectives based on the latest information available in the IDP, as developed by the IDSG and the ESSIP Plan Edition 2012. The results of this analysis are presented in the table below:

ATM functionalities (AFs)	Essential Prerequisite	IDP: • Activity Areas • Work Packages (WPs) • Sub-Work Packages (sWPs)	ESSIP objectives addressing the prerequisites[7]
AF # 1 - Extended AMAN and PBN in high density TMAs	AMAN en route interface	SWP5.2.1 task 193 (2012-2018)	ATC15 (2012-2017)
AF # 2 - Airport Integration and Throughput Functionalities	A-SMGCS Level 1 A-SMGCS Level 2 Electronic Flight Strip (in relation with CWP)	None None	AOP04.1 (2007-2011) AOP04.2 (2007-2017)
	Electronic Flight Strip TBS tool	None	
AF # 4 - Network Collaborative Management (Flow & NOP)	STAM phase 1	sWP1.2 (2011-2016)	None
AF # 6 Initial Trajectory Information Sharing (towards i4D)	Commission Regulation (EC) No 29/2009 on Data link services	WP4 (2010-2018)	ITY-AGDL

Table 1: Identification of deployment baseline pre-requisites

The ATM functionalities of the PCP listed above are building on existing investments and deployment decisions, which are for most of them steered and monitored through the IDP or the ESSIP Plan.

[7] Ref. ESSIP Plan ed. 2012. New objectives will be added in the ESSIP Plan ed. 2013 and will address some of the essential prerequisites (e.g. STAM phase 1)

AF # 1 - Extended AMAN and PBN in high density TMAs

- As indicated in the IDP Execution Progress Report, AMAN Data exchange (WP5.2.1 task 193) should be deployed at FAB level in the main ANSPs by the end of 2014. However, the UK, Italy and France plan to deploy it respectively in 2015, 2017 and from 2015 to 2017.
- The ESSIP Objective ATC15 concerns the implementation in en-route operations of information exchange mechanisms, tools and procedures in support of Basic AMAN operations. The full operational capability date is 2017 and the latest status of deployment presented in the ESSIP report 2011 is green.

Due to the current planning and state of implementation of the essential prerequisite AMAN en route interface, the timely and successful deployment of AF # 1 is potentially at risk.

AF # 2 - Airport Integration and Throughput Functionalities

- Deployment of A-SMGCS level 1 (ESSIP objective AOP04.1) is currently reported as being delayed compared to the initial objective of full deployment by end 2010. However, according to the ESSIP report 2011 the objective should be fully completed by the targeted airports in 2014.
- As the implementation of A-SMGCS level 1 is a prerequisite for the implementation of A-SMGCS level 2 (ESSIP objective AOP04.2), the full operational capability date was moved to end 2017. Implementation at the main airports is either completed or planned to be implemented by the end of 2014. However, delays are currently reported for Stockholm-Arlanda, Milan-Malpensa, Rome-Fiumicino and Manchester.

It is recommended to closely monitor the deployment of A-SMGCS level 2 at these airports in order not to jeopardize parts of AF#2 deployment.

- The Electronic Flight Strip in relation with CWP and the Electronic Flight Strip TBS tool are essential prerequisites for AF#2, but they are not currently part of the IDP or the ESSIP Plan.

It is recommended to include these 2 essential prerequisites in the IDP or in the ESSIP Plan in order to better assess and monitor their deployment status.

AF # 4 - Network Collaborative Management (Flow & NOP)

- As indicated in the IDP Execution Progress Report, STAM phase 1 (WP1.2) should be deployed by the end of 2014 in a selected set of FMPs, mainly those in Europe’s “core area”. Then as from 2015 onwards, the deployment will address remaining “core area” ANSPs, FABCE ANSPs and other performance constraining areas (e.g. Spain, Greece, Cyprus, Poland etc.). States outside core European area that are not part of STAM phase 1 deployment might consider to deploy directly STAM phase 2.

AF # 6 – Initial Trajectory Information Sharing (towards i4D)

- In accordance with Commission Regulation (EC) No 29/2009, data link services should be implemented in the EU plus in the States that have signed aviation agreements with the EU. Implementation dates should be 7 February 2013 for the core area and 5 February 2015 for the rest. As indicated in the IDP Execution Progress Report, based on the bottom-up collection of data and subject to additional information to be formally reported by Member States, within the core area, the following Member States would most probably not meet the IR target date: Austria, Portugal, Spain, Italy, United Kingdom, Ireland, and France.

It is recommended to carefully monitor the implementation of Commission Regulation (EC) No 29/2009 as it is an essential prerequisite for the successful deployment of AF # 6. In case of any significant delay in the implementation of the regulation, in particular in the core area, appropriate mitigation actions should be taken.

2.6 Proposing short-term technological solutions and setting foundations for future deployment decisions

The six AFs address ATM deficiencies and required performance improvements including safety, in all flight segments, at en route, approach / terminal and also airport levels. In an optimal scenario, the six AFs should be implemented as a package, achieving maximum benefits as described in the Cost Benefit Analysis (See Chapter 3 below), within the set time frame, and should also ensure a well-reasoned transition towards the next common projects and deployment decisions.

The driving philosophy is to implement ATM functionalities that deliver short-term benefits to the network. In addition, the proposal also seeks to secure first steps towards the development of key ground-ground (iSWIM) and air-ground (i4D) infrastructure, paving hereby the way towards the set-up of the ATM infrastructure of the future.

As a consequence, these first initiatives of the PCP towards common standardised and interoperable infrastructure should be followed by adequate deployment decisions in the future common projects. This would allow for an effective and efficient deployment of these infrastructures, unleashing their full potential in terms of benefits to the network.

In addition, the ATM functionalities proposed in this PCP are a first selection from the larger list of essential operational changes contained in Step 1 of the European ATM Master Plan. Some are mere initial steps towards more advanced technological solutions that will deliver more performance improvements. Such is the case e.g. for CTOT and TTA, a first step towards the implementation of i4D + CTO/CTA and paving the way towards full 4D trajectory.

The Commission is therefore invited to use the proposals of this PCP, not only for short-term deployment decisions, but also as a stepping stone for future common projects or any other deployment related activities.

Finally, it must be noted that the high level definition of the deployment architecture was not fully addressed as part of this mandate and decision to choose between, “local”, “non-local” or centralised deployment and operations of some of the ATM functionalities would probably have an impact on their cost-benefit analyses. This will be further addressed as part of the extension to this mandate and as part of the initiation sequence of the deployment in particular by the Deployment Manager.

3 COST-BENEFIT ANALYSIS OF THE PROPOSAL

3.1 Summary of the analysis

3.1.1 A CBA model developed and validated by an independent advisor

All Expert Groups were involved in building the CBA and reviewed the findings through 3 iterations. The model builds on SESAR CBA methodology previously reviewed and validated by stakeholders which was further refined by an independent advisor (Business Integration Partners, a consulting company contracted by the SJU for the sole purpose of the PCP mandate).

The model provides a solid and flexible framework for future common projects and serves as a template for individual stakeholders to review CBA assumptions.

The model enables a granular analysis of each ATM Functionality, per stakeholder, and allows for consolidation at global level. Only direct costs and benefits vs. indirect (e.g. revenues generated by traffic increase) were considered.

The impact assessment time horizon was set for 2014-2030 as per previous SESAR assessments. This timeframe is considered as the most relevant one for the purpose of the PCP since:

- most of the ground investments envisaged in the IDP or in the PCP would have to start to be upgraded, renewed, or decommissioned after a 15-20 years lifetime;
- most of the airborne investments are concentrated in the 2020-2024 timeframe.

Finally, it must be noted that the various assumptions used for the CBA lead to conservative figures in terms of benefits, and more generally to CBA results which remain on the safe side when being used for subsequent decision making.

The Net Present Value of the PCP impact assessment exercise results from the difference between the present values of its future cash inflows and outflows. This means that all annual cash flows have been discounted to the PCP start time (2014) at a predetermined discount rate, assumed equal to 8%. PCP impact assessment outcomes are presented in the following chapters both as discounted and undiscounted values, whereas the latter do not take into account the effect of the discount rate on future cash flows.

The USD/€ exchange rate used for the exercise is equal to 0, 75 (January 2013 average exchange rate, source European Central Bank).

All detailed assumptions and results for the CBA can be found in Appendix C.

3.1.2 Demonstrating a substantial positive Net Present Value

Assuming an “on-time” and “synchronised” deployment of the PCP and the achievement of targeted performance objectives, the implementation of the PCP in the geographical implementation scope of the European ATM Master Plan would generate a positive NPV of 2,4 Billion € over the period 2014 to 2030 for the entire community. The majority of financial benefits come from reduction in fuel burn and ANS productivity gains.

The implementation of the PCP will also provide non-financial benefits, primarily in the safety domain at airports but as well through improved passenger experience. Next to the value created for civil airspace users, the PCP will bring macro-economic benefits to the European economy that are not quantified in this proposal.

In order to properly identify the needs for synchronised deployment both from a technical and stakeholder perspective, the global CBA was broken down at the level of each ATM functionality as well as at the level of the main investors.

Individual business cases for each ATM functionality confirm that they will generate positive value with the exception of the two AFs (AF # 5 and AF # 6) which, by nature, consist in laying down the infrastructural building blocks for future CPs (due to longer payback times).

Specific stakeholder business cases confirm that the PCP will generate positive value for civil airspace users; however, scheduled airlines will benefit the most. Due to the nature of their businesses the financial cost of the PCP cannot be offset by benefits for service providers (ANSPs, Airports) as well as for the Network Manager or for the Military seen in isolation. As many service providers face quality-of-service issues, improvements brought by the PCP could help them address these, regardless of NPV-contribution.

The value brought by the PCP is particularly sensitive to the timely and synchronised deployment of ground (vs. airborne) related operational/system changes, and relatively insensitive to other deployment factors (e.g. even with a 0% traffic growth in Europe, the PCP NPV remains significantly positive).

It must be noted that the performance and charging Regulations shall have a significant impact on the redistribution of created value to airlines, in the form of charges reduction.

Looking forward, it is assumed that the Business Cases for the PCP elements will be refined by each stakeholder to commit their individual investments on the basis of refined cost/benefit assumptions which will be relevant at a lower level of granularity (e.g. local/regional basis).

The complete CBA analysis consolidated by the independent advisor is to be found in Appendix C of this proposal. To maximise the confidence in the PCP proposal a conservative approach was intentionally applied to the CBA assumptions. The benefits in particular are likely to be much more significant than outlined in this report.

3.2 About 2,5 billion € of investments, 93% of which is targeted to be realised within the timeframe of the EU's next financial perspective

An overall cost of 2,5 billion € has been estimated for the full deployment of investments within the scope of the PCP (3,8 billion € undiscounted). In particular, each stakeholder category would contribute to the overall investment associated to the PCP as illustrated in the following chart.

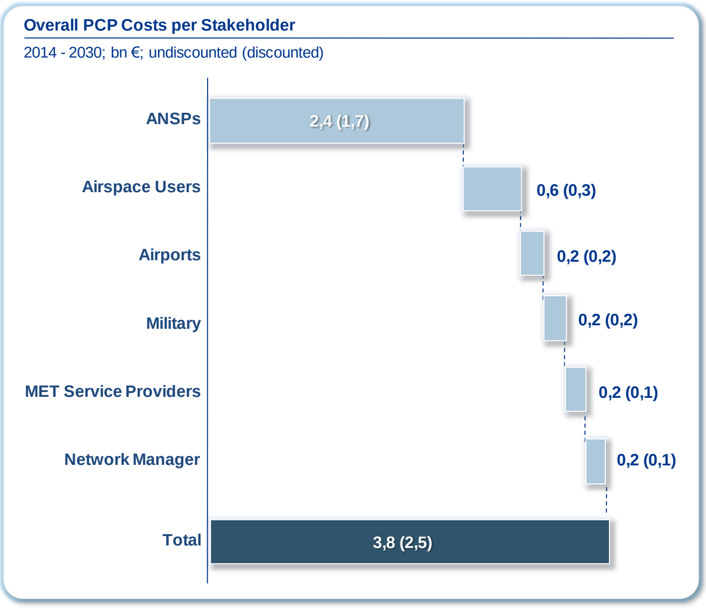


Figure 5: Overall PCP costs per stakeholder

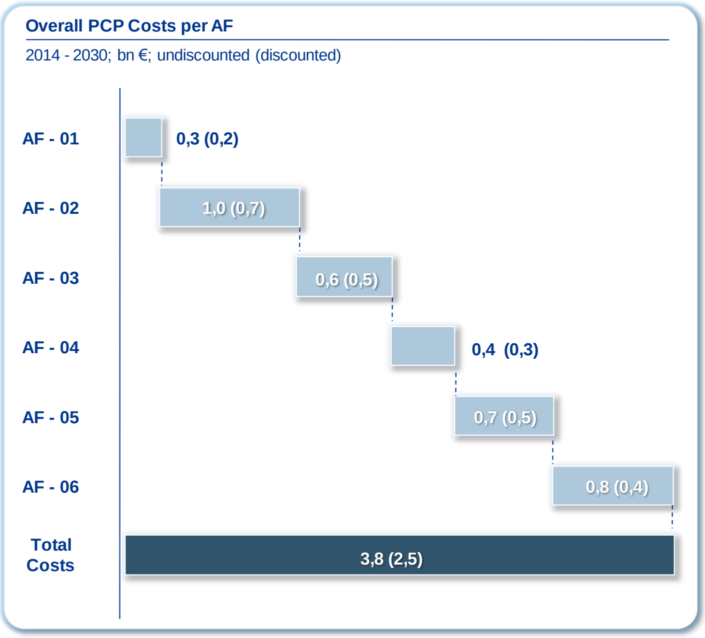


Figure 6: Overall PCP costs per ATM Functionality

As shown in the chart above, the highest share of PCP costs is associated with investments to be undertaken by ANSPs, which account for 64% of the total investments, followed by Airspace Users (16%), Airport Operators (5%) and Network Manager, Military and MET Service Providers (5% respectively).

With respect to the overall investment distribution, it can be noted that over 90% of the total investment - and approximately 100% of ground investment - would be realised by the involved stakeholders within the 2014 – 2024 period.

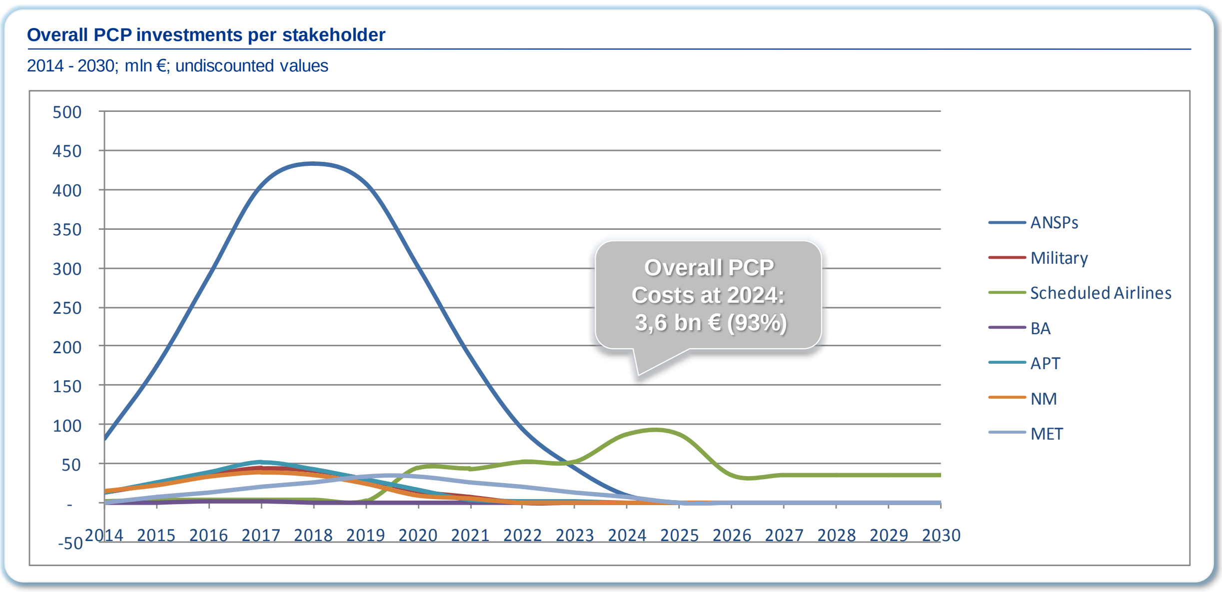


Figure 7: PCP investment distribution

Based on the following considerations:

- the expected availability of EU funding to support ANSP investments related to the PCP,
- the historical volume of ANSPs' CAPEX,
- the need for ANSPs to prioritise their investments in order to reach their RP2 performance targets,

the investments required for PCP alone can be envisaged with a neutral impact on ANS charges during the investment period and before the benefits of the PCP materialise for airspace users.

In addition, the institutional set-up and the available funding are expected to give the appropriate confidence to the manufacturing industry to start investments for the industrialisation phase and to allow filling the time gap between investment decisions and the delivery of the first benefits.

3.3 … generating about 4,9 billion € worth of performance gains in several areas

The PCP would generate benefits falling into two different categories, respectively including those with monetised and non-monetised impacts.

Specifically, the main benefits associated to the PCP which have been monetised in the impact assessment exercise are the following:

- Fuel burn reduction
- CO_2 emissions reduction
- Delay reduction
- Cost-effectiveness associated to ANS productivity increase

It is worth looking at the contribution provided by each of these benefits to the achievement of the overall benefit associated to the PCP, which amounts to a total of around 4,9 billion € (12,1 billion € undiscounted).

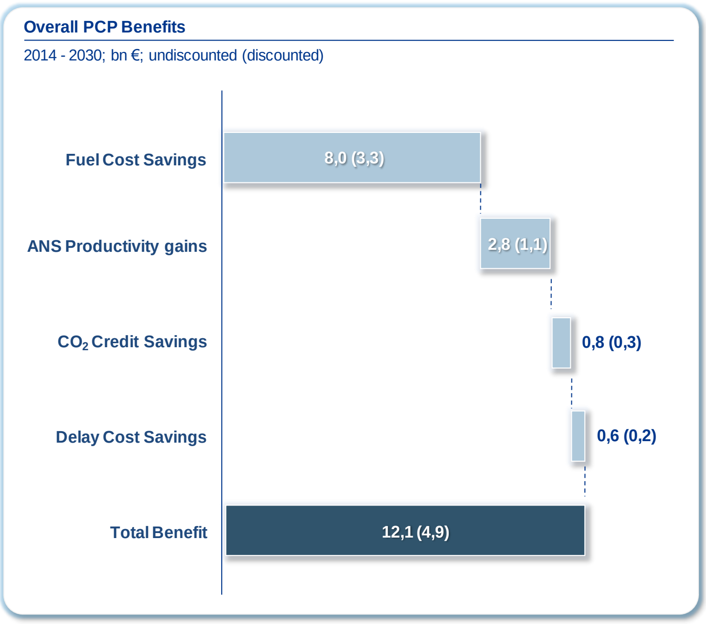


Figure 8: Overall PCP benefits

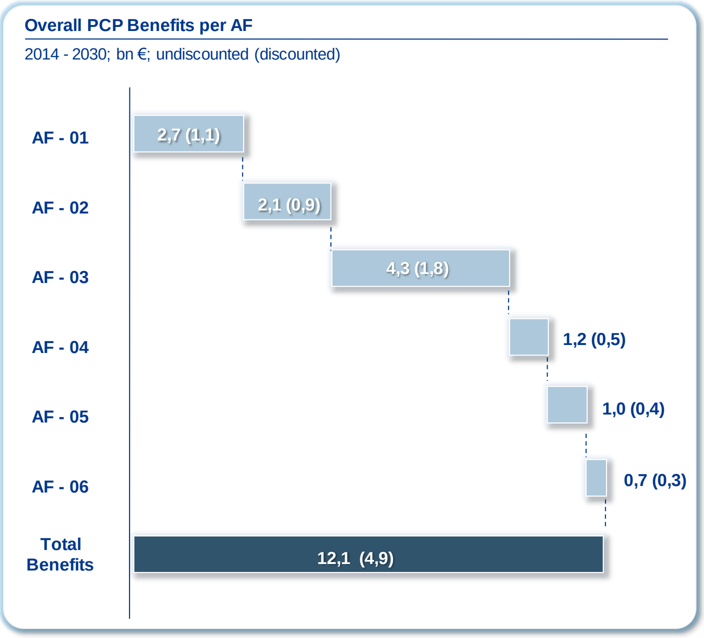


Figure 9: Overall PCP benefits per ATM Functionality

As highlighted in the previous chart, the reduction in fuel consumption represents the biggest share of benefits, accounting for 66% of the total value. In particular, the PCP would enable a 8,5 million tonne reduction in fuel consumption during the 2014-2030 time period, resulting in fuel costs savings amounting to around 8 billion €.

CO_2 Credit Savings account for around 6% of PCP total impact. The fuel consumption decrease generated by the PCP would enable a reduction of CO_2 emissions of around 26,9 million tonnes, thus providing extremely positive impacts from an environmental perspective; such reductions would result in savings amounting to 0,8 billion €.

With regard to the benefits related to ANS Productivity gain coming from air traffic controller productivity increase, it accounts for 23% of PCP total impact. The overall ANS Productivity benefit would generate savings amounting to 2,8 billion € during the 2014-2030 time period.

Delay reduction benefits account for 5% of PCP total impact. In particular, such benefits would result in savings amounting to 0,6 billion €, taking into account savings related to fuel, maintenance, crew and other costs as well as passenger compensation.

As already mentioned, the PCP would also generate further benefits which, although not monetised, have a positive impact in terms of safety, variability of airline operations or on the travel experience of passengers.

In particular, such non-monetised benefits are the consequence of an increase in Airspace capacity by 21,2%, an increase in Airport capacity by 3,9% and a decrease in Variability by 11,4%.

Finally, it must also be noted that only direct benefits have been taken into account for the CBA, consequently the impact of the PCP on the European economy is not considered as part of this proposal.

3.4 … and 2,4 billion € of net benefits (NPV)

The PCP would make a significant contribution to the European aviation sector over the period 2014-2030, also ensuring positive effects in terms of safety, the environment, quality of service and capacity impact.

It has been estimated that the implementation of the PCP, compared with a scenario in which such investments would not be undertaken (although excluding a potential increase in number of delays in case of traffic pick-up), would generate a Net Present Value amounting to 2,4 billion €, with a 9 year payback period.

Such Net Present Value is derived considering an overall cost of 3,8 billion € (2,5 billion €, discounted) undertaken by the involved stakeholders and benefits amounting to 4,9 billion € (12,1 billion €, undiscounted) over the considered time-frame.

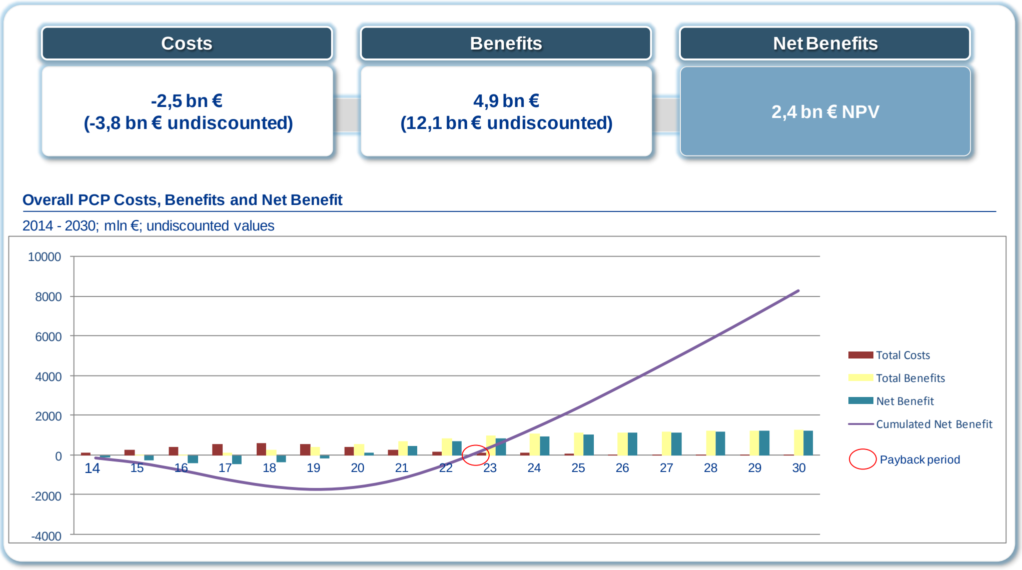
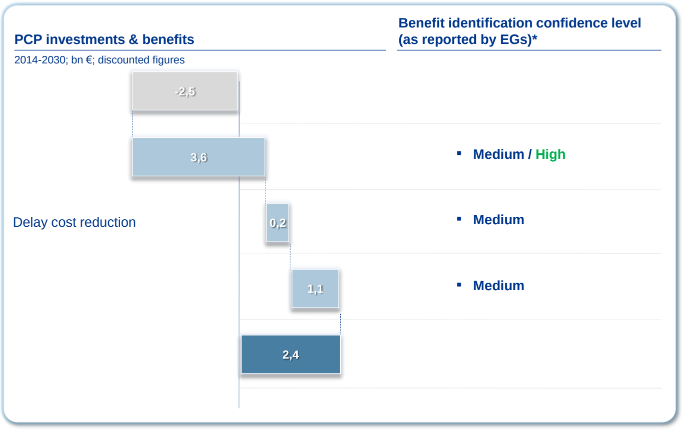


Figure 10: PCP impact assessment outcomes

A closer analysis of benefits and costs considered in the PCP impact assessment exercise is provided in the following chapters.



***High**: Validation Report available demonstrating benefits in given reference environment
Medium: any evidence/source coming from outside the SESAR Programme, Validation Report available demonstrating benefits in given reference environment partly (further R&D needed)
Low: allocation based on expert judgment only

Figure 11: Distribution of overall PCP investments and benefits, with associated confidence level

3.5 Sensitivity analysis shows a robust CBA

The global CBA remains positive even with a 0% growth scenario, severe cost overruns and/or lower performance gains.

Sensitivity Drivers	Value used	Range	Impact on PCP Net Present Value 2014 - 2030; bn €;	
Air Traffic Growth	1,5%	0% - 3%	-0,9	1,0
Fuel and CO_2 Savings	2,1%	1,6% - 2,5%	-0,7	0,7
Delay Cost Savings *(Reduction of delay length and Reduction of delayed flights)*	12,2% - 9,8%	9,8% - 5,7% 14,7% - 7,8%	-0,04	0,04
PCP Investment Costs - Ground	100%	130% - 70%	-0,7	0,7
PCP Investment Costs - Airborne	100%	130% - 70%	-0,07	0,07

NPV "Base" 2,4 bn €

Figure 12: Sensitivity analyses

3.6 Cost Benefit Analysis per ATM Functionalities

ATM Functionality	NPV
AF 01 - Extended AMAN and PBN in high density TMAs	0,9 bn €
AF 02 - Airport Integration and Throughput Functionalities	0,2 bn €
AF 03 - Flexible Airspace Management and Free Route	1,3 bn €
AF 04 - Network Collaborative Management (Flow & NOP)	0,2 bn €
AF 05 - iSWIM functionality	-0,03 bn €
AF 06 - Initial Trajectory Information Sharing (i4D)	-0,2 bn €

Figure 13: NPV per ATM Functionality

All AFs demonstrate a strongly positive CBA, except the infrastructure related ones. AFs # 5 and 6 have individual negative or marginally negative CBAs. However they constitute the first building blocks towards the setting up of the ground-ground and air-ground infrastructures of the future ATM system. For this reason, they are perceived as essential by the Steering Group of the PCP, provided that their deployment is supported by the use of appropriate public funding and modulation of ANS charges to encourage early aircraft equipage (AF # 6).

It will be of crucial importance to build on these initial steps to continue and achieve the setting up of these infrastructures through adequate deployment decisions in the next common projects.

AF # 5 has a marginally negative CBA in the deployment scenario envisaged for the PCP. The work performed to establish this proposal provides good indications that a wider deployment of the solutions can be further optimised considering “non-local” deployment scenarios. This will be explored further in application of the supplement to the mandate on the PCP received by the SJU from the Commission, to assess the interdependencies between the centralised services and the PCP proposal.

Defining investment requirements for Business Aviation investments was not considered to be justified for AF # 6 at this stage due to the high cost associated and the limited overall benefit expected. The proposal therefore assumes that business aviation will not be requested to equip in a first phase. In a second phase, a Commission mandate may potentially cover the equipment requirement (see AF # 6 deployment scenario).

3.7 Strongly positive overall CBA for the airspace users

The overall Airspace Users NPV stemming from the evaluation of costs and benefits associated to the PCP amounts to around 4,5 billion €. This NPV takes into account the recovery of direct airport investments through user fees.

Costs	Benefits	Net Benefits
0,24 bn € (0,56 bn € undiscounted)	4,78 bn € (12,01 bn € undiscounted)	4,53 bn € NPV*

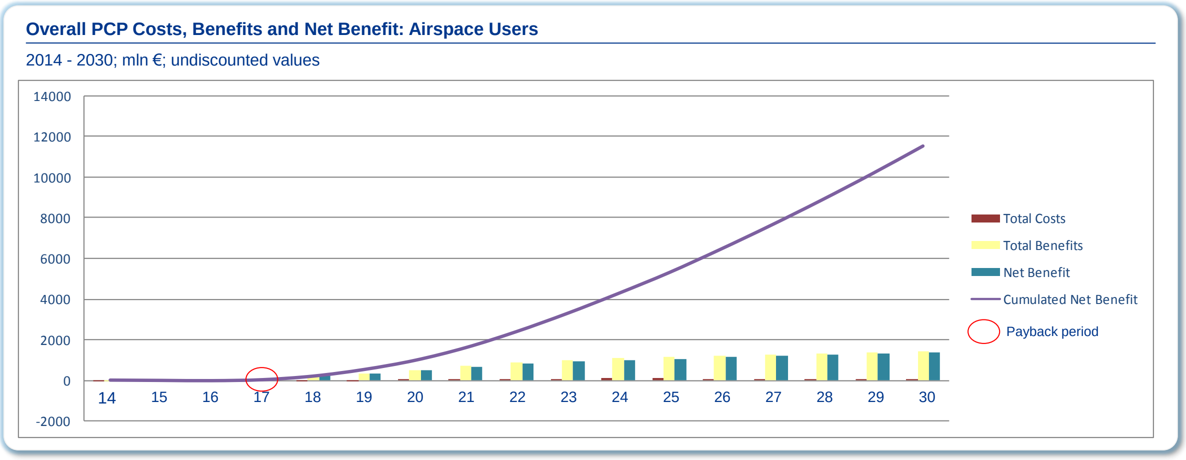


Figure 14: Overall CBA for airspace users

EU funding is expected to support ANSP investments related to the PCP in order to allow filling the time gap between investment decisions and the delivery of the first benefits. This complementary funding, together with the evaluation of the historical volume of ANSPs’ CAPEX and the need for ANSPs to prioritise their investments in order to reach their RP2 performance targets, allows drawing the conclusion that the investments required for PCP alone can be envisaged with a neutral impact on ANS charges during the investment period and before the benefits of the PCP materialise for airspace users.

Furthermore, the transfer of ANS productivity gains from ANSPs to airspace users is not presently accounted for in the Airspace User NPV. Such costs and benefits transfer have to be considered and formalised within the context of the Performance Scheme definition for Reference Periods 2 and 3.

It should be noted that the NPV for airspace users is negative for the infrastructure related AFs (AFs # 5 and 6) without the implementation of benefit transfer mechanisms and incentivisation strategies respectively (see Chapter 4 “Conditions for successful deployment”).

The Service Providers NPV stemming from the evaluation of costs and benefits associated to the PCP result in a negative value amounting to -1,01 billion € (-0,44 billion € NPV for ANSPs).

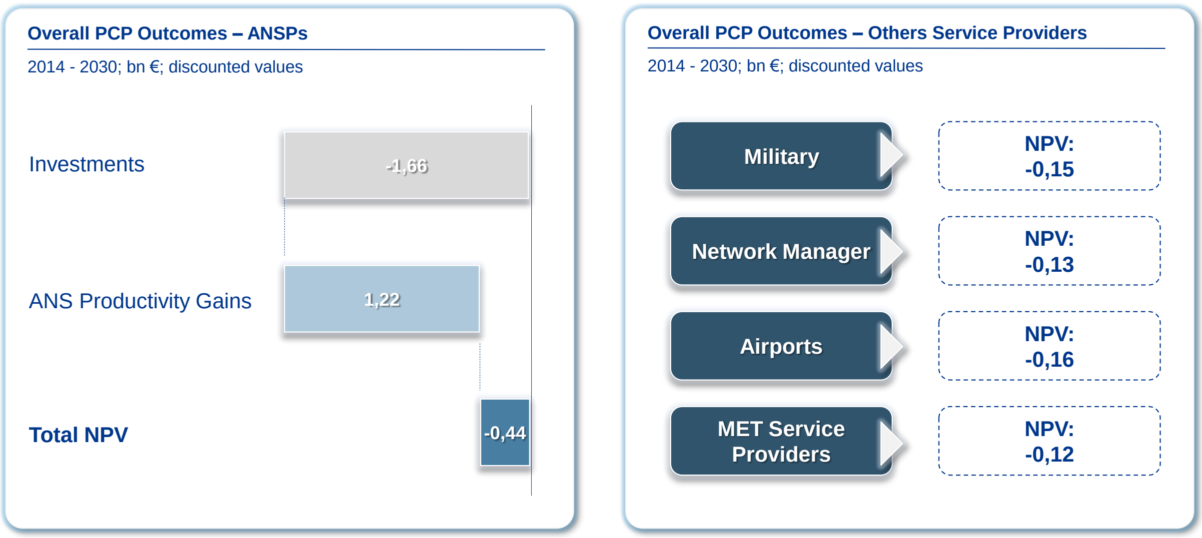


Figure 15: NPV for other categories of stakeholders

3.8 Estimated Network Performance gains

3.8.1 Overall estimated performance gains

The chart below shows, per Key Performance Areas, the overall performance gains that are expected to be achieved by the end of deployment, which is targeted for 2024.

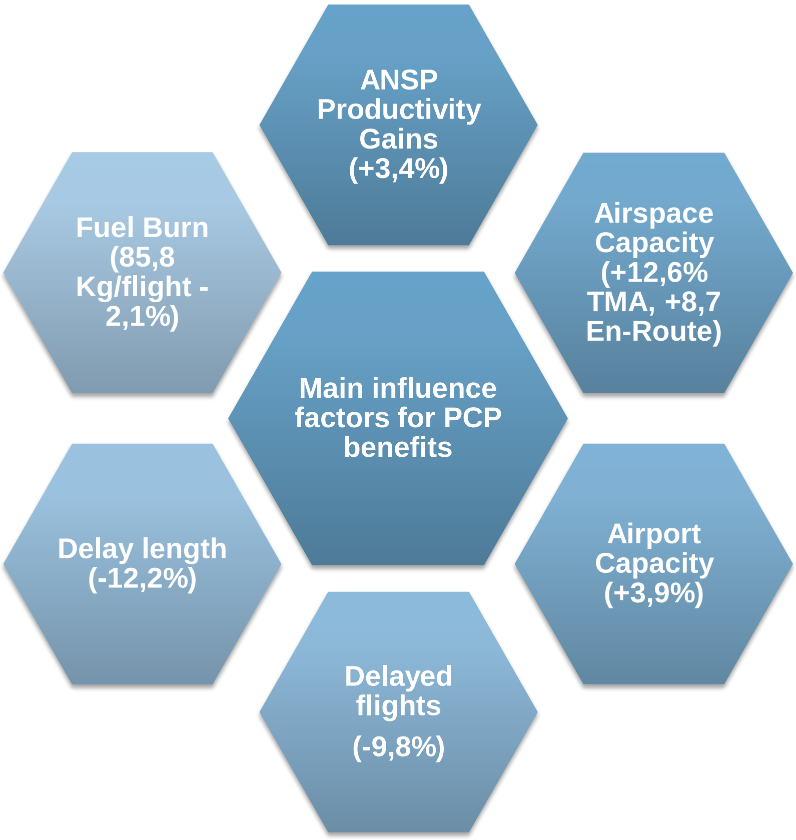


Figure 16: Network performance gains broken down per Key Performance Area[8]

It must be noted that these figures were established through a consensus building process at expert level and are derived from a combination of validation results, R&D performance analysis aggregation and expert judgement.

3.8.2 Estimated performance gain impact on Reference Period 2 (RP2, 2015-2019)

Considering the deployment scenarios associated with the PCP it is estimated that most PCP benefits will be captured in RP3 (2020-2024) and at the very end of RP2 (2015-2019). The materialisation of benefits during RP2 is outlined in the charts below.

[8] ANS Productivity gains are derived from ATCO productivity gains of +12%. Airspace Capacity gains +21,2% split in TMA (+12,51%) and En-Route (8,65%)

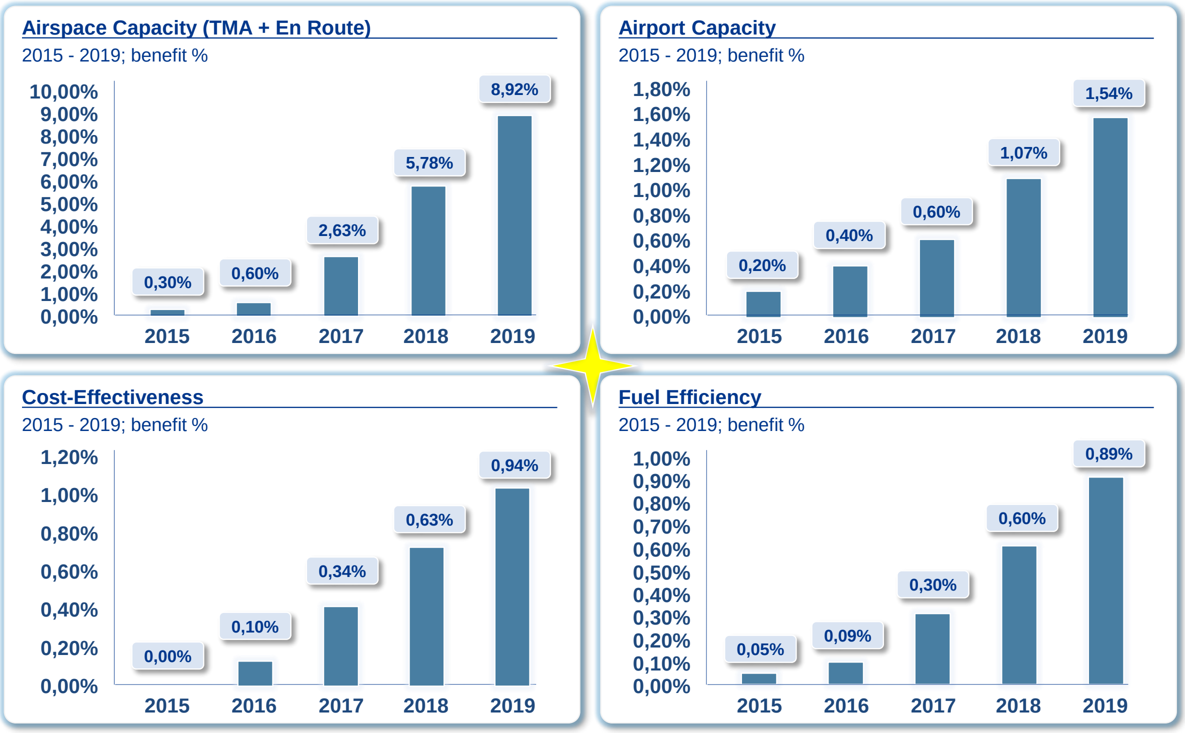


Figure 17: PCP benefits ramp-up 2015-2019

PCP performance objectives will have in turn to be translated into corresponding SES performance targets.

It should be noted that the PCP proposal will be subject to the Commission's consultation process in parallel and in roughly the same time frame as the consultation on EU-wide performance targets for RP2. It is understood that the Commission's ambition is to secure positive votes on both the RP2 EU-wide targets and the PCP proposal at the December 2013 meeting of the Single Sky Committee.

In such context, the outcome of the PCP and its expected contribution to performance will have to be considered in the course of the RP 2 consultation processes. It is anticipated that the PRB will note that the contribution to RP2 targets is modest, as outlined in this paragraph, but it may consider the PCP to:

- Control and monitor the investment plans of the ANSPs for RP2 and check their eligibility for recovery through ANS charges, as set out in both the performance and charging Regulations.
- Make sure that the investment plans are duly prioritised according to SESAR deployment, that there is a genuine effort to de-fragment investment policies, and that there is no redundancy in the investment plans.
- The expected PCP performance gains may also be used as an additional tool to justify and secure the level of ambition of the EU-wide targets.

3.9 Consequences of a do-nothing scenario

The analysis of a do-nothing scenario was not addressed or monetised as part of the PCP since such rationale is underpinning the decisions related to the SESAR Programme to the SES technological approach in general. However, would the PCP not be implemented, the following impact and risks can be anticipated:

- ANSP investments would remain uncoordinated, except in case of voluntary action at FAB level. Fragmentation of investment would remain high;
- The lack of convergence or slow convergence towards interoperability and economies of scale would continue;
- The implementation of the first building blocks of the infrastructure of the future would not be initiated, limiting the future performance improvement possibilities;
- There would be no contribution at all from technology deployment to the performance targets of RP2 and no possibility to further build on it in RP3;
- The selection and subsequent set-up of a Deployment Manager's would be jeopardised or postponed, creating delays for the implementation of the governance of SESAR deployment, thus putting the entire technological pillar of the SES at risk;
- The interim deployment programme and the on-going deployments that lay down some foundations for the upgrade of the European ATM system would deliver only partial benefits and remain of limited impact on the overall ATM performance in the coming years.

4 CONDITIONS FOR SUCCESSFUL DEPLOYMENT

4.1 Financial incentives

Financial incentives are foreseen under Article 4.6 (b) and Section 3 of Chapter III of the draft implementing Regulation on common projects “in particular to mitigate negative impacts on a specific geographical area or category of operational stakeholders”. Section 3 of Chapter III of the same Regulation provides more details on such incentives, which can be broken down into two main categories:

- European Union funding, focusing on the implementation projects (Level 3 of SESAR deployment governance). This funding may be allocated to air navigation service providers and/or airspace users, on a non-discriminatory basis. Union funding allocated to ANSPs is also beneficial to airspace users in that it is considered as “other revenues” in accordance with the charging Regulation, with the consequences that they are deducted from the chargeable cost-base.
- Incentives in relation with the performance and charging Regulations, which contain two main sub categories:
  - Incentives on air navigation service providers (Article 15) consisting in bonuses – penalties for reaching / not reaching performance targets in particular in the capacity / delay key performance area. This category is not perceived as relevant for common projects.
  - Incentives on airspace users in the form of ANS charges modulation (Article 16) are possible to optimise the use of air navigation services, reduce the environmental impact of flying and/or encourage the use of specific routes. These criteria would be relevant e.g. for the use of free routing as contained in the PCP proposal. In addition, charges modulation may aim at accelerating the deployment of SESAR ATM capabilities, which is fully relevant in the PCP context.

Incentives should be based on existing SES regulatory instruments and be targeted at:

- Ensuring synchronisation (including alignment of requirements) and timely deployment;
- Mitigating negative business cases either for some specific AFs (# 5 & # 6) or specific stakeholders categories;
- Encouraging and securing on-time equipage of aircraft (AF # 6) and overcoming the last mover advantage;
- Compensating possible negative cash-flow during the transition phase (long payback times) and avoiding pre-financing by airspace users;

In the PCP context, the cost-benefit analysis demonstrates in section 3.6 & 3.7 that:

- Two ATM Functionalities (AF # 5 and AF # 6) have individual marginally negative CBAs. They also have an important bearing on airspace users due to important airborne equipment costs and long payback time. They are however necessary to establish the foundations for the future ATM infrastructure. For these reasons these two AFs should be considered as priorities for the setting up of incentive schemes, both through EU funding and charges modulation to encourage on-time equipage of aircraft. In line with the deployment schedules detailed in Chapter 6 for these AFs, charges modulation should be introduced for AF # 6 as of 2020. The modulation of charges should result in a temporary reduction of ANS charges for civil airspace users that are equipped (compared to those that are not) and ensure for these an average payback time of no more than 3 years for investments on aircrafts. EU funding may be necessary to support the timely implementation of this differentiated charging mechanism.

- Using the stakeholder categories approach, EU funding should target first ANSPs, Network Manager and MET service providers whose costs fall within the scope of the performance scheme regulation and which are affected by negative NPVs. In addition, charges modulation may also be used to drive airspace users' behaviour, e.g. to encourage the use of free routing (AF # 3).

This is synthesised in the graph below:

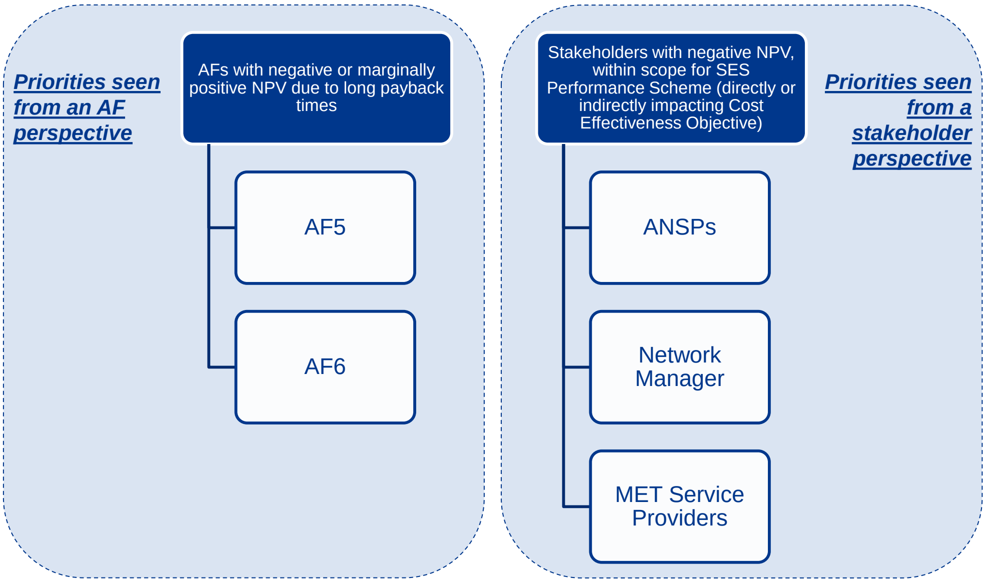


Figure 18: Priorities for EU financial incentivisations

Addressing charges modulation scheme for AF # 6 is an issue to be addressed with priority: whilst 2020 is a reasonable target for implementing a charges modulation scheme, for AF # 6 and should this proposal be considered, the Commission's attention is drawn on the following issues:

- To be effective in securing airspace user's on-time investments, the agreement and decision this incentive measure should occur before the AF # 6 actual start of deployment sequence (i.e. before 2016-2017);
- The charges modulation scheme would require a Commission legal instrument;
- The content of the scheme would have to be carefully defined, in all details, and amongst others, the following issues would have to be addressed:
  - Scope of application (AF per AF, or at the level of implementation project?);
  - Treatment of the over or under recoveries that may be incurred by the ANSPs e.g. because of traffic variation;
  - Practical implementation in relation to route and terminal ANS charges collection.

For these reasons, it is suggested that work should start on this issue as early as possible.

The incentives identified and proposed above in this section are compatible with the following assumptions:

- A maximum of 3 billion € of EU funding was pre-identified to support SESAR deployment in the next financial perspective. Only part of it will be allocated to the PCP.
- EU funding starts in 2014 and targets full implementation before end 2020 (last “cash out year” 2024).
- Maximum 50% co-financing for ground investments in period 2014-2024
- Maximum 20% co-financing for airborne investments in period 2014-2024
- All stakeholders within geographical scope of the European ATM Master Plan would be eligible for co-financing (i.e. beyond the EU Member States)
- All stakeholders contributing to SESAR implementation would be eligible for co-financing (incl. e.g. Military, MET Service Providers, Network Manager)
- The technical scope is expected to have an impact on the next financial perspective:
  - Potential prerequisites stemming from the Baseline deployment are identified in the PCP proposal
  - The PCP allows to already take a view on the content recommended for the next common projects and SESAR deployment programme.
- The Deployment Manager may, at a later stage, develop and propose further innovative incentive solutions, notably to compensate negative cash flows during the investments / deployment phase, until full operational capabilities are in place and deliver benefits to the airspace users.

4.2 Eligibility, monitoring and control of investments

The draft performance and charging Regulations establish a powerful system to control and monitor ANSP investments:

- In accordance with Article 11 of the draft performance Regulation, the performance plans shall contain “a description of investment, including that necessary to achieve the performance targets with a description of their relevance in relation with the European ATM Master Plan, the Network Strategy Plan and the common projects referred to in Article 15a of the service provision Regulation”. This means that a performance plan can be rejected by the Commission if such relevance cannot be demonstrated
- In accordance with Article 6.4 of the draft charging Regulation, “Major investments in new ATM systems and major overhauls of existing ATM systems are only eligible (for cost-recovery through user charges) insofar as they can be related to the implementation of the European ATM Master Plan, and, in particular, through the common projects specified in Article 15a of the service provision Regulation “. This control is carried out every year through the Commission’s validation of the unit rates for user charges.
- In accordance with Annex II of the charging Regulation, “Every year of the reference period, (Member States and ANSPs shall provide) the difference between the investments of the air navigation service providers recorded in the performance plans and the actual spending, as well as between the planned date of entry into operation of these investments and the actual situation”. This allows for the continuous monitoring of ANSP investment and verification that investment planned are actually undertaken, within schedule and budget.

- The combined use of these tools shall enable the Commission to ensure as from 2015, start of the second performance reference period (RP2) that appropriate investments shall be decided by the ANSPs, in line with the requirements of the common projects. This will support as well increasing the confidence of airspace users in the on-time delivery of the ground infrastructure. Finally, this will help as well securing the manufacturing industry decisions for the investments that have to be made for the industrialisation phase.

4.3 Operational incentives

Historically the principle of “First Come First Served” (FCFS) has been applied to manage air traffic flows. This principle implies that the different stakeholders in the aviation system (airspace users, service providers...) have been operating under a paradigm that does not necessarily promote the most efficient use of ATM “capabilities” (to be understood as both ATM systems and procedures).

The implementation of AF # 6 will require synchronised modifications to both ground and airborne capabilities, in accordance with the European ATM Master Plan. In this context, the “First Come First Served” principle will not necessarily guarantee the most efficient and effective handling of mixed capabilities. As a consequence, the SESAR Joint Undertaking proposes a paradigm shift towards “Best Efficiency Best Served” (BEBS), leading to a progressive stronger focus on a "Serve by Schedule" philosophy for main airports at which point the 4-D Business Trajectory objective can be fully realised..

More specifically a first BEBS supporting measure is proposed to be implemented for AF # 6 which would consist in giving a preferential service to equipped aircraft (e.g. ATFCM priority). BEBS implementation should be enforced through neutral, transparent and non-discriminatory processes (i.e. in this case all aircraft that are capable will have access to the preferential service).

The decision should be made to choose between this possible incentive and the charges modulation outlined in Section 4.1. A combination of both may also be considered.

Should this operational incentive proposal be considered, the Commission’s attention is drawn to the fact that the concrete feasibility and implementation details should be explored, in particular with the Network Manager. Stakeholders should be consulted and possible opposition should be identified and addressed. The need for a possible legal instrument should also be assessed and addressed.

5 TECHNICAL SPECIFICATIONS OF THE PCP

This chapter contains the core part of the PCP proposal. It is composed of six sections containing the detailed description of each of the six AFs proposed for deployment.

According to Article 2 (3) of the draft implementing Regulation on common projects, ATM functionalities reflect "*a group of ATM operational functions or services related to trajectory, airspace and surface management or to information sharing within the en route, terminal, airport or network operating environments*".

