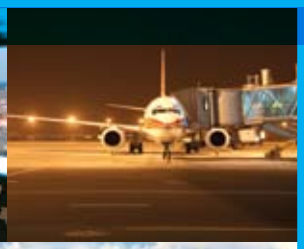
SESAR

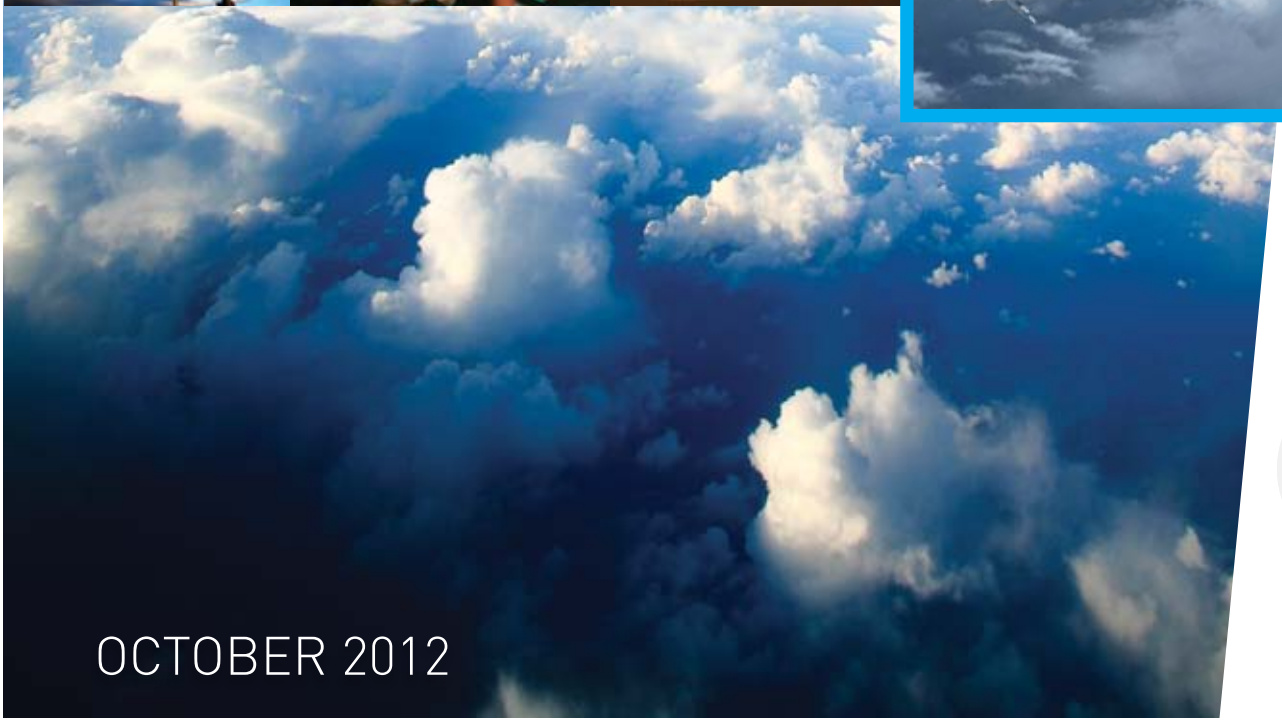
THE ROADMAP FOR SUSTAINABLE AIR TRAFFIC MANAGEMENT

European ATM Master Plan

EDITION 2

EXECUTIVE SUMMARY - **MILITARY**





OCTOBER 2012

Updated with SESAR's first developments

founding members

EUROPEAN UNION

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INTRODUCTION:
What is the European ATM Master Plan?

Within the Single European Sky (SES) initiative, the European ATM Master Plan (Master Plan) is the agreed roadmap driving the modernisation of the Air Traffic Management system and connecting SESAR[1] research and development with deployment. It is the key tool for SESAR deployment, providing the basis for timely, coordinated and efficient deployment of new technologies and procedures.

The first edition of the European ATM Master Plan was endorsed on 30 March 2009 and adopted on 12 June 2009 by the SESAR Joint Undertaking (SJU) which is responsible through EU Council Regulation for the maintenance of the Master Plan.

This 2012 edition of the Master Plan embeds major updates which mark a clear distinction compared with the initial document:

- it takes benefit of the first results achieved by the SESAR Programme to prioritise a set of essential changes that either provides significant performance benefits and/or forms a pre-requisite towards the implementation of the target concept;
- it prepares for the SESAR deployment phase, developing stakeholder roadmaps which provide a temporal view (up to 2030) of the ATM Technology Changes required and updating the Business View, providing a basis for timely and synchronised deployments;
- it promotes and ensures interoperability at global level, in particular in the context of ICAO.

PERFORMANCE VIEW:
What are the performance needs and targets?