Whilst the deployment of the six AFs is recommended as a package, this chapter allows for an individual and separate assessment of each AF. This aims at allowing identification of the scenario used for the individual costs and benefits of each AF, as well as detailing the technical specification of each of the AFs.

The description of each AF is structured as follows:

1 Description of the AF (the "What" and the "why", described as Scope and outline, highlighting the expected improvements, Operational requirements, and Impact on ground and airborne equipment (system impact),

2 Geographical scope of implementation and associated time frames: The "Where" and the "Who" (geographical scope and stakeholders - entities concerned) and the "When" (synchronisation planning with identification of sub scenarios as appropriate to differentiate the stakeholder categories and description of the start / end of deployment and the start of benefit / full benefit achieved),

3 Identification of possible regulatory and/or standardisation needs,

4 Alignment with safety requirements,

5 Cost-Benefit Analysis, with differentiation per stakeholder category.

5.1 AF # 1: Extended AMAN and PBN in high density TMAs

5.1.1 Description of the AF ("What" and "why"):

5.1.1.1 Scope and Outline

This AF shall improve the precision of the approach trajectory as well as facilitate traffic sequencing at an earlier stage, thus allowing reduced fuel consumption and environmental impact in descent/arrival phases.

It shall support extension of the planning horizon out to a minimum of 180 – 200 NM, up to and including the Top of Descent of arrival flights and the early de-confliction of arrival streams into multiple airports in selected complex terminal airspace environments.

The AF also covers the development and implementation of fuel efficient and/or environmental friendly procedures for arrival/departure (RNP 1 SIDS and STARS) and approach (RNP APCH).

5.1.1.2 Operational Requirements

Arrival Management Extended to en route Airspace

The system integrates information from arrival management systems operating out to a certain distance to provide an enhanced and more consistent arrival sequence reducing holding by using speed control to absorb some of the queuing time.

The AMAN horizon shall therefore be extended from the current 100-120NM to 180-200NM. This is expected to result in improved arrival flight trajectories for airspace users with efficiency and environmental benefits. The traffic presentation at terminal area entry should be significantly improved with the bulk of traffic sequencing being conducted in the en route and early descent phases. This will result in more efficient terminal area operations with greatly reduced low altitude path stretching for sequence building purposes. Efficient overall management of the extended arrival operation is essential including the Sequence Manager role which takes on greater importance when AMAN operations are extended to 180-200NM.

Techniques to manage the AMAN constraints take the form of tools/advice to controllers such as Time to Lose or Gain and speed advice and the initial implementation should adopt this method.

ATS systems in en route units shall be able to manage arrival constraints in the en route sectors which will support AMAN operations in the adjacent/subjacent TMAs. This requires specific enhancement in data exchange, data processing and information display at the relevant Controller Working Positions. The impact of arrival management constraints on en route sectors is important along with the required co-ordination dialogues between all actors involved in extended arrival management operations.

Arrivals Management into Multiple Airports

Assistance to Multiple airport arrival management in the terminal area environment is required especially in view of the emerging use of secondary airports which are located in close proximity to major airport hubs.

This issue shall be addressed by the extension of arrival management horizon into the en route phase including the arrival management for multiple airports and the integration of departing traffic from airports within the extended arrival management horizon.

It should be noted that this does not include the linking of arrival and departure management.

In complex TMA situations with several airports, AMAN capabilities shall comprise the simultaneous optimisation of traffic streams to different airports at a time, based upon specific prioritization criteria.

Enhanced Terminal Airspace using RNP-Based Operations

The scope of the PCP is “PBN in high density TMAs - Development and implementation of environmental friendly procedures for arrival/departure and approach”, and covers the following navigation specifications:

- SIDs and STARs using the RNP 1 specification with the use of the Radius to Fix (RF) path terminator described in the PBN Manual Volume II Part C, Appendix 1, as well as ability to meet altitude constraints, as described in PBN Manual Volume II, Attachment A;
- RNP APCH (with APV).

Enhanced Terminal Airspace using RNP-Based Operations focuses on the use of the RNP 1 specification for the design of routes used by aircraft compliant with the RNP 1 specification in high traffic density TMAs including:

- RNP 1 Arrivals/Transitions/SIDs/STARs.
- Continuous climb/descent operations making use of altitude constraints.

The new procedures shall demonstrate they will lead to enhanced flight efficiency and shorter, more direct or more environmental friendly routes with simple connections to the en route structure.

RNP APCH is a navigation specification in the PBN Manual (ICAO Doc. 9613) enabling a final approach procedure using GNSS with or without Baro-VNAV (or SBAS). The advantages of RNP APCH are improved airport access and the possibility to design straight-in procedures due to the fact that they are independent from the location of ground navaids, as well as increased safety due stable descent paths thanks to the CDO technique and/or baro-VNAV (or SBAS) functionality.

The PBN Implementing Rule is currently under development. The definition of this AF has been done in coordination with the current preferred option being proposed as part of the PBN IR development and consultation process. It should be noted however that the process is on-going and it is possible there will be changes to the final PBN IR which should as far as possible be considered during the deployment of this AF.

5.1.1.3 System Impact

The system impact of this AF include evolutions in the AMAN function (extended horizon, multiple airport) and Controller Working Position (aircraft RNP capability in a/c label, display of conformance monitoring tools in RNP areas).

The RNP based instrument procedures supported by existing RNP APCH and Baro VNAV capabilities for mainline aircraft and possibly LPV capabilities (based on SBAS) for regional and business jets.

RNP 1 specification with the use of the Radius to Fix (RF) attachment for SIDS and STARS will be required.

Arrival Management Extended to En Route Airspace

1 Impact on ground equipment

Current System Capability:

AMAN systems are already deployed at some ATSUs in Europe, although without a common standard the baseline deployments vary significantly.

New Functionality:

AMAN system tools shall be updated to provide arrival sequence time information into en route decision making.

The ATS systems of upstream ATSUs shall be enhanced to manage AMAN constraints, i.e. data exchange, data processing and information display at controller working positions. Further system enablers to be considered include Air-ground coordination of AMAN constraints (e.g. through required time of arrival) which are likely in the next Common Project - also link to the initial 4D capability utilising the Controlled time of arrival (CTA) (described as part of AF # 6).

Data provision to downstream ATSUs (AMAN) with flight information of arriving flights can be managed to a certain extent and in a first step with current technology. SWIM should be considered as a future enabler for these exchanges. However it must be stressed that ground-ground SWIM trajectory exchange is directly supporting extended AMAN operations when generalised.

2 Impact on airborne equipment

No impact in the initial implementation. Future options may integrate CTA into AMAN and require initial 4D capability on board the aircraft.

Arrival Management into multiple Airports

1 Impact on ground equipment

Current System Capability:

AMAN systems are already deployed at some ATSUs in Europe, although without a common standard the baseline deployments vary significantly.

New Functionality:

AMAN system tools shall be updated to serve multiple airports to provide simultaneous optimisation of traffic streams into different airports at a time, based upon specific prioritization criteria.

2 Impact on airborne equipment

No impact.

Enhanced Terminal Airspace using RNP-Based Operations

Enhanced Terminal Airspace using RNP-Based Operations specifically includes:

- RNP 1 SIDs, STARs and transitions (with the use of the Radius to Fix attachment described in the PBN Manual Volume II Part C Appendix 1, as well as ability to meet altitude constraints, as described in PBN Manual Volume II, Attachment A)
- RNP APCH (with LNAV, LNAV/VNAV and LPV minima)

1 Impact on ground equipment

The ATC tools and Safety Nets shall be adapted to enable the Terminal Area and Approach PBN operations.

2 Impact on airborne equipment

RNP 1 operations require aircraft conformance to a track-keeping accuracy of +/- 1NM for at least 95% of flight time, together with on-board performance monitoring and alerting functionality and high integrity navigation databases.

For RNP APCH, as defined in the EASA AMC 20-27, the Lateral and Longitudinal Total System Error (TSE) of the onboard navigation system must be equal to or better than:

±1 NM for 95% of the flight time for the initial and intermediate approach segments and for the RNAV missed approach.

±0.3 NM for 95% of the flight time for the final approach segment.

RNP 1 as well as RNP APCH capability requires inputs from GNSS. Many existing aircraft can achieve RNP 1 capability as well as ability to meet altitude constraints with their additional existing on-board equipment.

Vertical Navigation in support of APV can be provided by GNSS SBAS or by barometric altitude sensors.

5.1.2 Geographical scope of implementation and associated timeframes

5.1.2.1 Geographical scope

The implementation is targeted at the following 25 airports:

Figure 19: Geographical scope of implementation of AF # 1

London-Heathrow, Paris-CDG, London-Gatwick, Paris-Orly, London-Stansted, Milan-Malpensa, Frankfurt, Madrid-Barajas, Amsterdam, Munich, Rome-Fiumicino, Barcelona, Zurich, Düsseldorf, Brussels, Oslo, Stockholm-Arlanda, Berlin, Manchester, Palma, Copenhagen, Vienna, Dublin, Nice, Istanbul.

This list represents the population of airports with more than 150 000 IFR movements per year and with a capacity need of at least 60 movements per peak hour expected by 2019.

Further details with regards to the geographical scope of implementation can be found in Appendix D.

5.1.2.2 Implementation timeframes:

The phasing of deployment is planned as follows:

Start of Investment	End of Investment	Start of Benefit	Full Benefit	Start of Deployment	End of Deployment
2015	2023	2018	2024	2018	2023

Table 2: Implementation dates for AF # 1

The deployment dates related to sub-systems within AF # 1 are reported in the following table:

Sub-systems	Start of Investment	End of Investment	Start of Deployment	End of Deployment
AMAN System upgrade for	2015	2023	2018	2023

E-AMAN				
ATS System upgrade for E-AMAN	2015	2023	2018	2023
PBN Airspace/Procedures/ATS-System	2015	2023	2018	2023

Table 3: Implementation dates for AF # 1 subsystems

5.1.3 Regulatory and standardisation needs

5.1.3.1 Regulatory needs

For AMAN Extended Horizon to en route airspace and the AMAN for multiple airports, the need is foreseen to have means of compliance issued by the Commission (based on EUROCAE reference documents). If the associated standardisation activity is not initiated as soon as possible, the risk of not having the means of compliance available in due time is high, resulting in a non-harmonised deployment of the AF.

The ATM Functionality #1 is designed so as to build on the PBN Implementing Rule and RNP means of compliance, currently under elaboration by the Commission and EASA. The risk of not having them available in due time to allow for implementation of the PCP is estimated to be low.

The progress on PBN Acceptable Means of Compliance and Guidance Material, currently under preparation by EASA present a medium risk regarding its availability in due time. The impact would be a non-harmonised deployment of this AF. This topic needs to be closely monitored.

Further details with regards to regulatory needs can be found in Appendix E.

5.1.3.2 Standardisation needs

There are currently no standards in place for AMAN. A need has been identified to develop performance standards for the AMAN Extended Horizon to en route airspace and the Arrival Management into multiple airports functionalities to provide means of compliance with the Interoperability Regulation (EC) No 552/2004. The risk of not having them available in due time is medium. The impact would be a non-harmonised deployment of this AF. It is recommended that EUROCAE take this action on board as soon as possible. Its progress should be monitored.

There are currently no standards for the ATC tools and safety nets required to support RNP based operations. This lack might be covered by the PBN acceptable means of compliance of EASA (above mentioned). In case EASA would not cover this aspect, the risk of not having available these standards in due time would be high, with negative impact in the industrialisation and thus in delays and a non-harmonised deployment of this AF. In that case, a standardisation activity in EUROCAE would need to be triggered.

Further details with regards to standardization needs can be found in Appendix E.

5.1.4 Alignment with safety requirements

This analysis is the result of the evaluation of the level of development of Safety Assessment Reports and the review of the ATM Functionality technical documentation from an Authority point of view, done by the Expert Groups and by EASA. As conclusions, the following items can be mentioned:

- There are Safety Assessment Reports on P-RNAV, APV, and SBAS.
- Safety Assessments on AMAN and E- AMAN are on-going.

As a result of the analysis, some other items were found which would require further action previously to the full deployment of this AF. These items are the following:

- There is a need to develop a PBN Safety Assessment Report for some generic operational environment(s).
- The review by EASA of the existing Safety Assessment Reports, as well as the review of the ones delivered in the future, should be completed. Due consideration should be given also to their review by National Authorities.
- Safety Assessment Reports on AMAN and E-AMAN should be completed.
- It would be opportune to promote the harmonisation and simplification of the RNP certification procedures in EASA. It should be agreed and clarified that the designers of flight procedures can be considered as a type of AIS service provider, and thus subject to certification in accordance with SES II regulations

5.1.5 Cost-Benefit Analysis

This AF is expected to improve the precision of approach trajectory as well as to facilitate traffic sequencing at earlier stage, thus allowing reduced fuel consumption and environmental impact in descent/arrival phases.

On the basis of analyses carried out, the NPV associated to the deployment of this AF would amount to 0,9 billion €, with a 6 years payback period; the distribution of associated costs, benefits and cumulated net benefits over the considered time period is represented in the following chart.

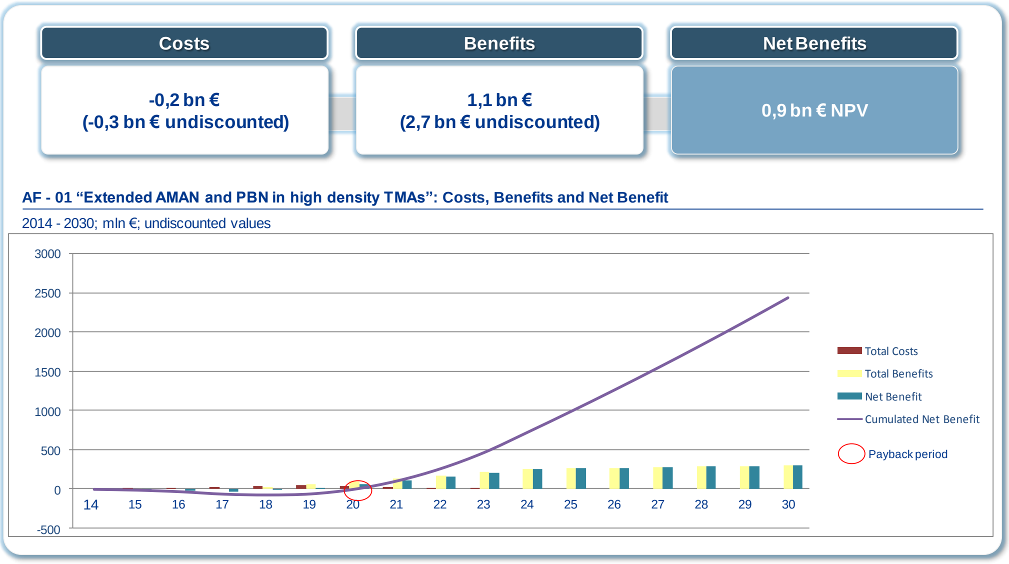


Figure 20: Overall CBA for AF # 1

Impact assessment outcomes

The total benefit associated to the deployment of this AF amounts to 1,1 billion € (2,7 billion € undiscounted) and would bring significant benefits in terms of fuel consumption reduction (-2,3 million tonnes), thus ensuring fuel cost savings exceeding 2,0 billion €.

Fuel cost savings represent 79% of total benefits associated to this AF, followed by delay related benefits (8%), CO_2 savings (8%), ANS charge reduction due to productivity gains (5%).

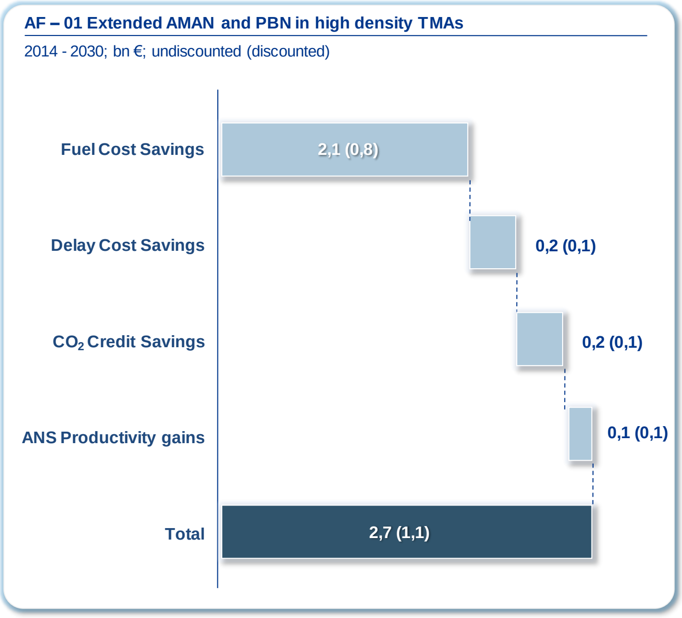


Figure 21: Breakdown of benefits for AF # 1

100% of the costs - amounting at 0,2 billion € (0,3 billion € undiscounted) - are associated to investments to be realised by ANSPs.

In particular, the overall investment would stem from the implementation of three different sub-systems:

- “AMAN System upgrade for e-AMAN”, cost accounts for 39% of total investment;
- “ATS System upgrade for e-AMAN”, cost accounts for 29% of total investment;
- “PBN Airspace/Procedures/ATS-System”, cost accounts for 32% of total investment.

5.2 AF # 2: Airport Integration and Throughput Functionalities

5.2.1 Description of the AF (“What” and “why”)

5.2.1.1 Scope and Outline

“Airport Integration and Throughput Functionalities” covers the development of Airport, Tower and Approach functionality to improve runway safety and throughput; enhance taxi integration and safety for the benefit of airport Tower, Approach and airspace users.

It includes Departure Management Synchronised with Pre-departure sequencing, Departure Management integrating Surface Management Constraints, Time Based Separation for Final Approach, Automated Assistance to Controller for Surface Movement Planning and Routing, Airport Safety Nets and Enhanced runway usage awareness to reduce hazardous situations on the runway.

5.2.1.2 Operational Requirements

Departure Management Synchronised with Pre-departure sequencing

This concept contains two parts

1 Pre-departure management, with the objective of metering the departure flow to a runway by managing Off-block-Times (via Start-up-Times) which consider the available runway capacity. In combination with Airport – Collaborative Decision Making (A-CDM), Pre-departure management aims thus at reducing taxi times, increasing CFMU-Slot compliance and increasing predictability of departure times for all linked processes.

2 Departure management, with the objective of maximising traffic flow on the runway by setting up a sequence with minimum optimised separations.

The pre-departure sequence refers here only to the organisation of flights from the stand/parking position. Pre-departure sequences shall be established collaboratively with the airport CDM partners concerned, taking into account agreed principles to be applied for specified reasons (runway holding time, slot compliance, departure routes, airline preferences, night curfew, evacuation of stand/gate for arriving aircraft, adverse conditions (de-icing), actual taxi/runway capacity, current constraints, etc.).

Based on the actual progress of operations from airlines during the turnaround process, the system shall elaborate a collaborative sequence and provides both target Start-up approval time (TSAT) and a target take-off time (TTOT), taking into account variable taxi times and aligned to real situation according to the actual aircraft Take Off.

Actors involved during the Turnaround process shall provide an accurate and timely target off-block time (TOBT). The system calculates a TTOT, may ask the Network manager (NM) for a CTOT as close as possible to the TTOT and shall provide the controller with the list of TSAT and TTOT for the a/c metering.

The pre-departure list is used by ATC tower controllers, mainly by the Delivery Clearance tower controller to follow the TSAT window and Tower supervisor as the best available information about traffic demand.

The underlying runway departure sequence provided by the system is information available for the runway controller while sequencing departing aircraft, as and when feasible, that will be fully relevant when Surface management constraints will be properly integrated and monitored.

Departure Management integrating Surface Management Constraints

The departure sequence at the runway shall be fine-tuned according to real traffic situation reflecting any delay off gate or during taxi to the runway in use which may trigger an update to the departure sequence. The system shall interact with, and provides assistance to, the ground controller and runway controller to coordinate surface movements and to manage an optimised departure sequence consistently with real surface traffic.

Advanced Surface Movement Guidance and Control System (A-SMGCS) shall provide better taxi-time, from monitoring of real surface traffic situation and from consistent management and assistance between departure sequence and taxi route to Improve Departure sequence acceptance Benefits will be more important at airports with a complex layout or during non-nominal situations.

This deployment is dependent on the further development of A-SMGCS routing and planning functions which is beyond the current definition of A-SMGCS Level 2.

Time Based Separation for Final Approach – Headwind Component Only

The objective is to recover loss in airport arrival capacity currently experienced in headwind conditions on final approach under distance-based wake turbulence radar separation rules. By using time-based parameters, this loss is mitigated, having a positive effect on runway throughput and runway queuing delays. Minimum radar separation is not affected.

Whilst TBS (Time-Based Separation) operations are not exclusive to a headwind on final approach, the current deployment proposal is specifically targeted at realising the potential capacity benefits in these currently constraining conditions.

Radar separation minimum and vortex separations parameters shall be integrated in the Time Based Separation support tool that provide guidance to the controller to achieve the time proposed spacing to counter the effect of the headwind.

Automated Assistance to Controller for Surface Movement Planning and Routing

The Routing and Planning functions of A-SMGCS shall provide the automatic generation of taxi routes, with the corresponding estimated taxi time and management of potential conflicts and of Departure Manager (DMAN) sequence, for mobiles operating on the movement area. This functionality goes beyond the current A-SMGCS Level 1&2 specification and further development of this standard is required.

Taxi routes can be manually modified by the ATCO before being assigned to mobiles. These routes are then available in the airport Flight Data Processing System (FDPS).

The operational concept targets large airports with a complex taxiway layout.

Procedures shall define the roles and responsibilities of ATCOs and flight crew, and notably the management of routes, depending on their status (planned, cleared or pending on an airport with multiple ground sectors).

Related Surface alerts are covered in the following Safety Nets section.

Automated Assistance to Controller for Surface Movement Planning and Routing is dependent on the deployment of electronic flight strip systems which has started in Europe.

This is expected to improve taxi times and operations in low visibility conditions. There is a safety benefit through surface conformance monitoring.

No air ground data exchange is considered for this PCP.

Airport Safety Nets

The scope of this activity is considered to cover both the Runway and Airfield Surface Movement area.

Two functions are considered as mature for deployment in the timeframe:

1 Conflicting ATC clearances: when the Tower Runway Controller provides mobiles with ATC clearances that, if followed, would bring them into conflict with other mobiles:

   Tower Runway Controller support tools shall provide the detection of Conflicting ATC Clearances and shall be performed by the ATC system based on the knowledge of data such as the clearances given to mobiles by the Tower Runway Controller, the assigned runway and holding point. Working procedures shall ensure that all clearances given to aircraft or vehicles are input in the ATC system by the controller on the Electronic Flight Strip (EFS).

   Different types of conflicting clearances shall be identified (e.g. Line-Up vs. Take-Off). Some of them shall only be based on the controller input; others shall in addition use other data such as A-SMGCS Surveillance data to confirm that an abnormal situation is detected.

The detection of Conflicting ATC Clearances shall aim to provide an early prediction of situations that if not corrected would end up in hazardous situations that would be detected in turn by the runway incursion monitoring system (RIMS) if in operation

2 Non-conformance to ATC instructions or procedures: when a mobile deviates from its assigned clearance or airport procedures:

This service shall alert ATCOs when mobiles deviate from ATC instructions, procedures or route, potentially placing the mobile at risk. The introduction of Electronic Flight Strips (EFS) means that the instructions given by the ATCO are now available electronically and shall be integrated with other data such as flight plan, surveillance, routing, published rules and procedures. The integration of this data shall allow the system to monitor the information and when inconsistencies are detected, an alert is provided to the ATCO (e.g. No push-back approval)

For both safety nets, the Controller will make the appropriate input on the EFS and give voice instructions to resolve the situation and hence cancel the alert.

The new alerts shall be considered as an additional layer on top of the existing A-SMGCS Level 2 alerts and not seen as a replacement for them. The alerts that exist today are triggered at the last moment giving the controller and flight crew very little time to react. The new alerts shall be more predictive than reactive, identifying situations that could lead to a potential incident and thus giving the controller more time to resolve the problem safely.

Enhanced runway usage awareness to reduce hazardous situations on the runway

The Runway Status Lights (RWSL) system is a support tool for flight crews and vehicle drivers.

RWSL is a surveillance driven system that automatically indicates to flight crews and vehicle drivers when it is unsafe to enter, use or cross a runway, through new airfield lights which can be composed of Runway Entrance Lights (REL), Take-off Hold Lights (THL) and Runway Intersection Lights (RIL).

In normal operations, the exchanges between actors remain the same.

Pilots and vehicle drivers shall comply with the tower runway controller's clearances, except when compliance would require crossing an illuminated red REL, RIL or THL. In such a case the pilots shall hold short of the runway for REL or stop the aircraft for THL and RIL (if possible), contact the tower runway controller and await further instructions.

If pilots notice an illuminated red REL/THL/RIL and remaining clear of the runway/aborting take-off is impractical for safety reasons, then they shall proceed according to their best judgment of safety (understanding that the illuminated REL/THL/RIL indicate the runway is unsafe to cross or enter/take-off on) and contact the tower runway controller at the earliest opportunity.

Deployment is dependent on the availability of surface surveillance normally implemented as part of ASMGCS level 1&2.

The main benefit is related to the increase of runway usage awareness, and consequently an increase of runway safety. This supports the European Performance Scheme RP2 regarding the reduction of the number of the most severe runway incursions (categories A and B).

5.2.1.3 System Impact

The main system impacts of this AF include:

- The integration of DMAN and A-CDM supporting optimised pre-departure sequencing.

- Optimised DMAN integrating an advanced A-SMGCS routing function integrated into airport flight data processing systems.
- The deployment of advanced A-SMGCS for optimised Routing along with the associated CWP development.
- A new separation tool to enable Time Based Spacing (TBS) for increased capacity through optimised spacing providing automatic monitoring and alerting.

Safety nets are enhanced by integrating A-SMGCS surveillance data and controller runway related clearances as well as introducing Airport Conformance Monitoring integrating A-SMGCS Surface Movement Routing, surveillance data and controller routing clearances.

New surface lighting capability for Runway Status Lights (RWSL) as well as RWSL automatic control systems that interface lighting and ASMGCS surveillance systems and operating rules will be deployed.

There is no impact on the airborne systems in this AF.

Departure Management Synchronised with Pre-departure sequencing

1 Impact on ground equipment

Current System Capability:

A-CDM and initial DMAN are required enablers for deployment of this AF and this capability is available today at a number of major European airports.

Electronic Flight Strips are also a pre-requisite.

No air ground data capability is required.

New Functionality:

DMAN and A-CDM systems shall be integrated, supporting optimised pre-departure sequencing with supporting information Management systems for the airline (TOBT feeding) and airport (contextual data feeding).

2 Impact on airborne equipment

No impact.

Departure Management integrating Surface Management Constraints

1 Impact on ground equipment

Current System Capability:

Initial DMAN is already deployed at a number of major European airports.

Electronic Flight Strips are a pre-requisite.

No air ground data capability is required.

New Functionality:

Current DMAN systems shall be updated to take account of variable and updated taxi times to calculate the TTOT and TSAT. Interfaces between DMAN and A-SMGCS routing shall be developed.

Optimised DMAN integrating A-SMGCS constraints using Electronic Flight Strips with an advanced A-SMGCS routing function shall be integrated into airport flight data processing systems for departure sequencing and routing computation.

An A-SMGCS routing function shall be deployed which goes beyond the current ASMGCS Level 1&2 specification. This can be considered as an A-SMGCS level 2+.

An updated controller working position shall be developed to integrate the updated A-SMGCS and DMAN tools.

2 Impact on airborne equipment

No impact.

Time Based Separation for Final Approach – Headwind Only

1 Impact on ground equipment

Current System Capability:

Initial AMAN is already deployed at a number of major European airports.

Safety nets are already deployed.

Minimum radar separation and wake vortex standards are parameter inputs.

New Functionality:

The FDP/sequencing tool (i.e. AMAN) shall be modified to be compatible with TBS and able to switch between time and current distance based wake turbulence radar separation rules. Switching from TBS to Distance Based Separation (DBS) is necessary to cover contingency and other locally-driven requirements.

The CWP shall be updated to integrate the new TBS tool with safety nets to support the relevant approach controller and tower runway controller, specifically required to calculate TBS distance respecting minimum radar separation using actual glide slope wind conditions.

The new separation tool shall provide automatic monitoring and alerting on non-conformant final approach airspeed behaviour, Automatic monitoring and alerting of separation infringement, Automatic monitoring and alerting for the wrong aircraft being turned on to a separation indicator.

The TBS tool and associated CWP shall also calculate Indicator distance, display indicator distance on controller displays and include radar and vortex spacing requirements.

There is no relaxation of radar separation minima under this concept. Nonetheless, safety nets capturing automatic monitoring and alerting of separation infringement require adaptation to fit a TBS operation, and specifically, safety nets for individual TMA operations shall be reviewed to take into account the mitigations used to manage some of the identified hazards in the context of TBS.

2 Impact on airborne equipment

No impact.

Automated Assistance to Controller for Surface Movement Planning and Routing

1 Impact on ground equipment

Current System Capability:

A-SMGCS Level 1 & 2 is already deployed at a number of major European airports.

Electronic Flight Strips are a pre-requisite.

No air ground data capability is required.

New Functionality:

An advanced A-SMGCS routing and planning function shall calculate the most operationally relevant route as free as possible of conflicts which permits the aircraft to go from stand to runway/ from runway to stand or any other surface movement. This shall be a further development of the current ASMGCS Level 1 and 2 specifications (which can be considered as ASMGCS level 2+).

The CWP shall be updated with appropriate human-machine interface systems to interact with surface route trajectory.

The airport FDPS shall be able to receive planned and cleared routes assigned to mobiles and manage the status of the route for all concerned mobiles. These routes shall then be made available in the airport FDPS.

Related Surface alerts are covered in the dedicated Safety Nets section below.

2 Impact on airborne equipment

No impact.

Airport Safety Nets

1 Impact on ground equipment

Current System Capability:

The deployment of Electronic Flight Strip systems is a prerequisite and it is assumed that the surveillance aspects of A-SMGCS (Level 1 and 2) will also already be deployed.

No air ground data capability is required.

New Functionality

Airport safety nets shall be enhanced by integrating A-SMGCS surveillance data and controller runway related clearances as well as introducing Airport Conformance Monitoring integrating A-SMGCS Surface Movement Routing, surveillance data and controller routing clearances.

A-SMGCS shall include the advanced routing and planning Function discussed in the preceding sections in addition to Level 1 and 2 capability to fully support conformance monitoring alerts.

A-SMGCS shall include a new function to generate and distribute the appropriate alerts.

The CWP shall be updated to host warnings and alerts with an appropriate human machine interface (including support for cancelling an alert).

Electronic Flight Strips (EFS) shall integrate the instructions given by the ATCO with other data such as flight plan, surveillance, routing, published rules and procedures. The integration of this data allows the system to monitor the information and when inconsistencies are detected and provides alerts to the ATCO.

Standards

Common European Operational procedures will be required with a generic safety case.

The A-SMGCS standards will require to be updated with the additional routing and planning functions. This will need to be done through EUROCAE WG-41.

2 Impact on airborne equipment

There is no impact.

Enhanced runway usage awareness to reduce hazardous situations on the runway

1 Impact on ground equipment

Current System Capability:

No current lighting capability.

A-SMGCS Level 1 and 2 is available and deployed at major European airports.

New Functionality

RWSL shall be implemented as a fully automatic system based on the A-SMGCS (Advanced Surface Movement Guidance and Control System) surveillance.

A new control function generating the appropriate status for the airport Field Lighting System according to surface, runway and landing traffic movements in relation to runway occupancy status shall be implemented. The A-SMGCS (including surveillance) and RWSL systems and operating rules shall be integrated.

Information on runway usage shall be directly made available to the vehicle drivers and flight crews through new airfield lights (i.e. Runway Entrance Lights and Take-off Holding Lights; Runway Intersection Lights in case of crossing runways).

The Tower controller CWP shall display the status of lights (red/switched-off) and the status of the system.

Standards

Operational standards are in process in ICAO.

The A-SMGCS standards will require to be updated with the integration of the RWSL operation. This will need to be done through EUROCAE WG-41.

2 Impact on airborne equipment

There is no impact.

5.2.2 Geographical scope of implementation and association timeframes

5.2.2.1 Geographical scope

Time-based separation

The implementation is targeted on the following 17 airports: London-Heathrow, London-Gatwick, Madrid-Barajas, Amsterdam-Schiphol, Frankfurt, Rome-Fiumicino, Munich, Vienna, Zurich, Paris-Orly, Oslo, Düsseldorf, Milan-Malpensa, Manchester, Copenhagen, Dublin and Istanbul.

This selection was made on the basis of the Performance Review Report of EUROCONTROL's PRC (PRR 2012) showing an additional ASMA time above the European average as well as the impact of the wind conditions at the 30 major European airports.

Runway Status Lighting Systems

The implementation is targeted on the following 15 airports: Madrid, Rome-Fiumicino, Palma, London-Heathrow, Paris-CDG, Amsterdam-Schiphol, Frankfurt, Zurich, Copenhagen, Vienna, Brussels, Milan-Malpensa, Paris-Orly, Stockholm-Arlanda and Istanbul.

This selection is based on the operational environment requirements described in SESAR requirements documents and an analysis performed by airport experts taking into account the particular need of each European airport. In this document the suitability of the solution to an airport is defined according to criteria such as level of traffic vs. hub constraints, multiple runways and complex layout, and safety level according to the runway incursion criteria.

Airports safety nets

The implementation is targeted on the same airports as for AF # 1, i.e.: London-Heathrow, Paris-CDG, London-Gatwick, Paris-Orly, London-Stansted, Milan-Malpensa, Frankfurt, Madrid-Barajas, Amsterdam-Schiphol, Munich, Rome-Fiumicino, Barcelona, Zurich, Düsseldorf, Brussels, Oslo, Stockholm-Arlanda, Berlin, Manchester, Palma, Copenhagen, Vienna, Dublin, Nice, Istanbul.

CWP and A-SMGCS optimised routing

The implementation is targeted on the same airports as for AF # 1, i.e.: London-Heathrow, Paris-CDG, London-Gatwick, Paris-Orly, London-Stansted, Milan-Malpensa, Frankfurt, Madrid-Barajas, Amsterdam-Schiphol, Munich, Rome-Fiumicino, Barcelona, Zurich, Düsseldorf, Brussels, Oslo, Stockholm-Arlanda, Berlin, Manchester, Palma, Copenhagen, Vienna, Dublin, Nice, Istanbul.

Further details with regards to the geographical scope of implementation can be found in Appendix D.

5.2.2.2 Implementation timeframes:

Sub-systems	Start of Investment	End of Investment	Start of Deployment	End of Deployment
DMAN A-CDM	2014	2020	2015	2020
Time Based Separation	2014	2023	2017	2023
Airports Safety Nets	2014	2020	2015	2020
CWP and A-SMGCS Optimised Routing	2014	2023	2018	2023
Runway Status Lighting Systems	2014	2020	2015	2020

Table 4: Implementation dates for AF # 2 subsystems

5.2.3 Regulatory and standardisation needs

5.2.3.1 Regulatory needs

On Time Based Wake Vortex Separation, and Distance Based Wake Turbulence Radar Separation, means of compliance can be issued by EASA; these would deviate from ICAO, as timeframe for ICAO would be incompatible with PCP. It is noted that EASA has not this activity in its rulemaking plan yet. If the activity is triggered soon, the risk of not having the result in due time would be low. This activity has to be closely monitored.

On Time Based Separation tools, it is foreseen the need to have means of compliance issued by the Commission. If the associated standardisation activity is not initiated as soon as possible, the risk of not having the means of compliance available in due time is high, resulting in a non-harmonised deployment of the AF. Deployment will be subject to local safety case and there is no specific impact expected on ICAO or EASA regulations. Deployment will be consistent with aspects of RECAT EU expected adoption by end of 2013.

On ground systems and constituents for AMAN/DMAN, it is foreseen the need to have means of compliance that would require the initiation of the activity as soon as possible, either through a Commission mandate or as part of EASA rulemaking plan. Otherwise, the risk of not having it available in due time would be high, with the risk of a delayed or non-harmonised implementation of the AF.

There would be a need for an update of the Community Specification on airport CDM in line with the updated EUROCAE reference documents. If the associated standardisation activity is not initiated as soon as possible, there is a high risk of not having the need satisfied in due time, with a negative impact on the harmonised implementation of the AF.

On the ASMGCS, it is foreseen a need for an update of the existing Community Specification in line with the updated EUROCAE reference documents; if the associated standardisation activity is not initiated as soon as possible, there is a high risk of not having the need satisfied in due time, with a negative impact on the harmonised implementation of the AF.

Further details with regards to the regulatory needs can be found in Appendix E.

5.2.3.2 Standardisation needs

It must be noted that the needs on the AMAN standardisation activities described in AF #1 will be also impacting this AF # 2. Interdependencies between both AFs in the field of AMAN standardisation have to be considered when monitoring standardisation progress in both.

To support Time Based Separation, it is foreseen the need to have standards at the level of performance specifications for AMAN and TBS tools, which do not exist today. The risk of not satisfying this need is high, with a negative impact in industrialization and consequently potential delays in the deployment of this AF. It is required the initiation of the activity in EUROCAE as soon as possible.

European standards already exist for A-CDM (EUROCAE standards and a Community Specification published by ETSI which references the EUROCAE documents); integration of the A-CDM with initial DMAN will require an update of the A-CDM standards within EUROCAE to support the AF deployment. If the activity is not initiated as soon as possible, the risk of not satisfying this need is high, with a negative impact in the harmonised deployment of this AF.

European standards already exist for A-SMGCS Level 1&2 (EUROCAE standards and a Community Specification published by ETSI which references the EUROCAE documents). \It is foreseen a need to initiate activity in EUROCAE, as soon as possible, to update these existing standards with due consideration to routing, alerting and planning functions adapted to PCP, together with RWSL operation to ASMGCS Level 3 (or potentially Level 2+ as required for the AF). Otherwise, there is a high risk of not satisfying the need, with a negative impact in the harmonised deployment of this AF.

Further details with regards standardization needs can be found in Appendix E.

5.2.4 Alignment with safety requirements

This analysis is the result of the evaluation of the level of development of Safety Assessment Reports and the review of the ATM Functionality technical documentation from an Authority point of view, done by the Expert Groups and by EASA. As conclusions, the following items can be mentioned:

Safety Assessments Reports have been completed on:

- Conflicting ATC Clearances
- TBS for arrivals
- Conformance Monitoring
- A-SMGCS Guidance Function
- Safety Plan has been completed on Separation Minima Reduction.

As a result of the analysis, some other items were found which would require further action previously to the full deployment of this AF. These items are the following:

- Safety Assessment Report for A-SMGCS integrating Routing and Planning functions should be completed.
- There is a need to confirm that the Safety Assessment Report for SESAR CWP is covering the safety aspects related to the integration of A-SMGCS in the SESAR CWP.
- There is a need for a generic Safety Assessment Report on RWSL.

The review by EASA of the existing Safety Assessment Reports, as well as the review of the ones delivered in the future, should be completed. Due consideration should be given also to their review by National Authorities.

When moving from distance based separations to time based separations the specific impact of the TBS tools on the following systems/functions will need to be assessed also from a safety point of view:

- AMAN
- Safety nets (for final approach)
- Surveillance systems and procedures

As a result of the analysis, some other items were found which would require further action previously to the full deployment of this AF. These items are the following:

- It would be opportune to have a confirmation that there is no need for a specific safety assessment on DMAN with pre-departure sequencing planning tool and DMAN with A-SMGCS.
- When planning concrete deployment, relevance of electronic flight strips for pre-departure sequencing and DMAN coordination can be confirmed, considering its relevance to safety.

Finally, some recommendations for the local implementation of the AF are issued:

- SMAN integration with AMAN and DMAN might be considered for each particular local application implementation.
- As part of the safety case for local implementation (in compliance with Commission Regulation 1034/2011), it has to be confirmed that safety targets on Runway Incursions are taken into account.
- Under a “total system approach” (as required by Commission Regulation 1034/2011), interdependencies between new and existing functions should be checked in each local implementation situation.
- Local declarations of conformity will be needed in accordance with Commission Regulation 552/2004.

5.2.5 Cost-benefit analysis

This AF is expected to improve runway safety and throughput, ensuring benefits in terms of fuel consumption and delay reduction as well as airport and airspace capacity.

Although the value of safety improvements were not monetised, the NPV would amount to 0,2 billion €, with a 10 years pay-back period.

The distribution of costs, benefits and cumulated net benefits over the considered time period is represented in the following chart.

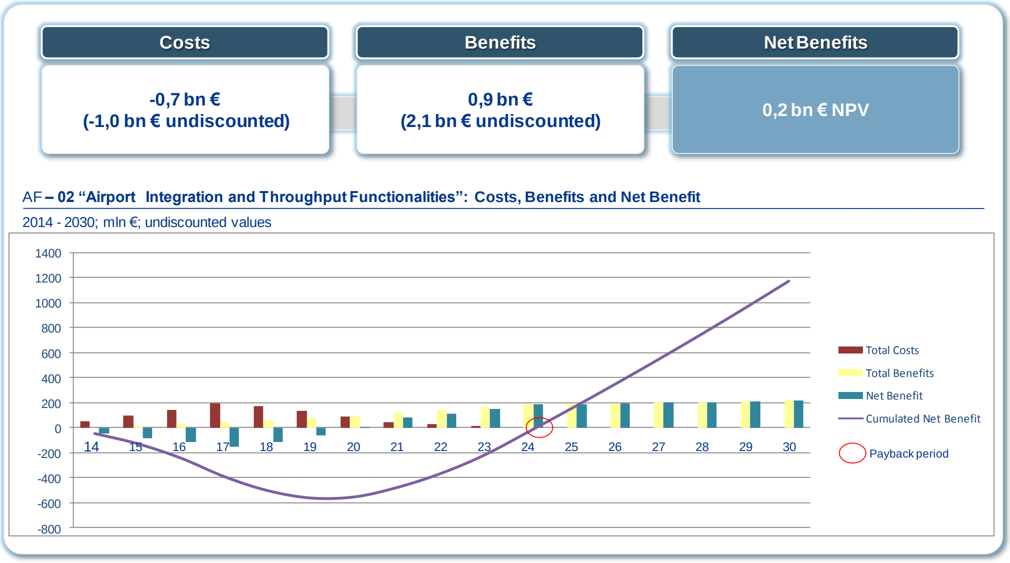


Figure 22: Overall CBA for AF # 2

Over 90% of benefits are related to fuel cost savings. The implementation of this AF would ensure a reduction of around 2 million tonnes in the overall fuel consumption over the 2014 – 2030 time period, thus enabling fuel costs savings for around 0,8 billion € (1,9 billion € undiscounted)

Moreover, such reduction in terms of fuel consumption would have a positive impact on the environment, with a reduction of CO_2 emissions exceeding 6,0 million tonnes.

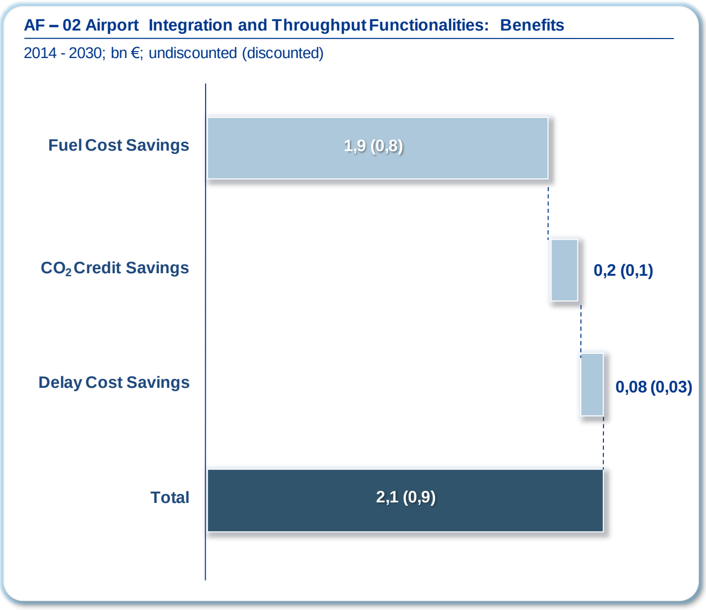


Figure 23: Breakdown of benefits for AF # 2

The overall cost associated to this AF is expected to be shared by two stakeholders' categories, namely ANSPs (84% of total investment) and Airport Operators (16% of total investment).

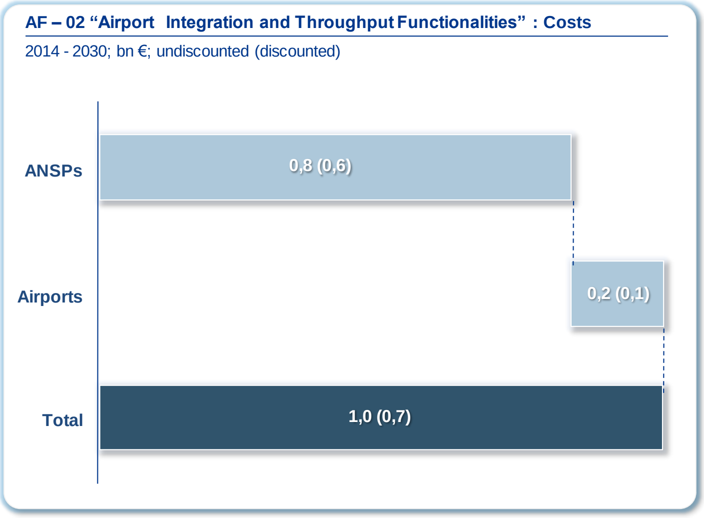


Figure 24: Breakdown of costs per stakeholder for AF # 2

In particular, the overall investment would be related to the implementation of five different sub-systems:

- "DMAN A-CDM", whose cost accounts for 36% of total investment
- "TBS", whose cost accounts for 30% of total investment
- "Airport safety Net", whose cost accounts for 7% of total investment
- "CWP and A-SMGCS Optimised Routing", whose cost accounts for 14% of total investment
- "RWSL", whose cost accounts for 13% of total investment

5.3 AF # 3: Flexible Airspace Management and Free Route

5.3.1 Description of the AF ("What" and "why")

5.3.1.1 Scope and Outline

"Flexible Airspace Management and Free Route" covers the European network for AFUA, and all en route sectors above FL310 for Free Route Operations.

AF # 3 aims at the deployment of Free Route operations at the Regional Level to allow airspace users (AUs) to freely plan a route between fixed published entry and exit points, with the possibility to route via intermediate (published or unpublished) way points, without reference to the published ATS route network, subject to airspace availability. Free Route will be deployed both through the use of permanent Directs (DCTs), published within the conventional fixed-route network, and through Free Route Airspace (FRA), where AUs are free to define and fly via user-defined points and segments not previously published.

Advanced Flexible Use of Airspace (AFUA) will be utilised to support more efficient use of airspace via a more intense use of airspace configurations, modular areas and cross-border areas through a continuous CDM process, the output of which is shared in real time by all ATM stakeholders.

Advanced controller tools, such as Medium-Term Conflict Detection (MTCD), Conflict Resolution Advisories (CORA) and Conformance Monitoring (CM) will support the provision of the evolving concept of operations.

5.3.1.2 Operational Requirement

Airspace Management and Advanced Flexible Use of Airspace

The possibility to design ad-hoc structure delineation at short notice is offered to respond to short-term Airspace Users' requirements not covered by pre-defined structures and/or scenarios. Changes in the airspace status shall be shared with all other concerned users by the system, i.e. Network Manager (ASM and ATFCM function), ANSPs, civil and military Airspace Users (FOC/WOC) but are not uplinked to the pilot. For example, military/police/search & rescue/etc… will request the change, the relevant ANSP shall process/action this segregated airspace change then publish the output using ASM systems connected via SWIM. ASM procedures and processes shall be required to change from procedures and processes based on a fixed ATS route structure surrounding published segregated airspace to a new environment where airspace is managed dynamically to meet the changing needs of civil and military AUs.

Data-sharing shall be enhanced with respect to the availability of civil/military airspace structures in support of a more dynamic ASM and FRA implementation.

ASM solutions shall be adapted in support of all airspace users, including enabling the alignment of FRA, CDR & DCT availability based on forecast demand received from the NM, which provides enhanced ASM network assessment.

There will be enhanced cooperation during the medium to short-term planning phases (i.e. during the integration of ASM/ATFCM planning activity). Furthermore, there will also be enhanced cooperation at the tactical level (i.e. FUA level 3).

Free Routing

Free routing is the ability of an Airspace User to file (and fly) a flight plan, or trajectory, which includes a significant segment of the intended route that is not defined using published airway segments but is instead specified by the airspace user.

Outside dedicated FRA, a limited free-routing capability shall be enabled by publishing ‘directs’ (DCT), which will allow AUs to fly between fixed way-points on a published route without following the entire published route.

Within FRA AUs shall follow user-preferred routes; in most cases there are no published way-points, except on entering and leaving FRA, although their existence may be required under specific local circumstances.

Free-Routing via DCT

In a fixed-route network, it is possible that there may be opportunities to shorten the routes flown by aircraft by flying direct from one way-point to another non-sequential way-point on the same, or different published route. Although direct routes are already frequently offered tactically, the difference here is that the DCTs shall be published as such in aeronautical publications and shall be available for flight planning.

DCTs only exist where there is a fixed-route network and shall always route from one published way-point to another. Their availability may be subject to traffic demand and/or time constraints.

Free-Routing in FRA

FRA is airspace where there is no fixed-route network and no published way-points. Aircraft may file and fly along a route following way-points defined by the airspace users. FRA shall be published in aeronautical publications and has a defined Volume of Interest (VOI) with lateral, vertical and possibly temporal limits. It may be necessary, for example, to limit the availability of FRA in certain high-density areas. The lateral limits of a VOI may be relatively small, for example defined within the boundaries of an FIR, or it may be an entire FIR or even across multiple FIRs, for example across a FAB. The vertical limits can be defined to meet specific needs. Where FRA is established only between published hours, a fixed-route network shall be established for those times then FRA is not active.

Entry and exit to FRA shall be via defined way-points which themselves form part of the adjacent fixed-route network. Once inside FRA, AUs shall be free to define their own routes and, whilst it is anticipated that such routes will usually seek to be straight lines between entry and exit points, AUs may define multiple way-points to follow, for example, a great-circle route.

Medium Term Conflict Detection with Conflict Resolution Advisories and Conformance Monitoring

The system shall provide real-time assistance to the tactical controller for monitoring trajectory conformance and provides resolution-advisory information based upon predicted conflict detection.

Trajectory prediction & de-confliction shall provide the Tactical Controller (at sector level and in real time) with an automated Medium Term Conflict Detection tool with resolution advisory information.

5.3.1.3 System Impact

ATM systems shall be able to support variable and dynamic Airspace Configurations developed and agreed through a continuous CDM process.

Data repositories are required that include information on real-time airspace status and traffic demand, for closer to real-time optimisation.

Tools shall enable FPL checks against current and planned airspace status.

Flight Data Processing systems shall be modified to support FRA (incl. incremental trajectory exchange capabilities).

Enhanced Controller Working Positions might include conflict detection and resolution tools that identify and provide resolution advisories for the increasingly variable conflict points that are anticipated to exist within FRA.

Airspace Management and Advanced Flexible Use of Airspace

1 Impact on ground equipment

Current System Capability:

FUA is currently implemented via an exchange of data between national authorities, who follow their own processes to agree civil/military Airspace Utilisation Plans and transmit them, typically once per day, to the NM. Periodic updates are also transmitted, known as Updated Utilisation Plans (UUP). The update process is moving from fixed update times to a rolling UUP, where data can be supplied continuously.

The NM systems hold environment data – that is data that are extracted from national AIPs – which describe published airspace structures. The AUP/UUP information is added to this environment data to form the basis upon which ASM decisions are made, such as activation of CDRs, Managed Danger Areas and unusual aerial activity. Entry of airspace coordinates for areas not defined in the environment data is often a manual process.

Interaction between ASM and ATFCM systems is by messaging or, in some cases, manual data entry. Interface to ATS systems is usually via the Integrated Flight-plan Processing System (IFPS), Surveillance Data Processing Systems (SDPS) and FDPS.

New Functionality

The key tenet for new functionality to support AFUA is better integration of ASM, ATS and ATFCM aspects, as described below:

- ASM Systems

  The ASM support system shall support the fixed and conditional route networks currently in place, as well as new DCTs, FRA and dynamic airspace configurations, able to consider both civil and military demands. The system shall be able to respond to changing demands in near real-time to allow civil and military airspace users trajectories to be impacted as little as possible by the changing demands on the network, in a predictable and plannable manner. Interactions with the system shall be through a rolling CDM process between all relevant stakeholders, at local and sub-regional levels, resulting in continuous enhancements to the NOP. The system shall support cross-border activities, resulting in shared use of segregated airspace regardless of national boundaries.

  Airspace configurations shall be accessible via the Airspace Data Repository (ADR), which will always contain the up-to-date and foreseen airspace configurations, to allow users to file and modify their FPLs based on current and accurate information.

  The ATM system shall support flexible configuration of ATC sectors so that their dimensions and operating hours can be optimised according to the demands of the NOP.

  The system shall allow a continuous assessment of impact of the changing airspace configurations to be made to support ATFCM.

- ATFCM Systems

  Although one of the aims of the improvements in system interactions described above is to lessen the need for ATFCM, ATFCM systems shall support an increasingly-dynamic flow management environment. The ATFCM system, therefore, shall be able to interact with the ASM and ATS systems to perform DCB and enable appropriate and timely ATFCM measures to be implemented, using tools such as the Enhanced Tactical Flow Management System (ETFMS).

- ATC Systems

  Greater integration between ground systems will also have an impact on systems that support direct provision of ATS, in particular the FDPS, SDPS and human-machine interface systems, such as the controllers' displays. As airspace and route information changes, these systems shall reflect the changes in a seamless and timely manner to enable a smooth and continuous provision of services. The ability to reflect changing sectorisation, the activation and de-activation of dynamic airspace blocks and the change of a volume of airspace from a fixed route network to FRA are key changes that need to be understood and correctly represented in the ATS systems.

  The IFPS shall be modified to reflect the changes in the definition of airspace and routes so that the routes, flight-progress and associated information can be made available to the ATC systems.

  In an environment where airspace and route structures are dynamic, it is important that external agencies such as military ATC and air defence (AD) units work on the same information. Consequently, the ASM, ATFCM and ATS systems shall interface to such systems in a way that allows their users to provide services based on a common understanding of the airspace and traffic environment. The systems of these external actors shall be modified to enable this functionality.

- AIS systems

  Centralised AIS systems, such as the EAD, shall be able to promulgate this information to all affected stakeholders in a timely manner so that planning may be undertaken based on accurate information relevant to the time of the planned operations. Local AIS systems shall be updated to enable this functionality, and to enable the upload of changing local data.

- Other systems

  With the increasing integration of AOP and NOP, airlines, airports and military planners shall be able to interface effectively with the new systems. Consequently, interfaces shall be defined to allow dynamic data to be sent to the external stakeholders' systems, and for those stakeholders to be able to communicate information in an accurate and timely manner. The systems of these external actors shall be modified to enable this functionality.

2 Impact on airborne equipment

No impact.

Free-Routing via DCT

1 Impact on ground equipment

Current System Capability:

ANSPs currently have the ability to clear flights to fly DCT between non-sequential published way-points, but this is a tactical intervention. Pass updated info to ATC support tools Some ANSPs already publish DCTs that are plannable, but this facility is not widespread.

New Functionality

NM systems:

The NM system shall be updated to enable Flight plan processing and checking for selection of DCTs.

ANSP systems: no impact.

Airspace Users systems: no impact.

2 Impact on airborne equipment

No impact.

Free Routing in FRA

1 Impact on ground equipment

Current System Capability:

Fixed route structures underpin the current ATM concept and current systems are capable of supporting DCT

New Functionality

Ground systems shall be modified to support free-route operations as listed below.

- NM systems shall implement the following functionality:
  - Flight plan processing and checking for Free Route Operations Airspace;
  - IFPS real-time routing proposals based on FRA;

- ETFMS/IFPS to deal with a more flexible and dynamic sector configuration to the traffic demand/pattern;
- ATFCM planning within Free Route Operations Airspace;
- Tools for re-routeing;
- Tool to calculate and manage traffic loads at FMP and central level.

- ANSP systems shall implement the following functionality:
  - Adaptation of FDP system, including HMI considerations, which shall be able to:
    - Manage trajectory/FPL without reference to the ATS network; and
    - Pass updated info to ATC support tools.
  - Adaptation of Flight Planning systems to support FRA and cross-border operations;
  - Establishment of ASM/ATFCM tools able to manage different airspace availability and sectors capacity in FRA (including civil/military coordination, RAD adaptation to FRA and STAM); and
  - Evolution/Establishment of ATC support tools like Conflict Detection Tools (CDT), Conflict Resolution Assistant (CORA), Conformance Monitoring, and APW for mobile or ad hoc areas).
- ANSP systems may implement:
  - The capability to receive and utilise updated flight data coming from an aircraft, in which case data link functionality will be required.
- Airspace Users systems: computer flight planning systems shall be upgraded to meet full concept.

2 Impact on airborne equipment

No impact.

Medium Term Conflict Detection with Conflict Resolution Advisories and Conformance Monitoring

1 Impact on ground equipment

Current System Capability

MTCD, CORA and CM tools are deployed unevenly across Europe, with local implementations based on user need. Their ability to deal with FRA, DCT and AFUA will vary across implementations.

New Functionality

FDPS and SDPS shall be updated to support the introduction of new routing and ASM concepts and the consequent evolution or development of ATC support tools such as MTCD, CORA and CM. In addition, safety nets shall be modified to be able to function correctly in the new environments.

The new operating environments may require changes in the way that controllers interact with pilots, and so modifications may be necessary in the Controller Working Position.

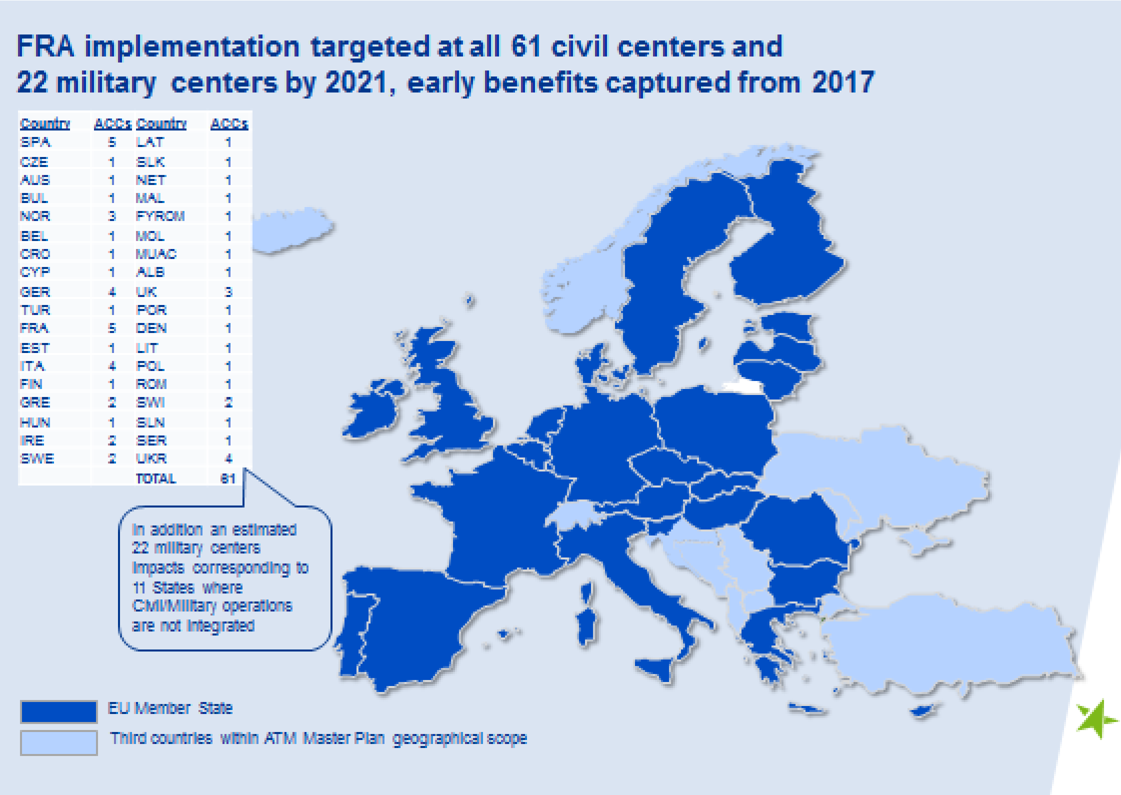
2 Impact on airborne equipment

No impact.

5.3.2 Geographical scope of implementation and associated timeframes

5.3.2.1 Geographical scope

Free Route Airspace implementation shall be applied on the entire European network above FL310. In this case, all 61 civil Air Traffic Control Centres of the EUROCONTROL Member States plus Estonia and 22 military Air Traffic Control Centres (corresponding to those eleven States where Civil / Military operations are not integrated) are concerned by the implementation."



Country	ACCs	Country	ACCs
SPA	5	LAT	1
CZE	1	SLK	1
AUS	1	NET	1
BUL	1	MAL	1
NOR	3	FYROM	1
BEL	1	MOL	1
CRO	1	MUAC	1
CYP	1	ALB	1
GER	4	UK	3
TUR	1	POR	1
FRA	5	DEN	1
EST	1	LIT	1
ITA	4	POL	1
FIN	1	ROM	1
GRE	2	SWI	2
HUN	1	SLN	1
IRE	2	SER	1
SWE	2	UKR	4
		TOTAL	61

Figure 25: Geographical scope of implementation of AF # 3

The proposal to implement Free Route operations above FL 310, rather than the other options envisaged of FL 270 or FL 370, results from the finding that FL 310 is the flight level above which maximum benefits are to be achieved in relation to the amount of controlled traffic. Implementation at the FL 270 would lead to a marginal improvement of the benefit while an implementation at FL 370 would halve the NPV. This analysis is illustrated in the two figures below.

However, it must be noted that the implementation of this ATM Functionality can be incremental and that intermediate steps at different flight levels can be envisaged as part of the Deployment Programme.

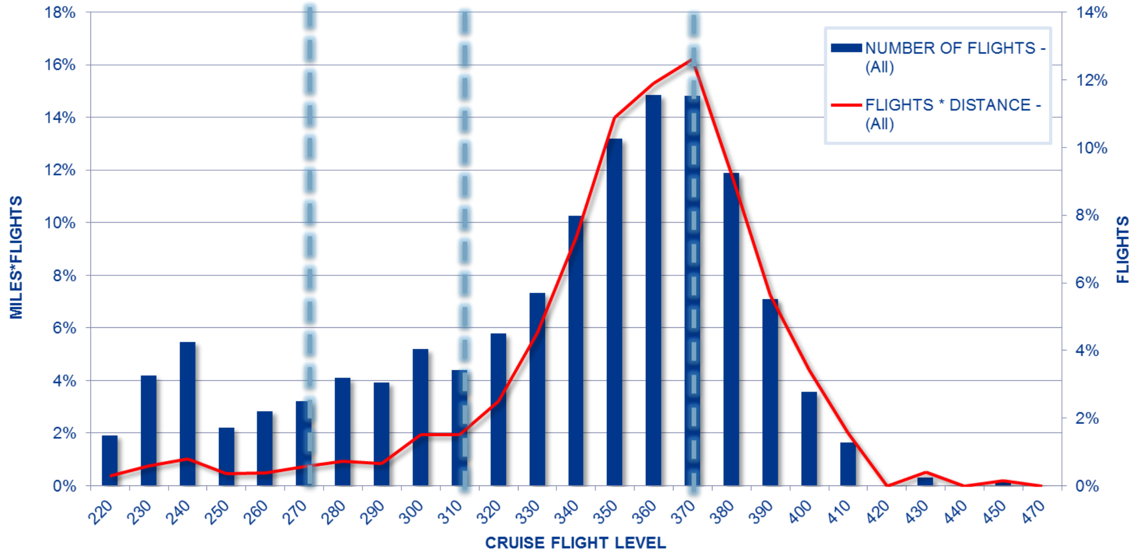


Figure 26: Distribution of traffic per Flight Level, June 2012

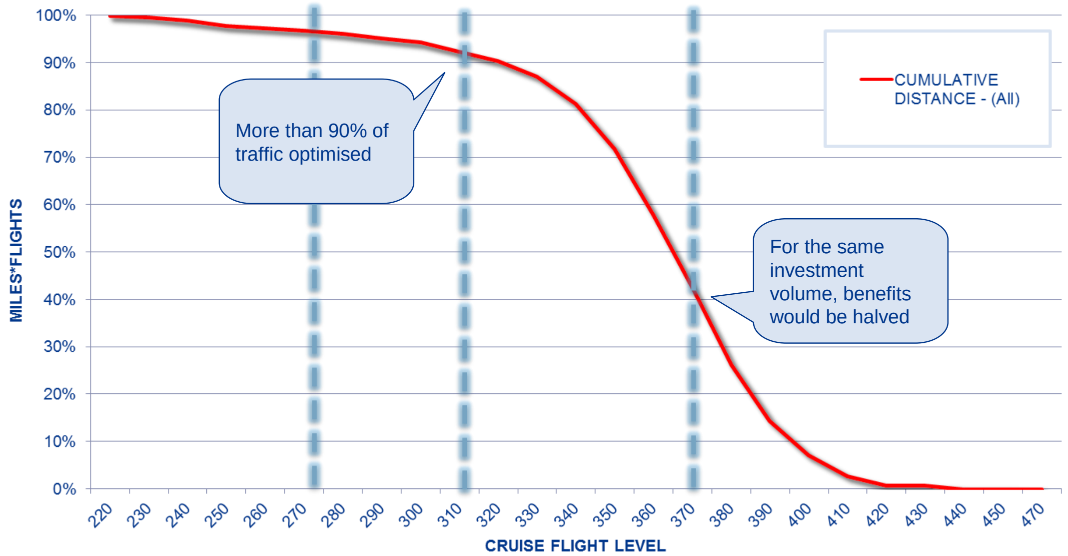


Figure 27: Cumulative share of traffic per Flight Level, June 2012

Further details with regards to the geographical scope of implementation can be found in Appendix D.

5.3.2.2 Implementation time frames

2017 is the target date for full implementation of Direct Routing from FL310 at network level[9].

2021 is the target date for full implementation of Free Route Airspace from FL310 at network level.

[9] Several ANSPs have already started to implement Free Route and deployment will continue under the IDP. Benefits have already started to occur. The date of 2017 for benefits defines the date at which network level benefits are expected to be reached.

Start of Investment	End of Investment	Start of Benefit	Full Benefit	Start of Deployment	End of Deployment
2014	2021	2017	2022	2017	2021

Table 5: Implementation dates for AF # 3

5.3.3 Regulatory and standardisation needs

There are no specific regulatory or standardisation needs identified for this AF.

5.3.4 Alignment with safety requirements

This analysis is the result of the evaluation of the level of development of Safety Assessment Reports and the review of the ATM Functionality technical documentation from an Authority point of view, done by the Expert Groups and by EASA. As conclusions, the following items can be mentioned:

- Free Routing Safety Plan has been completed.
- The Free Routing Safety Assessment is conducted in relation to Medium Term Conflict Detection.
- Safety Assessment for Medium Term Conflict Detection has been completed.

As a result of the analysis, some other items were found which would require further action previously to the full deployment of this AF. These items are the following:

- Completing the Free Routing Safety Assessment Report for its full scope.
- The review by EASA of the existing Safety Assessment Reports, as well as the review of the ones delivered in the future, should be completed. Due consideration should be given also to their review by National Authorities. Any further evolution of A-FUA would require a verification of the validity of the considerations given to FUA in the PCP

5.3.5 Cost-benefit analysis

This AF would enable a more efficient use of airspace, thus providing significant benefits linked to fuel consumption and delay reduction.

The NPV amounts to 1,3 billion €, with a 7 years payback period.

The distribution of costs, benefits and cumulated net benefits over the considered time period is represented in the following chart.

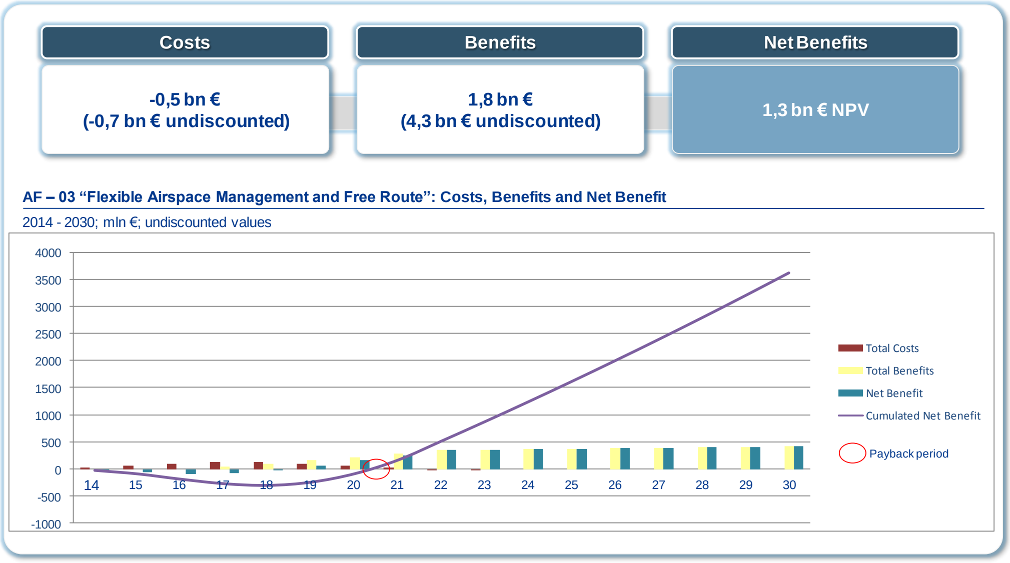


Figure 28: Overall CBA for AF # 3

The implementation of this AF would generate savings associated to fuel costs exceeding 1,6 billion € (3,8 billion €), deriving from a reduction in fuel consumption of around 4 million tonnes over the 2014 – 2030 time period.

The decrease in fuel consumption would also bring important benefits for the environment, with a reduction of CO_2 emissions exceeding 12 million tonnes.

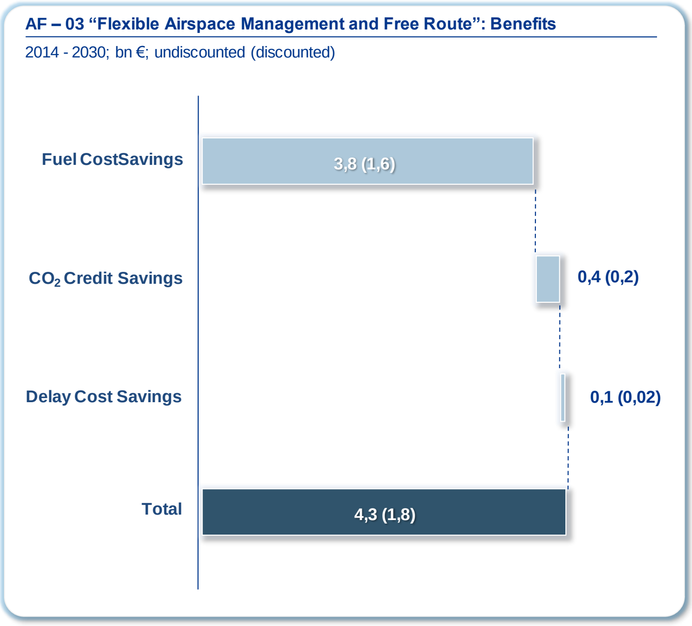


Figure 29: Breakdown of benefits for AF # 3

ANSPs, Military, Airspace Users and Network Manager would be expected to contribute as investors for the implementation of this AF.

In particular, the overall cost, amounting at 0,5 billion € (0,7 billion € undiscounted) would be shared by the different stakeholders' categories as follows:

- ANSPs: 75% of total investment;

- Military: 22% of total investment;
- Network Manager: 2% of total investment;
- Airspace Users (ground investment): 1% of total investment.

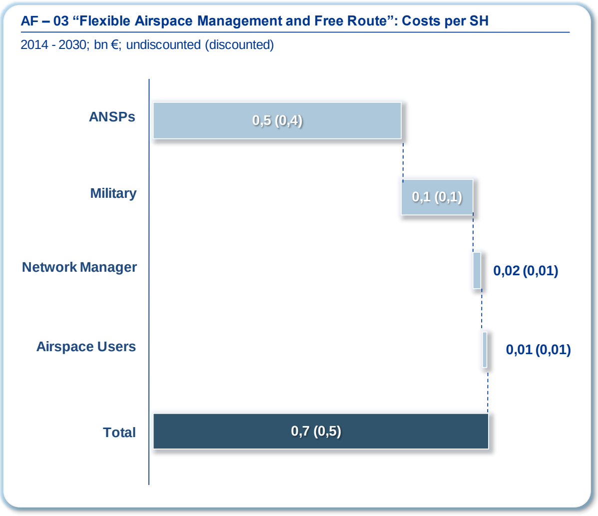


Figure 30: Breakdown of costs per stakeholder for AF # 3

5.4 AF # 4: Network Collaborative Management (Flow & NOP)

5.4.1 Description of the AF ("What" and "why"):

5.4.1.1 Scope and Outline

"Network Collaborative Management (Flow & NOP)" covers improvement of the European ATM network performance. It shall support Airspace Users, Airport Operators and ANSPs in meeting their business objectives by increasing cost-efficiency through improved network performance, notably capacity and flight efficiency. Flow Management shall be refined to move to a Cooperative Traffic Management (CTM) environment, optimising the delivery of traffic into sectors and airports. This will make better use of available resources, while minimising the need for current ATFCM regulations and supporting arrival sequencing. The quality and timeliness of the network information shared by all ATM stakeholders will be improved.

A key element of collaborative network management is the exchange, modification and management of trajectory information. All NOP and AOP stakeholders have a varying influence on the evolution of a flight's trajectory and so collaboration between them is vital. AF# 4 considers the network aspects of this collaboration and is supported by the 'Initial Trajectory Information Sharing' defined in AF# 6. AF# 6 itself includes the first steps towards improved predictability at both Network and local level through the improved use of target times and trajectory information.

5.4.1.2 Operational Description

This AF comprises three elements:

1. Enhanced Short Term ATFCM Measures;
2. Collaborative NOP for Step 1; and
3. CTOT to Target Times for ATFCM purposes.

Optionally, a further element may be included:

4. Automated Support for Traffic Complexity Assessment

Enhanced Short Term ATFCM Measures

ANSPs shall adopt and improve the tactical capacity management procedures to optimize capacity throughput (with the use of Short Term ATFCM Measures – STAM). The tactical capacity management procedures shall be supported by automated tools for hot-spot detections in the network view, and for promulgation and implementation of STAM, including CDM. These tools are envisaged to be at local or regional network management function level and shall be applicable in the pre-tactical timeframe (e.g. up to 2 hours before flights enter a sector).

Tactical capacity management procedures using STAM shall be enhanced in order to ensure a close and efficient working relationship between ATC and the network management function.

Collaborative NOP for Step 1

A Collaborative NOP Information structure (information model, classification by types of actions, influencers, performance objectives, relationships between actions, objectives, issues, etc.) shall be available. The Collaborative NOP shall be updated through data exchanges between Network Manager and stakeholders' systems to the required level of service. This will enable the Network Manager and stakeholders to prepare and share operational decisions (e.g. TTA, STAM) and their justifications in real-time. The focus shall be on the time period from Day -7 until the day of operations. In addition to data currently available, airports' constraints (AOP-NOP integration) and severe weather impacting capacity shall be accommodated.

Integration of information between the AOP and NOP optimises the network and airport management by timely and simultaneously updating AOP and NOP, providing Network and Airport Managers with a commonly updated, consistent and accurate Plan.

Network KPIs will be developed and monitored using the collaborative NOP information platform for giving feedback to operational staff on the difference between how well the network performed compared to expectations (for the previous day, or for the last week).

The development of a Collaborative NOP will focus on the availability of shared operational data and shall be able to be read and modified by all appropriate stakeholders, possibly linked through B2B interfaces using local tools (e.g. AOP as an extension of A-CDM platform). Query mechanisms to provide all stakeholders with a tailored overview of operations are an essential element for deployment.

CTOT to Target Times for ATFCM purposes

Target Times shall be applied to selected flights for ATFCM purposes, to improve predictability by cooperatively managing ATCFM congestions at the point of congestion rather than only at departure. This moves from addressing decongestion simply through application of CTOT at the departure airport, to use of a target time at a given congested node, refined via the arrival airport's AOP, to allow the NOP to take account of the anticipated congestion at the arrival airport. Target times shall be used to support airport arrival sequencing processes in the en route phase, optimises ATC arrival capacity and minimises flight inefficiencies resulting from vectoring and holding activity.

Improving the interaction between ATC, NOP and AOP will improve traffic predictability and provides the cornerstone for delivering traffic to downstream ATC sectors in a 'shape' (rate, sequence, complexity) that allows best use of available resources, and for network support to airport arrival sequencing processes. This reduces the need for ATFCM measures and reduces the need for excessive airport holding.

Automated Support for Traffic Complexity Assessment

Automated tools continuously monitor sector demand and evaluate traffic complexity by applying predefined complexity metrics according to a predetermined qualitative scale. Forecast complexity, coupled with demand, enables ATFCM to take timely action to adjust capacity or demand profiles through various means, in collaboration with ATC and Airspace Users.

Complexity prediction for local Network Management, analysing aircraft trajectories using RBT and other demand information, coupled with the use of validated complexity metrics shall allow prediction of changes in traffic complexity and potential overload situations, allowing mitigation strategies to be applied.

The tools enable the detection of volumes/nodes of high complexity caused by trajectory confliction, thus enhancing tactical decision-making to ensure safe and orderly management of traffic. Tools are likely to be at ACC level (e.g. local or regional Network Manager) and be applicable in the pre-tactical timeframe – e.g. up to 2 hours before flights enter a sector.

The Extended FPL currently being defined is the FPL enriched with 4D Trajectory and additional data shall allow NM systems to process trajectories much closer to the AUs' trajectories. Extended Flight Plan would be seen as an essential enabler to support complexity assessments.

5.4.1.3 System Impact

The system impact of this AF includes the need for airspace configurations to be developed and agreed through a continuous CDM process. Data repositories shall provide information on real-time airspace status and traffic demand, to enable closer to real-time optimisation of network operations. Furthermore, tools shall enable FPL checks to be carried out against the latest airspace status.

The airspace tools shall be able to take account of A-FUA constraints where, for example, dynamic military training areas will need to co-exist with FRA.

Where FRA is implemented, FDP systems that include the capability to make incremental trajectory changes will be required. Due to the absence of pre-defined routes, enhanced conflict detection and resolution tools shall identify and resolve more variable conflict points

Enhanced Short Term ATFCM Measures

1 Impact on ground equipment

Current System Capability:

There is currently no effective capability to apply enhanced short-term ATFCM measures.

New Functionality

NMs shall update ATFCM planning at Network and Local level to support hot-spot detection, notification of STAM applications, network assessment and continuous monitoring of network activity.

ANSP systems shall be upgraded, in particular the adaptation of FDP systems, surveillance data processing systems and human-machine interfaces. ASM/ATFCM tools shall manage different airspace availability and sector capacity (including civil/military coordination, RAD adaptation and STAM).

2 Impact on airborne equipment

No impact.

Collaborative NOP for Step 1

1 Impact on ground equipment

Current System Capability:

Current A-CDM systems do provide refined information to the NM that is used by the NM to adjust slot allocation. However, A-CDM is not universally deployed, and the level of sharing of information is limited.

New Functionality

The NM shall establish a rolling NOP to provide an overview of the ATFCM situation from strategic planning to real-time operations. Data shall be accessible by authorised stakeholders. Systems shall be adapted to support network management systems (such as ETFMS), algorithms, databases and user-interfaces to integrate data from the AOP.

The increased interaction and inter-dependence of NOP and AOP will require increasingly linked systems, supported by personnel training at Network ACC and airport level. The systems, databases and displays shall be updated to interface with the modified NOP or AOP systems and processes.

2 Impact on airborne equipment

No impact.

CTOT to Target Times for ATFCM purposes

1 Impact on ground equipment

Current System Capability:

CTOTs are currently issued by the NM based on information available, which is usually FPL data. In some cases, this is refined by information supplied from A-CDM sources. CTOTs are not typically modified by information sourced from the destination airport.

New Functionality

NM systems shall be adapted to support target time sharing, at least as part of CHMI (NOP portal) content and possibly by B2B interoperability with local tools or part of Demand Data Repository (DDR3). Systems shall be able to adjust CTOTs based on refined and agreed TTAs at the destination airport. CASA algorithms shall process target times. Systems may need to be adapted in order to process downlinked trajectory data (e.g. EPP), which should be considered an improvement, and not a pre-requisite.

ANSPs will require tools that support the function to integrate Network Information with ATC planning information (INAP), e.g. combining local and network ASM, sectorisation/ATCO staffing and ATFCM data. AMAN systems will need to be adapted to enable TTAs to be integrated into the AOP for further communication NM for processing into the NOP.

FDP systems may need to be adapted in order to process downlinked trajectory data (e.g. EPP) which should be considered an improvement, and not a pre-requisite.

2 Impact on airborne equipment

If EPP procedures are implemented, aircraft will need to be able to downlink trajectory data.

Automated Support for Traffic Complexity Assessment

1 Impact on ground equipment

Current System Capability:

Demand capture is limited to flight plans. Most GAT FPLs are shared and processed centrally. OAT FPLs are selectively shared and not processed centrally.

Dynamic sector configuration exists at some ATCC, but they are not sufficiently supported by automation functions.

There is some notion of capacity planning and airspace design processes supported by appropriate data and tools.

New Functionality

For NM functionality, ETFMS/IFPS shall be upgraded to deal with a more flexible and dynamic sector configuration to the traffic demand/pattern. ATFCM planning needs to be significantly enhanced at Network and Local levels, including interaction between the two levels. In addition, tools are required for re-routeing and to calculate and manage traffic loads and complexity at FMP and central level.

ANSPs will be increasingly involved in managing improved coordination across the network using ANSP-derived data. To enable this, the following changes will be needed:

The FDP system shall be adapted to include interfaces to the NOP and the HMI;

Flight Planning systems shall be updated;

ASM/ATFCM tools shall be able to manage different airspace availability and sectors' capacity (including civil/military coordination, RAD adaptation and STAM).

2 Impact on airborne equipment

No impact.

5.4.2 Geographical scope of implementation and association timeframes

5.4.2.1 Geographical scope

Network Collaborative Management (Flow & NOP) is intended to be applied on the entire European network. In this case, all 61 civil Air Traffic Control Centres of the EUROCONTROL Member States plus Estonia and 22 military Air Traffic Control Centres (corresponding to those eleven States where Civil / Military operations are not integrated) are concerned by the implementation."

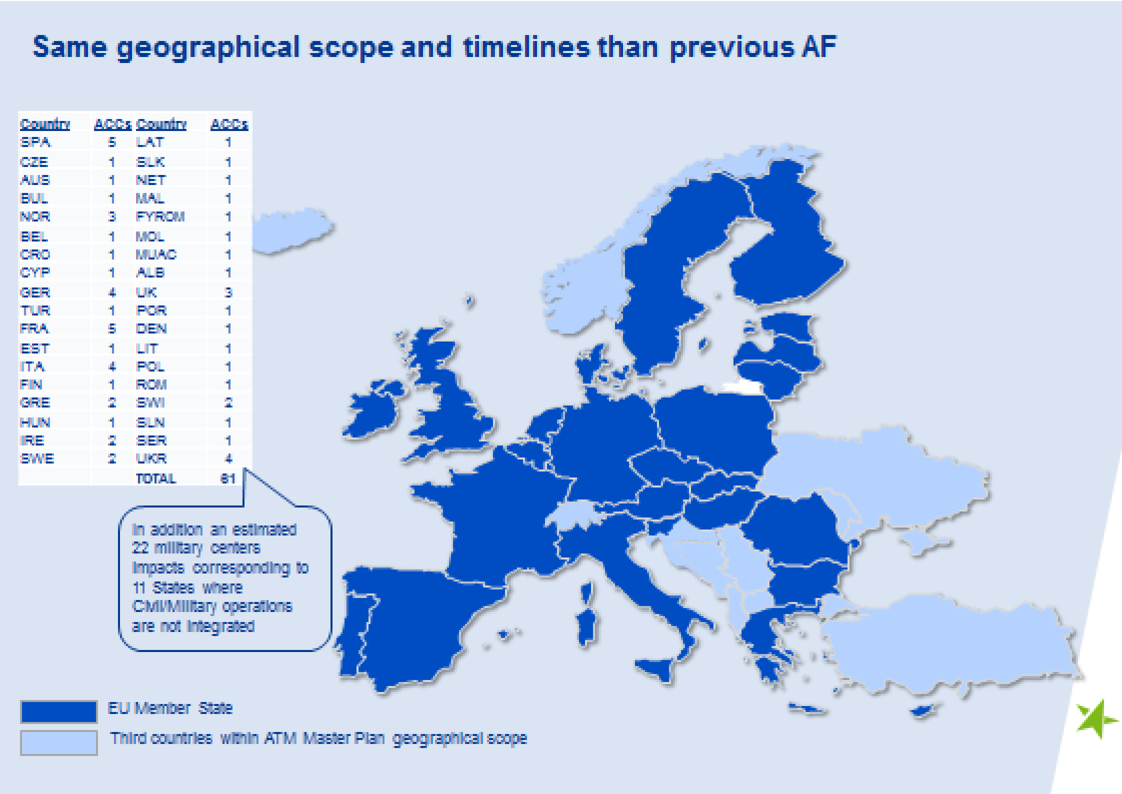


Figure 31: Geographical scope of implementation of AF # 4

Further details with regards to the geographical scope of implementation can be found in Appendix D.

5.4.2.2 Implementation timeframes

Start of Investment	End of Investment	Start of Benefit	Full Benefit	Start of Deployment	End of Deployment
2014	2021	2017	2022	2017	2021

Table 6: Implementation dates for AF # 4

5.4.3 Regulatory and standardisation needs

There are no specific regulatory or standardisation needs identified for this AF.

5.4.4 Alignment with safety requirements

This analysis is the result of the evaluation of the level of development of Safety Assessment Reports and the review of the ATM Functionality technical documentation from an Authority point of view, done by the Expert Groups and by EASA. As conclusions, the following item can be mentioned:

- Dynamic DCB Safety Assessment Report has been completed.

The review by EASA of the existing Safety Assessment Reports, as well as the review of the ones delivered in the future, should be completed. Due consideration should be given also to their review by National Authorities.

5.4.5 Cost-benefit analysis

This AF is expected to improve the quality and the timeliness of the network information shared by all ATM stakeholders, thus ensuring significant benefits in ANS productivity gains and delay cost savings.

The NPV associated would amount to 0,2 billion €, with a 11 years pay-back period.

The distribution of costs, benefits and cumulated net benefits over the considered time period is represented in the following chart.

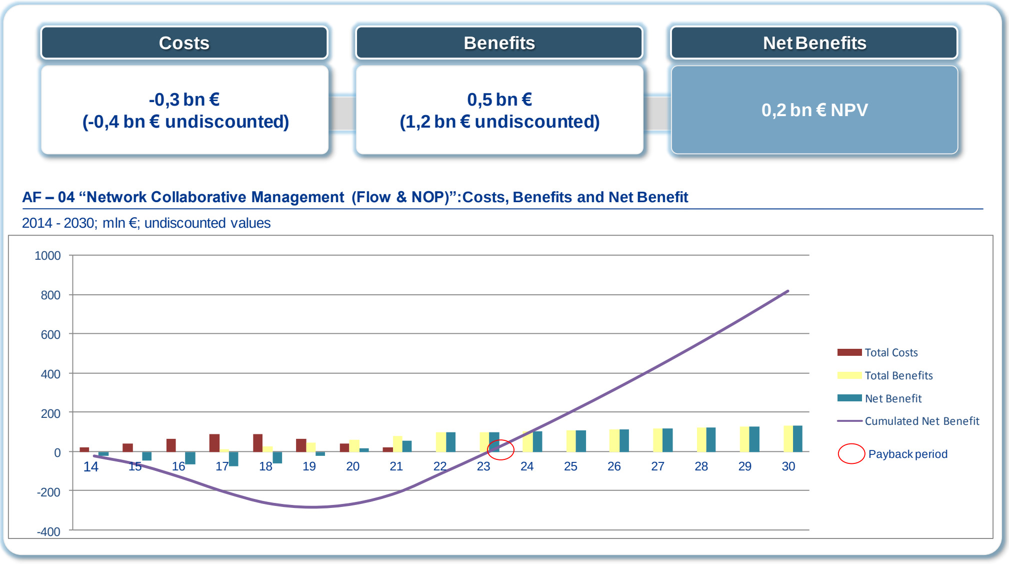


Figure 32: Overall CBA for AF # 4

Looking at the benefits, the implementation would generate major improvements in ANS productivity, generating savings amounting at around 0,4 billion € (1 billion € undiscounted), which impact for 78% on the total benefits associated to this AF.

Another important benefit is linked to delay reduction, which would generate savings exceeding 0,1 billion € (0,2 billion € undiscounted).

Finally, marginal gains in terms of fuel consumption reduction would be obtained, with fuel costs savings amounting just under 0,1 billion € and CO_2 emissions reduction of around 0,1 million tonnes.

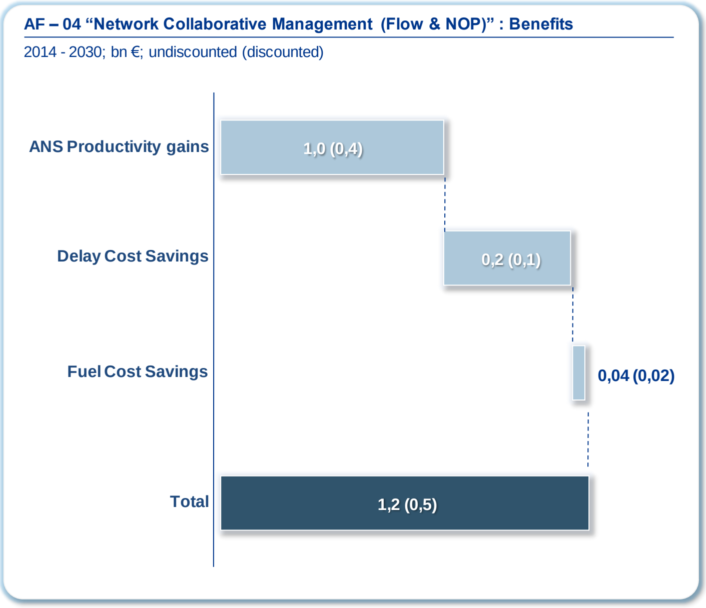


Figure 33: Breakdown of benefits for AF # 4

With regard to the costs associated, civil ANSPs, the Network Manager and the Airports Operators would be involved as investors, contributing to the overall AF cost as follows:

- ANSPs: 75% of total investment
- Network Manager: 13 % of total investment
- Airport Operators: 12 % of total investment

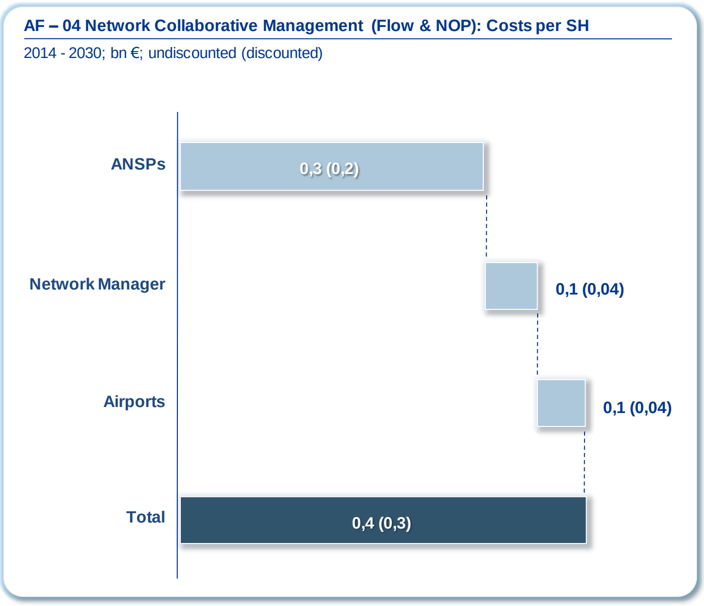


Figure 34: Breakdown of costs per stakeholder for AF # 4

5.5 AF # 5: iSWIM functionality

5.5.1 Description of the AF ("What" and "why")

5.5.1.1 Introduction

System Wide Information Management (SWIM) is concerned with the development of services to establish the information exchanges that are required to implement the SESAR concept in an agile and cost-effective in a way that is new to aviation. This will contribute to an acceleration of information exchange service development, beyond the deployment of the first information services, thereby reducing the threshold to information access. SWIM will make the ATM system more flexible, more agile, minimising the development/deployment and operation costs.

SWIM consists of standards, infrastructure and governance enabling the management of ATM information and its exchange between qualified parties via interoperable services.

5.5.1.2 Interoperability

The key objective of applying standards in service development lies in the re-usability of all elements that make up a service. Service creation is concentrated on finding the right combination of pre-defined elements like common logical information models, open and standardised data formats, and application of defined technologies.

The increased interoperability of data formats and interfaces will make possible a building-block architecture, in which ATM systems from different manufacturers can be seamlessly connected, eliminating the need for expensive tailor-made interfaces.

The SWIM infrastructure is also built on components using standardised technology and interfaces, based on open standards.

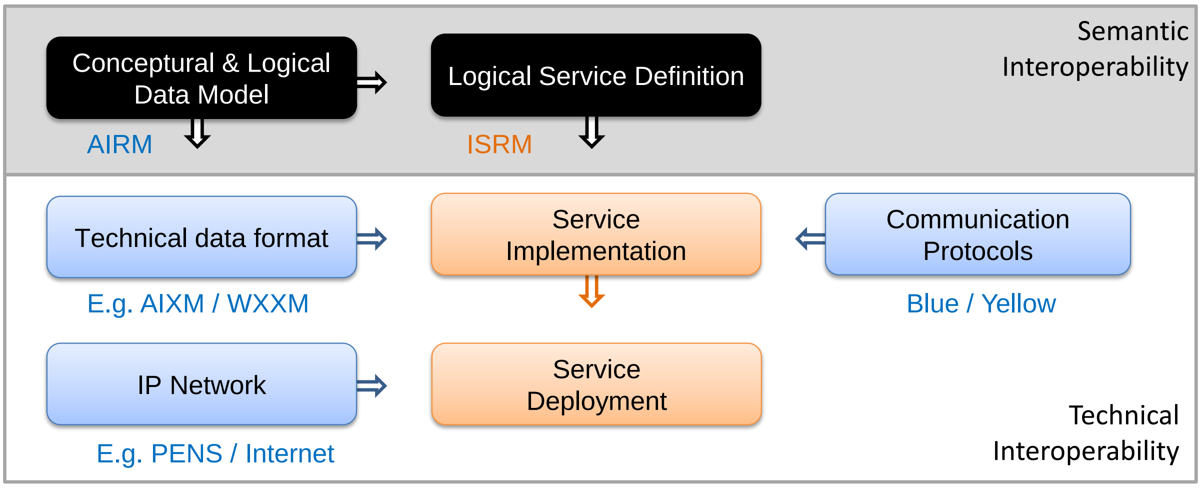


Figure 35: Elements ensuring flexibility, cost-efficiency and interoperability

Semantic interoperability (AIRM and ISRM)

The current ATM system lacks a standardised information- and services model. This is manifested in the lack of consistency of the information contained in various databases and existing services. This is a weakness for a network which aims to share information to improve services and introduce advanced automation. A well-defined, consistent information structure which enables a cohesive set of databases to be used has been developed and aligned with existing models. It consists of an ATM Information Reference Model (AIRM) and an Information Service Reference Model (ISRM).

Technical interoperability (SWIM AF Profiles)

Even when semantic interoperability has been ensured, logical information can still be described in various technical formats, information can be exchanged using various technical protocols and systems can be connected using different IP networks:

Technical data format

Different domain specific technical information formats have been defined in the past and are still evolving. These technical information formats are not governed by SESAR, rather SESAR has been contributing to them, to assure alignment with the AIRM consolidated conceptual and logical information.

Communication protocols

Communicating systems use well-defined formats for exchanging messages. Each message has an exact meaning intended to provoke a defined response of the receiver. A communication protocol describes the syntax, semantics, and synchronisation of communication. To achieve technical interoperability, communications protocols have to be agreed upon between parties exchanging information.

IP Network

The initial SWIM is to be supported by IP-based networks which may be the Pan-European IP based Network Service (PENS), the Internet or any other IP network service arrangement.

One solution does not fit all. Not all information needs to be distributed following the same quality of service requirements. Therefore a limited set of combinations of technical data format, communication protocols and IP networks have been defined, each meeting a specific set of quality of service requirements. These combinations of standards are called SWIM Technical Infrastructure Profiles.

5.5.1.3 Establish trust

Stakeholders' willingness to exchange information depends on mechanisms that assure trustworthiness of both the involved parties and the applied technical exchange mechanisms, for example by applying authorisation and security means up to a level that meets specific information exchange needs or by implementing a certification process ensuring the required Quality of Service will be met by the service providers.

The expectations about products and activities relates to features like quality, reliability, compatibility, interoperability, efficiency and effectiveness. The process for demonstrating that these features meet the requirements of standards and specifications is called compliance assessment. SWIM compliance assessment helps to ensure that products and activities deliver on their promises, which raises confidence and leads to trust.

The harmonisation of the compliance assessment criteria and procedures has the benefit of having a single transparent method that is used across different providers, consumers, locations and environments for assessing the compliance of products and activities.

5.5.1.4 Managing future evolution

The SWIM foundation material consisting of standards for service development, common infrastructure components and the compliancy framework are considered stable enough to be formally established as base-line. Nevertheless, even the foundation material is likely to evolve over time. Some level of governance over this evolution is expected to be required. Items to be considered are:

- Managing the evolution of standards

- Managing common infrastructure
- Ensure a trusted and controlled evolution of critical services
- Managing the service architectural landscape
- Centralisation verses locally provided data

Preliminary results indicate a need to establish the role for a SWIM governance body based on European regulation. However, the current understanding of such needs has not sufficiently matured, to start drafting any regulation at this time. During deployment of iSWIM it is proposed to allocate the SWIM governance role to the deployment manager until formal regulation is in place.

5.5.1.5 Scope and outline of iSWIM

The iSWIM functionality consists of a set of services that are built on standards and delivered and consumed through an IP-based network by SWIM enabled systems. This iSWIM functionality can be further broken down into:

3 Common infrastructure components - Generic cross-service requirements on the service development method, service security and services supervision have led to the recognition of a number of common cross-profile infrastructure components. By allocating these generic cross-service requirements to cross-profile common components, a uniform, interoperable and cost-effective solution is ensured.

4 SWIM AF Profiles and Technical Infrastructure

5 Aeronautical data domain services - providing and using static and dynamic information, airspace services and airport mapping information services.

6 Meteorological domain services - delivered in general by designated National MET Service Providers, in answer to the needs of ATC (En Route, Approach or Aerodromes), Airports, Network Management, Airlines and other Airspace users.

7 Network domain services - covering ATFCM, flight data and flow demand and capacity services provided mostly during the strategic and pre-tactical phases and additionally during the tactical and post-ops phases.

8 Flight data domain services - including but not limited to Flight Object services provided and consumed during the pre-tactical and tactical phases by ATC systems and the Network Manager including contribution of Airports bringing departure information to the Flight data

9 SWIM enabled systems – connecting new and existing legacy systems through the notion of common SWIM AF profiles.

In the trajectory management framework (TMF) the Flight Object consists of both a 4-D trajectory and the constraints within which a trajectory can be changed or optimised. Since a significant part of these constraints are referencing aeronautical and meteorological data, the deployment of services that support unambiguity of information in these domains prevails in priority over the deployment of services within the flight and network domains.

1 Common infrastructure components

Even though some initial services could be deployed without common components, these components are included in the iSWIM scope in order to capture the benefits of interoperability as soon as possible, thereby avoiding the need for later readjustment of early deployed services.

The registry

The Registry will be used for publication and discovery of information regarding service consumers and providers, the logical information model, SWIM enabled services, business, technical, and policy information.

Public Key Infrastructure (PKI)

The PKI is the common function responsible for signing, emitting and maintaining certificates and revocation lists. The PKI plays a key role in establishing trust as it ensures that information can be trusted. Open standards and COTS products already exist.

Supervision of the System of Systems

The necessity of a supervision of the system of systems is currently under investigation and still needs to be confirmed.

The common components shall be newly deployed. They are interconnected to the infrastructure for the different SWIM AF profiles. Their impact to (existing) legacy systems is therefore only indirect through the infrastructure of the profiles. The change of the EAD and NOP profiles of the NM systems, may impact the certificate management of those systems.

2 SWIM AF Profiles and Technical Infrastructure

A SWIM AF profile implementation results in interoperable (runtime) infrastructure via which ATM data and services are distributed, shared and consumed. Its implementation may, depending on the specific needs profile, differ from one stakeholder to another, in terms of both the scope and the type of implementation. It shall be based on commercial off-the-shelf (COTS) standards-based and interoperable products and services, but it is possible that in some cases ATM specific software may need to be developed;

Blue SWIM AF Profile

This profile shall be used for Flight Object ATC2ATC and ATC2ATFCM data exchange. Keywords are secured access, high response rates and more generally the required SWIM infrastructure Quality of Service (QoS) supporting the deployment of the Flight Object services used in particular in the tactical phase of the flights.

Yellow SWIM profile

This profile shall be used for any other ATM data (aeronautical, meteorological, airport etc.). Keywords are low-threshold-access-(through still secure)-solutions, affordability and rapid pick-up. It is also foreseen that this profile shall be able to be used for any other ATM data (aeronautical, meteorological, airport, etc.).

3 Aeronautical information services

Operational objectives

Aeronautical information is increasingly exchanged digitally between interoperable systems. The aeronautical information services target a further integration & harmonisation of AIS/AIM information as published by States with the usage of this information in digital format by Airspace Users, ATC and ATFCM. It is increasingly important that all ATS stakeholders use consistent data to perform trajectory calculation during execution. The services fulfil the requirements of much more dynamic airspace data publication.

Moving from AIS to AIM and from hardly readable NOTAM to Digital NOTAM is essential for the origination, aggregation and distribution of Aeronautical Information at various levels (e.g. AIP, RAD, NOTAM, Airport Maps...). It will make information more readily and harmonised available with fully automated filterable and query capabilities on any subset by any other system. It will facilitate a much more dynamic processing and it will eradicate the inconsistencies between data of various sources.

The aeronautical information services support the operational objectives and changes as described in the EG#3 “Network DCB and free routing”.

Required information exchanges

The tables below provides the various roles for each of the services (P: Provider, C: Contributor, U: User). Further it identifies the likely used SWIM Profile.