Air traffic has not evolved in line with the forecast underpinning the 1st edition of the Master Plan. Although there are still considerable uncertainties regarding the near future, the consensus economic forecasts are for a resumption of near-trend growth in the medium-term and it is on this basis that the Master Plan is developed.

The proposed SES strategic performance objectives presented in this document provide a practical expression of the SES high-level political goals, in terms of measurable Key Performance Indicators (KPIs), and are based on the best current estimation of traffic growth. The SES performance-driven approach focuses on the four Key Performance Areas (KPAs) of environment, cost-efficiency, safety, and capacity/quality of service.

SESAR contributes to meeting these SES strategic performance objectives and drives R&D activities towards the achievement of a set of validation targets.

1 As part of the Single European Sky initiative, SESAR (Single European Sky ATM Research) represents its technological dimension. It will help create a “paradigm shift”, supported by state-of-the-art and innovative technology. The SESAR programme will give Europe a high-performance air traffic management infrastructure which will enable the safe and environmentally friendly development of air transport.

DEPLOYMENT VIEW:
What is required to be deployed to achieve performance needs and targets?

The transition towards the target Operational Concept follows three complementary Steps. Step 1, Time-based Operations is the focus of the current Master Plan and progresses through Step 2, Trajectory-based Operations to Step 3, Performance-based Operations. Step 1 starts from the Deployment Baseline consisting of operational and technical solutions that have successfully completed the R&D phase and have been implemented or are being implemented.

As shown in the figure, the Master Plan identifies essential operational changes for Step 1 which should establish the foundations for the subsequent steps while responding to the performance needs. These changes are grouped in 6 Key Features that describe the main strategic orientations and are the means to deliver performance to achieve the performance goals. The civil-military dimension is an integral part of these operational changes.

How and when will it be deployed?

The operational changes are enabled through improvements to technical systems, procedures, human factors and institutional changes supported by standardisation and regulation.

The human element remains pivotal to the success of SESAR, and in ensuring that SESAR delivers the benefits expected in environment, cost efficiency, safety, and capacity. The SESAR concept of operations will drive changes to the procedures being used by all stakeholders, and in particular will start to modify responsibilities between technology, controllers and flight crew. This needs to be supported by relevant regulatory changes.

The Master Plan includes roadmaps of the identified changes per stakeholder group ensuring that their deployment is planned in a performance driven and synchronised way (e.g. between ground and air deployments) to maximise the benefits achieved.

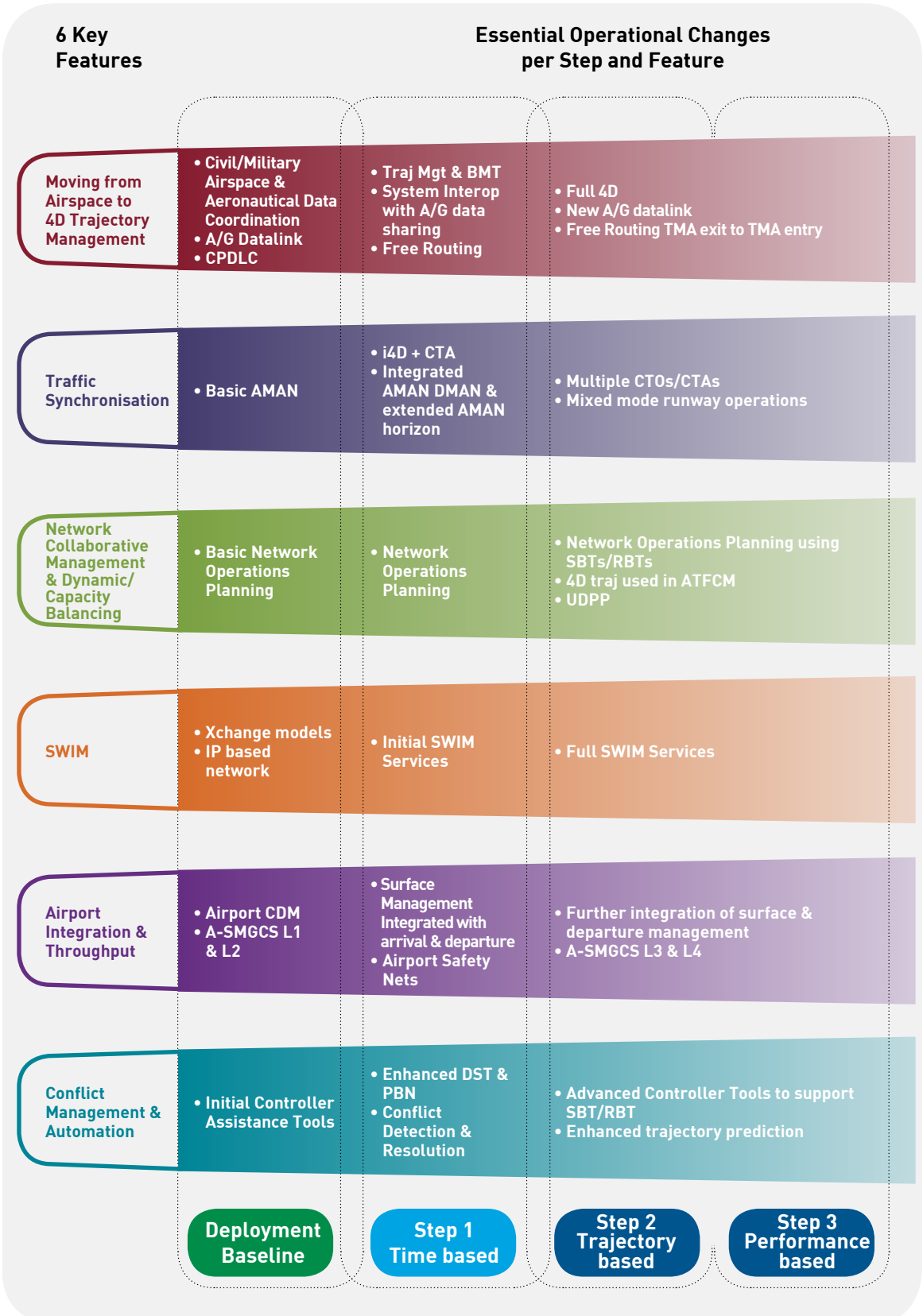
BUSINESS VIEW:
What are the costs and the benefits?