Information Exchange	NM	ANSP Civil	ANSP Military	AP OPR Civil	AP OPR Military	AU Civil Airline Operational Control	AU Military Wing Operations Centre	MET Service Provider	SWIM TI Profile
Notification of the activation of an Airspace Reservation/Restriction (ARES)	U	U	P						Yellow
Notification of the de-activation of an Airspace Reservation/Restriction (ARES)	U	U	P						Yellow
Pre-notification of the activation of an Airspace Reservation/Restriction (ARES)	U	U	P						Yellow
Notification of the release of an Airspace Reservation/Restriction (ARES)	U	U	P						Yellow
Provides aeronautical information feature on request. Filtering possible by feature type, name and an advanced filter with spatial, temporal and logical operators.	U	P, U	U	U	U	U	U		Yellow
Query Airspace Reservation/Restriction (ARES) information	U	P, U	U	U	U	U	U		Yellow
Provide Aerodome mapping data	U	P, U		U		U			Yellow
Airspace Usage Plans (AUP, UUP) - ASM level 1 and 2	P,U	P,U	P,U			U	U		Yellow
Proviides aeronautical information feature on request. Filtering possible by feature type name and an advanced filter with spatial, temporal and logical operators.	P, U	P, U	U						Yellow
Provides aeronautical information feature on request. Filtering possible by feature type name and an advanced filter with spatial, temporal and logical operators.	P, U	P, U	U	U	U	U	U		Yellow
D-Notams	U	P,U	U	P,U	U	U	U		Yellow
Airspace Usage Plans (AUP, UUP) - ASM level 3	U	P,U	P,U	U	U	U	U		Yellow
Airport Maps	U	U	U	P,U	U	U	U		Yellow

Table 7: Aeronautical services

System impact

As regional source of quality assured aeronautical information and for the integration of national AIS systems, Europe has developed the European Aeronautical Information Services Database (EAD). Further down the aeronautical information chain, data is also maintained in “operational” databases such as the NM/CACD and specific adaptations of the data are made in order to satisfy the operational data needs of ATM operational systems such as IFPS, ETFMS, national ATC and Airspace Users (CFSPs, F/WOCs) systems. Many copies and many versions of the same data are used simultaneously, with associated inefficiencies and the risk of information discrepancies.

Aeronautical information data exchanges shall be further standardised towards a full digital data-chain consisting of co-existing and orchestrated complementary services at national, sub-regional and regional level. The application of shared business and data verification rules ensures consistency at syntax and semantic level.

As ASM heavily relies on AIS/AIM data, systems supporting ASM will be impacted.

4 Meteorological information services

Operational objectives

The existing meteorological (MET) information services provision framework is traditionally based on the State obligation laid down in ICAO Annex 3 to provide at national level MET information. All national providers have the capability to provide MET information for its own area of responsibility, for Europe and some could provide it for the globe. Due to the nature of weather forecasting, it is however not obvious that the information provided for a specific point in time and space by one provider is identical to what is provided by another provider.

Whilst it is fair to state that weather will always be impacting aviation, the SESAR Programme, US NextGen and ICAO Global Air Navigation Plan objective is to better integrate MET information in ATM decision making processes and to minimise the disruptive effect and associated costs of weather events. This requires shared situational awareness on weather and access to the relevant MET information individual stakeholders used in their decisions that have an impact on more than one stakeholder in the ATM network.

The European and global aviation stakeholder requires a uniform access to MET information and the trust that the information used by a decision maker is identical to what other decision makers are using in the collaborative impact assessment and decision making environment.

SWIM Enabling meteorological information shall establish a shared and consistent situational awareness on MET and not potentially 39 different ‘weather pictures’ for Europe from 39 different providers. It will provide a consistent service delivered by MET Service Providers.

Required information exchanges

The first step of the SWIM enabling of meteorological information will be the transition of legacy standardised MET information, towards digital geo-referenced formats enabling their full integration into ATM Systems.

Then the deployment of a unified access portal, the SESAR 4D WX Cube, will enable the exposition of any ATM-oriented MET information (new or legacy) and will be the key enabler for this harmonised and consistent MET information service.

New digital MET services will be obtained through the standardisation and ATM-customization of capabilities and services currently available by multiple MET Service Providers in parallel instances but generally operated for non-ATM purposes.

The tables below provides the various roles for each of the services (P: Provider, C: Contributor, U: User). Further it identifies the likely used SWIM Profile.

Information Exchange	NM	ANSP Civil	ANSP Military	AP OPR Civil	AP OPR Military	AU Civil Airline Operational Control	AU Military Wing Operations Centre	MET Service Provider	SWIM TI Profile
Meteorological prediction of the weather at the airport concerned, at a small interval in the future: - wind speed and direction - the air temperature - the altimeter pressure setting - the runway visual range (RVR)		U		U		U		P	Yellow
Provide Volcanic Ash Mass Concentration	U	U	U	U	U	U	U	P	Yellow
Specific MET info feature service	U	U	U	U	U	U	U	P	Yellow
Winds aloft information service	U	U	U	U	U	U	U	P	Yellow
Meteorological information supporting Aerodrome ATC & Airport Landside process or aids involving the relevant MET information, translation processes to derive constraints for weather and converting this information in an ATM impact. The system capabiliity mainly targets a "time to decision" horizon between 20 minutes and 7 days.	U			U	U	U	U	P	Yellow
Meteorological information supporting En Route / Approach ATC process or aids involving the relevant MET information, translation processes to derive constraints for weather and converting this information in an ATM impact. The system capabiliity mainly targets a "time to decision" horizon between 20 minutes and 7 days.	U	U	U	U	U	U	U	P	Yellow
Meteorological information supporting Netowork Information Management process or aids involving the relevant MET information, translation processes to derive constraints for weather and converting this information in an ATM impact. The system capabiliity mainly targets a "time to decision" horizon between 20 minutes and 7 days.	U	U	U			U	U	P	Yellow
Hazardous meteorological conditions in the context of decisions that should have an effect on execution and short term planning.	U			U,P	U	U	U	C	Yellow

Table 8: Meteorological services

System impact

The deployment of a unified access portal, the SESAR 4D WX Cube, will enable the exposition of any ATM-oriented MET information (new or legacy) and will be the key enabler for this harmonised and consistent MET information service. ATM systems will need to be adapted making them able to incorporate advanced digital MET information and new MET-related Decision Aids functions.

In general, all following systems are impacted:

- ANSPs Civil and Military systems (covering en route / Approach Air Traffic Centres, ASM and AIM systems)
- The Network Manager system (the NOP portal and Back-end application using the NOP Portal to exchange information/services with the national ATM systems)
- Airport Civil and Military systems
- Civil Airline Operational centre and Military Wing Operations centres
- New SWIM Enabled MET Systems

5 Cooperative network information services

Operational objectives

The NM Portal and its B2B Web Services are the most visible interfaces to the Network Operations Planning functions. They are already making SESAR concepts a reality.

Sharing high quality and consistent operational data is at the heart of its operational improvements. The vast majority of current and future network operational processes are collaborative to ensure a sound common basis for decision making.

- Airspace Users shall file and manage their flight plans using the NM Portal fully integrated flight planning and flow management service, increasing the rate of automatically processed & accepted flight plans, and enabling easy choice of user preferred & flight efficient routes in consistency with the Airspace Users' business model aware of the network opportunities and constraints.
- Inputs can be made directly by the owner of the information and stakeholders can build their own applications using the B2B services provided. On the basis of the same information, all users will be able to customise & personalise their view to access the right information and tools for their roles and scope.
- A comprehensive crisis management toolset and associated collaboration tools shall be offered.
- European aviation is vulnerable for the disruptive consequences on aviation of hazards other than weather, like space weather, volcanic ash clouds etc. The readiness of ATM to handle (large) scale events related to such hazards is strongly reliant on the availability of relevant and consistent information to decision makers in day-to-day operations as well as during crisis situations.
- The NM Portal shall support the Network Collaborative Management (AF # 4).

Required information exchanges

The tables below provides the various roles for each of the services (P: Provider, C: Contributor, U: User). Further it identifies the likely used SWIM Profile.

Information Exchange	NM	ANSP Civil	ANSP Military	AP OPR Civil	AP OPR Military	AU Civil Airline Operational Control	AU Military Wing Operations Centre	MET Service Provider	SWIM TI Profile
Maximum airport capacity based on current and near term weather conditions				U				P	Yellow
Synchronisation of Network Operations Plan and Airport Operations Plan at a specific airport.	P, U			P, U					Yellow
Regulations	P	U	U						Yellow
Slots	P					U	U		Yellow
Short term ATFCM measures	P	U		U		U			Yellow
ATFCM congestion points	P	U		U		U			Yellow
Restrictions	P	U	U			U	U		Yellow
Free route validation	P	U	U			U	U		Yellow
Network and Airport Operation Plans	P,U			P,U					Yellow
Network and En-Route Approach Operation Plans	P,U	P,U							Yellow

Table 9: Network services

System impact

The NM Portal shall support all operational stakeholders in exchanging data electronically with the Network Manager. Stakeholders have the freedom to choose between a pre-defined online access, or connect their own applications using the system-to-system (B2B) web-technology based services.

6 Flight data services

Operational objectives

The foundation for the future ATM Concept is Trajectory-based Operations. The Trajectory Management concept involves the systematic sharing of aircraft trajectories between various participants in the ATM process to ensure that all partners have a common view of a flight and have access to the most up-to-date data available to perform their tasks.

In the pre-departure phase, Extended Flight Plan services will allow to capture airspace users' intended trajectory more accurately (ICAO FP + 4D trajectory + flight performance data). This enriched information will be used for better network planning initially and be provided as input to ATC for the execution phase, in a second stage, as part of the Flight Object.

Flight Object services shall be used during the pre-tactical and tactical phases by ATC systems and Network Manager, which will integrate departure information from Airports.

Various actors in the trajectory management concept can insert time constraints to be considered by an ATSU: e.g. NM will be able to insert time constraints (TOs and TTOs) at specific airspace entry points for flow measures or ATSUs operating busy TMAs will be able to insert their own time constraints at airport metering fixes (CTAs) as generated by an Arrival manager (AMAN).

For military airspace users operating as Mission Trajectory the metering and sequencing of flights in step 1 shall use only a single TTO/CTO (and not CTA) associated with entry/exit of ARES.

Required information exchanges

The tables below provides the various roles for each of the services (P: Provider, C: Contributor, U: User). Further it identifies the likely used SWIM Profile.

Information Exchange	NM	ANSP Civil	ANSP Military	AP OPR Civil	AP OPR Military	AU Civil Airline Operational Control	AU Military Wing Operations Centre	MET Service Provider	SWIM TI Profile
Various operations on a flight object: Acknowledge reception, Acknowledge agreement to FO, End subscription of a FO distribution, Subscribe to FO distribution, Modify FO constraints, Modify route, Set arrival runway, Update coordination related information, Modify SSR code, Set STAR, Skip ATSU in coordination dialogue.	P,C,U	P,C,U							Blue
Share Flight Object information	P,C,U	P,C,U							Blue
Validate flight plan and routes	P	U	U	U	U	U	U		Yellow
Flight plans, 4D trajectory, flight performance data, flight status	P	U	U	U	U	U	U		Yellow
Flights lists and detailed flight data	P	U	U	U	U	U	U		Yellow
Flight update message related (departure information)	P	P,U	U	U	U	U	U		Yellow
Flight Objects including the flight script composed of the ATC constraints and the 4D trajectory.	P, C, U	P, C, U	U	C, U	U	U	U		Blue

Table 10: Flight information services

System impact

Ground/ground (G/G) basic flight object exchange mechanisms shall be implemented between different ATSUs and the Network Manager (NM), providing consistent flight data to be used across the ATM network through SWIM mechanisms.

To support the Extended Flight plan and the improved OAT Flight Plan, AUs and NM systems shall be adapted to allow the exchange of enriched information using SWIM services. At Flight Plan filing time, data such as 4D trajectory and flight specific performance data shall be added to the ICAO Flight Plan. NM systems shall be adapted to make use of that enriched information which shall also be made available to ATC systems as soon as system evolution allows (i.e. through the creation of the corresponding Flight Object).

An initial SWIM infrastructure is put in place to support ATC-ATC and at a later stage ATC-NM interoperability based on the Flight Object Interoperability concept (a revised version of the ED-133 standard) to allow for a modern information exchange mechanism for safety critical flight plan information.

The flight object services require modifications to the ATM system capabilities (e.g. FDPSes) that are safety critical and essential for tactical operations.

Systems that are expected to be impacted:

- ANSPs Civil and Military systems covering en route / Approach Air Traffic Centres
- Interfaces with other regions
- The NOP Network Manager system

A prerequisite for Flight Object Interoperability is the availability of consistent and shared aeronautical and weather data across the whole Interoperability area.

5.5.2 Geographical scope of implementation and associated timeframes

5.5.2.1 Geographical scope

iSWIM functionality is intended to be applied on the entire European network.

- The provision of flow management and aeronautical / airspace data is to be organised centrally. It will be ensured through the concept of centralised services currently being developed.
- MET, flight object and trajectory data may also be candidates for "non-local" service provision. This part of the proposal is to be addressed under the extension of the SESAR JU's mandate received on 18 March 2013. However for the PCP the following scope has been defined:

	ANSPs	Airports	Military	Airspace Users
Flow Management & Flight Planning	All very high and high capacity need centers, TMAs and Towers	All 25 airports identified in the previous sections for AF1 and 2	-	AOC system providers
Aeronautical and Airspace	All very high and high capacity need centers, TMAs and Towers	All 25 airports identified in the previous sections for AF1 and 2	All centers in the 11 States that have non-integrated civil/military service provision	AOC system providers
Meteo	All very high and high capacity need centers, TMAs and Towers	All 25 airports identified in the previous sections for AF1 and 2	All centers in the 11 States that have non-integrated civil/military service provision	AOC system providers
Flight Object	All very high and high capacity need centers & TMAs	-	All centers in the 11 States that have non-integrated civil/military service	-

	provision

Further details with regards to the geographical scope of implementation can be found in Appendix D.

5.5.2.2 Implementation timeframes

Sub-systems	Start of Investment	End of Investment	Start of Deployment	End of Deployment
Flow Management and Flight Planning	2014	2024	2016	2024
Aeronautical and Airspace	2014	2024	2016	2024
Meteo	2014	2024	2016	2024
SWIM Infrastructure & Administration	2014	2024	2016	2024
Flight Object	2014	2024	2018	2024

Table 11: Implementation dates for AF # 1 subsystems

5.5.3 Regulatory and standardisation needs

5.5.3.1 Regulatory needs

There is no specific new regulatory element needed to deploy iSWIM in due time.

Although not critical for the planning of deployment, the need to introduce any modification on the following existing regulation will have to be further assessed:

- COTR IR 1032/2006;
- OLDI CS 149/06;
- FMTP IR 633/2007;
- FMTP CS 188/03;
- AMHS CS 323/24.

Further details with regards to regulatory needs can be found in Appendix E.

5.5.3.2 Standardisation needs

There are some concerns on the timely availability of standardisation material defining the required information exchange models which will support SWIM (AIXM, WXXM, FIXM and AIRM) and the SWIM profile definition. The risk is medium, with impact in the harmonised deployment of the AF.

There is a concern on the timely availability of the EUROCAE standard for Flight Object interoperability (the required update of the existing ED-133 document). The risk is medium, with impact in the harmonised deployment of the AF.

Further details with regards standardization needs can be found in Appendix E.

5.5.4 Alignment with safety requirements

This analysis is the result of the evaluation of the level of development of Safety Assessment Reports and the review of the ATM Functionality technical documentation from an Authority point of view, done by the Expert Groups and by EASA. As conclusion, it was found that the System Interoperability Safety Plan has been completed.

SWIM safety assessment depends upon the safety assessment of the services applications that will use SWIM. Therefore it will be completed once those safety assessments are also completed.

As a result of the analysis, some other items were found which would require further action previously to the full deployment of this AF. These items are the following:

- iSWIM users will need to define local additional safety related requirements on MET data/information which can be taken into account by MET Service Providers in each concrete implementation case.
- Where necessary, transition from the legacy systems to the SWIM environment has to be prepared before deployment, in particular on topics such as security of data distribution and military aspects

Regarding potential areas of improvement in the deployment planning, it has to be considered that the scope of System Interoperability safety plan might need to be extended.

The review by EASA of the Safety Assessment Reports delivered in the future should be completed. Due consideration should be given also to their review by National Authorities.

5.5.5 Cost-benefit analysis

This AF consists of a set of services that are delivered and consumed through an IP-based network by SWIM enabled systems, enabling significant benefits in terms of ANS productivity.

The NPV associated amounts to minus 0,1 billion €.

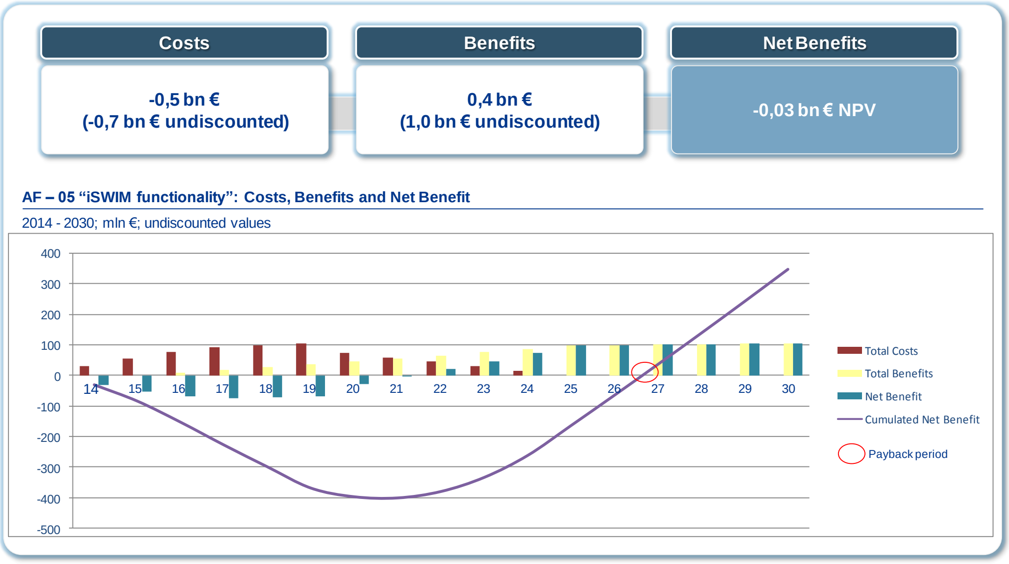


Figure 36: Overall CBA for AF # 5

The main monetised benefits are linked to an improvement of ANS Productivity which would bring savings for around 1 billion €.

From a costs perspective, all the stakeholders' categories taken into account in the impact assessment exercise would be expected to contribute to the overall investment, with the highest share of the investment associated to ANSPs and Met Service providers.

Specifically, the overall investment would be shared among the stakeholders' categories as follows:

- ANSPs: 41% of total investment
- MET Service Providers: 29% of total investment
- Network Manager: 15 % of total investment
- Military: 10% of total investment
- Airport Operators: 3% of total investment
- Airspace Users (ground investment): 2% of total investment

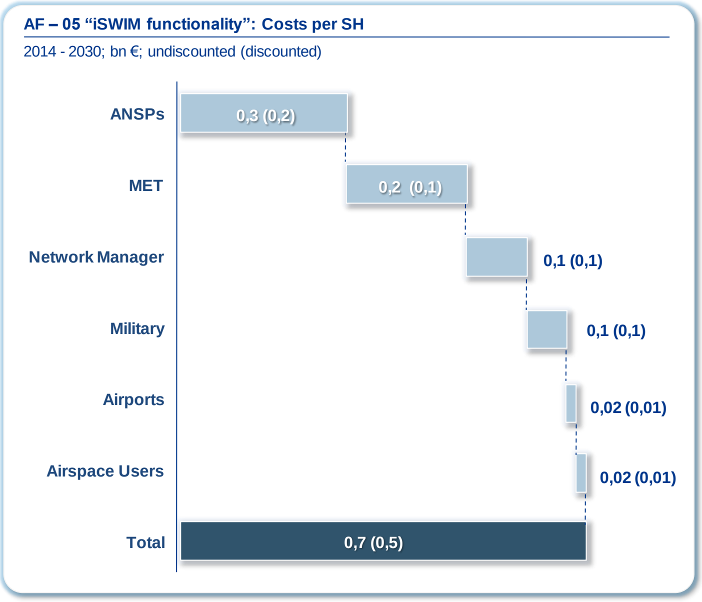


Figure 37: Breakdown of costs per stakeholder for AF # 5

Finally, the overall cost associated would stem from the deployment of the following sub-services:

- "Flow Management & FPL", whose cost accounts for 8% of total investment;
- "Aeronautical & Airspace", whose cost accounts for 22% of total investment;
- "Meteo", whose cost accounts for 39% of total investment;
- SWIM Infrastructure & Administration, whose cost accounts for 2% of total investment;
- "Flight Object": whose cost accounts for 28% of total investment.

5.6 AF # 6: Initial Trajectory Information Sharing (towards i4D)

5.6.1 Description of the AF ("What" and "why")

5.6.1.1 Scope and Outline

This AF includes the first steps towards improved predictability at both Network and local level through the improved use of target times and trajectory information.

The sharing and use of on-board 4D trajectory data by the ground ATC system will result in improved predictability.

This improved predictability of aircraft trajectory will benefit both airspace users and ANSPs implying less tactical interventions and improved de-confliction situation. This has a positive impact on fuel saving and reduction of delay variability.

The AF prepares the environment (anticipating the airborne and ground system requirements) for initial 4D (i4D) and the use of Controlled Time of Arrival (CTA) and Controlled Time Over (CTO), but i4D itself remains outside the scope.

5.6.1.2 Operational Description

Target times and 4D trajectory data can be used to enhance ATM ground system performance.

This relies on all actors having a consistent view of the situation; it is therefore essential that the trajectory held on the ground in the trajectory prediction tools, in the Flight Data Processing Systems (FDPS) and in the wider Network systems is as close as possible to the trajectory held on-board the aircraft in the Flight Management System (FMS).

A phased approach to this use of target times and trajectory information can be envisaged:

- Initially moving to target times (TTO/TTA) at the ATFCM constraints (e.g. congestions) for regulated flights, i.e. to better manage en-route or airport ATFCM congestions instead of using (only) CTOTs, with benefits in terms of more effective ATFCM, improved ATC predictability and consequential benefits to performance. The ATFCM target time (TTO or TTA) may be used as input for arrival sequencing.
- The use of TTA (and CTOT for that matter) purely defined to support arrival sequencing, i.e. also for non-regulated flights, with benefits to arrival flight efficiency and airport throughput.

These initial steps will be further supported by the use of air-ground trajectory exchange for a critical mass of aircraft estimated at 20% of the fleet operating in Europe (corresponding to approximately 50% of flights operating in Europe).

This then prepares the environment for the subsequent step, beyond the scope of this AF, of achieving the initial 4D implementation:

- The use of CTAs (and CTO's) that, supported by air-ground system negotiation processes that consider sequencing requirements with the actual and planned aircraft 4D profile, allowing more accurate sequencing (AMAN) support in the context of i4D, providing further benefits to arrival flight efficiency and airport throughput.

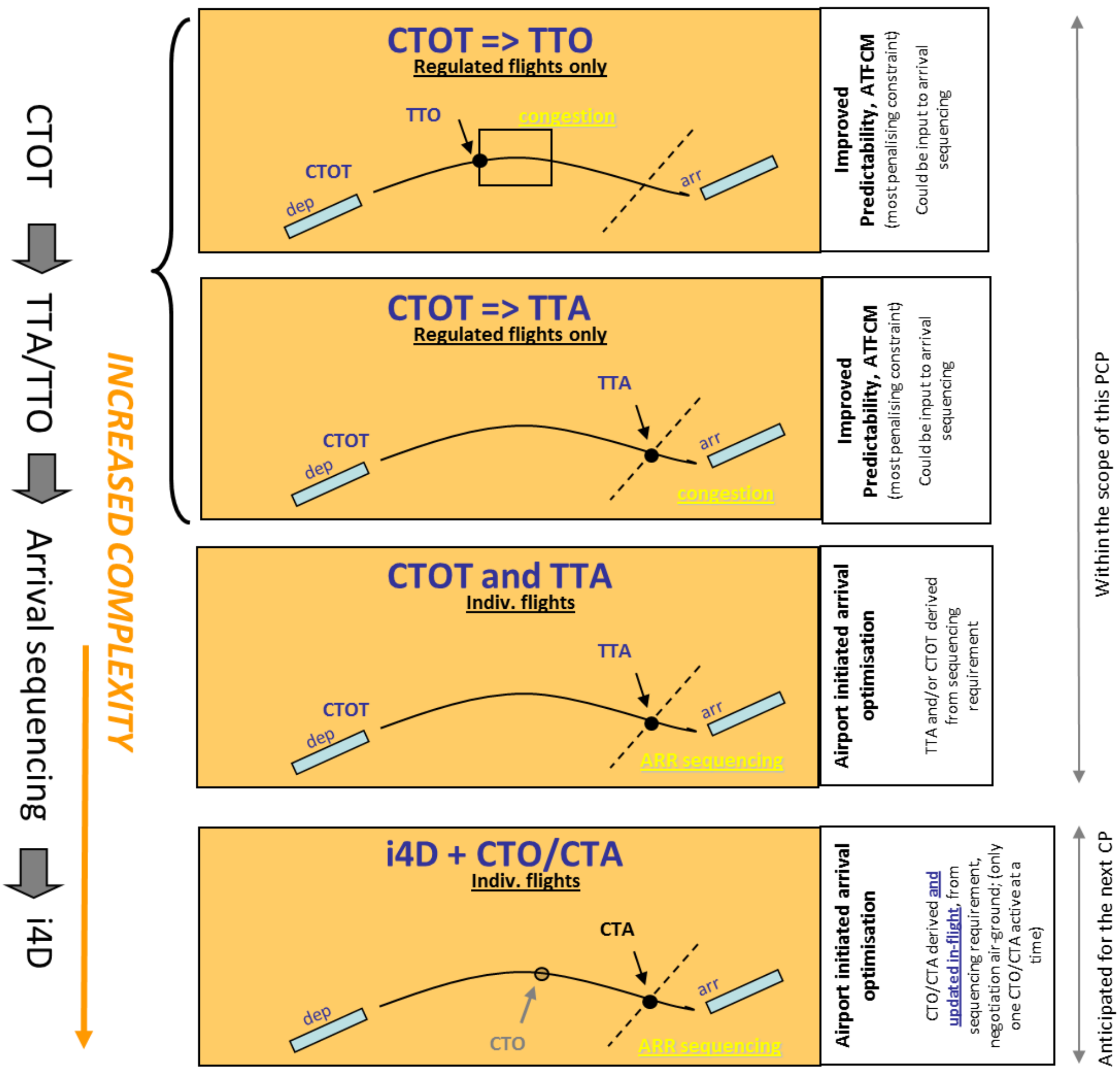


Figure 38: Example of i4D concept breakdown used to perform PCP trade-offs

Improved consistency between air and ground trajectories through down-linked trajectory data enhances the overall performance of decision support tools. Congestion can be more precisely anticipated, allowing better adaptation to real traffic situation and therefore reducing the need for tactical intervention.

The predicted trajectory can be synchronised between the ground system and the aircraft by the downlink of trajectory data between equipped aircraft and the ANSP that are able to incorporate this information into their FDP system.

Furthermore improved interoperability between the ground systems of adjacent ATSU shall enable better exchange of the trajectory data supporting better coordination between centres, extending the horizon of the ground trajectory prediction tools.

These initial steps are paving the way towards i4D (outside the scope of this PCP) which will provide additional improvements to tactical capacity management due to:

- Feeding updated AMAN systems with reliable trajectory data as well as the Reliable RTA Interval (ETA min/max). (linked to AF # 1)

- Use of RTA function to sequence aircraft.
- The aircraft's FMS can fly an optimised airborne trajectory to reach the RTA point (the flying-to-time element, which is not used in the "EPP-only mode").
- Use of CTA (accuracy 30 seconds for En-Route and 10 seconds for TMA) for dynamic Demand & Capacity Balancing / Network Management instead of the TTO/TTA (accuracy +- 3 minutes).

5.6.1.3 System Impact

Datalink communications systems (CPDLC and ADS-C as defined in the ATN Baseline 2 standard under development in EUROCAE/RTCA) support the sharing of trajectory information between ATC and Aircraft.

The down-linked trajectory data consists of the Extended Projected Profile (EPP) which includes:

- The Flight Intent (input to aircraft FMS) i.e. the waypoints of the route and associated altitude, possible time and/or speed constraints agreed between ATM actors.
- The Predicted Trajectory (output from aircraft FMS) i.e. the Flight Intent augmented with intermediate waypoints and associated altitude, time and speed estimates computed by aircraft FMS to build the lateral transitions and vertical profiles.
- Aircraft derived parameters e.g. gross weight, speed min/max, etc.

The trajectory data shall be automatically down-linked according to the datalink contract terms:

- On a periodic basis;
- On event (e.g. in case of change of predicted trajectory versus previously shared predicted trajectory more than the thresholds specified by ANSP);
- On request.

These updates of the trajectory shall be automatically performed from the aircraft system to the ANSP system according to the contract terms. They feed the ground tools, increasing the accuracy of the ground computed trajectory and allow potential conflicts within a medium-term time horizon to be identified and resolved earlier thus reducing the risk of unexpected events.

Flight Data Processing (FDP) systems will need to be updated to enable the use of downlinked trajectory information as well as the capability to share trajectory information between adjacent ATSUs.

Implementation of monitoring tools in the Controller Working Position (CWP) for trajectory adherence to the flight plan, along with the associated evolution of safety nets will also be required.

1 Impact on ground equipment

ANSP systems:

Datalink communications systems shall support CPDLC and ADS-C as defined in the “ATN Baseline 2” standard, supporting sharing of information between ATC and Aircraft (downlink of aircraft trajectory using EPP).

Flight Data Processing (FDP) systems shall be adapted to make use of downlinked trajectories and Controller Working Position (CWP) shall implement monitoring of trajectory adherence to the flight plan.

FDP to FDP trajectory exchange between ATSUs shall be supported using flight object exchange (refer to AF # 5)

2 Impact on airborne equipment

The “ATN Baseline 2” functionality, supporting CPDLC and ADS-C, including the provisions for i4D, will be required to support the downlink of trajectory information through the EPP.

5.6.2 Geographical scope of implementation and associated timeframes

5.6.2.1 Geographical scope

This AF shall be implemented across the entire European ground infrastructure network. That is to say, all 61 civil Air Traffic Control Centres of the EUROCONTROL Member. In addition 20% of the aircraft operating within European Airspace are sought to equip on a voluntary basis to reach a first critical mass within the scope of the PCP (corresponding to 45% of flights operating in Europe).

Further details with regards to the geographical scope of implementation can be found in Appendix D.

5.6.2.2 Implementation timeframes

	Start of Investment	End of Investment	Start of Benefit	Full Benefit	Start of Deployment	End of Deployment
Ground	**2016**	**2022**	**2018**	**2024**	**2018**	**2024**
Airborne	**2018**	**2025**	**2018**	**2030**	**2018**	**2025**

Table 12: Implementation dates for AF # 6

Ground deployment will be phased as follows:

- Acceptance of EPP data and display to controller: 2018
- Automated conformance monitoring for controllers: 2018
- Feeding MTCD: 2020
- Feeding Traffic Management Systems/Complexity management systems: 2020

Airborne deployment as follows:

- Voluntary forward/retrofits for mainline aircraft in the period 2020-2025,
- Voluntary forward fit for regional aircraft in the same period,
- Business aviation, Military would also be able to modify their aircraft provided the solution is made available in due time by the manufacturing industry although it will not be a formal requirement as part of the PCP (also not included in CBA calculations),
- The ramp-up equipage of the fleet and traffic are illustrated on the figure below.

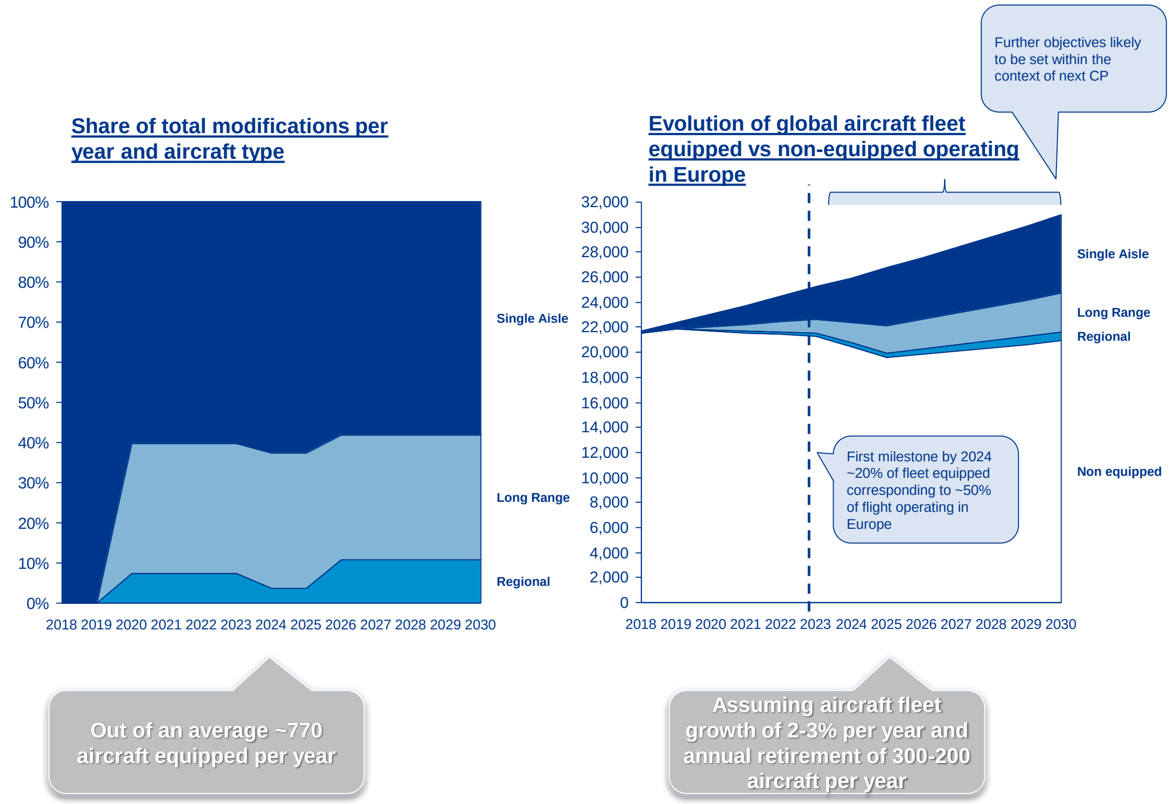


Figure 39: Aircraft modifications ramp-up to reach initial critical mass

5.6.3 Regulatory and standardisation needs

5.6.3.1 Regulatory needs

In the area of Data Link, activity is foreseen in the elaboration of means of compliance, by the Commission and/or by EASA for the ATN Baseline 2 set of Data Link applications enabled by VDL/2 and its operations, based on EUROCAE standards. The associated risk is low.

In the field of i4D navigation requirements, specifications are expected to be produced by EASA, including requirements for the FMS CTA capability, based on EUROCAE standards. The associated risk is low.

In the field of ground systems and equipment, this AF # 6 shares with AF # 5 the potential constraints that could introduce the elaboration of the FDP interoperability standard (there referred as Flight Object), produced by EUROCAE.

Further details with regards to the regulatory needs can be found in Appendix E.

5.6.3.2 Standardisation needs

In the area of Data Link, activity is underway in the elaboration of EUROCAE standards for ATN Baseline 2 which includes the i4D application. This is being done in association with the US through RTCA. The associated risk is medium as the US schedule is longer term than the European planning and there is some pressure to delay the publication of the joint standards. This could result in negative impact in the industrialisation and thus in delays in the deployment of this AF.

In the field of i4D FMS navigation requirements, activity is underway in the elaboration of EUROCAE standards. The associated risk is low.

Further details with regards to the standardization needs can be found in Appendix E.

5.6.4 Alignment with safety requirements

This analysis is the result of the evaluation of the level of development of Safety Assessment Reports and the review of the ATM Functionality technical documentation from an Authority point of view, done by the Expert Groups and by EASA. As conclusions, the following items can be mentioned:

- The Safety Assessment Report for the use of on board 4D trajectory data and on i4D + CTA has been completed.
- The safety assessment of the Trajectory Management Framework has been completed. This is only addressing i4D and not the CTA part.

As a result of the analysis, some other items were found which would require further action previously to the full deployment of this AF. These items are the following:

- The System Interoperability with Air and Ground data sharing safety plan and assessment should be finished.
- The scope of Safety Assessment for the use of on board 4D trajectory data has to be adapted to the scope of the PCP (scoping only i4D and not i4D+CTA).

Finally, it is recommended for the local implementation of this AF that, where necessary, particular specificities in the use of i4D in ENR or in TMA be taken into consideration. In particular, special attention will have to be taken when elaborating the local safety argument to the potential impact of mixed traffic (conventional and i4D), simultaneously in a given volume of airspace. Although mitigation measures are implementable, they can cause limitations in capacity. In such cases, application of the BEBS principle should be considered to limit the impact and mitigate the risk.

The review by EASA of the existing Safety Assessment Reports, as well as the review of the ones delivered in the future, should be completed. Due consideration should be given also to their review by National Authorities

5.6.5 Cost-benefit analysis:

This AF is expected to improve predictability of aircraft trajectory for the benefit of both airspace users, Network Manager and ANSPs implying less tactical interventions and improved de-confliction situation. This would have a positive impact on ANS Productivity, fuel saving and delay variability.

The NPV associated amount to -0,2 billion €.

The distribution of costs, benefits and cumulated net benefits over the considered time period is represented in the following chart.

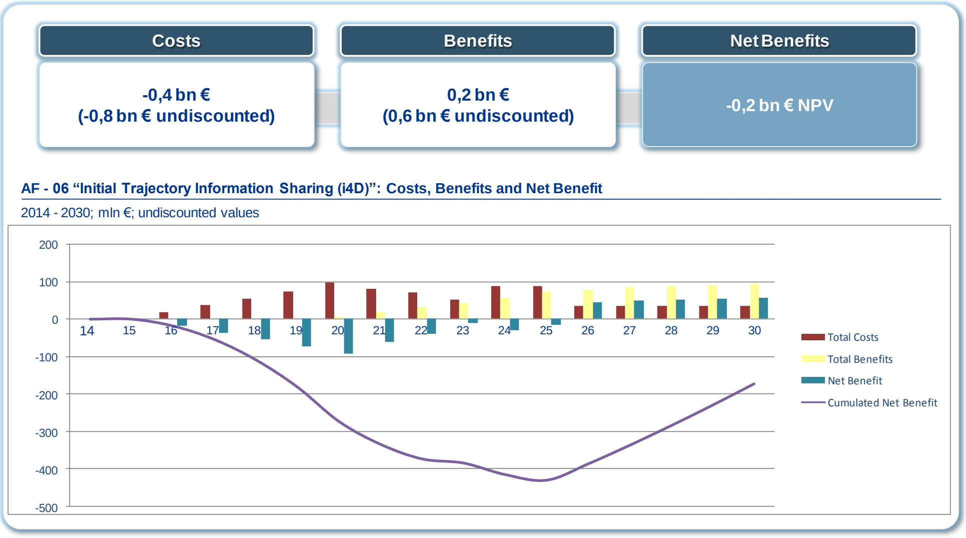


Figure 40: Overall CBA for AF # 6

The gains in terms of ANS productivity represent the most important benefit achievable through the implementation of this AF.

Specifically, ANS productivity increase contributes to the benefit associated to this investment by 94%, followed by fuel cost and CO_2 related savings, accounting respectively for 5% and 1%.

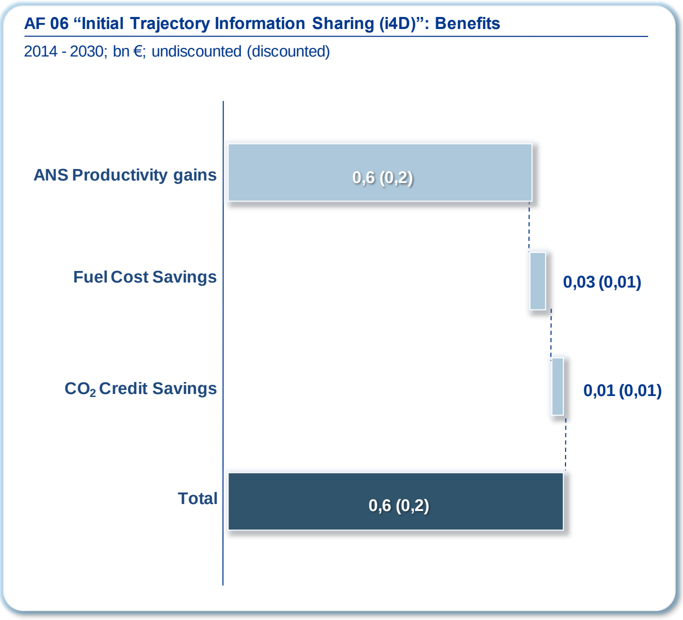


Figure 41: Breakdown of benefits for AF # 6

Looking at the costs, three stakeholders categories would be expected to contribute to the overall investment associated to this AF, namely Airspace Users, ANSPs and Network Manager; the highest share of the costs is associated to airborne investment to be undertaken by Airspace Users.

Specifically, the overall investment would be shared among the involved stakeholders' categories as follows:

- Airspace Users (airborne investment): 66% of total investment
- ANSPs: 33% of total investment
- Network Manager: 1% of total investment

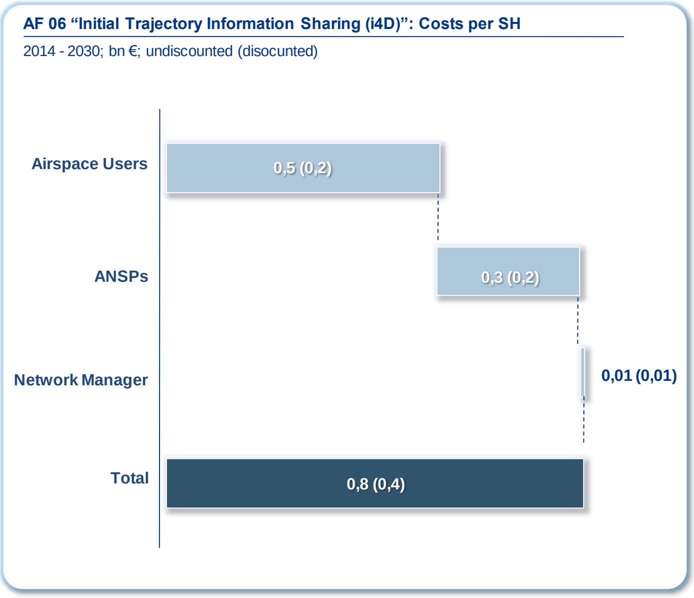


Figure 42: Breakdown of costs per stakeholder for AF # 6

6 HIGH PRIORITY RISKS IDENTIFIED

	Risk	ATM Functionality concerned	Proposed mitigation action	Key references in document
1	Maturity of the solutions identified within PCP will not be fully achieved up to and within the scope of Release 4	All	Adopt a top-down approach for the definition of SJU Release 4 & 5.	Sections 2.1, 2.2
2	Regulatory and standardisation needs are not resolved in time	AF # 1, 2, 5, 6	Monitoring of the standardisation and regulatory roadmaps	Sections 3.1, 4.1, 4.2, 5.1-7
3	Charges modulation scheme is not set up in time	AF # 6 and possibly AF # 3	Start work as soon as possible to address the scoping, drafting, legal and technical aspects	Sections 4.1, 5.7
4	The high level definition of how the AFs will be deployed is not able to take account of specific constraints that come from the different local implementation baselines. This may impact on the detailed deployment and transition planning.	All	The Deployment Manger will need to carry out a deep analysis of the local baseline architecture and address any issues that arise due to the implementation of the new functionalities, in particular any transition issues.	Sections 2.5, 7
5	Interoperability and global harmonisation will not be ensured	AF # 5 and # 6	Further examine solutions to ensure that the iSWIM concept and associated optimised deployment scenario is broadly adopted within the context of the supplement to the mandate. Further determine the needs and level of interoperability related standards or ICAO provisions in the frame of	Sections 2.4, 5.6, 5.7

			European coordination of aligning the MP with the ICAO ASBU evolution as well as under the coordination activities of the EU-US MoC SESAR/NextGen with the FAA. Particular attention must be paid on the definition and timeframe of the ATN B2 (in relation to AF # 6) and on the definition of the FIXM (in relation to AF#5)	
6	Delays are experienced in the implementation of those Deployment Baseline elements identified as essential pre-requisites for the PCP	AF # 1, 2, 4, 6	Consider including in the scope of responsibility of the Deployment Manager (Deployment Programme) these essential pre-requisites Consider earmarking public funding to de-risk potential delays in implementation due to the economic crisis and business model specificities. Initiate level 2 and 3 procurement activities as soon as possible.	Section 2.5
7	Airspace User investments to reach initial critical mass of aircraft equipped not ensured	AF # 6	Ensure that conditions for successful deployment are implemented in time. Consider Implementing Rule ensure the timely implementation of ground related investments.	Sections 4.1, 4.2, 5.7

8	Governance and funding is not implemented in time to ensure successful deployment	All	Consider launching the procurement activities related to Level 2 and 3 of SESAR deployment governance as early as possible. Launch new cycle of Demonstration Activities focusing on PCP content in 2013.	Sections 4.1, 4.2, 7
9	Failure to manage Human Performance (Human Factors, Competency and Change Management) issues in the implementation phase	All	Deployment Manager to examine social dialogue implications of all deployment activities for all groups of operational aviation staff. Deployment Manager to ensure appropriate coordination between all stakeholders concerned to ensure consistency between initiatives related to Human Factors, Competency and Social Dialogue.	Sections 5.1-7, 7

7 NEXT STEPS AND WAY FORWARD

7.1 Next steps

This document contains the proposal from the SESAR Joint Undertaking on the content of the PCP. In drafting this proposal the SJU aimed at de-risking to the maximum extent possible the comments, remarks and positions that the various stakeholders or stakeholder groups may express on the scope of the PCP.

It must be noted that this extensive coordination does not, however, constitute any formal endorsement of this proposal by the various stakeholders or stakeholder groups. This material should be used by the Commission to consequently launch the formal consultation in view of the final endorsement by Member States.

Consequently, the Commission is invited to consider the SESAR JU proposal and decide on initiative towards the adoption of the 6 ATM Functionalities identified in the proposal as a package for the PCP.

The Commission's attention is drawn to the fact that this proposal does not address yet the high level definition of the deployment architecture issue and of the interdependencies between the ATM functionalities proposed and the new concept of centralised services. The possibility of some "non-local deployment" aiming to maximise the benefit generated by some ATM functionalities is only briefly touched upon. This crucial aspect of deployment will be further developed in a separate document to be delivered by end June 2013.

7.2 Focus areas for the consultation of stakeholders

The following issues are earmarked as crucial for the stakeholder consultation:

- The overall balance of the proposal and the interdependencies identified advocating for an implementation of the 6 AFs as a coherent package;
- The results of the CBA, both at global and individual levels;
- The proposed incentive mechanisms;
- The link with the Interim Deployment Programme and the transition period towards selection of the Deployment Manager
- The human and change management dimension, to secure the buy-in of the ATM staff and ensure a proper transition.

7.3 Timely set-up of the deployment sequence

The deployment sequence presented in this proposal is both realistic and ambitious:

- realistic because the various dates identified for the individual ATM Functionalities were cross-checked against the latest information available in the ESSIPs as well as the ones available in the plans of the various stakeholder groups;
- ambitious because each of the six ATM Functionalities require a high level of synchronisation as well as, in a number of cases, the completion of R&D activities or the implementation of some elements of the deployment baseline.

In addition:

- a significant part of the investments needs to start in the 2014-2016 timeframe. To mitigate any risks of delay and de-synchronisation in SESAR implementation, the launching of the procurement activities related to Level 2 but as well to Level

3 of SESAR deployment governance needs to be considered as early as possible.

- The setting up of charges modulations, where deemed appropriate, will necessitate substantial additional work, of regulatory and technical nature. The launching of such activities needs to be considered as early as possible.

7.4 Candidates for next common projects

The PCP process is expected to initiate an incremental approach, meaning that next common projects should take account of the progress in deploying the deployment baseline and the evolving PCP maturity on the basis of the results of validation activities carried out by the SJU in Releases 3 and 4. In the course of the elaboration of this proposal, a number of potentially good candidates have been identified for consideration for a possible 2nd Common Project. These are:

- i4D + CTO/CTA for all flights
- Dynamic sectorisation and constraint management
- Sector Team Operations
- Improved Surface Management
- Additional SWIM services

7.5 Impact on Research and Development activities

The definition of the PCP proposal was based on an in-depth analysis of the SJU Research & Development Programme content, and in particular of the upcoming SESAR Releases. In order for the various PCP components to be ready in due time for their deployment (taking into account the time to industrialisation), a need to further secure and prioritise the Programme activities was identified.

Consequently, the outcome of the PCP will be used as a top-down input for:

- The definition of the SESAR Releases 4 and 5;
- The SJU Member's contributions re-allocation that will be performed by the end of 2013.

APPENDIX A DESCRIPTION AND MAPPING OF THE PCP "CANDIDATES" AGAINST THE EUROPEAN ATM MASTER PLAN KEY FEATURES

SESAR Key Features	Deployment baseline	Pilot Common Project candidates	STEP 1 (time based)
Moving from Airspace to 4D Trajectory Management	• Civil/Military Airspace & Aeronautical Data coordination • A/G Data link • CPDLC	• Free routing at network level	• Free routing • Trajectory Mgt & Business Mission Trajectory • System Interoperability with Air / Ground data sharing
Traffic Synchronisation	• Basic AMAN	• CTOT and TTA • Integrated AMAN DMAN and E-AMAN horizon • PBN in high density TMAs	• I4D +CTA • Integrated AMAN DMAN and E-AMAN horizon
Network Collaborative Management & Dynamic Capacity Balancing	• Basic Network Operations Planning	• Initial integration AOP/NOP • Enhanced ATFCM Processes • Airspace management and AFUA	• Network Operations Planning
SWIM	• Xchange models • IP based network	• Initial SWIM Services	• Initial SWIM Services
Airport Integration & Throughput	• Airport CDM • A-SMGCS L1&L2	• Wake Vortex Separation based on time • Airport Safety Nets	• Airport Surface Management, integrated with Arrival and Departure • Airports safety nets
Conflict Management & Automation	• Initial Controller assistance tools	• Medium Term Conflict Detection and Resolution	• Enhanced Decision Support Tools and PBN • Conflict Detection and Resolution

A.1 Candidate 1: Free routing at network level

Free route (FRA) operations require a specified airspace within which users may freely plan a route between a defined entry and a defined exit point with the possibility of routing via intermediate (published or unpublished) waypoints, without reference to the ATS route network, subject to airspace availability. Within this airspace, flights remain subject to air traffic control.

A.1.1 Free routing concept in Step 1 of the European ATM Master Plan

In such concept airspace users know which airspace is or is not available: route availability is complemented or replaced by information on the availability of airspace volumes.

In free route airspace there are no longer discrete crossing points (e.g. at a navigation aid) but a larger number of possible conflict points along each free planned route. ATC support tools are necessary to mitigate the effect of less predictability of conflicts, and to maintain safety:

- Advanced conflict detection tools (e.g. Medium Term conflict Detection (MTCD)/Tactical Controller tools (TCT) from 8 to 20 Nautical Miles), including a what-if function and resolution proposals (e.g. Conflict and Resolution Advisor (CORA) Level 2) if necessary.
- Monitoring Aids (e.g. MONA) to improve traffic awareness in particular trajectory conformance tools.

At the same time, efficient civil/military coordination and cooperation will be a key contributing factor to allow for an optimum use of available airspace through the application of Airspace Management (ASM) solutions.

A.1.2 The PCP Proposal

This concept is crucial in that it will enhance the use of available airspace and reduce fuel use by optimising trajectories and profiles.

Expected performance improvements are in:

- Flight efficiency by, for example, providing more direct routes (subject to constraints of any segregated airspace), and by allowing more optimised flight trajectories and profiles;
- Capacity by enhancing the use of available airspace.

A.2 Candidate 2: CTOT and TTA

Within the Traffic synchronisation key feature of the European ATM Master Plan, the i4D + CTA essential operational change addresses the aircraft capability to comply with a requirement to reach a specific trajectory point at a contracted time (Controlled time of Arrival, CTA, or Controlled time Over, CTO). This can be exploited both in en route for metering of flows or in TMA for arrival sequencing. This capability is associated with the aircraft capability to provide by datalink estimates of time (Estimated time of Arrival (ETA) min/max or Estimated time Over (ETO) min/max) as computed within the aircraft Flight Management System (i4D).

A.2.1 i4D + CTA in Step 1 of the European ATM Master Plan

Within Step 1, the ground ATM system's access to ETA min/max for aircraft fitted with i4D (initial 4D) capability is implemented as a foundation.

This exchange of ETA min/max between the aircraft and the ground system is enabled by the downlinking of trajectory information by the aircraft (using ADS-C) as well as the necessary CPDLC messages to enable the ground to negotiate a suitable CTA with the aircraft.

The introduction of aircraft capable of meeting a CTA with appropriate accuracy improves the performance and reliability of the Arrival MANager (AMAN) system. This gives better performance in the sequencing and scheduling of the arrival stream as well as higher potential for the aircraft to fly optimised trajectories at speeds and descent rates that save fuel, reduce noise and at the same time provides all stakeholders with higher predictability.

Besides this CTA capability, aircraft are also able to operate with a single CTO allocation for en route synchronisation or separation purposes.

In Step 1, aircraft can manage only one CTO/CTA. A new CTO/CTA can only be managed after completion of the current CTO.

A.2.2 The PCP Proposal

From the overall i4D concept the "Flying-to-Time" (use of CTA/CTO with a guaranteed accuracy of 10/30 seconds) is not part of this PCP, but the air-ground trajectory sharing part of i4D via the downlink of the ADS-C EPP as described by AF#6. The flying to target times (TTA/TTO) is supported by current FMS technology with accuracies of approximately 2 or 3 minutes and the times should be flown on a "best effort basis".

Therefore, within the scope of the PCP, the proposal addresses only part of the full Step 1 concept described including arrival sequencing. The aim is to address specific workload delivery weaknesses known to exist within the current system due to the lack of predictability. Improved predictability, will bring increased confidence in traffic and workload forecasts, reducing the need and magnitude of ATFCM measures. This will be achieved by moving from a pure CTOT (Calculated Take Off time) mechanism to the use of Target time of Arrival for all flights, with the added value of connecting with e-AMAN and ATC view of the Airspace Users flight intentions. The use of CTO/CTA enabled by trajectory exchange between the aircraft and the ground can further support the improved predictability.

Expected performance improvements are in:

- capacity through enhanced runway throughput due to better sequencing of arriving flights; less lateral deviation, reduced holding and reduction of the controller workload;
- Flight efficiency - allocation of a CTA before Top of Descent allows the aircraft to fly a near idle profile and on Performance Based Navigation (PBN) procedures in closed loop operations, i.e. the optimum profile integrating the time constraint and reducing the use of stack holding.

A.3 Candidates 3 and 4: Integrated AMAN-DMAN and extended AMAN horizon

Within the Traffic synchronisation key feature of the European ATM Master Plan, the use of extended Arrival MANager (AMAN) horizon consists of coordination between a TMA ATS Unit and an en route ATS Unit to delay or accelerate a given flight in its en route phase to synchronise its arrival at a TMA entry point.

Integration of AMAN and Departure MANager (DMAN) functions at a given airport is intended to improve resource planning for the turn-around time of a flight by taking into account the local constraints that can impact the arrival or the departure traffic flows therefore improving accuracy of arrival and departure times.

Integrated AMAN DMAN and Extended AMAN Horizon in Step 1 of the European ATM Master Plan

A.3.1 Within Step 1, the following operational improvements are to be deployed:

- Improved AMAN integrating the use of Performance Based Navigation (PBN), together with Continuous Descent Approaches (CDAs). Sequencing support is based upon on-board trajectory data sharing and CTA for equipped aircraft allowing for a mixed aircraft capability to operate within the same airspace and providing a transition framework to full 4D operations within Steps 2 & 3.
- Further development of the en route elements of AMAN.
- Coupling of arrival airport AMAN with DMAN at departing airports with the objective of taking into account arrival constraints to deliver the take-off/push back clearances at departing airports.
- Managing the arrivals at various airports within the same TMA.

A.3.2 The PCP Proposal

For the purpose of the PCP, 'Extended AMAN' specifically considered the following:

- Arrival Management Extended to en route Airspace, limited to the extension of AMAN to 180-200NM;
- Arrivals Management into Multiple Airports.

Expected performance improvements are in capacity, through optimised usage of terminal airspace and available runway capacity and through dynamic runway rebalancing to better accommodate arrival and departure patterns. They are also in flight efficiency through reduction of ground and airborne holding delays and optimised descent profiles on predetermined PBN trajectories.

A.4 Candidate 5: Initial integration AOP/NOP

Network Management is ensuring consistency between individual actions and the overall objectives of the ATM Network. In the context of the European ATM Master Plan, it will evolve around airspace structure enhancements, route network improvements and the co-operative Network Operations Planning, demand and capacity management and network performance management.

The linking of Airport Operating Plan (AOP)/Network Operating Plan (NOP) parameters optimises the network and airport management by timely and simultaneously updating AOP and NOP providing Network and Airport Managers with a commonly updated, consistent and accurate Plan.

A.4.1 Network Operations Planning (NOP) in Step 1 of the European ATM Master Plan

During Step 1 there will be a SWIM-based NOP. The initial Web services (Business to Business (B2B)) made available in the Baseline will be expanded .The initial approach to collaborative planning will be the implementation of an interactive Network Operations Plan which will provide an overview of the ATFCM situation from planning to real-time operations. Local ASM tools are deployed to provide Airspace Management data to the NM.

The linking of AOP/NOP parameters optimises the network and airport management by timely and simultaneous updating of AOP and NOP via SWIM, providing Network and Airport Managers with a commonly updated, consistent and accurate Plan.

Network planning and operations include initial steps of airspace configuration. Through CDM the network resources and infrastructure are configured and managed to optimise network performance. The aim is that every actor (network, ANSPs, airports, airspace users) will realise the NOP through a rolling cooperative process and by sharing operational data.

A.4.2 The PCP Proposal

The PCP proposal consists of:

1. **Initial deployment of AOP/NOP information sharing**, for which agreement on data to be exchanged between Airports and Network (2-way) will be achieved in 2013, as well as the options for information exchange means supporting initial deployment, e.g. B2B exchanges of messages and/or use of SWIM-based services. AOP/NOP information sharing forms the foundation for all other elements, with interface in the planning time horizon , stretching time line for departures from current 3 hours horizon, and linking to airport (time-based) operations.

2. **Initial deployment of AOP/NOP cooperative traffic management**: Based on AOP/NOP information sharing and Network and Airport (APOC) organisational roles / responsibilities:

    a. Collaborative management of adverse conditions, based on increased exchange of data (e.g. MET data, capacity information).

    b. Collaborative arrival sequencing: optimum arrival sequence considering Network and Departure constraints.

    c. Initial deployment of tools to reflect airspace user preferences and provide what-if capabilities.

    d. Deployment of APOC decision support tools and “what if” tools for both the network and airport where local complexity necessitates.

The AOP/NOP integration will be based on common European standardised interfaces with B2B services already providing a platform for deployment during transition to SWIM based services.

AOP/NOP integration will provide visibility on the management of European, network and airport performance targets, embedded in the AOP processes, further enhanced by an airport focal point for collaborative activities with the network (later integrated into the Airport Operations Centre).

Expected performance improvements are in:

- Capacity by enhancing the use of available airspace via better collaborative planning and collaborative decision-making, sharing of operational data and the introduction of the “Airspace Configurations” concept and tools to better integrate ATCFM/ASM/ATC.
- Flight efficiency – Enhancing predictability through better anticipation and management of ATM constraints, offering optimised trajectories closer to those preferred by the user.
- Cost efficiency – Operations and provisions of enhanced collaborative network planning approach and management of rare resources to deliver the highest benefits to the network.

A.5 Candidate 6: Enhanced ATFCM processes

Improving the ATC-ATFCM-Airport operations interaction will improve traffic predictability and provides the cornerstone for delivering traffic flows to downstream ATC sectors in a ‘shape’ (rate, sequence, complexity) that allows best use of available resources, and for network support to airport arrival sequencing processes, thus reducing the need for ATFCM measures and reducing the need for excessive airport holding.

A.5.1 E-ATFCM in Step 1 of the European ATM Master Plan

In Step 1, network operations will be time-based, making better use of available capacity. Requirements include narrowing the operational gap between ATC and ATFCM as regards planning and execution. Operational procedures will be developed which involve coordination between more than one ACC, Airport Operations and the Network Manager. The principles of Variable Profile Areas (VPAs) will be introduced.

In addition to the Network planning and operations, this Essential Operational Change will address:

- short-term ATFCM measures;
- User Driven Prioritisation Process (UDPP) tools and procedures;
- enhanced civil-military co-ordination, airspace management systems equipped with the pan-European airspace co-ordination tools and flexible airspace structures;
- the tools that support dynamically shaped sectors and dynamic organisation of terminal airspace, modular temporary airspace structures and reserved areas and the support to dynamic sectorisation and dynamic constraint management;
- dynamic/flexible sectorisation: the ability to be flexible and dynamic in organising the airspace to cope with the traffic pattern will be a key functional enabler to the User Preferred Routing concept (e.g. dynamic modular sectorisation).

A.5.2 The PCP Proposal

The improvements addressed in this proposal aim to:

- improve predictability by achieving an adherence to (improved) planning to the extent possible without affecting the flexibility required for ATC/airspace user operations,
- reduce the need for ATFCM measures (generating delays and re-routings) by stepwise assessing alternative solutions and, as required, manage specific flights in quasi real-time (STAMs);
- improve predictability by cooperatively managing ATCFM congestions at the point of congestion rather than only at departure (moving from CTOT to a target time at a given congested node);
- using target times to support airport arrival sequencing processes in the en route phase, optimising the use of available ATC arrival capacity and minimising flight inefficiencies resulting from vectoring and holding activity.

Complexity management tools, basic and enhanced, will increase the accuracy and effectiveness of the processes to align traffic demand with available capacity and associated ATFCM measures.

Overall, the more predictable delivery of traffic flows into congested areas and arrival airports will reduce the need to keep some of the real capacity as a safety buffer to absorb unexpected demand peaks. This in turn will lessen the need for flow regulations and allow higher throughput rates. In addition, traffic demand will be better matched to available capacity. Together, these performance effects will result in a reduction of ATFCM delay.

A.6 Candidate 7: Airspace management and AFUA

The Deployment Baseline addresses several system improvements relating to the enhanced en route airspace management structure and Flexible Use of Airspace (FUA).

The enhanced en route airspace structure addresses the multiple route options, modular temporary airspace structures and reserved areas, improvements to the route network including cross-border sectorisation and the initial steps towards flexible sectorisation management.

It is important now that the FUA procedures developed over the past years are exploited to their maximum through a much closer cooperation between the Network Manager and the local civil and military partners. It is essential that the Network Manager achieves to coordinate from a network perspective the availability of civil/military airspace structures and the appropriate utilisation of those by civil users.

This should be achieved through a more proactive and simplified exchange of data and information between the ANSPs, the Network Manager and the airspace users so that the airspace users will receive a more consolidated network picture on airspace availability for both the strategic and the pre-tactical phases.

A.6.1 Airspace Management and AFUA in Step 1 of the European ATM Master Plan

The possibility to design ad-hoc structure delineation at short notice is offered to respond to short-term Airspace Users' requirements not covered by pre-defined structures and/or scenarios. In Step 1, changes in the airspace status are not uplinked to the pilot yet but are shared with all other concerned users by the system, i.e. Network Manager (ASM and ATFCM function), ANSPs, civil and military Airspace Users (Flight Operation Centres and Wing Operations Centres). The objective is to better respond to military airspace requirements and/or meteorological constraints while giving more freedom to GAT flights to select the preferred route trajectories and to achieve more flexibility from both civil and military partners.

A.6.2 The PCP Proposal

In the context of this PCP description, the expected evolutions and basic concepts which constitute the link between the deployment baseline and further deployment under Step 1 extend beyond FUA only and require better integration of ASM, ATS and ATFCM aspects, as described below:

Extensive use of Airspace Configurations. These are defined as “the predefined and coordinated organisation of ATS Routes of the ARN and/or Terminal Routes and their associated airspace structures (including temporary airspace reservations and Free Routes Airspace portions, if appropriate) and ATC sectorisation. Airspace Configurations are aimed at responding to and balancing performance driven strategic objectives (capacity, flexibility, flight efficiency, environmental) at all levels, network, sub-regional and local, while taking due account of military mission effectiveness.

Airspace Configurations will result from a CDM process where improvements to the airspace organisation and management are agreed. The CDM Process will be based on the cooperation between airspace users, the local functions, the Network Manager as appropriate and, where available, sub-regional functions (FABs). It will be conducted through a process, set up to agree upon a predefined set of Airspace Configurations for a given airspace volume and time, including route structures, airspace structure and associated sectorisation.

Continuous, seamless and reiterative planning, allocation and operational deployment of optimum airspace configurations, based on airspace request at any time period within both pre-tactical Level 2 and tactical Level 3. This will result in a rolling process, supporting enhancement of the daily Network Operations Plan. This will allow airspace users to better take benefit from changes to airspace structures in real-time.

Extensive use of modular areas and Introduction of mechanisms allowing the definition and use of flexible, ad hoc, reserved/segregated airspace structures within a given Airspace Configuration, and improved management of segments of CDRs.

More flexibility in definition and operation of sector configurations taking into account not only traffic demand but also the airspace availability as result of the CDM process; indeed airspace allocation and sector configuration should offer enough flexibility in order to identify the best combination to satisfy civil and military requests, exploit resources available and minimize the need of ATFCM measures, while keeping to a simple and straightforward coordination process.

More extensive cross border operations across Europe, supported by FABs implementations, resulting in shared use of reserved/segregated areas, taking into account reasonable sharing of environmental nuisance.

The elements described represent a realistic evolution, based on enablers developed within preceding ATM related programmes, projects and trials. The improved and better coordinated ASM/ATFCM/ATC process that will be the result of the work will support Network performance by providing processes and procedures from strategic planning to tactical usage.

Most of the improvements of the ASM/ATFCM processes expected in PCP-time frames will be related to the closer interaction between operating phases (Level 1, Level 2 and Level 3). This interaction will result in a seamless (running) process enabled by continuous CDM. The three levels will be maintained, but the processes of which they comprise will no longer be restricted to a particular time interval (i.e. non-overlapping phases). However, the decision on the operations of an airspace will be part of only one operating phase at a given time.

The other major improvement expected will come through a much closer interaction between the ASM/ATFCM process and the actions required by ATC, making it into a combined and closely coordinated ASM/ATFCM/ATC process.

The resulting performance impact of these improvements is primarily expected in the areas of flight efficiency and airspace utilisation. A better dialogue regarding evolving military needs should result in a reduced number of unused airspace reservations. Better knowledge of expected airspace and route availability prior to departure should enable civil airspace users to file flight plans with a more efficient trajectory, thereby reducing the efficiency gap between the last filed flight plan and the actually flown trajectory. In addition, more airspace and route availability translates into more trajectory options and more airspace capacity.

A.7 Candidate 8: Initial SWIM Services

The current mechanisms (with many proprietary formats and protocols) for exchanging information between the ATM stakeholders are a legacy from the pre-Internet era and are inadequate.

SWIM will make the ATM system more flexible, more agile, minimising the development/deployment and operation costs. SWIM will introduce a complete change in how information is managed throughout its lifecycle across the whole European ATM system. SWIM consists of standards, infrastructure and governance, enabling the management of ATM information and its exchange between qualified parties via interoperable services.

A.7.1 Information sharing

The rationale for information sharing is to unlock the information and to make it available to a greater number of ATM stakeholders. This will create new opportunities for the stakeholders to optimise their business processes by increasing the overall productivity, quality and safety of the ATM system.

SWIM will provide the technical means to restrict access to the information if necessary for business and security reasons.

A.7.2 Service orientation

SWIM will use services as the mechanism for information exchange and apply methodological, technical and information management standards to their development. The services approach allows the producers of information to be decoupled from the consumers, thus increasing flexibility and agility in responding to business needs.

SWIM enables wider discoverability of pertinent information and available services, thereby making it easier and less costly to share.

A.7.3 Federation

A federative approach means that each stakeholder will be able to maintain their own responsibility in the domains of operations, service provision, technical infrastructure and ownership of information.

This principle, however, provides the possibility for a specific stakeholder to delegate responsibilities to other stakeholders.

A.7.4 Standards

Semantic interoperability will be assured by developing a common information model, allowing all stakeholders to share the same understanding of the information being exchanged. Interoperability will also be guaranteed by developing a common information service model, which standardises the way information is exchanged.

Interoperability of services will be assured by their deployment on the SWIM technical infrastructure which is compliant with appropriate, widely-used, non-ATM specific technological standards in conjunction with a minimal set of ATM-specific complementary standards.

A.7.5 Governance

SWIM information and services will be governed throughout their lifecycle. Governance will ensure controlled evolution and implementation of information models, service models and infrastructure. The governance will also create trust between SWIM participants by ensuring that participants are qualified to participate in the execution of the services.

The implementation of SWIM is not a "big-bang" replacement of the existing ATM environment, but rather an evolutionary process based on a gradual transition towards a service-oriented European ATM system. The adoption of SWIM will be flexible, fostering increased levels of collaboration within business domains and enabling supporting systems to interact in an interoperable and standardised way.

A.7.6 SWIM in Step 1 of the European ATM Master Plan

The transition to SWIM will build on developments that have already started pre-SESAR, e.g. the introduction of Network Operations Planning B2B services, the development and validation of flight object standard (ED133), evolution of EAD (European AIS Database) services.

SWIM will facilitate the exchange of flight information between ATC centres.

SWIM will provide easy access to the Network Operation Plan information services and to the existing and new Aeronautical Information Service (AIS) information in a digital form (e.g. terrain and obstacle (eTOD) or aerodrome mapping databases see section 4.4.1.1). SWIM will enable an extensive CDM process to ensure the balance between capacity and demand of the traffic flow, resulting in the Network Operations Plan.

A.7.7 The PCP Proposal

The PCP proposal focuses on the implementation of the initial SWIM functionality (iSWIM). It consists of a set of services that are delivered and consumed through IP-based network by SWIM enabled systems. This iSWIM functionality can be further broken down in:

A set of services according to the 4 different data domains (Flow Management, Flight and trajectory, Aeronautical and Airspace, Meteo);

SWIM enabled Systems (either new or legacy) representing the development needed to make the link between ATM applications using internal data representation and the delivery and/or consumption of the inter-system shared services & data;

A communication infrastructure and two SWIM technical infrastructure profiles adapted to different quality requirements (one to support Flight Object services, the other merging the current EAD & NOPB2B profiles);

SWIM Administration activities (registry, service quality assurance, security...).

Expected performance benefits are in cost-efficiency by providing a global integrated data sharing function to replace multiple and fragmented data exchange frameworks.

A.8 Candidate 9: Wake vortex separation based on time

The objective is to recover loss in airport arrival capacity currently experienced in headwind conditions on final approach under distance-based wake turbulence radar separation rules. By using time-based parameters, this loss is mitigated, having a positive effect on runway throughput and runway queuing delays. Minimum radar separation is not affected.

A.8.1 Wake vortex separation based on time in Step 1 of the European ATM Master Plan

The application of time based wake turbulence radar separation rules on final approach (TBS) provides consistent time spacing between arriving aircraft in order to maintain runway approach capacity independently of any headwind component. In Step 1, the final approach controller and the Tower runway controller are to be provided with the necessary TBS tool support to enable consistent and accurate delivery to the TBS rules on final approach. The minimum radar separation and runway related spacing constraints will be required to be respected when applying the TBS rules. In addition, Time Based spacing will also ensure that, in still wind conditions when wake vortices do not decay as rapidly, that wake vortex separations are consistently applied resulting in better levels of safety than at the moment.

A.8.2 The PCP Proposal

The PCP proposal is confined to wake vortex separation to only include the head wind component and not cross wind. Whilst TBS (time-Based Separation) operations are not exclusive to a headwind on final approach, the current deployment proposal is specifically targeted at realising the potential capacity benefits in these currently constraining conditions.

Radar separation minimum and vortex separations are parameters that will be integrated in the time Based Separation support tool that provide guidance to the controller to achieve the time proposed spacing to counter the effect of the headwind.

Expected performance benefits are in capacity by recovering the reduction in the achieved arrival capacity currently experienced in headwind conditions when applying the current distance based wake turbulence radar separation rules on final approach, with a positive effect on runway throughput and runway queuing related delays.

A.9 Candidate 10: Airport safety nets

Increases to runway throughput are being investigated to improve airport capacity. However, surface movement capacity has to be increased without making the risk of runway incursion any greater. A range of measures are needed including conflict detection and warning systems.

A.9.1 Airport Safety Nets in Step 1 of the European ATM Master Plan

The ground systems detect potential conflicts/incursions involving mobiles with other mobiles or obstacles on runways, taxiways and in the apron area. Alerts are provided to controllers and vehicle drivers together with potential resolution advisories (depending on the complexity of resolution possibilities). In Step 1, the ground system also alerts the controller in case of unauthorised traffic. Flight crew traffic situational awareness is improved and the aircraft system generates its own traffic alert in the case of traffic proximity on the runway.

A.9.2 The PCP Proposal

The geographical scope of this activity is considered to cover both the Runway and Airfield Surface Movement area.

In the PCP proposal, two functions are considered as mature for deployment in the given timeframe:

Conflicting ATC clearances: when the Tower Runway Controller provides mobiles with ATC clearances that, if followed, would bring them into conflict with other mobiles,

The detection of Conflicting ATC Clearances is a support tool for the Tower Runway Controller and will be performed by the ATC system based on the knowledge of data such as the clearances given to mobiles by the Tower Runway Controller, the assigned runway and holding point. Working procedures need to ensure that all clearances given to aircraft or vehicles are input in the ATC system by the controller on the Electronic Flight Strip (EFS).

Different types of conflicting clearances are identified (e.g. Line-Up vs. Take-Off). Some of them are only based on the controller input; others are in addition using other data such as A-SMGCS Surveillance data to confirm that an abnormal situation is detected.

Non-conformance to ATC instructions or procedures: when a mobile deviates from its assigned clearance or airport procedures.

The objective of this service is to alert ATCOs when mobiles deviate from ATC instructions, procedures or route, potentially placing the mobile at risk. The introduction of Electronic Flight Strips (EFS) means that the instructions given by the ATCO are now available electronically and can be integrated with other data such as flight plan, surveillance, routing, published rules and procedures. The integration of this data allows the system to monitor the information and when inconsistencies are detected, the ATCO can be alerted (e.g. No push-back approval)

For both safety nets, the Controller will make the appropriate input on the EFS and give voice instructions to resolve the situation and hence cancel the alert.

The new alerts are considered as an additional layer on top of the A-SMGCS Level 2 alerts and not seen as a replacement for them. The alerts that exist today are triggered at the last moment giving the controller and flight crew very little time to react. The new alerts are more predictive than reactive, identifying situations that could lead to a potential incident and thus giving the controller more time to resolve the problem safely.

Performance benefits are expected in safety, by providing appropriate tools to avoid runway incursions and to reduce the rate of traffic incident on taxiway and apron.

A.10 Candidate 11: Medium term conflict detection & resolution

Conflict Detection Tools in a planning phase of the traffic are normally used by the Planning Controller (PC) as a first filter in identifying trajectories potentially in conflict within the area of interest. Within a proactive approach the planning controller with the use of the MTCD may reduce the tactical (executive) controller workload by re-planning flights to avoid potential conflicts, ensuring thus a more balanced sector workload. The medium term horizon for the basic conflict detection tools in use currently in the planning phase is expected to extend to approximately 20/30 minutes (Trajectory Prediction (TP), based on flight planned trajectory and local constraints and coordinated updates, dependent due to current associated uncertainty and other factors such as airspace and environment characteristics).

A.10.1 Medium Term Conflict Detection and Resolution in Step 1 of the European ATM Master Plan

The Step 1 improvement is to implement a set of automated support tools for assisting ATCOs. These tools provide real-time assistance to the tactical controller for monitoring trajectory conformance and provide resolution advisory information based upon predicted conflict detection.

At the same time, this will maintain or even improve the current level of safety, to ensure a safe traffic flow and provide separation between individual aircraft.

The implementation of these tools will improve the coordination between the tactical and planning controllers.

A.10.2 The PCP Proposal

In order to actively separate the traffic within the sector (area of interest) the tactical (executive controller) communicate clearances to the pilot. These clearances are normally open clearances. The open clearances are not implemented in the system trajectory and possible conflicts due to these clearances are not detected by the MTCD for planning phase. The executive controller will require a conflict detection tool dedicated to tactical use (manage clearances). Within a free route airspace, with system support, it is anticipated that the tactical controller will have a more proactive approach to tactical management of traffic.

Performance benefits are expected in safety, by using a tool that effectively monitors the ATM system allowing for early (short-term) detection of conflicts and proposes resolution measures; and also in flight efficiency, by introducing better trajectory prediction to reduce the temporal demand on the controller by assisting in the identification and resolution of conflicts. It can be expected that capacity will therefore increase as a function of reduced workload per flight.

A.11 Candidate 12: PBN in high density TMAs

ICAO's Performance Based Navigation Concept (PBN) aims to ensure global standardisation of RNP specifications and to limit the proliferation of navigation specifications in use world-wide. Significantly, it is a move from a limited statement of required performance accuracy to more extensive statements of required performance in terms of accuracy, integrity, continuity and availability, together with descriptions of how this performance is to be achieved in terms of aircraft and crew requirements. The PBN Concept is comprised of three components: The Navigation Specification, the Navaid Infrastructure and the Navigation Application.

The Navigation Specification prescribes the performance requirements in terms of accuracy, integrity, continuity and availability for proposed operations in a particular Airspace. A Navigation Specification is either a RNP specification or a RNAV specification. A RNP specification includes a requirement for on-board self-contained performance monitoring and alerting while a RNAV specification does not.

The Navaid Infrastructure relates to ground- or space-based navigation aids that are called up in each Navigation Specification.

The Navigation Application refers to the application of the Navigation Specification and Navaid Infrastructure in the context of an airspace concept to ATS routes and instrument flight procedures.

A.11.1PBN in Step 1 of the European ATM Master Plan

The European ATM Master Plan identifies PBN as an Essential Step 1 element in the SESAR key feature “Conflict Management and Automation”. The Enhanced Decision Support tools associated with the Performance Based Navigation (PBN) capabilities will offer a greater set of routing possibilities that could reduce potential congestion on trunk routes and at busy crossing points. PBN capability helps to reduce route spacing and aircraft separation.

After allocation of 2D routes, vertical constraints and longitudinal separations are provided by ATC to complement the 2D route. This will be achieved through surveillance-based separation and/or the dynamic application of constraints. New support tools (including MTCD), procedures and working methods have to be put in place.

A.11.2The PCP Proposal

Differently from what is reported in the European ATM Master Plan – Edition 2 of October 2012, within the PCP proposal PNB is associated to ‘the SESAR key feature “Traffic Synchronisation”. If this PCP proposal is accepted, the next update of the European ATM Master Plan will be corrected accordingly.

The scope is “PBN in high density TMAs - Development and implementation of fuel efficient and/or environmental friendly procedures for arrival/departure and approach”, and covers the following navigation specifications:

- RNP 1 SIDs (Standard Instrument Departures) and STARs (Standard Terminal Arrival Routes) (with the use of the Radius to Fix attachment described in the PBN Manual Volume II Part C)
- RNP APCH (with LNAV, LNAV/VNAV and LPV minima)
- Enhanced Terminal Airspace using RNP-Based Operations focuses on the use of RNP 1 routes used by compliant aircraft in high traffic density TMAs including:
- RNP 1 Arrivals/Transitions/SIDs/STARs

- Continuous climb/descent operations
- Expected performance benefits: RNP 1 SIDs and STARs allow the routes in the terminal airspace to be defined to best meet the needs of the airport, the air traffic controller and the pilot. This often means shorter, more direct or more environmental friendly routes, with simple connections to the en route structure.

The greater predictability of the RNP 1 SIDs and STARs improves adherence to the expected trajectory which can support the extended use of AMAN.

APPENDIX B MAPPING OF THE PILOT COMMON PROJECT ATM FUNCTIONALITIES WITH THE EUROPEAN ATM MASTER PLAN KEY FEATURES AND ESSENTIALS

Pilot Common Project ATM Functionalities to support Essential Operational Changes	Moving from Airspace to 4D Trajectory Management			Traffic Synchronisation		Network Collaborative Management & DCB	SWIM	Airport Integration & Throughput		Conflict Management & Automation	
	Trajectory Management and Business/Mission Trajectory	System Interoperability with Air/Ground data sharing	Free Routing	I4D + CTA	Integrated AMAN DMAN and extended AMAN horizon	Network Operations Planning	iSWIM	Surface management Integrated with Arrival & Departure	Airport safety nets	Enhanced DST & PBN	Conflict Detection & Resolution
AF # 1 Extended AMAN and PBN in high density TMAs	√				√					√	
AF # 2 Airport Integration and Throughput Functionalities								√	√		
AF # 3 Flexible Airspace Management including Free Route			√								
AF # 4 Network Collaborative Management (Flow & NOP)	√					√					
AF # 5 iSWIM functionality		√					√				
AF # 6 Initial Trajectory Information Sharing (towards i4D)		√		√			√				

APPENDIX C THE COST-BENEFIT ANALYSIS

C.1 METHODOLOGY

C.1.1 Approach overview

The PCP Impact Assessment exercise has been performed following a methodological approach aiming at ensuring the soundness of the outcomes through a continuous iteration process among all the involved stakeholder categories throughout the execution of the exercise itself.

In particular, the methodological approach followed for the exercise execution is composed of five steps.

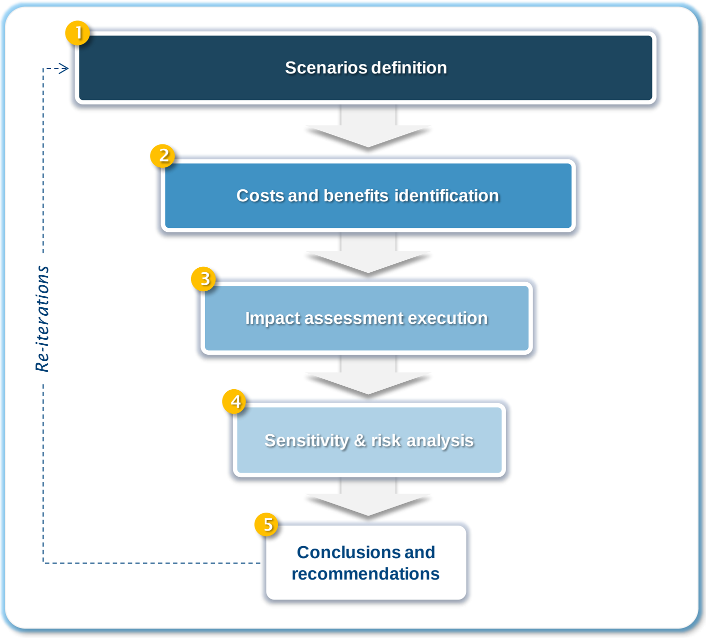


Figure 43: Impact Assessment methodology overview

1 Scenarios definition: the aim of the first step was to identify the Deployment scenarios (i.e. the scenarios in which PCP related investments are realized) to be compared with the Baseline scenario with reference to the following dimensions:

- Stakeholder categories involved as investors for each ATM Functionality (AF) within the PCP scope;
- Investment locations and number of investment instances per stakeholder category, with regard to each AF;
- Relevant dates associated to each AF, in terms of Start of investment, End of investment, Initial Operational Capability, Final Operational Capability, Start of Deployment and End of Deployment;
- Conditions for successful deployment, risks and safety assessment associated to each AF.

2 Costs and benefits identification: the aim of the second methodology step was to identify costs and benefits associated to the investment instances envisaged for each AF and to collect the related data, taking into account the information gathered during the previous step;

3 Impact Assessment execution: the aim of the third methodology step was to elaborate the Impact Assessment on the basis of the information and data gathered through steps 1 and 2, in order to identify Net Present Value and Payback period at global European level as well as at AF level;

4 Sensitivity and risk analysis: the aim of the fourth step was to perform sensitivity analyses in order to assess the impact of changes in selected key drivers on the overall NPV of the PCP as well as to identify high priority risks attached to AFs;

5 Conclusions and recommendations: the aim of the final step was to elaborate final conclusions and recommendations, also in terms of lessons learned, stemming from the Impact Assessment execution process.

It is worth noting that a continuous iteration process has taken place among the involved stakeholder categories throughout the Impact Assessment exercise, in order to share and consolidate data, information, assumptions as well as logics underpinning the model used for the exercise.

The main assumptions underpinning the PCP Impact Assessment are reported in the following paragraph.

C.1.2 Assumptions

The PCP Impact Assessment exercise has been performed on the basis of specific assumptions which have been agreed among the stakeholder categories involved in the study process. In particular, the main assumptions underpinning the exercise are related to the following dimensions:

- PCP content, scope and time horizon;
- PCP Costs;
- PCP Benefits;
- Other assumptions.

An overview of each of these dimensions is hereafter provided.

<u>PCP content, scope and time horizon</u>

The PCP content is constituted of six ATM Functionalities (AFs), for some of which a further breakdown in Sub-systems has been envisaged:

1 AF # 1 Extended AMAN and PBN in high density TMAs, including the following three Sub-systems: AMAN System upgrade for e-AMAN, ATS System upgrade for e-AMAN, PBN Airspace/Procedures/ATS-System;

2 AF # 2 Airport Integration and Throughput Functionalities, including the following five Sub-systems: DMAN A-CDM, TBS, Airport safety Net, CWP and A-SMGCS Optimised Routing, RWSL;

3 AF # 3 Flexible Airspace Management and Free Route;

4 AF # 4 Network Collaborative Management (Flow & NOP);

5 AF # 5 iSWIM functionality, including the following five Sub-systems: Flow Management & FPL, Aeronautical & Airspace, Meteo, SWIM Infrastructure & Administration, Flight Object;

6 AF # 6 Initial Trajectory Information Sharing (towards i4D).

The impact assessment exercise has been performed taken into account the following scope in terms of stakeholders involved:

- ANSPs
- Airspace Users: Scheduled Airlines and Business Aviation (aircraft flying in Europe)
- Network Manager
- Airport Operators
- Military
- MET service providers

Each of the above mentioned stakeholders categories has been assumed to be involved as investor in the various AFs within the PCP as shown in the following chart.

SHs / AFs	AF 01	AF 02	AF 03	AF 04	AF 05	AF 06
ANSPs	✓	✓	✓	✓	✓	✓
Military			✓		✓	
Airspace Users			✓		✓	✓
Airports		✓		✓	✓	
Network Manager			✓	✓	✓	✓
MET Service Providers					✓	

Figure 44: Stakeholders involvement per ATM Functionality

The geographical scope of the PCP covers the geographical scope of the European ATM Master Plan and has been defined on the basis of the following categorisations:

- ACCs:
    - Very High Capacity needs (VHCn) / High Capacity needs (HCn): above 200 movements per hour (22 ACCs by 2019);
    - Medium Capacity needs (MCn) / Low Capacity needs (LCn): under 200 movements per hour (39 ACCs by 2019);
- TMAs:
    - Very High Capacity needs (VHCn) / High Capacity needs (HCn): above 60 movements in peak hour (20 TMAs by 2019);
    - Medium Capacity needs (MCn) / Low Capacity needs (LCn): under 60 movements in peak hour (146 TMAs by 2019);
- Airports:
    - Very High Capacity needs (VHCn) / High Capacity needs (HCn): above 150.000 movements per year (25 Airports by 2019);
    - Medium Capacity needs (MCn) / Low Capacity needs (LCn): under 150.000 movements per year (106 Airports by 2019).

Taking into account the above mentioned categories, a specific number of investment instances have been identified for each stakeholder category with reference to the considered AFs.

With regard to ANSPs, it is worth noting that such stakeholder category would be involved as investor in all the AFs within the PCP scope; the number of investment instances for the relevant AFs is reported in the table below.

ATM Functionality	ANSPs					
	ACCs		TMAs		Towers	
	VHCn / HCn	MCn / LCn	VHCn / HCn	MCn / LCn	VHCn / HCn	MCn / LCn
AF-01 Extended AMAN and PBN in high density TMAs						
AMAN System upgrade for e-AMAN			20			
ATS System upgrade for e-AMAN	16					
PBN Airspace/Procedures/ATS-System			20			
AF-02 Airport Integration and Throughput Functionalities						
DMAN A-CDM					25	
TBS					17	
Airport safety Net					25	
CWP and A-SMGCS Optimised Routing					25	
RWSL					16	
AF-03 Flexible Airspace Management and Free Route	22	39				
AF-04 Network Collaborative Management (Flow & NOP)	22	39				
AF-05 iSWIM functionality						
Flow Management & FPL	22		20		23	
Aeronautical & Airspace	22		20		23	
Meteo	22		20		23	
SWIM Infrastructure & Administration						
Flight Object	22		20			
AF-06 Initial Trajectory Information Sharing (i4D)	22	39				

Table 13: ANSPs number of investment instances

Airspace Users would be expected to be involved as investors in AF # 3, AF # 5 and AF # 6. Specifically, ground investments would be envisaged for the implementation of Airlines Operational Centres associated to AF # 3 and AF # 5, whereas airborne investments for Scheduled Airlines would be undertaken with reference AF # 6.

ATM Functionality	Airspace Users		
	Ground	Airborne	
	AOC	Retrofit	Forward fit
AF-03 Flexible Airspace Management and Free Route	5		
AF-05 iSWIM functionality			
Flow Management & FPL	5		
Aeronautical & Airspace	5		
Meteo	5		
SWIM Infrastructure & Administration			
Flight Object			
AF-06 Initial Trajectory Information Sharing (i4D)		4.576	5.453

Table 14: Airspace Users number of investment instances (AOCs and equipped aircraft)

Detailed figures related to AF # 6 airborne investments in terms of retrofit and forward fit aircraft are provided in the following chart.

		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
FORWARD FIT														
AF - 06	Total number of a/c forward fitted	80	80	317	317	317	317	575	575	575	575	575	575	575
	Single Aisle	80	80	165	165	165	165	334	334	334	334	334	334	334
	Long Range			90	90	90	90	179	179	179	179	179	179	179
	Regional			62	62	62	62	62	62	62	62	62	62	62
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
RETROFIT														
AF - 06	Total number of a/c retrofitted	170	170	530	530	530	530	1058	1058					
	Single Aisle	170	170	345	345	345	345	689	689					
	Long Range			185	185	185	185	369	369					
	Regional													
Number of equipped aircraft		250	250	847	847	847	847	1.633	1.633	575	575	575	575	575
Cumulated Number of equipped aircraft		250	500	1.347	2.194	3.041	3.888	5.521	7.154	7.729	8.304	8.879	9.454	10.029
% of Total Fleet equipped		1%	2%	6%	9%	12%	15%	21%	27%	28%	29%	30%	31%	32%
% of Total Flights equipped		2%	6%	12%	18%	28%	38%	47%	58%	60%	61%	62%	62%	63%

Table 15: AF #6, retrofit and forward fit aircraft

Airport Operators investments would be focused on AF # 2, AF # 4 and AF # 5; the number of investment instances for relevant AFs is reported in the table below.

ATM Functionality	Airport Operators	
	Airports	
	VHCn / HCn	MCn / LCn
AF-02 Airport Integration and Throughput Functionalities		
DMAN A-CDM	25	
TBS		
Airport safety Net	25	
CWP and A-SMGCS Optimised Routing		
RWSL	15	
AF-04 Network Collaborative Management (Flow & NOP)	25	106
AF-05 iSWIM functionality		
Flow Management & FPL	25	
Aeronautical & Airspace	25	
Meteo	25	
SWIM Infrastructure & Administration		
Flight Object		

Table 16: Airport Operators number of investment instances

With regard to the Military stakeholder category, investments would take place for two AFs, namely AF # 3 and AF # 5, as shown in the following table.

ATM Functionality	Military	
	ACCs	
	VHCn / HCn	MCn / LCn
AF-03 Flexible Airspace Management and Free Route	22	
AF-05 iSWIM functionality		
Flow Management & FPL		
Aeronautical & Airspace	22	
Meteo	22	
SWIM Infrastructure & Administration		
Flight Object	22	

Table 17: Military number of investment instances

MET Service Providers would be involved as investors in the deployment of AF # 5. Specifically, investments would be expected to take place at the following levels:

- Airports level, for MET services with local coverage;
- National level, for MET services with national coverage;
- Regional level, for MET services covering the entire EU Airspace.

The number of investment instances for MET Service Providers is reported in the table below.

ATM Functionality	MET Service Providers		
	Local coverage	National coverage	Regional coverage
AF-05 iSWIM functionality			
Flow Management & FPL			
Aeronautical & Airspace			
Meteo	25	44	1
SWIM Infrastructure & Administration			
Flight Object			

Table 18: MET Service Providers number of investment instances

Finally, the Network Manager is expected to be involved as investor in AF # 3, AF # 4, AF # 5 and AF # 6.

It is worth noting that the exercise has been performed taking into account impacts in terms of costs and benefits deriving exclusively from the deployment of the PCP, excluding Deployment Baseline essential pre-requisites.

From a time horizon perspective, the time-frame 2014-2030 has been assumed as reference time period for the PCP Impact Assessment exercise.

PCP Costs

Costs related to single investment instances have been estimated and used as inputs for the identification of the overall cost associated to each AF. Specifically, the following cost categories have been taken into account:

- **Procurement costs.** Such category includes costs associated to the following items referred to a single AF unit (or AF Sub-system unit where applicable): system design, HW and SW, implementation and project management activities, safety activities (including the approval process from NSA side) and Integration costs;
- **Training costs.** Such category includes costs for training "first wave" delivery referred to a single AF unit (or AF Sub-system unit where applicable);
- **Procedures costs.** Such category includes costs attached to the definition of procedures for starting the operations of a given AF (or AF Sub-system where applicable) in one site.

In the following tables the unit costs per AF (inclusive of procurement, training and procedures costs) are outlined with reference to each stakeholder category.

ATM Functionality	ANSPs				
	ACCs		TMAs		Towers
	VHCn / HCn Unit cost (mln €)	MCn / LCn Unit cost (mln €)	VHCn / HCn (Separeted) Unit cost (mln €)	VHCn / HCn (Integrated) Unit cost (mln €)	VHCn / HCn Unit cost (mln €)
AF-01 Extended AMAN and PBN in high density TMAs					
AMAN System upgrade for e-AMAN		5,0	5,0	5,0	
ATS System upgrade for e-AMAN	4,6				
PBN Airspace/Procedures/ATS-System		4,0	4,0	4,0	
AF-02 Airport Integration and Throughput Functionalities					
DMAN A-CDM					11,1
TBS					17,0
Airport safety Net					2,3
CWP and A-SMGCS Optimised Routing					5,3
RWSL					3,1
AF-03 Flexible Airspace Management and Free Route	15,4	3,9			
AF-04 Network Collaborative Management (Flow & NOP)	10,2	2,6			
AF-05 iSWIM functionality					
Flow Management & FPL	0,8		0,8	0,5	0,3
Aeronautical & Airspace	0,8		0,8	0,5	0,3
Meteo	0,8		0,8	0,5	0,3
SWIM Infrastructure & Administration					
Flight Object	4,6		4,6	2,6	
AF-06 Initial Trajectory Information Sharing (i4D)	8,8	2,2			

Table 19: ANSPs unit costs

ATM Functionality	Airspace Users			
	Ground	Airborne		
	AOC Unit cost (mln €)	Retrofit Unit cost for old aircraft (k €)	Retrofit Unit cost for new aircraft (k €)	Forward fit Unit cost (k €)
AF-03 Flexible Airspace Management and Free Route	1,6			
AF-05 iSWIM functionality				
Flow Management & FPL	0,5			
Aeronautical & Airspace	2,4			
Meteo	0,3			
SWIM Infrastructure & Administration				
Flight Object				
AF-06 Initial Trajectory Information Sharing (i4D)				
Single Aisle		50.019	32.588	32.588
Long Range		50.019	32.588	32.588
Regional		-	-	285.000

Table 20: Unit costs for Airspace Users

Regarding retrofit unit costs reported in the table above, “Retrofit unit cost for old aircraft” has been applied to aircraft built before 2011 while “Retrofit unit cost for new aircraft” has been applied to aircraft built between 2012 and 2015.

ATM Functionality	Airport Operators	
	Airports	
	VHCn / HCn Unit cost (mln €)	MCn / LCn Unit cost (mln €)
AF-02 Airport Integration and Throughput Functionalities		
DMAN A-CDM	2,8	
TBS		
Airport safety Net	0,6	
CWP and A-SMGCS Optimised Routing		
RWSL	4,9	
AF-04 Network Collaborative Management (Flow & NOP)	1,0	0,3
AF-05 iSWIM functionality		
Flow Management & FPL	0,3	
Aeronautical & Airspace	0,3	
Meteo	0,1	
SWIM Infrastructure & Administration		
Flight Object		

Table 21: Unit costs for Airport Operators

ATM Functionality	Military
	ACCs
	VHCn / HCn Unit cost (mln €)
AF-03 Flexible Airspace Management and Free Route	6,5
AF-05 iSWIM functionality	
Flow Management & FPL	
Aeronautical & Airspace	2,0
Meteo	0,5
SWIM Infrastructure & Administration	
Flight Object	0,5

Table 22: Unit costs for Military

ATM Functionality	Network Manager Unit Cost (mln €)
AF-03 Flexible Airspace Management and Free Route	**15,7**
AF-04 Network Collaborative Management (Flow & NOP)	**56,8**
AF-05 iSWIM functionality	
Flow Management & FPL	**9,4**
Aeronautical & Airspace	**51,1**
Meteo	**15,0**
SWIM Infrastructure & Administration	**12,0**
Flight Object	**13,8**
AF-06 Initial Trajectory Information Sharing (i4D)	**8,7**

Table 23: Unit costs for Network Manager

ATM Functionality	MET Service Providers		
	Local coverage Unit cost (mln €)	National coverage Unit cost (mln €)	Regional coverage Unit cost (mln €)
AF-05 iSWIM functionality			
Flow Management & FPL			
Aeronautical & Airspace			
Meteo	**5,4**	**0,9**	**28,7**
SWIM Infrastructure & Administration			
Flight Object			

Table 24: Unit costs for MET Service Providers

The identification of the overall costs associated to each AF has been performed by combining the cost figures referred to single AF units with information concerning the number of investment instances which would be undertaken.

Furthermore, it is worth noting that investments undertaken by involved stakeholders for each AF have been distributed between “Start of Investment” and “End of Investment” dates on the basis of specific curves reflecting their yearly distribution, as shown in the table below.

AF Investment duration (number of years)	Cost distribution per year (%)										
2	50%	50%									
4	20%	30%	30%	20%							
5	18%	20%	25%	20%	18%						
6	12%	17%	22%	22%	17%	12%					
7	6%	13%	19%	25%	19%	13%	6%				
8	5%	10%	15%	20%	20%	15%	10%	5%			
9	4%	8%	12%	16%	20%	16%	12%	8%	4%		
10	3%	7%	10%	13%	17%	17%	13%	10%	7%	3%	
11	3%	6%	8%	11%	14%	18%	14%	11%	8%	6%	3%

Table 25: AF investments distributions

PCP Benefits

The benefits which would be generated by the deployment of AFs within the PCP scope have been grouped into two categories:

- **Monetised benefits.** Such category includes those benefits for which a numerical evaluation (e.g. decrease of fuel, CO_2, delay etc.) has been performed and that have been subject to economic valuation in the Impact Assessment exercise. A definition of the benefits included in this category as well as the overall performance gains due to the PCP are provided in the following table.

Benefit	Description	Overall performance gain
Fuel Savings	Fuel Savings represent the savings that Airspace Users will make from flying fewer additional NM, e.g. fewer manoeuvres to resolve conflicts, direct routes across sectors/centres/FABs, better descent profiles	85,8 kg per flight (-2,1%)
CO_2 Savings	Fuel Savings translate into benefit for Airspace Users also in terms of reduced CO_2 emissions. Such benefit is monetised in terms of EU Emission Allowances, or EUAs, which are credits that are allocated to the companies covered by the EU Emission Trading Scheme (each credit represent the right to emit 1 tonne of carbon dioxide)	270,1 kg per flight (-2,1%)
ANS Productivity gains	ANS Productivity gains refer to benefits for ANSPs in terms of Cost Effectiveness expected to be achieved through ATCO productivity increases of 12%	3,2%
Delay Savings	Delay Savings refer to Tactical and Strategic Delay savings for Airspace Users stemming from a reduction in Delay length and Delayed Flights. Tactical Delay savings come from reducing the unpredictable delay exceeding the delay buffer foreseen in the flight plan; Strategic Delay savings come from reducing the delay buffer foreseen in the flight plan	Reduction of delay length 12,2% & Reduction of delayed flights 9,8%

Table 26: Monetised benefits

Monetised benefits ramp-up has been defined on the basis of IOC and FOC dates, according to a linear distribution.

- **Non-monetised benefits.** Such category includes those benefits which have not been subject to economic valuation (e.g. airspace capacity, variability, etc.). Such benefits, although not contributing directly to the numeric outcomes of the Impact Assessment, constitute each a positive value generated by the PCP to consider in addition to the monetised benefits. A definition of the benefits included in this category as well as the overall performance gains associated to the PCP is provided in the following table.

Benefit	Description	Overall performance gain
Airspace capacity	The airspace capacity benefit refers to additional IFR Movements per airspace volume per unit time (most challenging environment) enabled by the PCP	21,2% (8,7% En Route & 12,5% TMA)

Airport capacity	The airport capacity benefit is the additional movements that the PCP will allow at airports that are (or will become) congested.	3,9%
Variability	Reducing the delay variability (by improving the predictability of flight duration variability) allows airports to use the resources on the ground more efficiently, thus reducing the variable costs per movement.	-11,4%

Table 27: Non monetised benefits

The PCP benefits associated to each ATM Functionality are shown in the table below[10].

ATM Functionality	Airport Capacity (%)	Airspace Capacity-En Route (%)	Airspace Capacity-TMA (%)	Cost-Effectiveness (%)	Fuel Efficiency (Kg/flight)	Variability (%)	Reduction of Delay Length (%)	Reduction of Delayed Flights (%)
AF-01 Extended AMAN and PBN in high density TMAs	1,9%	0,0%	7,8%	0,1%	25,0	3,3%	4,5%	3,6%
AF-02 Airport Integration and Throughput Functionalities	2,0%	3,0%	0,0%	0,0%	19,6	7,4%	1,7%	1,4%
AF-03 Flexible Airspace Management incl. Free Route	0,0%	2,0%	0,0%	0,0%	40,0	0,6%	1,2%	0,9%
AF-04 Network Collaborative Management (Flow & NOP)	0,0%	3,6%	4,8%	0,9%	0,4	0,0%	4,8%	3,9%
AF-05 iSWIM functionality	0,0%	0,0%	0,0%	1,0%	0,0	0,0%	0,0%	0,0%
AF-06 Initial Trajectory Information Sharing (i4D)	0,0%	0,0%	0,0%	1,3%	0,8	0,0%	0,0%	0,0%
TOTAL	3,9%	8,7%	12,5%	3,2%	85,8	11,4%	12,2%	9,8%

Table 28: PCP Benefits per ATM Functionality

Fuel Savings

The Fuel Efficiency benefit would result in Fuel Cost Savings for Airspace Users. The mechanism used for the benefit monetisation is described in the following figure:

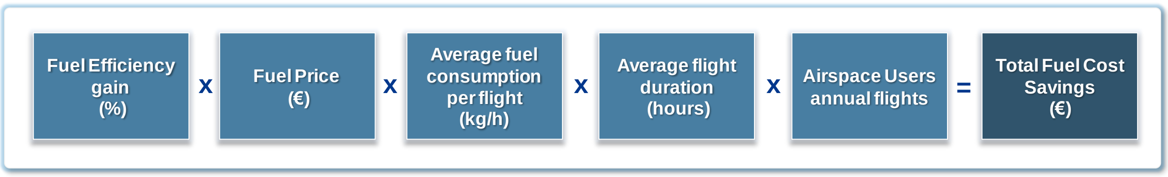


Figure 45: Fuel gains monetisation mechanism

where:

- Fuel Efficiency gain = Annual Fuel Efficiency benefit due to the PCP;
- Fuel Price = Fuel Price forecasts estimated on the basis of data provided by IATA;
- Average fuel consumption per flight = 2.872 kg per hour for Scheduled Airlines and 770 kg per hour for Business Aviation;
- Average flight duration = 1,45 hours for Scheduled Airlines and 1,50 for Business Aviation;

[10] On the basis of a conservative approach, Cost Effectiveness benefit attached to AF # 5 iSWIM Functionality – equal to 1,2% - has been adjusted to 1,0% (85% of the original value)

- Airspace Users annual flights = 90% of total air traffic in Europe (80% for Scheduled Airlines plus 10% for Business Aviation);

The fuel price values used for the Impact Assessment exercise are referred to Jet Fuel and have been estimated starting from data provided by IATA. Such data have been converted from USD/barrel to €/tonne on the basis of the following assumptions:

- Barrel-tonne conversion factor: 7,88;
- USD/€ exchange rate: 0,75.

The estimated evolution of fuel prices over the PCP time horizon, as resulting from the above mentioned assumptions, is shown in the following table.

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Jet Fuel - €/tonne	797,0	818,4	830,7	842,6	854,0	866,6	878,7	889,0	893,0	896,3	900,0	903,6	906,2	908,6	911,4	913,7	916,2

Table 29: Fuel Prices evolution 2014 - 2030

<u>CO_2 Credit Savings</u>

Fuel Efficiency benefit enables the reduction of CO_2 emissions resulting in CO_2 Credit Savings.

Such credit savings are linked to the mechanisms defined within the EU Emissions Trading Scheme (ETS); the legal framework underpinning the European carbon market (Directive 2003/87/EC) grants the holder of one EU Allowance (EUA) the right to emit one tonne of CO_2. The amount of EUAs allocated to each emitter in the scheme are set out in National Allocation Plans prepared by the Member States and approved by the European Commission. These plans determine the total quantity of CO_2 emissions that Member States grant to companies. Participating companies can buy or sell emission allowances, thus creating a market in emission allowances and a market price (carbon price). Allowances are traded as contracts. One contract represents 1 tonne of CO_2 EU Allowances/Certified Emissions Reduction units (EUAs/CERs).

On the basis of such framework, CO_2 Credit Savings have been monetised through the mechanism described in the following figure.

Average Fuel consumption per flight (kg/h) x Average flight duration (hours) x Fuel Efficiency gain (%) x CO_2 emissions kg per kg of fuel x Carbon Price (€/tonne) x Airspace Users annual flights = Total CO_2 Credit Savings (€)

Figure 46: CO2 Credit Savings monetisation mechanism

where:

- Average fuel consumption per flight = 2.872 kg per hour for Scheduled Airlines and 770 kg per hour for Business Aviation;
- Average flight duration = 1,45 hours for Scheduled Airlines and 1,50 for Business Aviation;
- Fuel Efficiency gain = Annual Fuel Efficiency benefit due to the PCP;
- CO_2 emissions kg per kg of fuel = 3,1 kg;
- Carbon Price = Carbon Prices forecast estimated on the basis of data provided by IATA;
- Airspace Users annual flights = 90% of total air traffic in Europe (80% for Scheduled Airlines plus 10% for Business Aviation).

The carbon price values used for the Impact Assessment have been estimated on the basis of data provided by IATA, converted from USD/tonne to €/tonne according to the exchange rate used in the exercise (i.e. 0,75).

The estimated evolution of carbon prices over the PCP time horizon is shown in the following table.

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Carbon price - €/tonne	4,3	5,6	7,4	9,8	13,0	17,1	22,6	23,3	23,9	24,6	25,4	26,0	26,9	27,6	28,4	29,3	30,1

Table 30: Carbon Prices 2014 - 2030

In particular, the envisaged carbon price evolution takes into account the following assumptions:

- the 2014 price forecast reflects the current price level for EUAs maturing in 2014;
- 2020 and 2030 price forecasts have been derived on the basis of data provided by IEA;
- Straight-line appreciation has been applied over the 2014-2020 and 2020-2030 time frames.

<u>ANS Productivity gains</u>

The PCP would be expected to generate benefits in terms of ANS productivity. Such gains have been translated in cost effectiveness benefits - ANS cost reduction - taking into account the weight of staff cost on air navigation service total cost (27%, source: PRU 2011).

Hence, ANS Productivity gains have been derived by multiplying ATCO Productivity increases associated to AFs within PCP scope by 27%.

The PCP ANS Productivity gains benefits have been monetized on the basis of the mechanism described in the figure below.

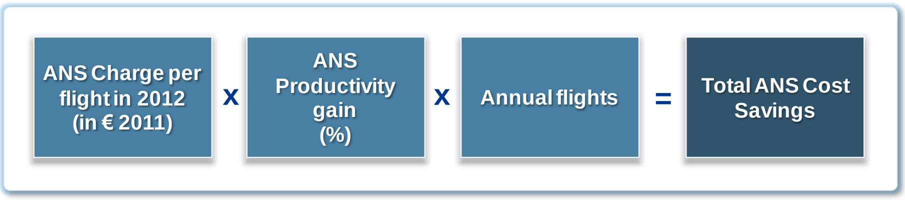


Figure 47: ANS Cost Savings monetisation mechanism

where:

- ANS Charge per flight in 2012 = 878;
- ANS Productivity gain = ANS cost reduction achieved through ATCOs Productivity increase due to the PCP;
- Annual flights = total air traffic in Europe.

<u>Delay Savings</u>

The estimation of Delay Savings associated to the PCP (provided by Eurocontrol) relies on the assumption that, without the Airspace Capacity increases enabled by the PCP itself, there will be a shortage of capacity that will lead to growing delays from 2018 onwards.

Assuming that PCP would be deployed, delays would be impacted in two ways:

1. By reducing the percentage of delayed flights;
2. By reducing the average delay length per delayed flight.

The evolution of these two delay metrics during the 2014-2030 time period, with and without PCP implementation, is reported in the following table.

Scenario with PCP																	
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Delayed flights (%)	10,0%	10,0%	10,0%	10,0%	9,9%	9,8%	9,7%	9,6%	9,5%	9,4%	9,3%	9,2%	9,1%	9,1%	9,0%	8,9%	8,8%
Ave delay per delayed flight	10,00	10,00	10,00	10,00	10,10	10,20	10,30	10,40	10,51	10,61	10,72	10,82	10,93	11,04	11,15	11,26	11,37
Scenario without PCP																	
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Delayed flights (%)	10,0%	10,0%	10,0%	10,0%	10,0%	10,0%	9,9%	9,9%	9,9%	9,9%	9,9%	9,8%	9,8%	9,8%	9,8%	9,8%	9,7%
Ave delay per delayed flight	10,00	10,00	10,00	10,00	10,22	10,45	10,67	10,89	11,12	11,35	11,57	11,80	12,03	12,26	12,49	12,72	12,95

Table 31: Delay metrics evolution with and without PCP

The figures reported in the table above have been used for the monetisation of Delay Savings, which are categorized in:

- Tactical Delay Savings, which refer to the reduction of unpredictable delays on the day of operations that exceeds the delay buffer foreseen in the flight plan;
- Strategic Delay Savings, which refer to the reduction of delay that is included in airline schedules (flight plan).

For the PCP Impact Assessment purpose, Tactical Delay has been assumed to represent 80% of total delays.

Tactical Delay Cost Savings which would be generated through the PCP have been monetised on the basis of the mechanism described in the figure below.

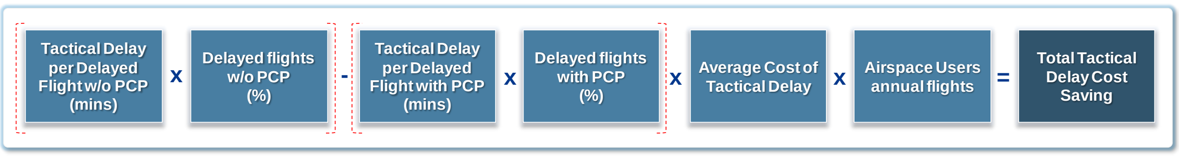


Figure 48: Tactical Delay Cost Savings monetisation mechanism

where:

- Tactical Delay per Delayed Flight without PCP = average delay minutes per delayed flight in the case the PCP is not deployed;
- Delayed flights without PCP = percentage of delayed flights on total number of flights in the case the PCP is not deployed;
- Tactical Delay per Delayed Flight with PCP = average delay minutes per delayed flight in the case the PCP is deployed;

- Delayed flights without PCP = percentage of delayed flights on total number of flight in case the PCP is not deployed;
- Average Cost of Tactical Delay = 31,4 € per minute;
- Airspace Users annual flights = 80% of total air traffic in Europe assumed to be covered by Scheduled Airlines;

Strategic Delay Cost Savings have been monetised on the basis of the mechanism described in the figure below.

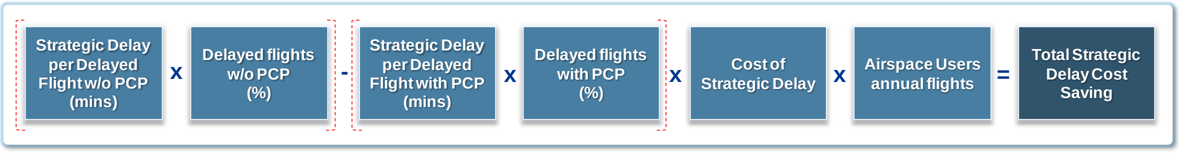


Figure 49: Strategic Delay Cost Savings monetisation mechanism

where:

- Strategic Delay per Delayed Flight without PCP = average delay minutes per delayed flight in the case the PCP is not deployed;
- Delayed flights without PCP = % of delayed flights on total number of flight in the case the PCP is not deployed;
- Strategic Delay per Delayed Flight with PCP = average delay minutes per delayed flight in the case the PCP is deployed;
- Delayed flights without PCP = % of delayed flights on total number of flight in case the PCP is not deployed;
- Cost of Strategic Delay = 20,9 € per minute;
- Airspace Users annual flights = 80% of total air traffic in Europe assumed to be covered by Scheduled Airlines.

With regard to the monetisation of Tactical Delay Cost Savings, further assumptions have been considered:

- Cost of delay "high" (cost associated to tactical delays exceeding 15 minutes) = 45,5 € per minute;
- Cost of delay "low"= 25,4 € per minute;
- Delay resulting in "high" cost = 30%.

The cost categories taken into account in determining the costs of Tactical and Strategic delays are reported in the table below.

	Tactical Delay				Strategic Delay	
	Low		High		All	
Cost Category	Ground (€/min)	Airborne (€/min)	Ground (€/min)	Airborne (€/min)	Ground (€/min)	Airborne (€/min)
Fuel Cost	0,1	15,6	0,1	15,6	1,0	18,8
Maintenance Cost	0,5	1,0	0,5	1,0		11,2
Crew Cost	7,3	7,3	8,8	8,8	9,0	9,0
Airport Charges	0,4	0,0	0,5	0,1	0,0	0,0
Rental and leases	0,0	0,0	0,0	0,0	10,9	10,9
Passenger Compensation	15,5	15,5	27,8	27,8	0,0	0,0
Percentage Ground vs Airborne	90%	10%	50%	50%	100%	0%
Percentage Low vs High	70%		30%			
TOTAL	25,4		45,5		20,9	

Table 32: Cost of Tactical and Strategic Delays detailed assumptions

where:

- Ground = Cost per minute of delay occurring during ground handling;
- Airborne = Cost per minute of delay occurring during actual flight time;
- Fuel Cost = additional fuel burned during tactical delay and strategic delay plus higher aircraft weight due to extra fuel foreseen for strategic delay;
- Maintenance Cost = higher planned maintenance cost for strategic delay as maintenance scheduled on increased planed flight time rather than actual flight time;
- Crew Cost = flight and cabin crew salaries and expenses that could be saved per minute of delay saved;
- Airport Charges = airport charges that could be saved per minute of delay saved;
- Rentals and leases = rentals and leases of flight equipment (full cost of fleet financing) that could be saved per minute of delay saved;
- Cost of passenger compensation and rebooking for missed connections that could be saved per minute of delay saved;
- Percentage Ground vs. Airborne = % of tactical delay occurring during ground handling and flight time respectively;
- Percentage Low vs. High = % of delay applying to the Low respectively to the High category.

Finally, Delay Savings have been allocated to AFs on the basis of their respective contribution to the PCP Airspace Capacity Benefit.

Other assumptions

The air traffic scenario used for the PCP Impact Assessment has been projected over the 2014 - 2030 time period assuming a 1,5% yearly growth rate, starting from 2013 value as reported in STATFOR Medium Term Forecast 2012-2019 (EUROCONTROL, February 2013).

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Traffic - mln flights	9,6	9,7	9,9	10,0	10,2	10,3	10,5	10,6	10,8	10,9	11,1	11,3	11,4	11,6	11,8	12,0	12,1

Table 33: PCP Air Traffic scenario

The Net Present Value of the PCP impact assessment exercise results from the difference between the present values of its future cash inflows and outflows. This means that all annual cash flows have been discounted to the PCP start time (2014) at a predetermined discount rate, assumed equal to 8%. PCP impact assessment outcomes are presented in the following chapters both as discounted and undiscounted values, whereas the latter do not take into account the effect of the discount rate on future cash flows.

The USD/€ Exchange rate used for the exercise is equal to 0,75 (January 2013 average exchange rate, source European Central Bank).

C.2 GLOBAL PCP IMPACT ASSESSMENT

C.2.1 Overall outcomes

The impact assessment exercise shows that the first PCP would make a significant contribution to the European aviation sector over the period 2014-2030, also ensuring positive effects in terms of environmental impact.

Specifically, it has been estimated that the implementation of AFs in the PCP scope, compared with a scenario in which such investments would not be undertaken, would generate a Net Present Value amounting at 2,4 billion €, with a 10 years payback period.

Such Net Present Value is derived considering an overall cost of 3,8 billion € (2,5 billion €, discounted) undertaken by the involved stakeholders and benefits amounting at 12,1 billion € (4,9 billion €, discounted) over the considered time-frame.

Please find below a chart illustrating the main PCP outcomes in terms of costs, benefits and net benefits.

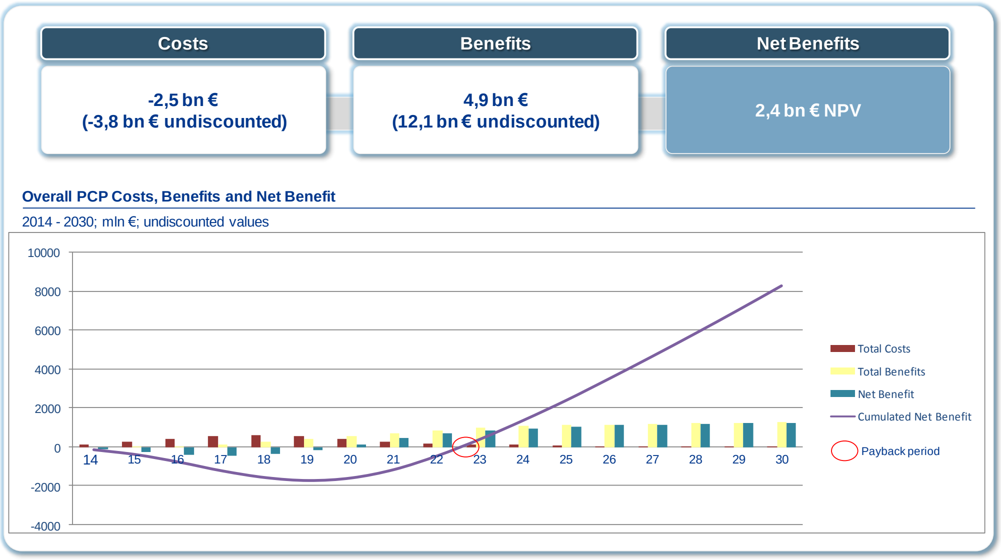


Figure 50: PCP impact assessment outcomes

A closer analysis of benefits and costs considered in the PCP impact assessment exercise is provided in the next chapters.

C.2.2 Focus on benefits

As explained in the Methodology chapter, the PCP would generate benefits falling into two different categories, respectively including those with monetised and non-monetised impacts.

Specifically, the main benefits associated to the PCP which have been monetised in the impact assessment exercise are the following:

- Fuel Savings;
- CO_2 Credit Savings;
- Delay Savings;
- ANS Productivity gains stemming from air traffic controller productivity increase.

It is worth looking at the contribution provided by each of these benefits to the achievement of the overall benefit associated to the PCP, which, as stated in the previous chapter, amounts at around 12,1 billion €.

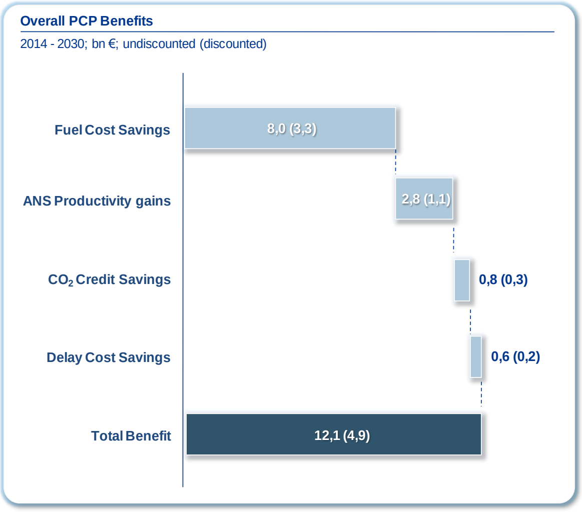


Figure 51: Overall PCP Benefits

As it can be noted in previous chart, the reduction in fuel consumption represents the biggest share of benefits, with 66% of the total. In particular, the PCP would enable a 8,5 mln tonnes fuel consumption reduction during the 2014-2030 time period, resulting in fuel costs savings amounting at around 8,0 billion €.

CO_2 Credit Savings account for around 6% of PCP total impact. Specifically, the fuel consumption decrease generated by the PCP would enable a reduction of CO_2 emissions of around 26,9 million tonnes, thus providing extremely positive impacts from an environmental perspective; such reductions would result in credit savings amounting at 0,8 billion €.

With regard to the benefits related to ANS Productivity gain coming from air traffic controller productivity increase, it accounts for 23% of PCP total impact. Specifically, the overall ANS Productivity gain benefit would generate savings amounting at 2,8 billion € during the 2014-2030 time period.

Delay reduction benefits account for 5% of PCP total impact. In particular, such benefits would result in savings amounting at 0,6 billion €, taking into account savings related to fuel, maintenance, crew and other costs as well as passenger compensation.

As already mentioned, the PCP would also generate further benefits which, although not monetised, have a positive impact on the European aviation sector.

In particular, such non-monetised benefits are represented by the an increase in Airspace capacity by 21,2%, an increase in Airport capacity by 3,9% and a decrease in Variability by 11,4%.

Performance gains estimations were analysed on the basis of validation results or any other factual evidence to the greatest extent possible. For each figure provided by experts groups, risks related to their confidence level where monitored and logged throughout the process. A summary of this confidence level can be found in Section 3.

Furthermore, it is worth noting that PCP benefit would generate positive impact on RP2 2015 – 2019 benefits targets in terms of Capacity (both airspace and airport capacity), Fuel Efficiency and Cost-Effectiveness, as shown in the figure below.

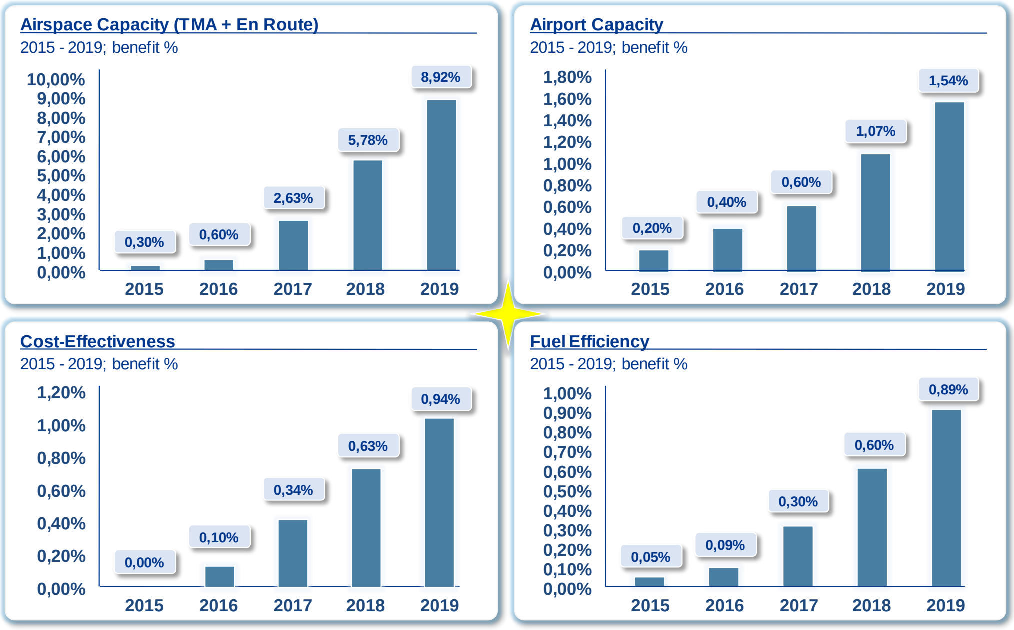


Figure 52: 2015 - 2019 PCP performance contribution

C.2.3 Focus on costs

An overall cost of 3,8 billion € has been estimated for the full deployment of ATM Functionalities included in the PCP.

In particular, each stakeholder category would contribute to the overall investment associated to the PCP as illustrated in the following chart.

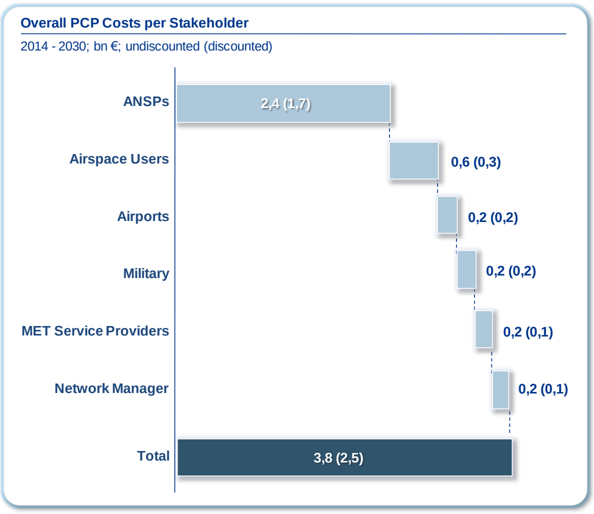


Figure 53: Overall PCP Costs per stakeholder

As shown in the chart above, the highest share of PCP costs is associated to investments to be undertaken by ANSPs, with 64% of the total, followed by Airspace Users (15%), Airport Operators (6%) and Network Manager, Military and Met Service Providers (5% respectively).

With respect to the overall investment distribution, it can be noted that over 90% of the total investment - and approximately 100% of ground investment - would be realized by the involved stakeholders within the 2014 – 2024 time period.

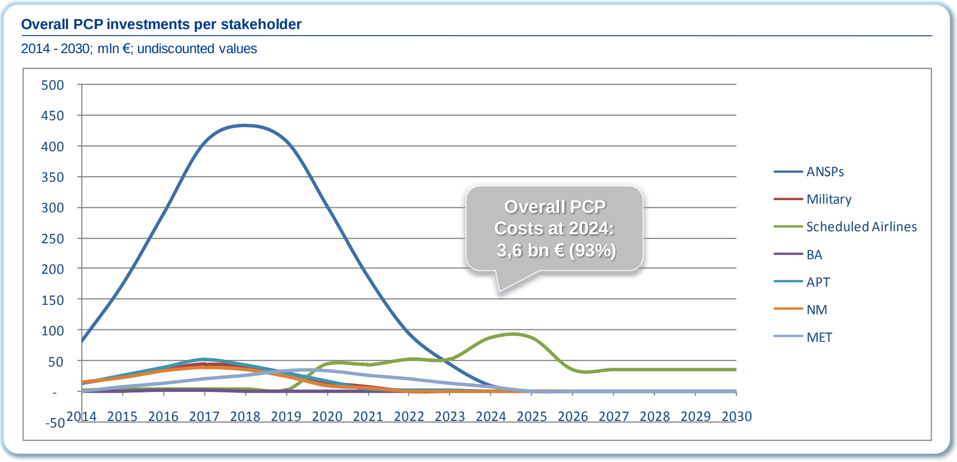


Figure 54: PCP investment distribution

C.2.4 Focus on outcomes per stakeholder category

The PCP is expected to generate different impacts in terms of NPV on the involved stakeholders' categories.

The Airspace Users would be expected to obtain the highest NPV, which would amount at around 3,3 billion €. Such NPV would result on the basis of costs for 0,6 billion € (0,3 billion € discounted) and benefits amounting at 9,0 billion € (3,6 billion € discounted).

It is worth noting that the identified Airspace Users NPV has been derived taking into account the following assumptions:

- ANS productivity gains generated by the PCP are not transferred to Airspace Users;
- ANSPs investments would have substantially neutral impact on charges; as a matter of fact, considering the PCP time horizon (2014 – 2030), the estimated share of ANSPs PCP investments would exceed the historical CAPEX volumes only by 0,05 billion € (0,03 billion € discounted) in the 2017 – 2019 time period, which would be covered by Airspace Users unless EU funding is made available;
- PCP related investments undertaken by Airport Operators would be fully covered by Airspace Users through landing fees.

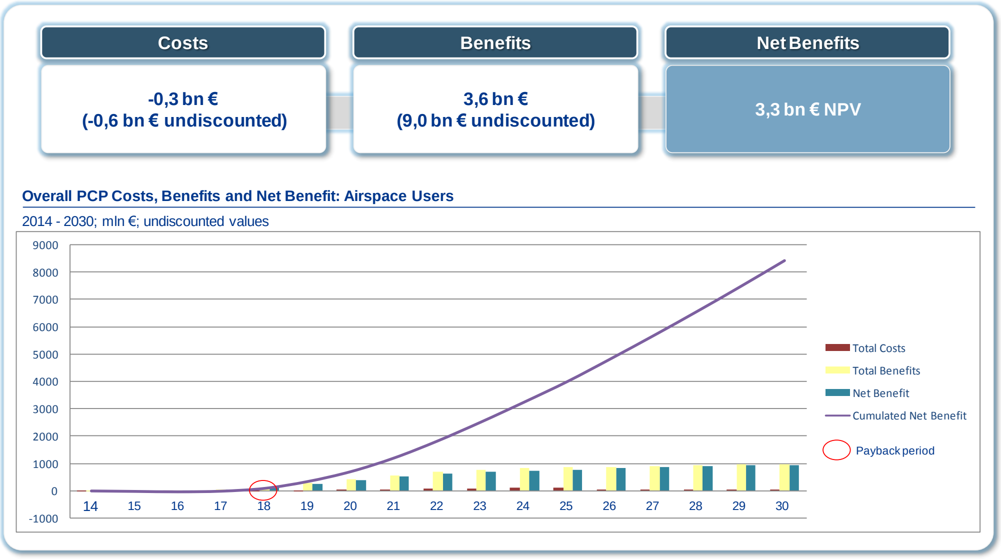


Figure 55: PCP overall outcomes for Airspace Users

Looking at the ANSPs, the total NPV associated to the PCP – assuming no transfers among stakeholders - would amount at around -0,5 billion €, resulting from costs for around 2,4 billion € (1,7 billion € discounted) and benefits in terms of ANS productivity gains amounting at 2,8 billion € (1,1 billion € discounted).

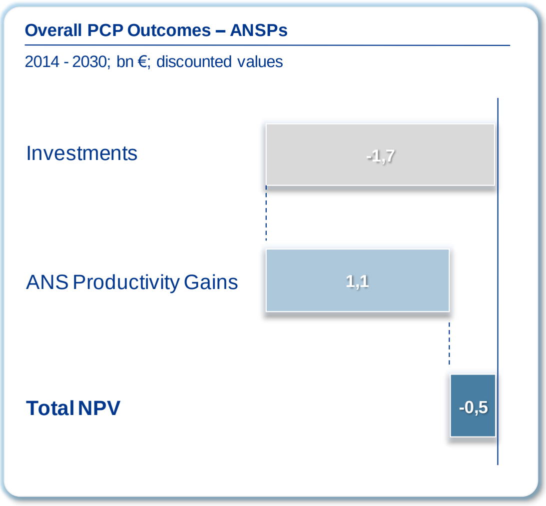


Figure 56: PCP overall outcomes for ANSPs

Finally, the other Service providers involved in the PCP would be expected to experience negative NPVs due to the specific nature of their business model:

- Airport Operators: -0,2 billion €;
- Met Service providers: -0,1 billion €;
- Military: -0,2 billion €;
- Network Manager: -0,1 billion €.

C.2.5 Sensitivity analysis

In order to take into account uncertainty areas relevant to PCP deployment as well as potential changes which might affect the aviation sector, a number of sensitivities have been considered.

In particular, specific sensitivity analyses have been performed in order to evaluate the impact of changes in five key drivers on the Net Present Value generated by the PCP.

The variables selected for the sensitivity analyses are the following:

- **Air traffic growth.** Two sensitivity scenarios have been taken into account: a “Worst Case” scenario assuming a 0% yearly air traffic growth and a “Best Case” scenario, assuming a 3% yearly air traffic growth, whereas the “Base implementation scenario” assumes a 1,5% yearly air traffic growth;
- **Fuel and CO_2 credit savings, Delay related savings.** Two sensitivity scenarios have been taken into account for each of the two drivers: a “Best Case” scenario, assuming savings exceeding those envisaged for the “Base implementation scenario” by 20% and a “Worst Case” scenario, assuming savings reduced by 20% compared to the “Base implementation scenario”;
- **Ground investment, Airborne investment.** Two sensitivity scenarios have been taken into account for each of the two drivers: a “Best Case” scenario, assuming costs reduced by 30% compared to the “Base implementation scenario” and a “Worst Case” scenario, assuming costs exceeding those envisaged for the “Base implementation scenario” scenario by 30%.

The main outcomes of the sensitivity analyses performed are presented in the next chart, which shows the variations in the PCP Net Present Value associated to the different sensitivity scenarios applied to the selected drivers.

As a result of the analyses carried out, it can be noted that a positive Net Present Value would be achieved even applying the “Worst Case” sensitivity scenario to all the selected sensitivity drivers taken in turn.

Moreover, the analyses have shown that air traffic growth represents the variable with the highest impact on the PCP NPV variability.

Sensitivity Drivers	Value used	Range	Impact on PCP Net Present Value 2014 - 2030; bn €;
Air Traffic Growth	1,5%	0% - 3%	-0,9 / 1,0
Fuel and CO_2 Savings	2,1%	1,6% - 2,5%	-0,7 / 0,7
Delay Cost Savings *(Reduction of delay length and Reduction of delayed flights)*	12,2% - 9,8%	9,8% - 5,7% 14,7% - 7,8%	-0,04 / 0,04
PCP Investment Costs - Ground	100%	130% - 70%	-0,7 / 0,7
PCP Investment Costs - Airborne	100%	130% - 70%	-0,07 / 0,07

NPV “Base” 2,4 bn €

Figure 57: Sensitivity analyses

Specifically, the main outcomes of the sensitivity analyses performed are as follows:

- **Air traffic growth:** a change in the volume of air traffic would affect the achievement of fuel, CO_2 and Delay related savings as well as Cost effectiveness benefits; in particular, assuming the application of the “Worst Case” scenario (0% yearly air traffic growth), the NPV generated by the PCP would drop to 1,5 billion €, resulting in a reduction of 38% compared to the “Base implementation scenario”. Instead, assuming a 3% yearly air traffic growth as envisaged in the “Best Case” scenario, the NPV generated by the PCP would amount at 3,5 billion €, thus resulting in an increase of 43% compared to the “Base implementation scenario”;
- **Fuel and CO_2 benefits:** a reduction of benefits attached to fuel consumption and CO_2 emissions reduction by 20% would result in a drop of the PCP NPV to 1,7 billion €, that is to say -30% compared to the “Base implementation scenario”, while an increase of such benefit by 20% would bring the PCP NPV up to 3,1 billion €, +30% compared to the “Base implementation scenario”;
- **Delay related benefits:** a reduction of delay related benefits by 20% would result in a drop of the PCP NPV to 2,4 billion €, that is to say -2% compared to the “Base implementation scenario”, while an increase of such benefit by 20% would bring the PCP NVP up to 2,5 billion €, +2% compared to the same scenario;
- **Ground investment, Airborne investment:** an increase in costs related to ground and airborne investments by 30% - as assumed in the “Worst Case” scenario - would result in a decrease on PCP NPV respectively to 1,8 billion € (-28%) and 2,4 billion € (-3%) compared to the “Base implementation scenario”; instead, a reduction in costs related to ground and airborne investments by 30% - as assumed in the “Best Case” scenario - would result in an increase in the PCP NPV respectively up to 3,1 billion € (+28%) and 2,5 billion € (+3%).

C.3 ATM FUNCTIONALITIES IMPACT ASSESSMENT

C.3.1 Overview

As mentioned in the Methodology chapter, the PCP includes six ATM Functionalities, each of which would provide a different contribution to the overall PCP costs, benefits and NPV.

Specifically, the AF # 2 Airport Integration and Throughput Functionalities is the one for which the highest investment would be expected, with a total cost amounting at around 1,0 billion €, representing 25% of the total PCP investment, followed by AF # 6 Initial Trajectory Information Sharing (towards i4D) (22%), AF # 5 iSWIM functionality (18%), AF # 3 Flexible Airspace Management and Free Route (17%), AF # 4 Network Collaborative Management (Flow & NOP) (11%) and AF # 1 Extended AMAN and PBN in high density TMAs (7%).

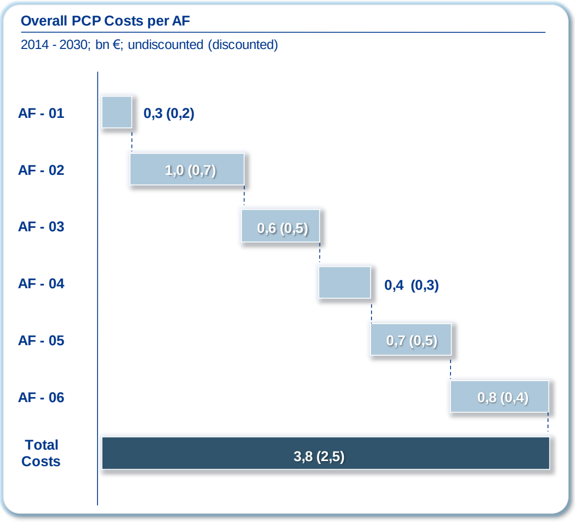


Figure 58: Overall PCP costs per ATM Functionality

Looking at the benefits, the highest contribution is provided by AF # 3 Flexible Airspace Management and Free Route, which generates benefits amounting at 4,3 billion € over the considered time period, representing around 35% of the overall PCP benefit, followed by AF # 1 Extended AMAN and PBN in high density TMAs (22%), AF # 2 Airport Integration and Throughput Functionalities (18%), AF # 4 Network Collaborative Management (Flow & NOP) (10%), AF # 5 iSWIM functionality (9%) and AF # 6 Initial Trajectory Information Sharing (towards i4D) (6%).

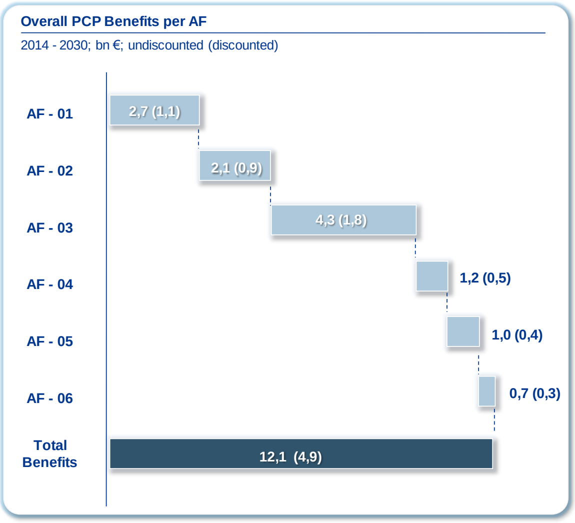


Figure 59: Overall PCP benefits per ATM Functionality

It is worth noting that all the ATM Functionalities in scope show a positive NPV, except AF # 5 and AF # 6 for which a NPV amounting at -0,03 billion € and -0,2 billion € respectively would be expected.

In particular, AF # 3 Flexible Airspace Management and Free Route would provide the highest contribution on the overall PCP NPV (54%), followed by AF # 1 Extended AMAN and PBN in high density TMAs (37%), AF # 2 Airport Integration and Throughput Functionalities (9%), AF # 4 Network Collaborative Management (Flow & NOP) (8%), AF # 5 iSWIM functionality (-1%) and AF # 6 Initial Trajectory Information Sharing (towards i4D) (-7%).

A closer analysis on costs, benefits and NPV associated to each ATM Functionality is provided in the following chapters.

C.3.2 AF # 1 Extended AMAN and PBN in high density TMAs

The AF # 1 Extended AMAN and PBN in high density TMAs is expected to improve the precision of approach trajectory as well as to facilitate traffic sequencing at earlier stage, thus allowing to reduce fuel consumption and environmental impact in descent/arrival phases. The deployment dates associated to this AF are reported in the following table.

Start of Investment	End of Investment	Start of Benefit	Full Benefit	Start of Deployment	End of Deployment
2015	2023	2018	2024	2018	2023

Table 34: AF # 1 Deployment dates

The deployment dates related to sub-systems within AF # 1 are reported in the following table.

Sub-systems	Start of Investment	End of Investment	Start of Deployment	End of Deployment
AMAN System upgrade for e-AMAN	2015	2023	2018	2023
ATS System upgrade for e-AMAN	2015	2023	2018	2023
PBN Airspace/Procedures/ATS-System	2015	2023	2018	2023

Table 35: AF # 1 Sub-systems Deployment dates

On the basis of analyses carried out, the NPV associated to the deployment of this ATM Functionality would amount to 0,9 billion €, with a 6 years pay-back period; the distribution of associated costs, benefits and cumulated net benefits over the considered time period is represented in the following chart.

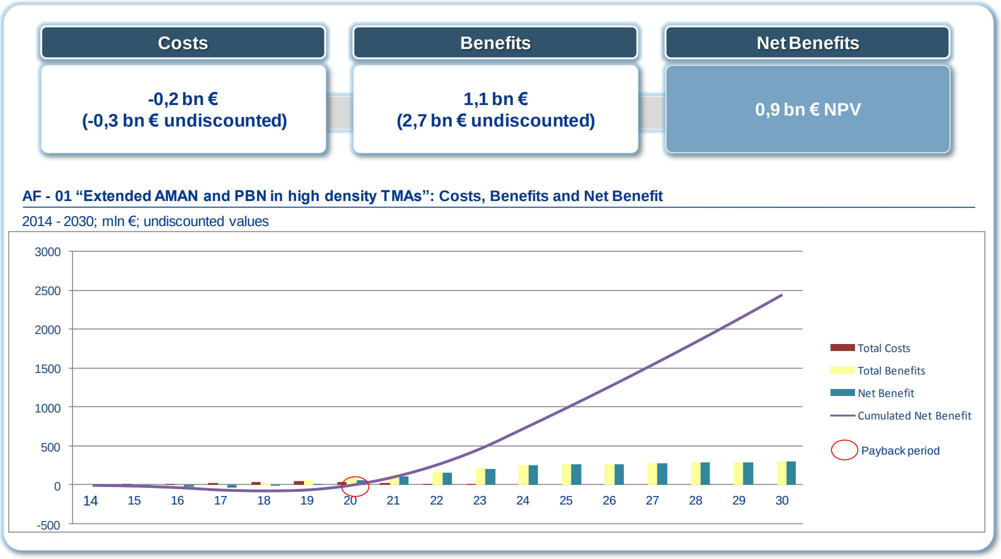


Figure 60: AF # 1 - Impact assessment outcomes

The total benefit associated to the deployment of AF # 1 Extended AMAN and PBN in high density TMAs amounts at 2,7 billion € (1,1 billion € discounted).

In particular, such ATM Functionality would bring significant benefits in terms of fuel consumption reduction (-2,3 million tonnes), thus ensuring fuel cost savings exceeding 2,0 billion €.

As a matter of fact, fuel cost savings represent 79% of total benefits associated to this ATM Functionality, followed by delay related benefits (8%), CO_2 Credit Savings (8%) and ANS Productivity gains (5%).

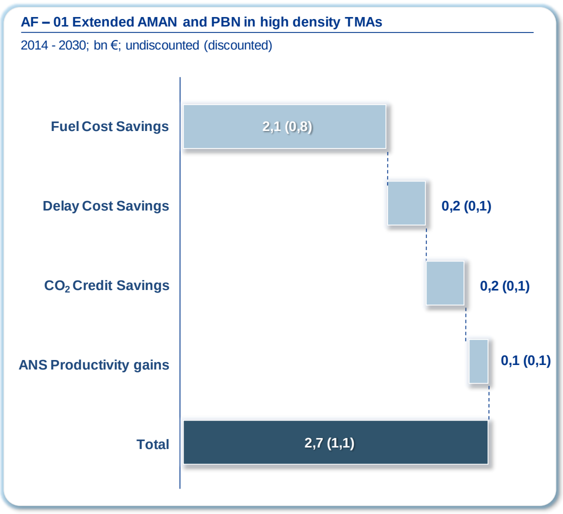


Figure 61: AF #1 benefits

With regard to the costs associated to AF # 1 - Extended AMAN and PBN in high density TMAs, 100% of such costs - amounting at 0,3 billion € (0,2 billion € discounted) - are associated to investments to be realized by ANSPs.

In particular, the overall investment would stem from the implementation of three different sub-systems:

- AMAN System upgrade for e-AMAN, whose cost accounts for 39% of total investment;
- ATS System upgrade for e-AMAN, whose cost accounts for 29% of total investment;
- PBN Airspace/Procedures/ATS-System, whose cost accounts for 32% of total investment.

Regarding the involved stakeholders, the Airspace Users would be expected to obtain the highest NPV, which would amount at around 1,0 billion €. Such NPV would result on the basis of benefits amounting at 2,5 billion € (1,0 billion € discounted) and no specific investment envisaged for this stakeholder category.

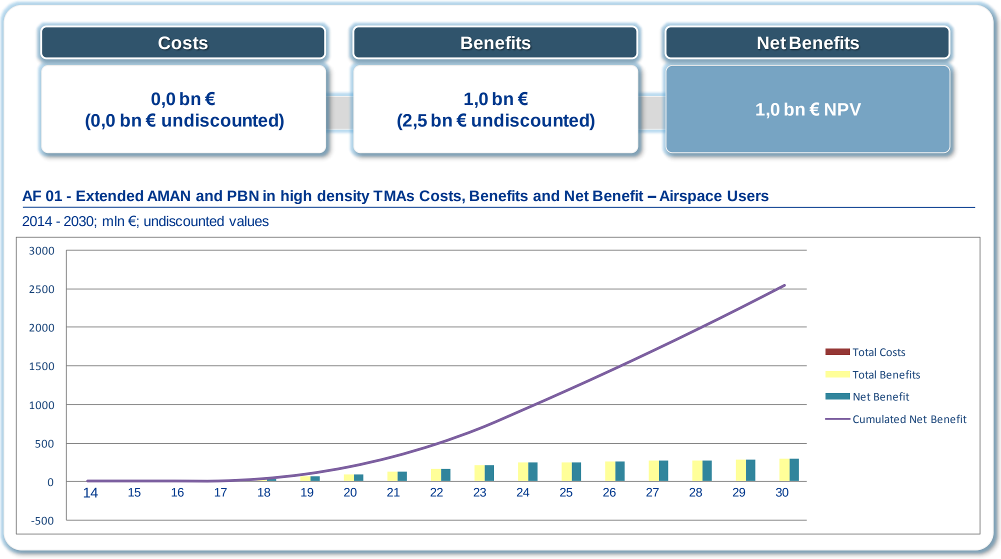


Figure 62: AF # 1 impact assessment outcomes for Airspace Users

Looking at the ANSPs, the total NPV associated to the PCP – assuming no transfers among stakeholders - would amount at -0,1 billion €, resulting from costs for around 0,3 billion € (0,2 billion € discounted) and benefits in terms of ANS productivity gains amounting at 0,1 billion € (0,1 billion € discounted).

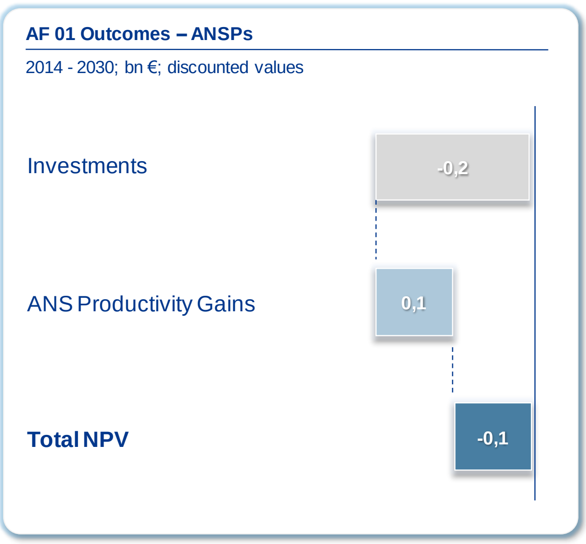


Figure 63: AF #1 Impact assessment for ANSPs

C.3.3 AF # 2 Airport Integration and Throughput Functionalities

The AF # 2 Airport Integration and Throughput Functionalities is expected to improve runway safety and throughput, ensuring benefits in terms of fuel consumption and delay reduction as well as airport and airspace capacity. The deployment dates associated to this AF are reported in the following table.

Start of Investment	End of Investment	Start of Benefit	Full Benefit	Start of Deployment	End of Deployment
2014	**2023**	**2015**	**2024**	**2015**	**2023**

Table 36: AF # 2 Deployment dates

The deployment dates associated to Sub-systems within AF # 2 are reported in the following table.

Sub-systems	Start of Investment	End of Investment	Start of Deployment	End of Deployment
DMAN A-CDM	2014	2020	2015	2020
Time Based Separation	2014	2023	2017	2023
Airports Safety Nets	2014	2020	2015	2020
CWP and A-SMGCS Optimised Routing	2014	2023	2018	2023
Runway Status Lighting Systems	2014	2020	2015	2020

Table 37: AF # 2 Sub-systems Deployment dates

The NPV associated to the deployment of AF # 2 Airport Integration and Throughput Functionalities would amount to 0,2 billion €, with a 12 years pay-back period.

The distribution of costs, benefits and cumulated net benefits associated to this ATM Functionality over the considered time period is represented in the following chart.

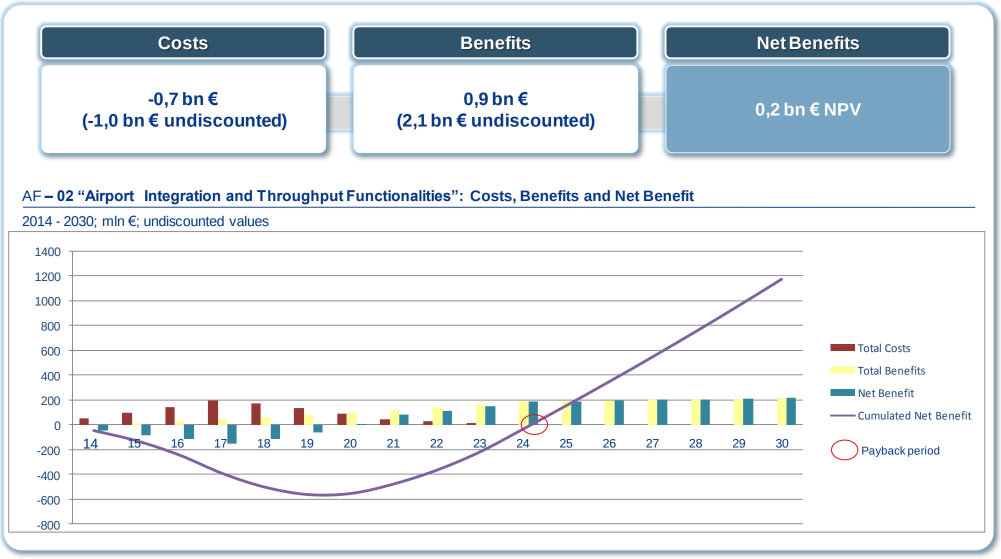


Figure 64: AF # 2 Impact assessment outcomes

Around 90% of benefits associated to AF # 2 Airport Integration and Throughput Functionalities is related to fuel cost savings: the implementation of this ATM Functionality would ensure a reduction of around 2,0 mln tonnes in the overall fuel consumption over the 2014 – 2030 time period, thus enabling fuel costs savings for around 1,9 billion €.

Moreover, such reduction in terms of fuel consumption would have a positive impact on the environment, with a reduction of CO_2 emissions exceeding 6,0 million tonnes.

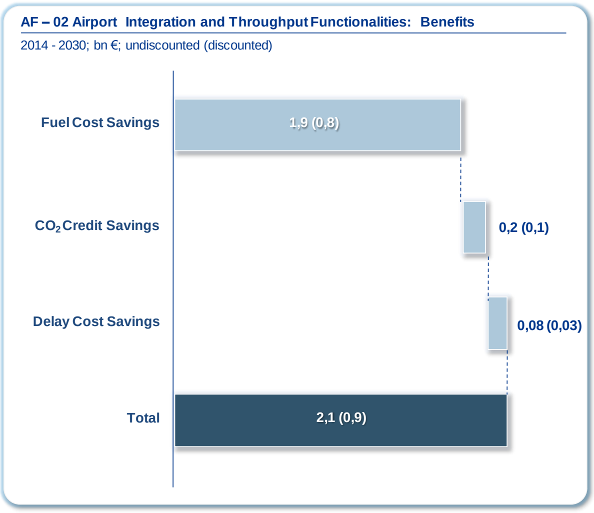


Figure 65: AF # 2 benefits

The overall cost associated to this ATM Functionality is expected to be shared by two stakeholders' categories, namely ANSPs (84% of total investment) and Airport Operators (16% of total investment).

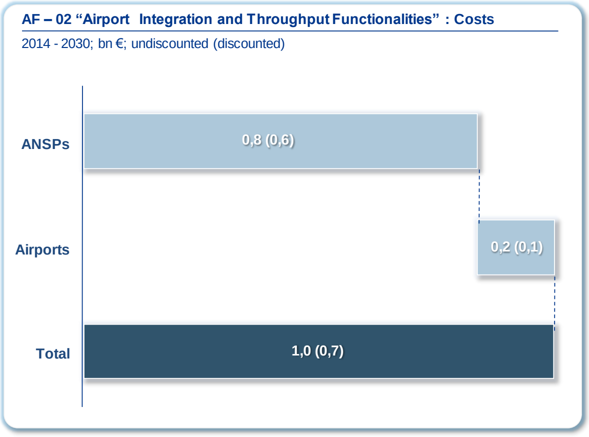


Figure 66: AF # 2 costs per stakeholder

In particular, the overall investment would be related to the implementation of five different sub-systems:

- "DMAN A-CDM", whose cost accounts for 36% of total investment;
- "TBS", whose cost accounts for 30% of total investment;
- "Airport safety Net", whose cost accounts for 7% of total investment;
- "CWP and A-SMGCS Optimised Routing", whose cost accounts for 14% of total investment;
- "RWSL", whose cost accounts for 13% of total investment.

With regard to the involved stakeholders, the Airspace Users would be expected to obtain the highest NPV, which would amount at around 0,8 billion €. Such NPV would result on the basis of benefits amounting at 2,0 billion € (0,8 billion € discounted) and no specific investment envisaged for this stakeholder category.

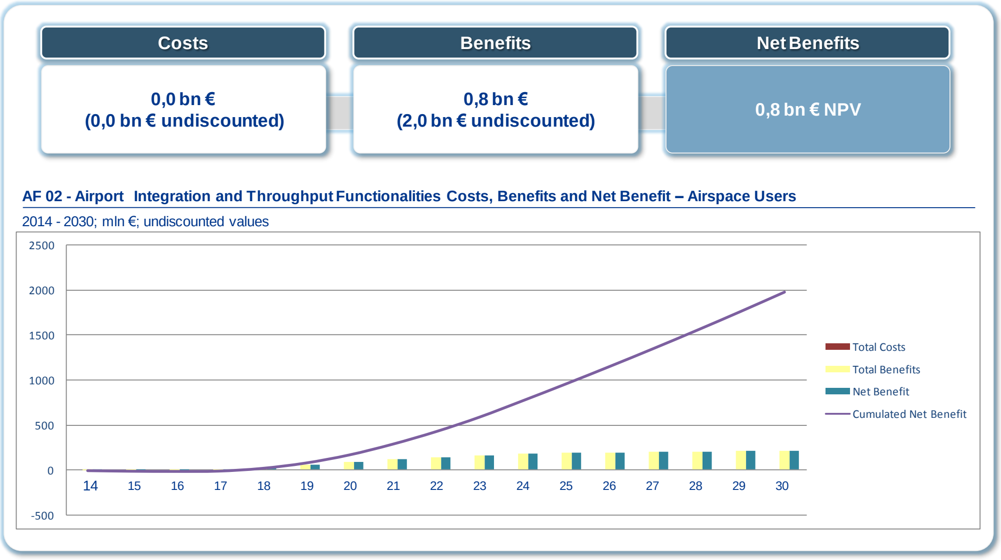


Figure 67: AF # 2 Impact assessment outcomes for Airspace Users

Other stakeholder categories involved, namely ANSPs and Airports, would experience negative NPVs, amounting respectively at -0,6 billion € and -0,1 billion € due to the specific nature of their business models.

C.3.4 AF # 3 Flexible Airspace Management and Free Route

The AF # 3 Flexible Airspace Management and Free Route would enable a more efficient use of airspace, thus providing significant benefits linked to fuel consumption and delay reduction. The deployment dates associated to this AF are reported in the following table.

Start of Investment	End of Investment	Start of Benefit	Full Benefit	Start of Deployment	End of Deployment
2014	2021	2017	2022	2017	2021

Table 38: AF # 3 Deployment dates

The NPV associated to the deployment of AF # 3 Flexible Airspace Management and Free Route would amount to 1,3 billion €, with a 8 years pay-back period.

The distribution of costs, benefits and cumulated net benefits associated to the ATM Functionality over the considered time period is represented in the following chart.

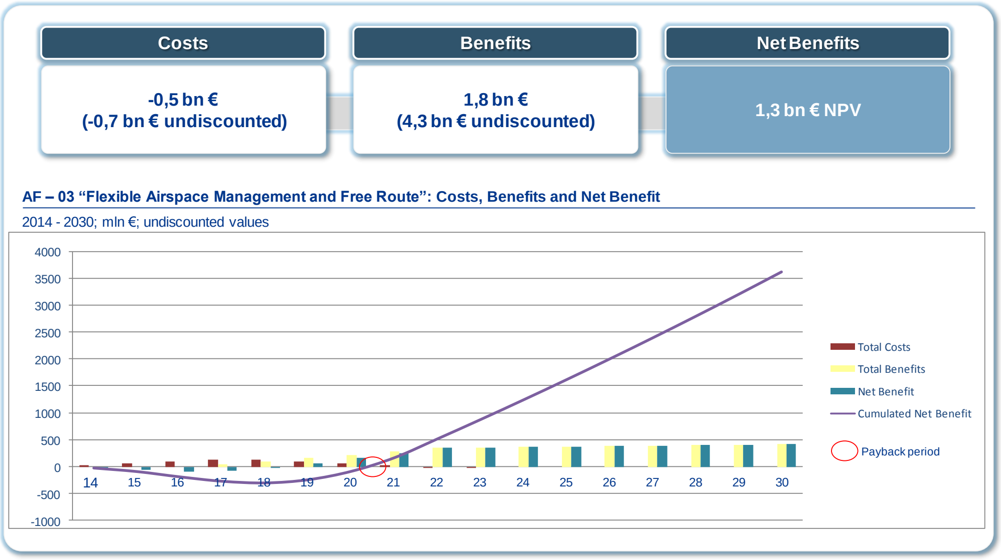


Figure 68: AF # 3 Impact Assessment outcomes

The implementation of AF # 3 Flexible Airspace Management and Free Route would generate savings associated to fuel costs amounting at 3,8 billion €, deriving from a reduction in fuel consumption of around 4 million tonnes over the 2014 – 2030 time period.

The decrease in fuel consumption would also bring important benefits for the environment, with a reduction of CO_2 emissions exceeding 12 million tonnes.

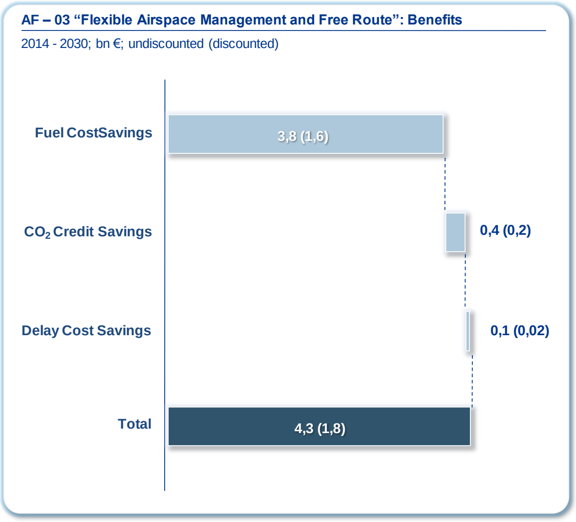


Figure 69: AF # 3 benefits

ANSPs, Military, Airspace Users and Network Manager would be expected to contribute as investors for the implementation of this ATM Functionality.

In particular, the overall cost of AF # 3, amounting at 0,7 billion €, would be shared by the different stakeholders' categories as follows:

- ANSPs: 75% of total investment;
- Military: 22% of total investment;
- Network Manager: 2% of total investment;
- Airspace Users (ground investment): 1% of total investment.

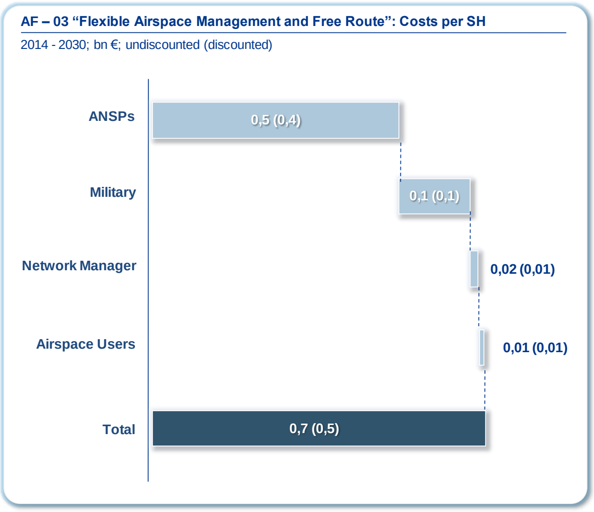


Figure 70: AF # 3 costs per stakeholder

Looking at the single stakeholder categories, a NPV amounting at around 1,8 billion € would be expected for Airspace Users.

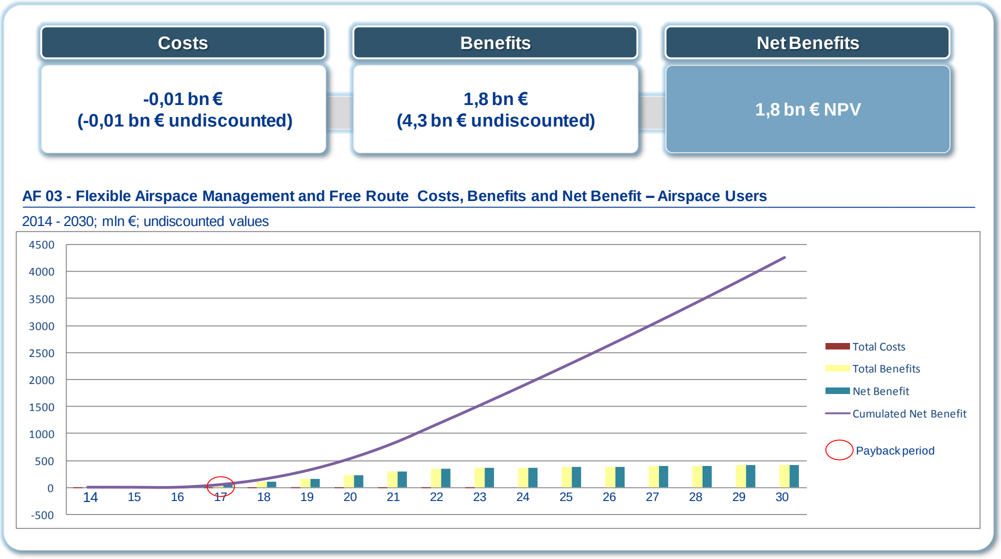


Figure 71: AF # 3 Impact assessment outcomes for Airspace Users

A negative NPV would be experienced by the other stakeholder categories involved in the implementation of this AF due to the nature of their business model:

- ANSPs: -0,4 billion € NPV;
- Military: -0,1 billion € NPV;
- Network Manager: -0,01 billion € NPV.

C.3.5 AF # 4 Network Collaborative Management (Flow & NOP)

The AF # 4 Network Collaborative Management (Flow & NOP) is expected to improve the quality and the timeliness of the network information shared by all ATM stakeholders, thus ensuring significant benefits in terms of ANS productivity gains and delay cost savings. The deployment dates associated to this AF are reported in the following table.

Start of Investment	End of Investment	Start of Benefit	Full Benefit	Start of Deployment	End of Deployment
2014	2021	2017	2022	2017	2021

Table 39: AF # 4 Deployment dates

The NPV associated to the deployment of AF # 4 Network Collaborative Management (Flow & NOP) would amount to 0,2 billion €, with a 11 years pay-back period.

The distribution of costs, benefits and cumulated net benefits associated to the ATM Functionality over the considered time period is represented in the following chart.

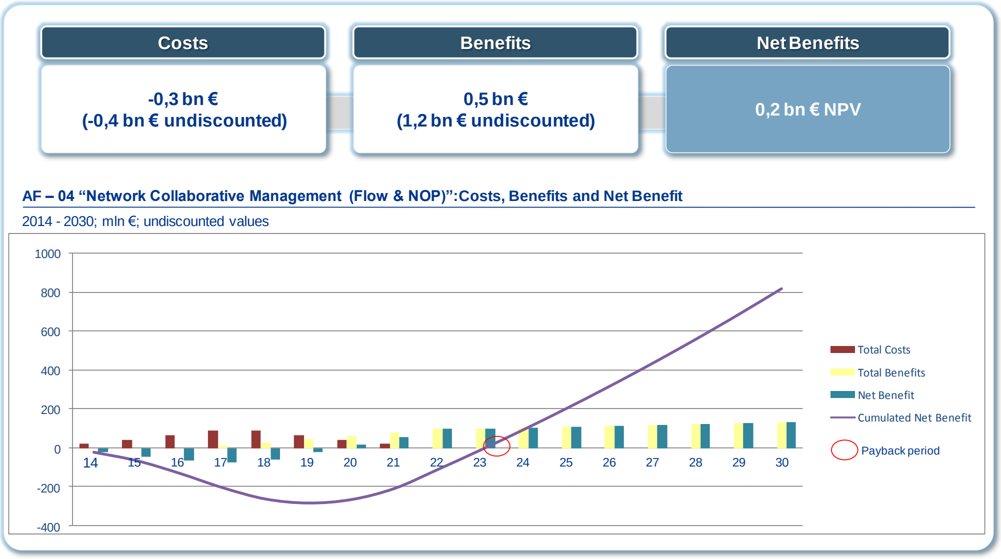


Figure 72: AF # 4 Impact assessment outcomes

Looking at the benefits, the implementation of AF # 4 Network Collaborative Management (Flow & NOP) would bring a major improvement in ANS productivity, generating savings amounting at around 1,0 billion €, which impact for 78% on the total benefits associated to this ATM Functionality.

Another important benefit associated to the deployment of this ATM Functionality is linked to delay reduction, which would generate savings exceeding 0,2 billion €.

Finally, gains in terms of fuel consumption reduction would be obtained, with fuel costs savings amounting at around 0,1 billion € and CO_2 emissions reduction of around 0,1 million tonnes.

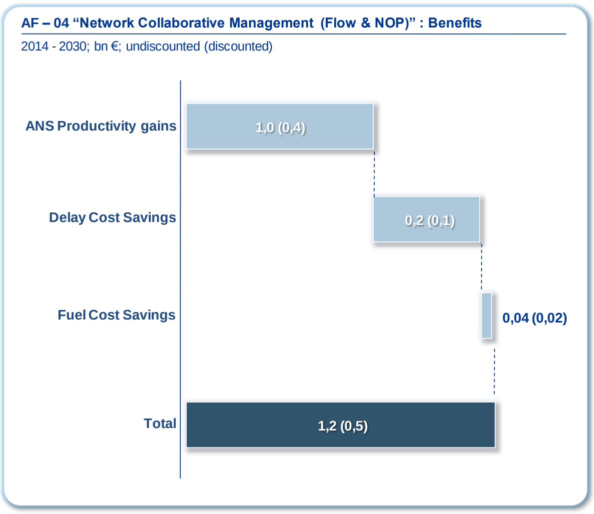


Figure 73: AF # 4 benefits

With regard to the costs associated to AF # 4 Network Collaborative Management (Flow & NOP), the civil ANSPs, the Network Manager and the Airports Operators would be involved as investors, contributing to the overall ATM Functionality cost as follows:

- ANSPs: 75% of total investment;

- Network Manager: 13 % of total investment;
- Airport Operators: 12 % of total investment.

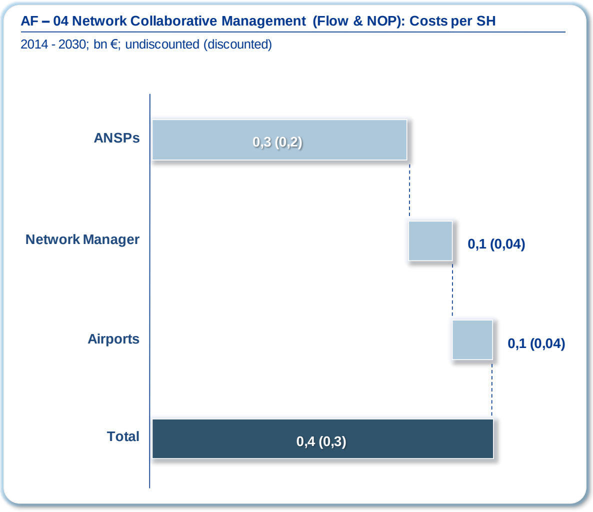


Figure 74: AF # 4 costs per stakeholder

Looking at the single stakeholder categories, the NPV for Airspace Users would be amounting at 0,1 billion €.

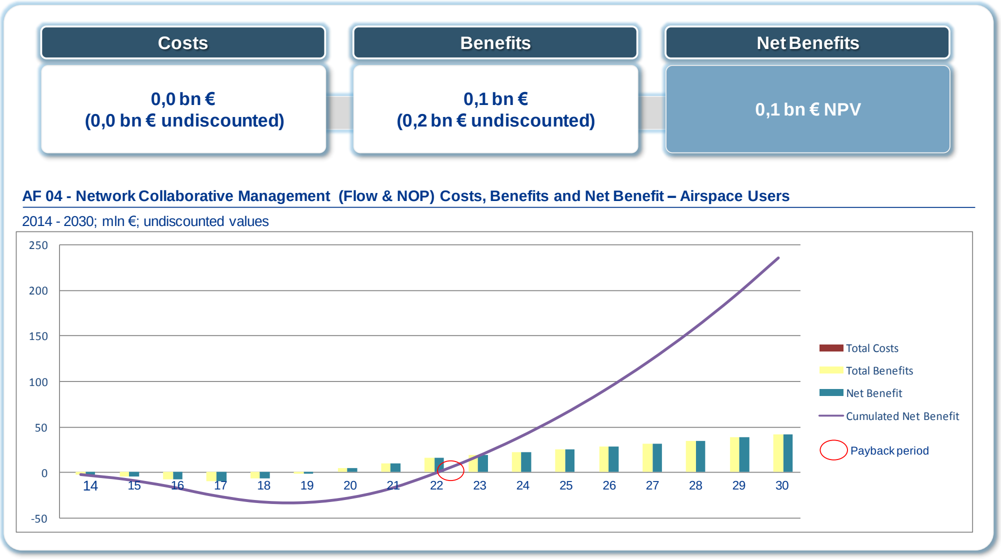


Figure 75: AF # 4 Impact assessment outcomes for Airspace Users

The ANSPs would be expected to experience a positive NPV amounting at 0,2 billion €, while other involved stakeholder categories, namely Airports and Network Manager, would have negative NPVs amounting at -0,04 billion € respectively due to the nature of their business model.

C.3.6 AF # 5 iSWIM functionality

The AF # 5 iSWIM functionality consists of a set of services that are delivered and consumed through an IP-based network by SWIM enabled systems, enabling significant benefits in terms of ANS productivity. The deployment dates associated to this AF are reported in the following table.

Start of Investment	End of Investment	Start of Benefit	Full Benefit	Start of Deployment	End of Deployment
2014	2024	2016	2025	2016	2024

Table 40: AF # 5 Deployment dates

The deployment dates associated to Sub-systems within AF #5 are reported in the following table.

Sub-systems	Start of Investment	End of Investment	Start of Deployment	End of Deployment
Flow Management and Flight Planning	2014	2024	2016	2024
Aeronautical and Airspace	2014	2024	2016	2024
Meteo	2014	2024	2016	2024
SWIM Infrastructure & Administration	2014	2024	2016	2024
Flight Object	2014	2024	2018	2024

Table 41: AF # 5 Sub-systems Deployment dates

The NPV associated to the deployment of AF # 5 iSWIM functionality would amount to -0,03 billion €, with a 14 years pay-back period.

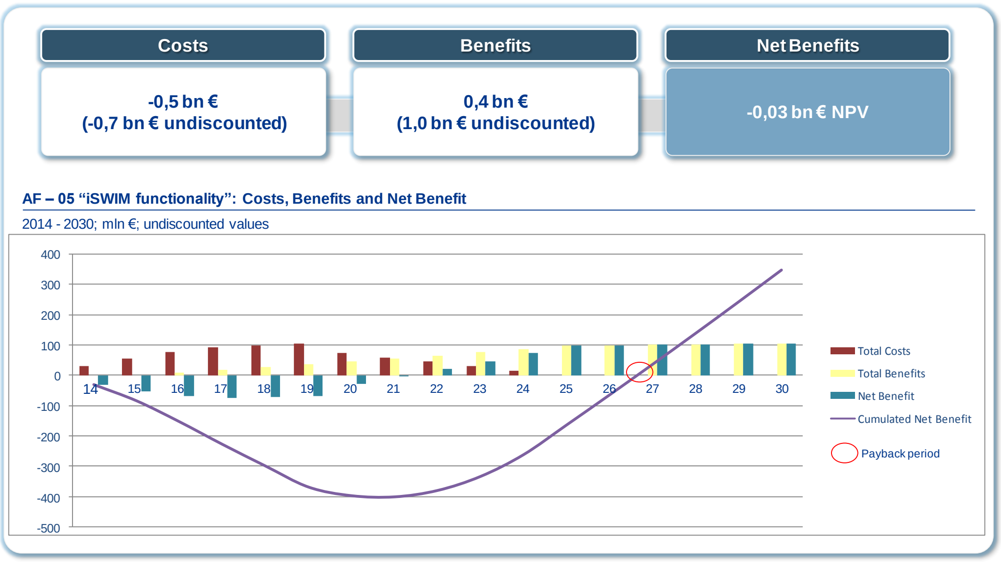


Figure 76: AF # 5 Impact assessment outcomes

The main monetised benefit associated to the deployment of this ATM Functionality is linked to an improvement of ANS productivity which would bring savings for around 1,0 billion €.

From a costs perspective, all the stakeholders' categories taken into account in the impact assessment exercise would be expected to contribute to the overall investment, with the highest share of the investment associated to ANSPs and Met Service providers.

Specifically, the overall investment would be shared among the stakeholders' categories as follows:

- ANSPs: 41% of total investment;
- MET Service Providers: 29% of total investment;
- Network Manager: 15% of total investment;
- Military: 10% of total investment;
- Airport Operators: 3% of total investment;
- Airspace Users (ground investment): 2% of total investment.

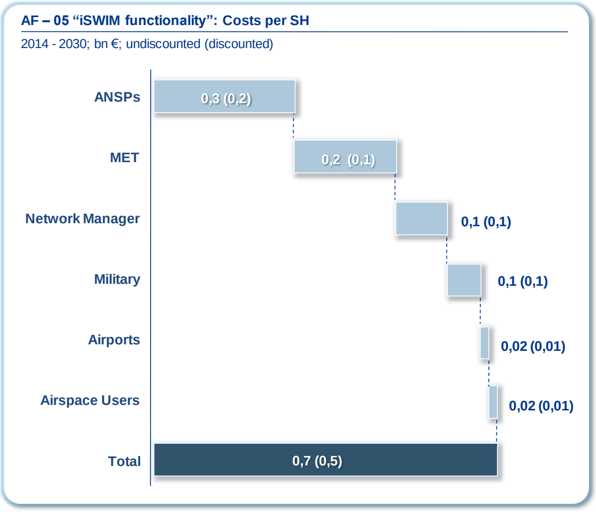


Figure 77: AF # 5 costs per stakeholder

Finally, the overall cost associated to this ATM Functionality would stem from the deployment of the following sub-systems:

- "Flow Management & FPL", whose cost accounts for 8% of total investment;
- "Aeronautical & Airspace", whose cost accounts for 22% of total investment;
- "Meteo", whose cost accounts for around 40% of total investment;
- SWIM Infrastructure & Administration, whose cost accounts for 2% of total investment;
- "Flight Object": whose cost accounts for 28% of total investment.

Looking at the single stakeholder categories, the Airspace Users would be expected to face a negative NPV, amounting at -0,02 billion €.

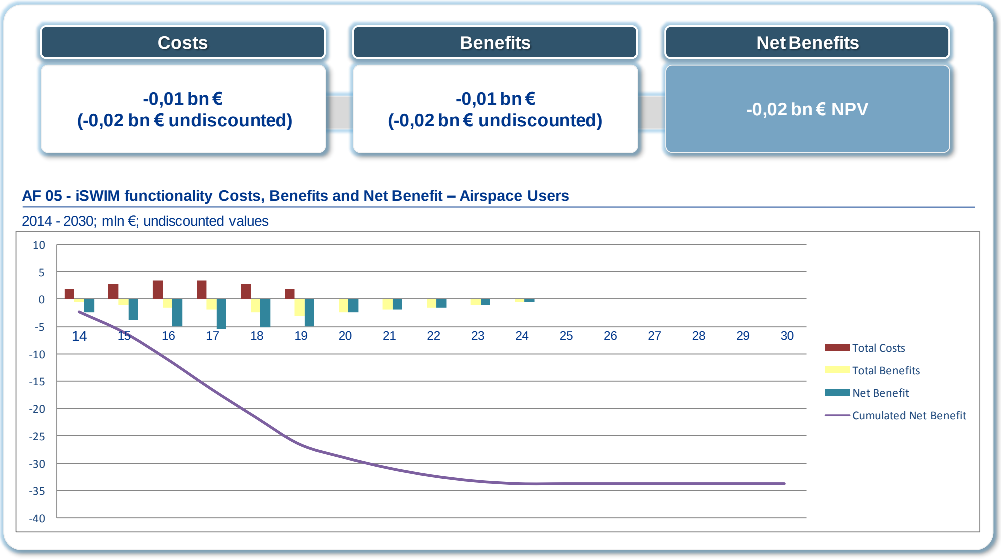


Figure 78: AF # 5 Impact assessment outcomes for Airspace Users

With regard to the ANSPs, the expected NPV would amount at around 0,2 billion €, as shown in the following figure.

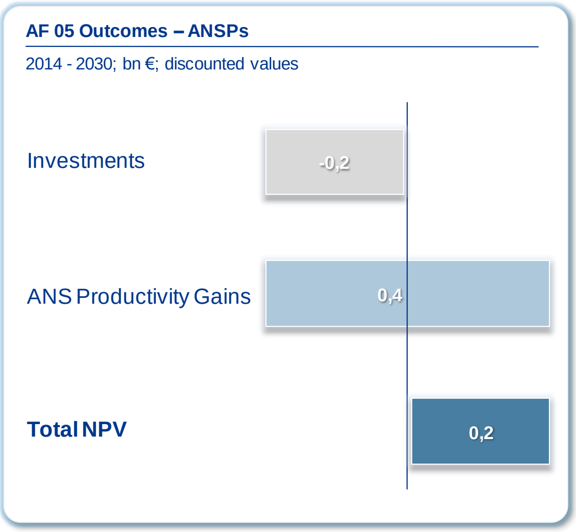


Figure 79: AF # 5 Impact assessment outcomes for ANSPs

The remaining stakeholders would be expected to experience negative NPVs due to the specific nature of their business models:

- Airport Operators: -0,01 billion € NPV;
- Met Service providers: -0,1 billion € NPV;
- Military: -0,1 billion € NPV;
- Network Manager: -0,1 billion € NPV.

C.3.7 AF # 6 Initial Trajectory Information Sharing (towards i4D)

The AF # 6 Initial Trajectory Information Sharing (towards i4D) is expected to improve predictability of aircraft trajectory for the benefit of both airspace users, Network Manager and ANSPs implying less tactical interventions and improved de-confliction situation. This would have a positive impact on ANS productivity, fuel saving and delay variability. The deployment dates associated to this AF are reported in the following table.

	Start of Investment	End of Investment	Start of Benefit	Full Benefit	Start of Deployment	End of Deployment
Ground	**2016**	**2022**	**2018**	**2024**	**2018**	**2024**
Airborne	**2018**	**2025**	**2018**	**2030**	**2018**	**2025**

Table 42: AF # 6 Deployment dates [11]

The NPV associated to the deployment of AF # 6 - Initial Trajectory Information Sharing (towards i4D) would amount to -0,2 billion €.

The distribution of costs, benefits and cumulated net benefits associated to the ATM Functionality over the considered time period is represented in the following chart.

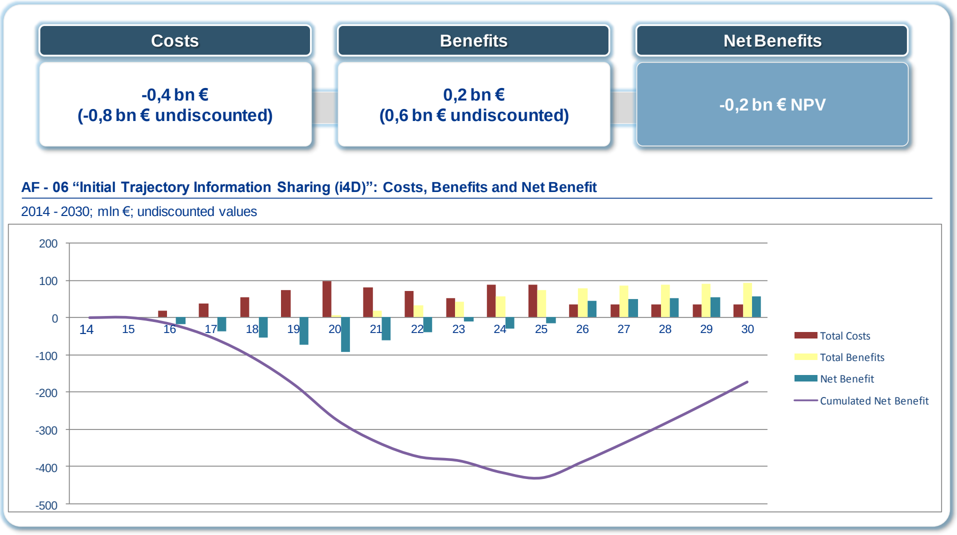


Figure 80: AF # 6 Impact assessment outcomes

The gains in terms of ANS productivity represent the most important benefit achievable through the implementation of this ATM Functionality.

Specifically, ANS Productivity gains contribute to the benefit associated to this investment by 94%, followed by fuel cost and CO_2 related savings, accounting respectively for 5% and 1%.

[11] 63% of benefit is monetised due to the percentage of flights equipped (32% of total fleet equipped at 2030, corresponding to 63% of total flights)

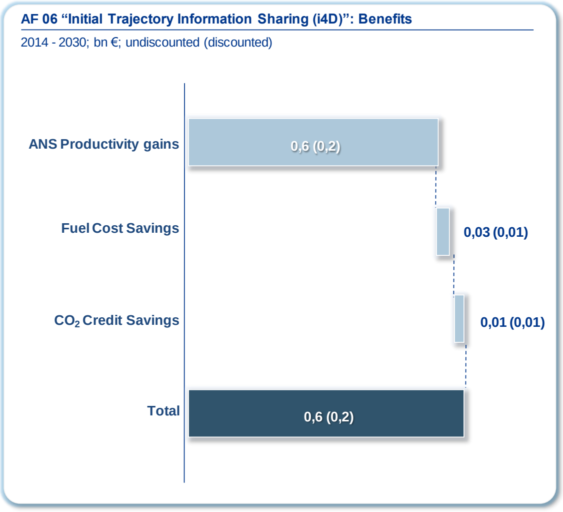


Figure 81: AF # 6 benefits

Looking at the costs, three stakeholders categories would be expected to contribute to the overall investment associated to this ATM Functionality, namely Airspace Users[12], ANSPs and Network Manager; the highest share of the costs is associated to airborne investment to be undertaken by Airspace Users.

Specifically, the overall investment would be shared among the involved stakeholders' categories as follows:

- Airspace Users (airborne investment): 66% of total investment
- ANSPs: 33% of total investment
- Network Manager: 1% of total investment

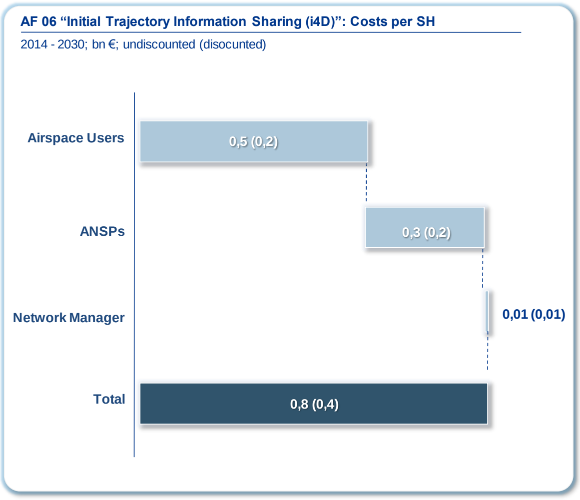


Figure 82: AF # 6 costs per stakeholder

Looking at the single stakeholder categories, the Airspace Users would be expected to face a negative NPV amounting at -0,2 billion €, stemming from costs for 0,5 billion € (0,2 billion discounted) and benefits amounting at 0,04 billion € (0,02 billion € discounted).

[12] Business Aviation costs not included

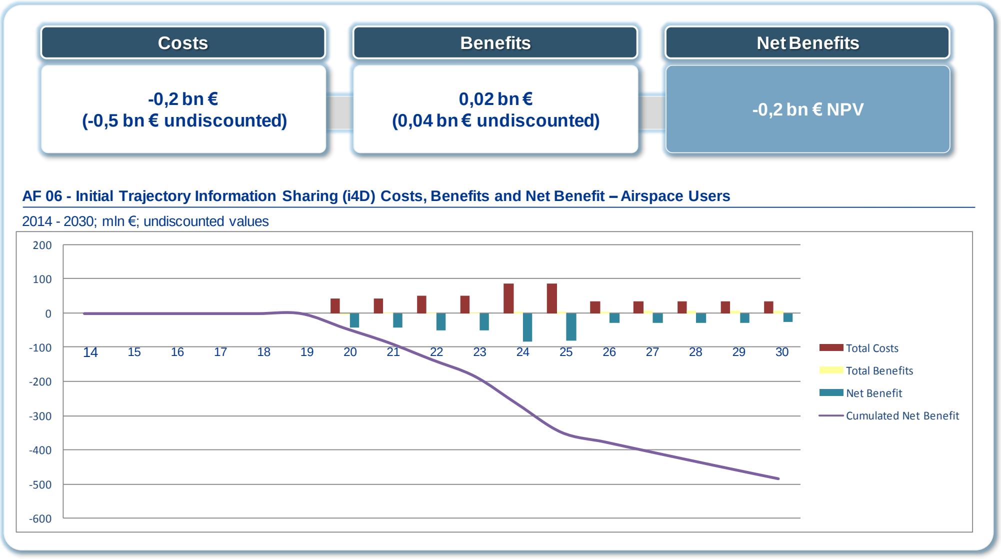


Figure 83: AF # 6 Impact assessment outcomes for Airspace Users

With regard to other involved stakeholders, ANSPs would experience a positive NPV amounting at 0,1 billion € while the Network Manager would face a slightly negative NPV amounting at -0,01 billion € due to the specific nature of their business models.

APPENDIX D GEOGRAPHICAL SCOPE

The analysis performed by Work Package C (European ATM Master Plan maintenance) was used as an input to the PCP expert groups which performed the definition of the geographical scope for civil stakeholders on the basis of pre-defined categories of operating environments. These operating environment categories where defined by Work Package C together with stakeholders taking into account actual and projected capacity performance needs and traffic complexity (data available for 2010, 2014, 2019, 2025 and 2030). The decision was taken to use 2019 as a reference date to reduce uncertainty although it is noted that the implementation of the PCP will for the most part be completed by 2025. Each category can in turn be linked to specific ACCs, TMAs and Airports as highlighted in this Appendix. Where appropriate and to avoid unnecessary costs these categories were refined on the basis of complementary sources of information provided in this Appendix. The geographical scope of Military was defined using Eurocontrol data in particular with regards to levels of integration between civil and military air navigation service provision.

D.1 AF # 1: Extended AMAN & PBN in High Density TMAs

The implementation is targeted at the following 25 airports:

London-Heathrow, Paris-CDG, London-Gatwick, Paris-Orly, London-Stansted, Milan-Malpensa, Frankfurt, Madrid-Barajas, Amsterdam, Munich, Rome-Fiumicino, Barcelona, Zurich, Düsseldorf, Brussels, Oslo, Stockholm-Arlanda, Berlin, Manchester, Palma, Copenhagen, Vienna, Dublin, Nice, Istanbul.

This list represents the population of airports with more than 150 000 IFR movements per year and with a capacity need of at least 60 movements per peak hour expected by 2019.

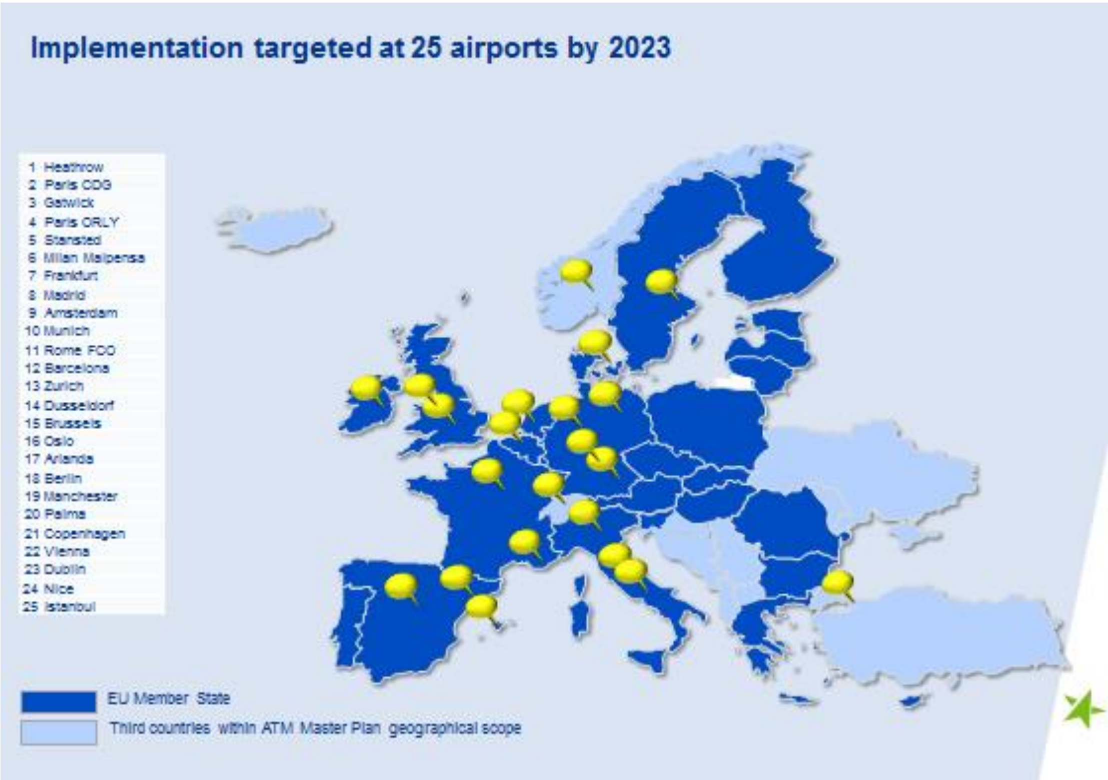


Figure 84: AF # 1 geographical scope of implementation

D.2 AF # 2: Airport Integration and Throughput Functionalities

- **Time-based separation**: The implementation is targeted on the following 17 airports: London-Gatwick, London-Heathrow, Madrid-Barajas, Amsterdam-Schiphol, Frankfurt, Rome-Fiumicino, Munich, Vienna, Zurich, Paris-Orly, Oslo, Düsseldorf, Milan-Malpensa, Manchester, Copenhagen, Dublin and Istanbul.
    - Source: this selection was made on the basis of the Performance Review Report of EUROCONTROL's PRC (PRR 2012) showing an additional ASMA time above the European average as well as the impact of the wind conditions at the 30 major European airports.
- **Runway Status Lighting Systems**: The implementation is targeted on the following 15 airports: Madrid, Rome-Fiumicino, Palma, London-Heathrow, Paris-CDG, Amsterdam-Schiphol, Frankfurt, Zurich, Copenhagen, Vienna, Brussels, Milan-Malpensa, Paris-Orly, Stockholm-Arlanda and Istanbul.
    - Source: this selection is based on the operational environment requirements described in SESAR requirements documents and an analysis performed by PCP expert group experts taking into account the particular need of each European airport. In this document the suitability of the solution to an airport is defined according to criteria such as level of traffic vs. hub constraints, multiple runways and complex layout, and safety level according to the runway incursion criteria.
- **Airports safety nets**: The implementation is targeted on the same airports as for AF # 1, i.e.: London-Heathrow, Paris-CDG, London-Gatwick, Paris-Orly, London-Stansted, Milan-Malpensa, Frankfurt, Madrid-Barajas, Amsterdam-Schiphol, Munich, Rome-Fiumicino, Barcelona, Zurich, Düsseldorf, Brussels, Oslo, Stockholm-Arlanda, Berlin, Manchester, Palma, Copenhagen, Vienna, Dublin, Nice, Istanbul.
- **CWP and A-SMGCS optimised routing**: The implementation is targeted on the same airports as for AF # 1, i.e.: London-Heathrow, Paris-CDG, London-Gatwick, Paris-Orly, London-Stansted, Milan-Malpensa, Frankfurt, Madrid-Barajas, Amsterdam-Schiphol, Munich, Rome-Fiumicino, Barcelona, Zurich, Düsseldorf, Brussels, Oslo, Stockholm-Arlanda, Berlin, Manchester, Palma, Copenhagen, Vienna, Dublin, Nice, Istanbul.

D.3 AF # 3: Flexible Airspace Management and Free Route

Free Route Airspace implementation shall be applied on the entire European network above FL310. In this case, all 61 civil Air Traffic Control Centres of the EUROCONTROL Member States plus Estonia and 22 military Air Traffic Control Centres (corresponding to those eleven States where Civil / Military operations are not integrated) are concerned by the implementation.

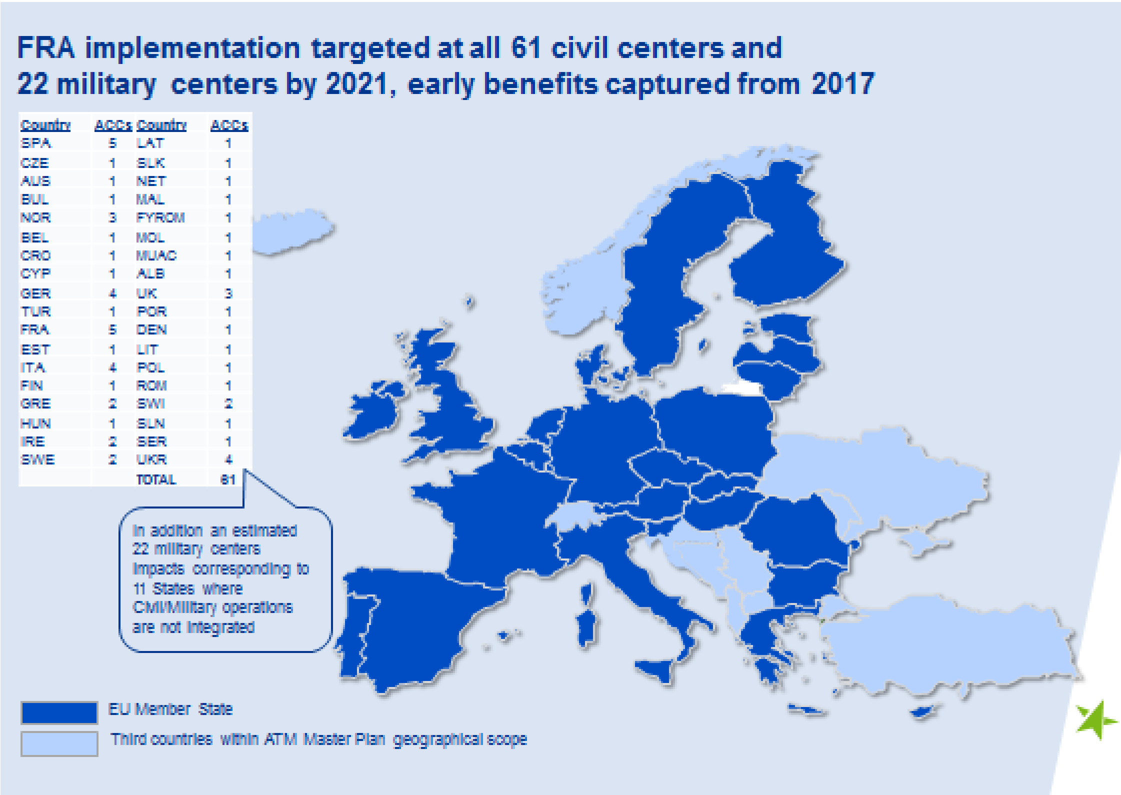


Figure 85: AF # 3 geographical scope of implementation

The proposal to implement Free Route operations above FL 310, rather than the other options envisaged of FL 270 or FL 370, results from the finding that FL 310 is the flight level above which maximum benefits are to be achieved in relation to the amount of controlled traffic. Implementation at the FL 270 would lead to a marginal improvement of the benefit while an implementation at FL 370 would halve the NPV. This analysis is illustrated in the two figures below.

However, it must be noted that the implementation of this ATM Functionality can be incremental and that intermediate steps at different flight levels can be envisaged as part of the Deployment Programme.

Civil ACCs

All categories of civil ANSP ACCs are within the geographical scope of the AF3:

- Very High (V.H.): ACCs with more than 300 mov/h of capacity needs
- High (H): ACCs with mov/h of capacity needs between 200 and 300
- Medium (M): ACCs with mov/h of capacity needs between 50 and 200
- Low (L): ACCs with less than 50 mov/h of capacity needs

A comprehensive list of ACCs and related performance data can be found in the table below.

ACC	Name	2010			2019			Increase of cap (%)
		Category by Capacity needs	Capacity Baseline 2010	Complexity	Category by Capacity needs	Capa needs	Complexity	
EGTTCTA	LONDON ACC CENTRAL	V.H	368	4	V.H	469	4	27%
EDUUUTA	KARLSRUHE UAC	V.H	310		V.H	439		42%
EDYYUTA	UAC MAASTRICHT	V.H	306	3	V.H	404	4	32%
EGTTTCT/	LONDON ACC CENTRAL	H	271	3	V.H	324	3	19%
LFMMCTA	MARSEILLE EAST + WES	H	216	2	V.H	311	3	44%
LFFFCTA	PARIS EAST	H	244	2	V.H	306	3	25%
LIRRCTA	ROMA ACC	H	236	2	V.H	303	2	28%
EDGGCTA	LANGEN ACC	H	239	4	V.H	301	4	26%
LTAACTA_	ANKARA ACC	M	171	1	H	299	2	75%
EDMMCTA	MUENCHEN ACC	H	222	4	H	261	4	17%
EGPXNEW	PRESTWICK ACC	H	215	2	H	258	3	20%
LOVVCTA	ACC WIEN	M	151	3	H	252	4	67%
LECMCTA	MADRID ACC (LECMACN+LEC	M	180	2	H	240	2	33%
LFBBCTA	BORDEAUX U/ACC	M	170	2	H	236	3	39%
LFRRCTA	BREST U/ACC	M	169	2	H	235	3	39%
LIPPCTA	PADOVA ACC	M	179	2	H	228	3	27%
LYBACTA	BEOGRADE ACC	M	153	2	H	218	3	43%
LFEECTA	REIMS U/ACC	M	171	3	H	218	3	27%
LRBBCTA	BUCURESTI ACC	M	183	1	H	215	1	17%
LECBCTA	BARCELONA ACC	M	152	2	H	213	3	40%
LHCCCTA	BUDAPEST ACC	M	163	2	H	207	2	27%
LSAZACC	ZUERICH ACC	M	157	4	H	203	4	30%
LDZOCTA	ZAGREB ACC	M	107	2	M	195	2	82%
LKAACTA	PRAGUE ACC	M	150	2	M	195	3	30%
LBSRCTA	SOFIA CONTROL	M	136	1	M	190	1	40%
EPWWCTA	WARSZAWA ACC	M	119	1	M	189	2	59%
LIMMCTA	MILANO ACC	M	164	3	M	187	3	14%
LSAGACC	GENEVE ACC	M	137	4	M	174	4	27%
EDWWCTA	BREMEN ACC	M	151	2	M	162	2	8%
LGGGCTA	ATHINAI CONTROL	M	99	1	M	152	1	53%
EHAACTA	AMSTERDAM ACC(245-)	M	130	3	M	145	4	12%
EKDKCTA	COPENHAGEN ACC EAST	M	124	1	M	142	2	15%
EBBUCTA	BRUSSELS CANAC	M	112	4	M	139	4	24%
LZBBCTA	BRATISLAVA ACC	M	96	2	M	134	2	39%
EISNCTA	SHANNON ACC	M	114	1	M	133	1	17%
ESMMCTA	MALMO ACC	M	113	1	M	131	1	16%
LIBBCTA	BRINDISI ACC	M	117	1	M	127	1	9%
LGMDCTA	MAKEDONIA CONTROL	M	83		M	126		52%
LJLACTA	LJUBLJANA ACC	M	76	2	M	119	3	57%
LECSCTA	SEVILLA ACC	M	79	1	M	108	2	37%
LPPCCTA	LISBON ACC/UAC	M	85	1	M	107	1	25%
ESOSCTA	STOCKHOLM ACC	M	105	1	M	105	1	0%
LECPCTA	ACC PALMA	M	92	2	M	99	2	8%
ENOSCTA	OSLO ATCC	M	95	2	M	97	2	3%
UKBVCTA	KIEV ACC	M	72	1	M	89	1	24%
EYVCCTA	VILNIUS ACC	M	77	1	M	87	1	13%
LCCCCTA	NICOSIA CONTROL	L	46	1	M	85	2	84%
UKFVCTA	SIMFEROPOL ACC	M	75	1	M	83	1	10%
UKLVCTA	L'VIV ACC	M	72	1	M	80	1	11%
LAAACTA	TIRANA ACC	M	56	1	M	79	1	41%
EVRRCTA	RIGA ACC	M	65	1	M	70	1	8%
LWSSCTA	ACC SKOPJE	M	59	1	M	70	1	18%
GCCCCTA	CANARIAS ACC	M	59	1	M	70	1	18%
EIDWCTA	DUBLIN ACC	M	52	2	M	65	3	26%
UKOVCTA	ODESSA ACC	M	59	1	M	62	1	5%
EETTCTA	TALLIN ACC	M	54	1	M	61	1	13%
EFESNEW	TAMPERE ACC	M	56	1	M	59	1	4%
ENSVCTA	STAVANGER ATCC	M	53	1	M	58	1	10%
ENBDCTA	BODO ACC	M	57	1	M	58	1	1%
LMMMCTA	MALTA ACC	L	39	1	L	42	1	7%
LUUUCTA	CHISINAU ACC	L	40	1	L	40	1	1%

Table 43: ACC categories and related performance data

Military ACCs

All military ANSP ACCs that are not integrated with civil ANSPs are within the geographical scope of the PCP. According to Eurocontrol data this comprises the following 11 States[13]: Austria, Armenia, Belgium, Bulgaria, Czech Republic, France, Ireland, Italy, Portugal, Romania, Slovakia, and Spain.

Other stakeholders

Individual airspace user AOC centers are expected to raise their capability through investments that for CBA purposes where estimated to affect only directly the flight planning system manufacturers (5 estimated for CBA purposes covering all civil airspace user business models). Investment needs have also been identified for the Network Manager.

D.4 AF # 4: Network Collaborative Management (Flow & NOP)

Network Collaborative Management (Flow & NOP) is intended to be applied on the entire European network. In this case, all 61 civil Air Traffic Control Centres of the EUROCONTROL Member States plus Estonia and 22 military Air Traffic Control Centres (corresponding to those eleven States where Civil / Military operations are not integrated) are concerned by the implementation.”

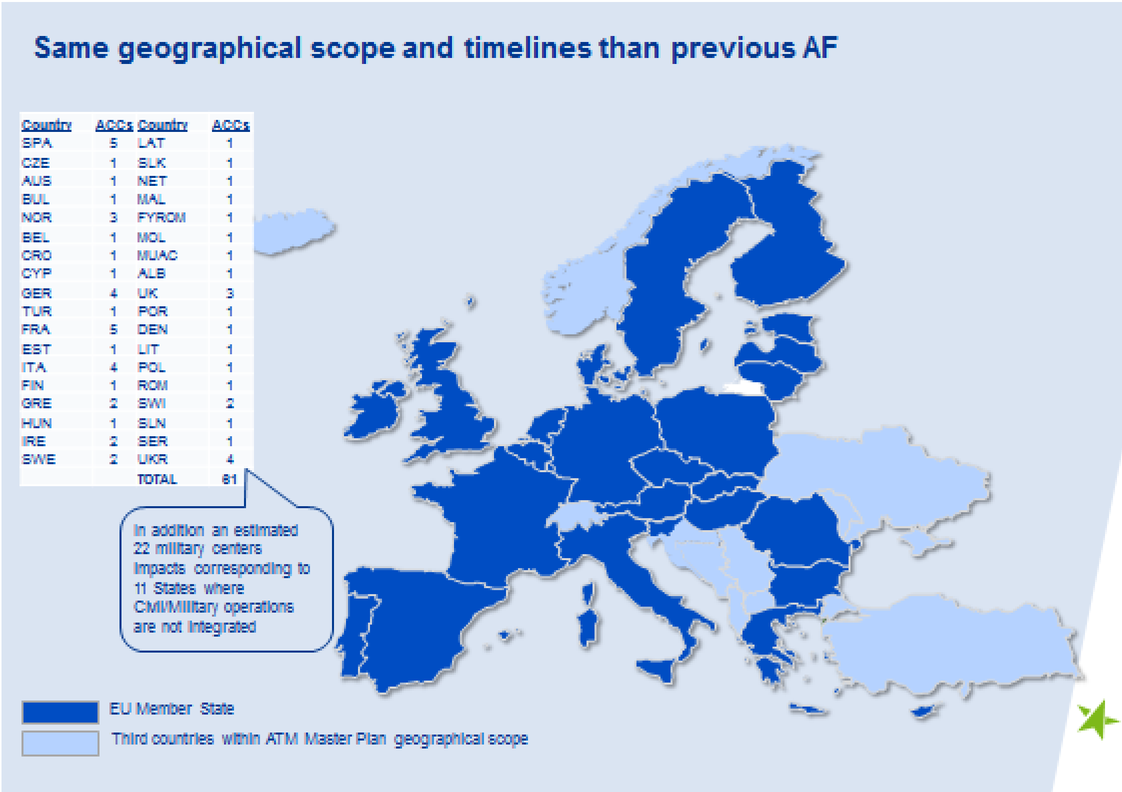


Figure 86: AF # 4 geographical scope of implementation

Civil ACCs

The list of concerned civil ACCs can be found in previous section (similar to AF 3).

Other stakeholders

The Network Manager is expected to invest to ensure the deployment of this AF.

[13] After coordination with EDA and for CBA purposes it was assumed 2 ACC unit for each of the 11 States

In addition, all categories of civil airports/TMAs are within the geographical scope of AF4 are expected to invest:

- Very High Capacity Needs (VHCN): TMAs with more than 100 movements by hour in peak hour (1% percentile)
- High Capacity Needs (H): TMAs with between 60-100 movements by hour in peak hour (1% percentile)
- Medium Capacity Needs (M): TMAs with between 30-60 movements by hour in peak hour (1% percentile)
- Low Capacity Needs (L): TMAs with less than 30 movements by hour in peak hour (1% percentile)

A comprehensive list of airports/TMAs and related performance data can be found in the tables below[14].

[14] The list provided contains information primarily for TMAs. A similar detailed categorization is available and was used for Airports. However for confidentiality reasons, this information cannot be disclosed for airport.

TMA	Code	2010		2019						
				Capacity Needs						
		Capacity Class	Capacity Needs	Capacity Class	With Const	Without Const	% of lost traffic per hour	Increase Cap Needs by % (2019 vs 2010)	TMA Type	Number of Airports
LONDON TMA TC	EGTTTCTA	VHCN	261,78	VHCN	338,98	340,82	0,54%	29,49%	TMA	> 1 AIRPORT
Langen ACC	EDGGACC	VHCN	231,29	VHCN	294,77	297,12	0,79%	27,45%	ACC-TMA	> 1 AIRPORT
PARIS TMA / ZDAP	LFFFACTA	VHCN	175,52	VHCN	228,97	229,57	0,26%	30,46%	TWR-TMA	> 1 AIRPORT
München ACC	EDMMACTA	VHCN	125,71	VHCN	156,91	158,21	0,82%	24,81%	ACC-TMA	> 1 AIRPORT
Bremen ACC	EDWWCTA	VHCN	128,40	VHCN	153,49	154,90	0,91%	19,54%	ACC-TMA	> 1 AIRPORT
ROMA TMA	ROMA TMA	VHCN	113,93	VHCN	147,42	147,72	0,21%	29,39%	ACC-TMA	> 1 AIRPORT
MILANO TMA	MILANO TMA	VHCN	103,75	VHCN	134,11	134,39	0,21%	29,26%	ACC-TMA	> 1 AIRPORT
MADRID TMA	LEMDTMA	HCN	99,72	VHCN	117,22	117,38	0,14%	17,54%	ACC-TMA	> 1 AIRPORT
PALMA TMA	LEPATMA	HCN	86,17	VHCN	106,18	106,71	0,50%	23,22%	TMA	> 1 AIRPORT
ARLANDA APPROACH	ESSATMA	HCN	86,40	VHCN	105,07	105,45	0,36%	21,60%	ACC-TMA	> 1 AIRPORT
OSLO TMA	ENOSTMA	HCN	77,87	VHCN	100,39	100,72	0,32%	28,91%	ACC-TMA	> 1 AIRPORT
BARCELONA TMA	LEBLTMA	HCN	77,78	HCN	96,34	96,48	0,15%	23,85%	ACC-TMA	> 1 AIRPORT
APP WIEN	LOWWTMA	HCN	69,97	HCN	92,06	92,66	0,65%	31,57%	TWR-TMA	> 1 AIRPORT
CANARIAS TMA	GCTMA	HCN	74,21	HCN	90,82	90,83	0,01%	22,39%	ACC-TMA	> 1 AIRPORT
COPENHAGEN APP	EKCHTMA	HCN	69,34	HCN	86,35	86,66	0,35%	24,53%	ACC-TMA	> 1 AIRPORT
ZUERICH APP	LSZHTMA	HCN	69,60	HCN	85,94	86,46	0,60%	23,48%	ACC-TMA	> 1 AIRPORT
APP BRUSSELS	EBBRTMA	HCN	64,09	HCN	82,37	82,94	0,69%	28,51%	TWR-TMA	> 1 AIRPORT
PADOVA TMA	PADOVA TMA	MCN	51,95	HCN	67,90	68,02	0,17%	30,70%	ACC-TMA	> 1 AIRPORT
HELSINKI APPROACH	EFHKTMA	MCN	51,09	HCN	66,41	66,61	0,31%	29,98%	TMA	> 1 AIRPORT
MANCHESTER APPROACH	EGCCTMA	MCN	49,23	HCN	62,00	62,25	0,39%	25,94%	ACC-TMA	> 1 AIRPORT
APP LYON	LFLLTMA	MCN	48,28	MCN	59,36	59,54	0,30%	22,96%	TWR-TMA	> 1 AIRPORT
GENEVE APP	LSGGTMA	MCN	46,55	MCN	59,26	59,45	0,31%	27,31%	ACC-TMA	> 1 AIRPORT
EIDW APP	EIDWCTA	MCN	40,56	MCN	59,20	59,28	0,13%	45,94%	TWR-TMA	1 AIRPORT
LISBOA APP	LPPTTMA	MCN	41,87	MCN	48,92	48,98	0,11%	16,83%	ACC-TMA	> 1 AIRPORT
BUCURESTI APPROACH	LROPTMA	LCN	27,37	MCN	48,66	49,36	1,41%	77,81%	TMA	> 1 AIRPORT
MALAGA TMA	LEMGTMA	MCN	36,05	MCN	45,91	45,92	0,02%	27,36%	ACC-TMA	1 AIRPORT
BUDAPEST APPROACH	LHBPTMA	MCN	30,26	MCN	44,36	44,58	0,49%	46,57%	TWR-TMA	1 AIRPORT
SIV TOULOUSE	LFBOTMA	MCN	36,22	MCN	42,42	42,45	0,08%	17,11%	TMA	> 1 AIRPORT
VALENCIA TMA	LEVCTMA	MCN	36,11	MCN	41,03	41,12	0,21%	13,62%	TMA	> 1 AIRPORT
APP MARSEILLE	LFMLTMA	MCN	30,89	MCN	39,40	39,44	0,11%	27,57%	TWR-TMA	> 1 AIRPORT
BIRMINGHAM APPROACH	EGBBTMA	LCN	28,26	MCN	38,22	38,34	0,33%	35,22%	TWR-TMA	> 1 AIRPORT
BERGEN/FLESLAND APP	ENBRTMA	MCN	30,47	MCN	36,56	36,62	0,17%	19,99%	TMA	> 1 AIRPORT
LIEGE APP	EBLGTMA	LCN	24,56	MCN	36,08	36,35	0,75%	46,87%	TWR-TMA	> 1 AIRPORT
JERSEY APPROACH	EGJJTMA	MCN	30,63	MCN	34,20	34,31	0,32%	11,65%	TWR-TMA	> 1 AIRPORT
BELFAST APPROACH	EGAATMA	LCN	27,46	MCN	34,00	34,04	0,10%	23,83%	TWR-TMA	> 1 AIRPORT
GOTEBORG APPROACH	ESGGTMA	LCN	28,32	MCN	33,27	33,47	0,58%	17,49%	TMA	> 1 AIRPORT
STAVANGER/SOLA	ENZVTMA	LCN	25,22	MCN	30,73	30,83	0,33%	21,85%	ACC-TMA	> 1 AIRPORT
BEOGRAD	LYBETMA	LCN	17,39	MCN	30,43	30,82	1,27%	74,99%	ACC-TMA	> 1 AIRPORT
OLBIA APP	OLBIA APP	LCN	22,00	LCN	29,87	29,89	0,09%	35,76%	TWR-TMA	1 AIRPORT
SEVILLA TMA	LEZLTMA	LCN	21,97	LCN	27,30	27,32	0,05%	24,30%	ACC-TMA	> 1 AIRPORT
FARO APP	LPFRTMA	LCN	21,20	LCN	26,85	26,97	0,43%	26,69%	TWR-TMA	> 1 AIRPORT
SOFIA APP	LBSFTMA	LCN	15,93	LCN	26,75	27,32	2,10%	67,90%	ACC-TMA	> 1 AIRPORT

TMA	Code	2010		2019						
				Capacity Needs						
		Capacity Class	Capacity Needs	Capacity Class	With Const	Without Const	% of lost traffic per hour	Increase Cap Needs by % (2019 vs 2010)	TMA Type	Number of Airports
APP BALE-MULHOUSE	LFSBTMA	LCN	21,83	LCN	26,09	26,35	0,98%	19,52%	TWR-TMA	> 1 AIRPORT
STRASBOURG APPROACH	LFSTTMA	LCN	22,64	LCN	25,53	25,71	0,71%	12,74%	TWR-TMA	> 1 AIRPORT
TIMISOARA APPROACH	LRTRTMA	LCN	13,53	LCN	25,13	25,19	0,27%	85,73%	TMA	> 1 AIRPORT
ZAGREB TMA	LDZATMA	LCN	15,79	LCN	24,78	24,93	0,60%	56,90%	TMA	> 1 AIRPORT
AREA OF RESP LOWS	LOWSTMA	LCN	18,32	LCN	24,06	24,18	0,50%	31,31%	TWR-TMA	> 1 AIRPORT
AQUITAINE SIV	LFBDTMA	LCN	20,22	LCN	22,97	22,98	0,03%	13,61%	TWR-TMA	> 1 AIRPORT
SPLIT TMA	LDSPTMA	LCN	15,93	LCN	22,62	22,63	0,05%	42,00%	TWR-TMA	> 1 AIRPORT
NANTES FIC	LFRSTMA	LCN	19,43	LCN	22,12	22,20	0,37%	13,88%	TWR-TMA	> 1 AIRPORT
VAERNES	ENVATMA	LCN	18,55	LCN	22,11	22,19	0,33%	19,19%	TMA	1 AIRPORT
PALERMO APP	PALERMO APP	LCN	15,84	LCN	21,85	21,85	0,01%	37,95%	TWR-TMA	1 AIRPORT
BILLUND APPROACH	EKBITMA	LCN	17,13	LCN	21,76	21,99	1,04%	27,04%	TWR-TMA	> 1 AIRPORT
BURGAS APP	LBBGTMA	LCN	11,16	LCN	19,96	20,01	0,22%	78,84%	TWR-TMA	> 1 AIRPORT
LIVERPOOL APPROACH	EGGPTMA	LCN	15,61	LCN	19,83	19,84	0,05%	27,04%	TWR-TMA	1 AIRPORT
MONTPELLIER FIC	LFMTTMA	LCN	17,02	LCN	19,71	19,72	0,01%	15,80%	TWR-TMA	> 1 AIRPORT
GALICIA TMA	LESTTMA	LCN	16,68	LCN	19,41	19,41	0,03%	16,35%	TMA	> 1 AIRPORT
PORTO APP	LPPRTMA	LCN	17,18	LCN	18,91	19,03	0,64%	10,05%	TWR-TMA	> 1 AIRPORT
LILLE FIC	LFQQTMA	LCN	15,67	LCN	18,30	18,32	0,13%	16,82%	TWR-TMA	> 1 AIRPORT
OSTGOTA APPROACH	ESSPTMA	LCN	12,08	LCN	18,24	18,27	0,17%	51,00%	TWR-TMA	>1 AIRPORT
BRINDISI TMA	BRINDISI TMA	LCN	15,69	LCN	18,19	18,20	0,05%	15,94%	ACC-TMA	> 1 AIRPORT
BODO TOWER	ENBOTMA	LCN	15,69	LCN	17,48	17,49	0,03%	11,44%	ACC-TMA	1 AIRPORT
DUBROVNIK TMA	LDDUTMA	LCN	11,90	LCN	17,40	17,44	0,23%	46,30%	TWR-TMA	1 AIRPORT
CLUJ APPROACH	LRCJTMA	LCN	9,89	LCN	17,14	17,27	0,74%	73,38%	TMA	> 1 AIRPORT
BRATISLAVA TMA	LZIBTMA	LCN	9,85	LCN	16,94	17,16	1,28%	71,97%	TWR-TMA	> 1 AIRPORT
AREA OF RESP LOWI	LOWITMA	LCN	13,60	LCN	16,90	17,00	0,63%	24,26%	TWR-TMA	> 1 AIRPORT
TALLIN APPROACH	EETNTMA	LCN	10,71	LCN	16,88	16,99	0,64%	57,60%	TWR-TMA	1 AIRPORT
BASTIA FIC	LFKBTMA	LCN	13,14	LCN	16,35	16,35	0,01%	24,46%	TWR-TMA	> 1 AIRPORT
BILBAO TMA	LEBBTMA	LCN	15,32	LCN	16,33	16,36	0,22%	6,56%	TWR-TMA	1 AIRPORT
TROMSO	ENTCTMA	LCN	13,23	LCN	16,03	16,04	0,07%	21,13%	TWR-TMA	1 AIRPORT
TIVAT	LYTVTMA	LCN	8,36	LCN	16,00	16,00	0,02%	91,49%	TWR-TMA	1 AIRPORT
GOSSELIES APP	EBCITMA	LCN	13,28	LCN	15,25	15,27	0,10%	14,90%	TWR-TMA	> 1 AIRPORT
FIRENZE APP	FIRENZE APP	LCN	12,33	LCN	15,21	15,22	0,04%	23,36%	TWR-TMA	1 AIRPORT
VARNA APP	LBWNTMA	LCN	8,21	LCN	14,58	14,70	0,78%	77,66%	TWR-TMA	> 1 AIRPORT
MADEIRA APP	LPMATMA	LCN	11,40	LCN	14,49	14,52	0,24%	27,08%	TWR-TMA	> 1 AIRPORT
EICK APP	EICKCTA	LCN	9,16	LCN	14,11	14,13	0,09%	54,05%	TWR-TMA	1 AIRPORT
ALESUND TOWER	ENALTMA	LCN	11,26	LCN	13,89	13,94	0,30%	23,35%	TWR-TMA	> 1 AIRPORT
CLERMONT-FERRAND FIC	LFLCTMA	LCN	11,18	LCN	13,71	13,71	0,02%	22,56%	TWR-TMA	> 1 AIRPORT
BERN APP	LSZBTMA	LCN	10,44	LCN	13,43	13,44	0,06%	28,69%	TWR-TMA	> 1 AIRPORT
MALMO APPROACH	ESMSTMA	LCN	10,18	LCN	13,36	13,42	0,46%	31,21%	TWR-TMA	1 AIRPORT
CARDIFF APPROACH	EGFFTMA	LCN	9,01	LCN	12,99	13,04	0,38%	44,20%	TWR-TMA	>1 AIRPORT
TMA GRAZ	LOWGTMA	LCN	9,90	LCN	12,81	12,93	0,91%	29,41%	TWR-TMA	> 1 AIRPORT
PAU PYRENEES SIV	LFBPTMA	LCN	10,38	LCN	12,57	12,57	0,01%	21,09%	TWR-TMA	> 1 AIRPORT

TMA	Code	2010		2019						
				Capacity Needs						
		Capacity Class	Capacity Needs	Capacity Class	With Const	Without Const	% of lost traffic per hour	Increase Cap Needs by % (2019 vs 2010)	TMA Type	Number of Airports
AREA OF RESP LINZ	LOWLTMA	LCN	9,66	LCN	12,49	12,66	1,31%	29,36%	TWR-TMA	> 1 AIRPORT
APP SION	LSGSTMA	LCN	8,03	LCN	12,42	12,43	0,14%	54,55%	TWR-TMA	1 AIRPORT
RENNES FIC	LFRNTMA	LCN	9,61	LCN	12,01	12,01	0,05%	24,96%	TWR-TMA	> 1 AIRPORT
HELGELAND TMA	HELGELAND TMA	LCN	11,69	LCN	11,99	11,99	0,00%	2,57%	ACC-TMA	> 1 AIRPORT
SEINE APPROACH	LFPMTMA	LCN	9,37	LCN	11,81	11,81	0,05%	26,05%	TWR-TMA	> 1 AIRPORT
DEAUVILLE FIC	LFRGTMA	LCN	8,66	LCN	11,33	11,34	0,05%	30,91%	TWR-TMA	> 1 AIRPORT
JONKOPING/AXAMO	ESGJTMA	LCN	8,90	LCN	11,02	11,05	0,24%	23,86%	TWR-TMA	1 AIRPORT
APP BREST (IROISE)	LFRBTMA	LCN	9,01	LCN	10,73	10,74	0,12%	19,02%	TWR-TMA	> 1 AIRPORT
KALLAX APPRAOCH	ESPATMA	LCN	7,80	LCN	10,55	10,59	0,43%	35,14%	TMA	> 1 AIRPORT
AALBORG APP	EKYTTMA	LCN	8,52	LCN	10,29	10,33	0,45%	20,78%	TWR-TMA	> 1 AIRPORT
PULA TMA	LDPLTMA	LCN	5,97	LCN	10,22	10,23	0,03%	71,37%	TWR-TMA	> 1 AIRPORT
PODGORICA	LYPGTMA	LCN	6,95	LCN	10,01	10,02	0,08%	43,98%	TWR-TMA	> 1 AIRPORT
TMA KLAGENFURT	LOWKTMA	LCN	7,34	LCN	9,98	10,00	0,12%	35,93%	TWR-TMA	> 1 AIRPORT
ZADAR TMA	LDZDTMA	LCN	5,47	LCN	9,90	9,91	0,03%	81,00%	TWR-TMA	1 AIRPORT
ZARAGOZA TMA	LEZGTMA	LCN	7,24	LCN	9,84	9,85	0,07%	35,91%	TMA	> 1 AIRPORT
KJEVIK TOWER	ENCNTMA	LCN	7,47	LCN	9,58	9,59	0,11%	28,27%	TWR-TMA	1 AIRPORT
KVERNBERGET TOWER	ENKBTMA	LCN	7,47	LCN	9,23	9,24	0,01%	23,60%	TWR-TMA	1 AIRPORT
POITIERS SIV	LFBITMA	LCN	8,02	LCN	9,21	9,21	0,03%	14,80%	TWR-TMA	> 1 AIRPORT
VISBY TOWER	ESSVTMA	LCN	8,02	LCN	9,13	9,13	0,05%	13,77%	TMA	1 AIRPORT
LIMOGES SIV	LFBLTMA	LCN	8,23	LCN	9,09	9,10	0,02%	10,51%	TWR-TMA	> 1 AIRPORT
LAMEZIA APP	LAMEZIA APP	LCN	7,83	LCN	9,09	9,09	0,03%	16,13%	TWR-TMA	1 AIRPORT
BIARRITZ SIV	LFBZTMA	LCN	7,03	LCN	9,09	9,09	0,03%	29,22%	TWR-TMA	1 AIRPORT
TURKU	EFTUTMA	LCN	6,25	LCN	8,72	8,72	0,00%	39,50%	TWR-TMA	1 AIRPORT
PIRKKALA APPROACH	EFTPTMA	LCN	6,02	LCN	8,72	8,72	0,01%	44,81%	TWR-TMA	1 AIRPORT
AARHUS APP	EKAHTMA	LCN	6,55	LCN	8,51	8,52	0,04%	29,95%	TWR-TMA	> 1 AIRPORT
EVENES TOWER	ENEVTMA	LCN	7,21	LCN	8,45	8,46	0,19%	17,19%	TWR-TMA	> 1 AIRPORT
SANTANDER TMA	LEXJTMA	LCN	6,75	LCN	8,38	8,38	0,01%	24,24%	TWR-TMA	1 AIRPORT
LOFOTEN TMA	LOFOTEN TMA	LCN	7,70	LCN	8,35	8,35	0,00%	8,48%	ACC-TMA	> 1 AIRPORT
PRISTINA	LYPRTMA	LCN	3,28	LCN	8,02	8,40	4,50%	144,79%	TWR-TMA	> 1 AIRPORT
RODEZ FIC	LFCRTMA	LCN	7,13	LCN	7,95	7,95	0,00%	11,59%	TWR-TMA	> 1 AIRPORT
KOSICE TMA	LZKZTMA	LCN	4,74	LCN	7,94	8,00	0,81%	67,63%	TWR-TMA	1 AIRPORT
VAASA TOWER	EFVATMA	LCN	6,23	LCN	7,89	7,90	0,07%	26,65%	TWR-TMA	1 AIRPORT
APP OOSTENDE	EBOSTMA	LCN	6,09	LCN	7,84	7,91	0,81%	28,76%	TWR-TMA	> 1 AIRPORT
KIRKENES TOWER	ENKRTMA	LCN	6,30	LCN	7,81	7,81	0,00%	23,99%	TWR-TMA	> 1 AIRPORT
KITTILÄ APPROACH	EFKTTMA	LCN	4,84	LCN	7,38	7,38	0,00%	52,55%	TWR-TMA	1 AIRPORT
SKRYDSTRUP APP	EKSPTMA	LCN	4,80	LCN	7,22	7,22	0,00%	50,24%	TWR-TMA	> 1 AIRPORT
OULU TOWER	EFOUTMA	LCN	6,11	LCN	7,20	7,23	0,33%	17,80%	TWR-TMA	1 AIRPORT
RIJEKA TMA	LDRITMA	LCN	3,25	LCN	7,11	7,11	0,03%	118,54%	TWR-TMA	> 1 AIRPORT
ANGELHOLM APP	ESTATMA	LCN	5,62	LCN	6,58	6,58	0,02%	17,09%	TWR-TMA	1 AIRPORT
ALMERIA TMA	LEAMTMA	LCN	6,40	LCN	6,52	6,52	0,02%	1,80%	ACC-TMA	1 AIRPORT
HAMMERFEST TOWER	ENHFTMA	LCN	5,98	LCN	6,46	6,46	0,00%	8,04%	ACC-TMA	> 1 AIRPORT
CONSTANTA APPROACH	LRCKTMA	LCN	3,47	LCN	6,39	6,41	0,25%	84,21%	TMA	> 1 AIRPORT
ALTA TOWER	ENATTMA	LCN	5,28	LCN	5,95	5,95	0,00%	12,82%	TWR-TMA	1 AIRPORT
POPRAD TMA	LZTTTMA	LCN	3,22	LCN	5,92	5,92	0,00%	84,03%	TWR-TMA	1 AIRPORT

TMA	Code	2010		2019						
				Capacity Needs						
		Capacity Class	Capacity Needs	Capacity Class	With Const	Without Const	% of lost traffic per hour	Increase Cap Needs by % (2019 vs 2010)	TMA Type	Number of Airports
HALMSTAD APP	ESMTTMA	LCN	4,31	LCN	5,06	5,06	0,00%	17,42%	TWR-TMA	1 AIRPORT
VAXJO-KRONOBERG	ESMXTMA	LCN	4,74	LCN	5,04	5,04	0,00%	6,36%	TWR-TMA	1 AIRPORT
RONNEBY APPROACH	ESDFTMA	LCN	4,38	LCN	5,02	5,02	0,00%	14,69%	TMA	1 AIRPORT
KARUP APP	EKKATMA	LCN	4,92	LCN	4,99	4,99	0,01%	1,45%	TWR-TMA	> 1 AIRPORT
BORLANGE TOWER	ESSDTMA	LCN	3,51	LCN	4,99	5,00	0,25%	42,32%	TWR-TMA	1 AIRPORT
ZILINA TMA	LZZITMA	LCN	2,69	LCN	4,92	4,92	0,00%	82,89%	TWR-TMA	1 AIRPORT
KUOPIO APPROACH	EFKUTMA	LCN	4,16	LCN	4,68	4,68	0,08%	12,39%	TWR-TMA	1 AIRPORT
JYVASKYLA APPROACH	EFJYTMA	LCN	3,39	LCN	4,58	4,58	0,08%	34,93%	TWR-TMA	1 AIRPORT
KALMAR APPROACH	ESMQTMA	LCN	4,36	LCN	4,13	4,13	0,02%	-5,28%	TWR-TMA	1 AIRPORT
ROVANIEMI APPROACH	EFROTMA	LCN	3,53	LCN	4,10	4,10	0,05%	16,12%	TWR-TMA	1 AIRPORT
PORI APPROACH	EFPOTMA	LCN	3,53	LCN	4,10	4,10	0,09%	16,12%	TWR-TMA	1 AIRPORT
RONNE TMA	EKRNTMA	LCN	4,02	LCN	3,99	4,00	0,09%	-0,78%	TWR-TMA	> 1 AIRPORT
ORNSKOLDSVIK APPROACH	ESNOTMA	LCN	3,14	LCN	3,79	3,80	0,29%	20,71%	TWR-TMA	1 AIRPORT
ANDOYA TOWER	ENANTMA	LCN	3,15	LCN	3,60	3,60	0,00%	14,39%	TWR-TMA	1 AIRPORT
IVALO TOWER	EFIVTMA	LCN	2,38	LCN	3,55	3,55	0,00%	49,22%	TWR-TMA	1 AIRPORT
KRISTIANSTAD APP	ESMKTMA	LCN	2,84	LCN	3,44	3,44	0,00%	21,08%	TWR-TMA	1 AIRPORT
BANAK TOWER	ENNATMA	LCN	3,05	LCN	3,40	3,40	0,00%	11,67%	TWR-TMA	1 AIRPORT
BARDUFOSS TOWER	ENDUTMA	LCN	2,76	LCN	3,12	3,12	0,01%	13,22%	TWR-TMA	1 AIRPORT
KOKKOLA APPROACH	EFKKTMA	LCN	2,62	LCN	3,09	3,09	0,07%	17,88%	TWR-TMA	1 AIRPORT
OSIJEK TMA	LDOSTMA	LCN	1,82	LCN	3,04	3,04	0,04%	67,43%	TWR-TMA	> 1 AIRPORT
KUUSAMO APPROACH	EFKSTMA	LCN	2,56	LCN	3,03	3,03	0,00%	18,14%	TWR-TMA	1 AIRPORT
ARVIDSJAUR	ESNXTMA	LCN	2,43	LCN	2,97	2,97	0,00%	22,47%	TWR-TMA	1 AIRPORT
JOENSUU APPROACH	EFJOTMA	LCN	2,56	LCN	2,80	2,81	0,12%	9,33%	TWR-TMA	1 AIRPORT
PIESTANY TMA	LZPPTMA	LCN	2,17	LCN	2,70	2,70	0,00%	24,43%	TWR-TMA	1 AIRPORT
VRSAC	LYVRTMA	LCN	1,01	LCN	2,67	2,67	0,00%	164,32%	TWR-TMA	1 AIRPORT
KURESSAARE TWR	EEKETMA	LCN	2,09	LCN	2,65	2,65	0,00%	26,71%	TWR-TMA	1 AIRPORT
ROROS TOWER	ENROTMA	LCN	2,09	LCN	2,59	2,59	0,00%	23,90%	TWR-TMA	1 AIRPORT
KEMI-TORNIO TOWER	EFKETMA	LCN	2,34	LCN	2,39	2,39	0,03%	1,78%	TWR-TMA	1 AIRPORT
LAPPEENRANTA TOWER	EFLPTMA	LCN	2,54	LCN	2,34	2,35	0,13%	-7,72%	TWR-TMA	1 AIRPORT
LJUNGBYHED TMA	ESTLTMA	LCN	2,93	LCN	2,21	2,21	0,00%	-24,65%	TWR-TMA	1 AIRPORT
BATAJNICA	LYBTTMA	LCN	0,92	LCN	2,00	2,00	0,04%	117,04%	TWR-TMA	> 1 AIRPORT
MALACKY MIL TMA	LZMCTMA	LCN	2,15	LCN	1,56	1,56	0,00%	-27,25%	TWR-TMA	> 1 AIRPORT
SLIAC TMA	LZSLTMA	LCN	1,01	LCN	1,49	1,49	0,00%	47,72%	TWR-TMA	1 AIRPORT
HALLI APPROACH	EFHATMA	LCN	0,74	LCN	1,20	1,20	0,00%	63,03%	TWR-TMA	> 1 AIRPORT
NIS	LYNITMA	LCN	1,38	LCN	1,05	1,06	1,13%	-24,23%	TWR-TMA	> 1 AIRPORT
VIDSEL APPROACH	ESPETMA	LCN	1,07	LCN	0,88	0,88	0,00%	-17,34%	TWR-TMA	1 AIRPORT
KAUHAVA APPROACH	EFKATMA	LCN	0,43	LCN	0,48	0,48	0,00%	13,23%	TWR-TMA	1 AIRPORT
UTTI APPROACH	EFUTTMA	LCN	0,30	LCN	0,28	0,28	0,00%	-5,00%	TWR-TMA	1 AIRPORT
KRALJEVO	LYKVTMA	LCN	0,05	LCN	0,03	0,03	0,00%	-37,20%	TWR-TMA	> 1 AIRPORT

Table 44: TMA/Airport categories and related performance data

D.5 AF # 5: iSWIM functionality

iSWIM functionality is intended to be applied on the entire European network.

The provision of flow management and aeronautical / airspace data is to be organised centrally. It will be ensured through the concept of centralised services currently being developed.

MET, flight object and trajectory data may also be candidates for "non-local" service provision. This part of the proposal is to be addressed under the extension of the SESAR JU's mandate received on 18 March 2013. However for the PCP the following scope has been defined:

	ANSPs	Airports	Military	Airspace Users
Flow Management & Flight Planning	All very high and high capacity need centers, TMAs and Towers	All 25 airports identified in the previous sections for AF1 and 2	N/A	AOC system providers
Aeronautical and Airspace	All very high and high capacity need centers, TMAs and Towers	All 25 airports identified in the previous sections for AF1 and 2	All centers in the 11 States that have non-integrated air navigation service provision	AOC system providers
Meteo	All very high and high capacity need centers, TMAs and Towers	All 25 airports identified in the previous sections for AF1 and 2	All centers in the 11 States that have non-integrated air navigation service provision	AOC system providers
Flight Object	All very high and high capacity need centers & TMAs	N/A	All centers in the 11 States that have non-integrated air navigation service provision	N/A

Table 45: AF # 5 geographical scope break-down

Note: Towers at civil airports (categories of civil airports/TMAs as described in previous section) are exclusively concerned by the 3 services highlighted above. The Network Manager is also expected to invest to ensure the deployment of this AF (see details in the CBA analysis).

Furthermore, the underlying MET infrastructure required to support PCP requirements call for the development, adaptation and harmonisation of existing MET capabilities. Specifically, investments would be expected to take place at the following levels:

ATM Operational User Environment Prototype			Associated MET Infrastructure Capability
LOCAL	Sub-Regional	Network	
√	√	√	Radar composite for 3-D convection
√	√	√	Nowcasting of convection
√	√	√	Super-ensemble mesoscale forecast of convection
√	√		Diagnostic and forecasting of icing
	√	√	Forecasting of clear-air-turbulence (CAT)
√			Forecast of impact of winter condition at airports
√		√	Network capacity reductions due to weather across Europe
	√	√	MET support to 4D Trajectory calculation
√	√		Impact of new sensors including: o ModeS observations of wind and temperature
Assessment of benefits for the 3 OUEs			o E-AMDAR observation of humidity

Table 46: MET geographical scope break-down

The number of investment instances for MET Service Providers included in the CBA analysis can be found in the table below:

ATM Functionality	MET Service Providers		
	Local coverage	National coverage	Regional coverage
AF-05 iSWIM functionality			
Flow Management & FPL			
Aeronautical & Airspace			
Meteo	**25**	**44**	**1**
SWIM Infrastructure & Administration			
Flight Object			

Table 47: MET investments break-down

D.6 AF # 6: Initial Trajectory Information Sharing (towards i4D)

This AF shall be implemented across the entire European ground infrastructure network. That is to say, all 61 civil Air Traffic Control Centres of the EUROCONTROL Member (as identified in previous sections). In addition 20% of the aircraft operating within European Airspace are sought to equip on a voluntary basis to reach a first critical mass within the scope of the PCP (corresponding to 50% of flights operating in Europe).

APPENDIX E STANDARDISATION AND REGULATORY ROADMAP AT ATM MP LEVEL

E.1 AF # 1:

Regulatory needs

The following AF # 1 regulatory needs are not covered by the work foreseen in the regulatory roadmap edition 2013, and should be considered for the next update of the regulatory roadmap:

- EASA AMC on PBN Operational Approvals

The need for a PBN implementing rule was already contained in the regulatory roadmap edition 2012.

The rest of the AF # 1 regulatory needs are covered by the work foreseen in the regulatory roadmap edition 2013, as shown in the following extract of the EASA developments of the regulatory activities:

Title	Description	Date at which the certification material is needed (2 Years before A/C EN IOC Date)	In support to A/C Enabler	Standardisation Enabler Code	Standardisation Enabler Title
AMC for Advanced RNP	Identification of the sub-set of ED-75/DO-236B functions that will be required	2016	A/C-04a A/C-05a	BTNAV-0207	Update of ICAO PANS-ATM for 3D navigation and Initial 4D Nota: Required Functions (e.g. FRT, Radius-to-Fix, etc.) are already standardised in Existing ED-75/DO-236B.

Table 48: AF # 1 regulatory needs already identified in the European ATM Master Plan

Standardization needs

The following AF # 1 standardisation needs are not covered by the work foreseen in the standardization roadmap edition 2013, and should be considered for the next update of the standardization roadmap:

- EUROCAE Standard on AMAN Extended Horizon and Multiple Airports

The rest of the standardisation needs fully or partly related to AF # 1 are covered by the work foreseen in the standardisation roadmap edition 2013:

Code	Title	Description	Comment	Publication
BTNAV-0205	Update of ICAO Performance Based Navigation (PBN) manual for Enhanced Controlled Time of Arrival (CTA)	Update ICAO Doc 9613 to address 4D navigation performance for single time constraint	STEP 1 – No Plan	2014

Table 49: AF # 1 standardization needs already identified in the European ATM Master Plan

E.2 AF # 2:

Regulatory needs

The following AF # 2 regulatory needs are not covered by the work foreseen in the regulatory roadmap edition 2013, and should be considered for the next update of the regulatory roadmap:

- EASA AMC on Time Based Wake Vortex Separation
- EASA AMC on AMAN/DMAN ground systems and constituents
- EC Community Specification on Airport CDM
- EC Community Specification on Time Based Separation tools

The rest of the AF # 2 regulatory needs are covered by the work foreseen in the regulatory roadmap edition 2013, as shown in the following extract of the Commission development of regulatory activities:

Title	Description	Publication Date	Associated Regulatory Activity	Remark
ASMGCS Level 3 & 4	Community Specifications for A-SMGCS Level 3 and 4	2017	Safety target in performance scheme Regulation	The proposed regulatory activity is not directly related to deployment of systems, constituents and procedures. Therefore, the CS date has been set to 2 years after the currently expected availability of the corresponding EUROCAE standard (enabler ASMGCS-0201).

Table 50: AF # 2 regulatory needs already identified in the European ATM Master Plan

Standardization needs

The following AF # 2 standardisation needs are not covered by the work foreseen in the standardisation roadmap edition 2013, and should be considered for the next update of the standardisation roadmap:

- ICAO amendment of Doc 4444 on Distance based wake turbulence radar separations
- EUROCAE Standard on Time Based Separation tools performance specifications
- EUROCAE Standard on AMAN
- EUROCAE Standard on A-SMGCS level 2
- EUROCAE Standard on A-SMGCS levels 3, 4 including SMAN
- EUROCAE Standard on Airport CDM

The rest of the AF # 2 standardisation needs are covered by the work foreseen in the standardisation roadmap edition 2013, as shown in the following extract of the closed standardisation activities:

Code	Title	Description	Comment	Publication
-	Data Exchange specification for Aerodrome Mapping Database	EUROCAE ED-99c and ED-119b	STEP 1 – No Done	2012

Table 51: AF # 2 standardization needs already identified in the European ATM Master Plan

E.3 AF # 5:

Regulatory needs

None.

Standardization needs

The following AF # 5 standardisation needs are not covered by the work foreseen in the standardisation roadmap edition 2013, and should be considered for the next update of the standardisation roadmap:

- SWIM Registry
- SWIM profile definition
- ICAO FIXM including Flight Object related services payload

Remaining AF # 5 standardisation needs are covered by the work foreseen in the standardisation roadmap edition 2013, as shown in the following extract of the closed standardisation activities:

Code	Title	Description	Comment	Publication
GGSWIM-	ATM	ATM enhanced with a	STEP 1 –	2016

06a	Information Reference Model (AIRM) extended with the Common Flight Object for Step1 (ground systems)	Common Flight Object - a complex data structure that contains full information about all parameters concerning a flight and which is made available to all ground systems (via the federative sharing network) that process information about the flight and keep it updated throughout the flight lifecycle.	Planned Based on ED-133	
SWIM-22	Aeronautical Information (based on AIXM) Services, Protocol and QoS	Develop standard for Aeronautical Information, Services and QoS based on the AIXM Structures for global applicability in ICAO Annex 15		2016
FCM-04	Update ED-133 for ATC to ATC and to NM flight data exchange following validation results	WG 59 Flight object ATSU/ATSU and ATSU/NM	STEP 1 - Planned	2015
SWIM-17	New Standard for Ground-Ground flight data exchange from ATC to non-ATC		The FO sharing with other entities (airports/Airlines) could lead to another type of service (e.g. web service at NMF level): to be further clarified	TBC
SWIM-14	Adapt Standard for AIMS - Exchanging Airspace Data, Protocol and Formats	Adapt/extend AIXM standard to cope with dynamic airspace data	STEP 1 - Planned	2013

AIS/M-07-1	Update of ICAO SARPs for ground sharing of Weather Data	* METCE by WMO as a global model; * WXXM by ICAO for today's messages (METAR, SPECI, TAF, SIGMET).	STEP 1 - On-going	2014

Table 52: AF # 5 standardization needs already identified in the European ATM Master Plan

E.4 AF # 6:

Regulatory needs

The following AF # 6 regulatory needs are not covered by the work foreseen in the regulatory roadmap edition 2013, and should be considered for the next update of the regulatory roadmap:

- EASA AMC on Data Link Operations
- EC Community Specification on VDL2

Remaining AF # 6 regulatory needs are covered by the work foreseen in the regulatory roadmap edition 2013, as shown in the following extract of the Commission development of regulatory activities:

Title	Description	Publication Date	Associated Regulatory Activity	Remark
DLS II	Development of material to serve as means of compliance to the provisions in the future Revision of EC29/2009 laying down requirements on data link services (DLS IR), to support Initial 4D applications and datalink extension to Airport Services.	2017	DLS II	The development and publication of associated MoC for regulations typically takes around two years to complete. Part of the certification baseline may be available before 2017

Table 53: AF # 6 regulatory needs already identified in the European ATM Master Plan (EC)

As well as in the following extract of the EASA development of regulatory activities:

Title	Description	Date at which the certification material is needed (2 Years before A/C EN IOC Date)	In support to A/C Enabler	Standardisation Enabler Code	Standardisation Enabler Title

AMC for Initial 4D	Extension of the EASA responsibility to the regulation of Air Traffic Management and Air Navigation Services (ATM/ANS) is expected in the next years. New IR is due to be published during 2013. EASA will adopt the corresponding CS/AMC during 2014 (iaw EASA rulemaking programme 2010-2015).	2014	A/C-11; A/C-31a4; A/C-37;	BTNAV-0207 BTNAV-XXXX	- Update of ICAO PANS-ATM for 3D navigation and Initial 4D - Update of ED-75 / DO-236
AMC for Use of PM CPDLC in Approach	Work to be performed with WG 78/SC214 results.	2014	A/C-31a2	AGDLS-ATC-AC-14a AGDLS-ATC-AC-15a AGDLS-ATC-AC-12a	New SPR for CPDLC approach messages New Interop for use of CPDLC in approach ICAO PANS-ATM Doc 4444 for new continental needs
AMCs for ADS-B-RAD, -APT	Counterpart of AMC 20-24 (ADS-B-NRA), based on ED-126	2013	A/C-48a	ADSB-0102	ED-102A/DO-260B (+ ED-161 SPR and Interop for ADS-B-RAD, ED-163 SPR and Interop for ADS-B-APT)

Table 54: AF # 6 regulatory needs already identified in the European ATM Master Plan (EASA)

Finally, the Commission is also invited to consider an Implementing Rule to secure the timely implementation of the ground related investments of the air-ground trajectory sharing.

Standardization needs

All needed AF # 6 standardisation needs are covered by the work foreseen in the standardisation roadmap edition 2013, as shown in the following extract of the closed standardisation activities:

Code	Title	Description	Comment	Publication
-	Mix of ATN B1 and ATN B2+	WG78/SC214	STEP 1 - On-going	2014
-	Mix of ATN B2 and FANS-1/A+	WG78/SC214	STEP 1 - On-going	2014
AGDLS-ATC-AC-12a	Update ICAO PANS-ATM Doc 4444 for optimised CPDLC message set including oceanic and new continental needs		STEP 1 - Planned	2015
BTNAV-0216	Update of ED-75/ DO-236 to support Initial 4D navigation capabilities	under EUROCAE WG-85 Standard on which will rely Initial 4D AMC	STEP 1 - On-going	2014

Table 55: AF # 6 standardization needs already identified in the European ATM Master Plan

APPENDIX F LIST OF ABBREVIATIONS

ABBREVIATION	DESCRIPTION
A/C	Aircraft
A/G	Air Ground
ACC	Area Control Centre
A-CCD	Advanced Continuous Climb Departure
A-CDM	Airport-Collaborative Decision Making
ACI	Airport Council International
AD	Aerodrome
ADR	Airspace Data Repository
ADS	Automatic Dependent Surveillance
ADSB	Automatic Dependent Surveillance Broadcast
ADS-B-APT	Automatic Dependent Surveillance Broadcast for Airport surface surveillance
ADS-B-NRA	Automatic Dependent Surveillance Broadcast in Non Radar Airspace
ADS-B-RAD	Automatic Dependent Surveillance Broadcast in Radar Airspace
ADS-C	Automatic Dependent Surveillance - Contract
AEA	Association of European Airlines
AF	ATFM Functionality
AFUA	Advanced Flexible use of Airspace
AGDL	Air Ground Data Link
AGDLS	Air Ground Data Link Server
AIM	Aeronautical Information Management
AIMS	Aeronautical Information Management System
AIP	Aeronautical Information Publication
AIRM	Aeronautical Information Reference Model
AIS	Aeronautical Information Services
AIXM	Aeronautical Information Exchange Model
AMAN	Arrival Manager
AMC	Airspace Management Cell
AMHS	Aeronautical Message Handling System
ANS	Air Navigation Service
ANSP	Air Navigation Service Provider
AOC	Airline Operational Control Centre
AOP	Airport Operations Plan
APCH	Approach
APOC	Airport Operations Centre
APT	Airport
APV	Approach Procedure with Vertical guidance
APW	Area Proximity Warning
ARES	Airspace Restricted
ARN	ATS Trunk Route Network

ASBU	Aviation System Block Upgrade
ASM	Airspace Management
ASMGCS	Advanced Surface Movement Ground Control System
AT	Aircraft Type
ATC	Air Traffic Control
ATCC	Air Traffic Control Centre
ATCEUC	Air Traffic Controllers European Unions Coordination
ATCO	Air Traffic Controller
ATFCM	Air Traffic Flow and Capacity Management
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ATN	Aeronautical Telecommunication Network
ATS	Air Traffic Services
ATSU	Air Traffic Services Unit
AU	Airspace User
AUP	Airspace Use Plan
B2B	Business-to-Business
Baro-VNAV	Barometric Vertical Navigation
BEBS	Best Efficiency Best Served
CACD	CFMU Airspace and Capacity Database
CANSO	Civil Air Navigation Services Organisation
CAPEX	Capital Expenditures
CASA	Computer Assisted Slot Allocation
CBA	Cost Benefit Analysis
CCD	Continuous Climb Departure
CDA	Continuous Descent Arrival
CDG	Roissy Charles de Gaulle Airport (LFPG)
CDM	Collaborative Decision Making
CDO	Continuous Descent Operations
CDR	Conditional Route
CDT	Conflict Detection Tools
CER	Certified Emissions Reduction
CFMU	Central Flow Management Unit
CFSP	Computerised flight plan service provider
CHMI	CFMU Human Machine Interface
CM	Configuration Management
CO2	Carbon Dioxide
CORA	Conflict Resolution Assistant
COTR	Co-ordination and Transfer
COTS	Commercial Off-the-Shelf
CP	Common Project
CPDLC	Controller/Pilot Datalink Communication
CS	Certification Specifications
CS/AMC	Certification Specifications/ACCEPTABLE MEANS OF COMPLIANCE

CTA	Controlled Time of Arrival
CTM	Cooperative Traffic Management
CTO	Controlled Time Over
CTOT	Calculated Take-Off Time
CWP	Controller Working Position
D	Danger Area
DCB	Demand and Capacity Balancing
DCT	Direct Route
DG	Directorate General
DLS	Data Link Services
DMAN	Departure Manager
DST	Decision Support Tool
EAD	European AIS Database
E-AMAN	Extended Arrival Manager
EASA	European Aviation Safety Agency
E-ATFM	Enhanced Air Traffic Flow management
EATMN	European Air Traffic management network
EBAA	European Business Aviation Association
EC	European Commission
ECA	European Cockpit Association
ECAC	European Civil Aviation Conference
EDA	European Defence Agency
EESC	European Economic and Social Committee
ELFAA	European Low Fares Airline Association
EN	Entry Node
ENR	En Route
EPP	Extended Projected Profile
ESSIP	European Single Sky Implementation Plan
ETA	Estimated Time of Arrival
ETFMS	Enhanced Tactical Flow Management System
ETO	Estimated Time Over
ETS	European Telecommunications Standards
ETSI	European Telecommunications Standards Institute
EU	European Union
EUA	EU Emission Allowance
EUROCAE	European Organisation for Civil Aviation Equipment
F/WOC	Flight/Wing Operations Centre
FAA	Federal Aviation Administration (USA)
FAB	Functional Airspace Block
FANS	Future Air Navigation System
FCFS	First Come First Serve
FCM	Flow and capacity management
FDP	Flight Data Processing
FDPS	Flight Data Processing System

FIR	Flight Information Region
FIXM	Flight Information Exchange Model
FL	Flight Level
FMP	Flow Management Position
FMS	Flight Management System
FMTP	Flight Message Transfer Protocol
FO	Flight Object
FOC	Flight Operations centre
FOC/WOC	Flight Operations Centre/Wing Operations Centre
FP	Framework Programme
FPL	Flight Plan message (ICAO format)
FRA	Free Route Airspace
FUA	Flexible Use of Airspace
G	Ground
GAT	General Air Traffic
GGSWIM	Ground Ground SWIM
GNSS	Global Navigation Satellite System
HMI	Human-Machine Interface
HW	Hardware
I4D	Initial 4 Dimensions
IACA	International Air Carriers Association
IAOPA	International Council of Aircraft Owner and Pilot Association
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IDSG	Interim Deployment Steering Group
IEA	International Energy Agency
IFATCA	International Federation of Air Traffic Controllers Associations
IFATSEA	International Federation of Air Traffic Safety Electronics Associations
IFPS	Integrated Initial Flight Plan Processing System
IFR	Instrument Flight Rules
INTEROP	Interoperability Document
IOC	Initial Operational Capability
IP	Internet Protocol
IR	Implementing rules
IS	Infrastructure Support Section (of ENGD)
IS	Intermediate System
ISRM	Information Service Reference Model
ITY-AGDL	Interoperability Air Ground Data Link
JU	Joint Undertaking
KPI	Key Performance Indicator
LNAV	Lateral Navigation
LNAV/VNAV	Lateral Navigation/Vertical Navigation
LPV	Localiser Performance with Vertical guidance
MET	Meteorological (information)

METAR	Meteorological Aerodrome report
METCE	meteorological Community Exchange Model
MoC	Memorandum of Cooperation
MONA	Monitoring Aids
MP	European ATM Master Plan
MT	Mission Trajectory
MTCD	Medium-Term Conflict Detection
N/A	Not Applicable or Not Available or Not Assigned
NATO	North Atlantic Treaty Organisation
NM	Network Manager
NMF	Network Management Function
NOP	Network Operations Plan
NOTAM	Notice to Airmen
NPV	Net Present Value
NRA	Non Radar Airspace
NSA	National Safety Authority
OAT	Operational Air Traffic
OFA	Operational Focus Area
OI	Operational Improvement
OJEU	Official Journal of the European Union
OLDI	On-Line Data Interchange
PANS	Procedures for Air Navigation Services
PBN	Performance Based Navigation
PC	Programme Committee
PCP	Pilot Common Project
PENS	Pan European Network Service
PRB	Performance Review Body
PRC	Performance Review Commission
P-RNAV	Precision RNAV
PRR	Performance Review Report
PRU	Performance Review Unit
QoS	Quality of Service
R&D	Research and Development
RAD	Route Availability Document
RBT	Reference Business/Mission Trajectory
RF	Radio Frequency
RIL	Runway Intersection Light
RIMS	Runway Incursion Monitoring System
RNAV	Area Navigation
RNP	Required Navigation Performance
RP	Required Performance
RTA	Remote Terminal Access System (phased-out system, see CHMI)
RTCA	Radio Technical Commission for Aeronautics
RWSL	Runway Status Light

S&VO	Support & Validation Office
SARP	Standard And Recommended Practices
SBAS	Satellite Based Augmentation System
SDPS	Surveillance Data Processing System
SES	Single European Sky
SESAR	Single European Sky ATM Research
SG	Steering Group
SID	Standard Instrument Departure
SIGMET	Significant Meteorological Information
SJU	SESAR Joint Undertaking
SMAN	Surface Manager
SMGCS	Surface Movement Guidance and Control System
SPP	SESAR Performance Partnership
SPR	Safety and Performance Requirements
STAM	Short-Term ATFM Measures
STAR	Standard Terminal Arrival Route
STATFOR	Eurocontrol Statistics & Forecasts Service
SWIM	System-Wide Information Management
TAF	Terminal Aerodrome Forecast
TBS	Time-Based Separation
TCT	Tactical Controller
THL/RIL	Threshold/Runway Intersection Light
TMA	Terminal Manoeuvring Area
TMF	Trajectory Management Framework
TOBT	Target Off Block Time
TP	Trajectory Prediction
TSAT	Target Start-Up Approval Time
TTA	Target Time of Arrival
TTO	Target Time Over
TTOT	Target Take Off Time
UDPP	User Driven Prioritisation Process
US	United States of America
UUP	Updated Airspace Use Plan
VDL	VHF Data Link
VNAV	Vertical Navigation
VOI	Voice Over Internet
VPA	Variable Profile Area
WG	Working Group
WMO	World Meteorological Organization
WOC	Wing Operations Centre
WP	Work Package
WX	Weather
WXXM	Weather Information Exchange Model

APPENDIX G TABLE OF FIGURES