The SESAR programme is a key contributor to the achievement of the Single European Transport Area[2] and enables smart economic growth for Europe. SESAR will provide an effective remedy to air transport capacity bottlenecks, fills gaps in the air traffic management system, enables significant reduction of CO_2 emissions, increases safety, and reduces overall costs. SESAR benefits all European stakeholders and extends beyond the air transport industry.

The Business View is a high level view, which does not replace the need for dedicated stakeholder business cases and cost benefit analyses. Mature solutions, supported by business cases containing a clear quantification of the deployment performance expectations will be the outcome of validation. Pending the validation of the assumed benefits, the approach has been to consider the monetisation of the performance validation targets as a first indication of potential benefits.

Investments required to implement the changes described in the Master Plan for all 3 Steps have been estimated to be between 23 and 32 Bn€ for civil stakeholders for the period 2014-2030. These include investments for Deployment Baseline, Step 1 and Step 2. While estimates of the investment required in the shorter term (Deployment Baseline and Step 1) have been recently updated, the costs for Step 2 correspond to estimates provided during the Definition phase. The investment cost for Step 2 will be reviewed once the technologies and functions supporting this step mature. No further cost assessments have been performed by the Military, earlier estimated to reach 7 Bn€. For Scheduled Airlines, taking into account the investments required for Step 1, SESAR is estimated to create a direct net positive impact of at least 5 Bn€ in the 2014-2030 period provided timely and synchronised deployment is achieved. To this value it is necessary to add other benefits such as those from delay avoidance and flight cancellation savings. In addition, Deployment Baseline and Step 1 will establish the basis on which Steps 2 & 3 will be deployed and thus bring further benefits.

2 White Paper 2011: Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system – EC COM(2011) 144 final


6 Key Features
Essential Operational Changes per Step and Feature
Moving from Airspace to 4D Trajectory Management
• Civil/Military Airspace & Aeronautical Data Coordination
• A/G Datalink
• CPDLC
• Traj Mgt & BMT
• System Interop with A/G data sharing
• Free Routing
• Full 4D
• New A/G datalink
• Free Routing TMA exit to TMA entry
Traffic Synchronisation
• Basic AMAN
• i4D + CTA
• Integrated AMAN DMAN & extended AMAN horizon
• Multiple CTOs/CTAs
• Mixed mode runway operations
Network Collaborative Management & Dynamic/ Capacity Balancing
• Basic Network Operations Planning
• Network Operations Planning
• Network Operations Planning using SBTs/RBTs
• 4D traj used in ATFCM
• UDPP
SWIM
• Xchange models
• IP based network
• Initial SWIM Services
• Full SWIM Services
Airport Integration & Throughput
• Airport CDM
• A-SMGCS L1 & L2
• Surface Management Integrated with arrival & departure
• Airport Safety Nets
• Further integration of surface & departure management
• A-SMGCS L3 & L4
Conflict Management & Automation
• Initial Controller Assistance Tools
• Enhanced DST & PBN
• Conflict Detection & Resolution
• Advanced Controller Tools to support SBT/RBT
• Enhanced trajectory prediction
Deployment Baseline
Step 1 Time based
Step 2 Trajectory based
Step 3 Performance based

The investment figures should be taken with caution as underlying figures had a very high variance, in particular for Airport Operators and Regional Airlines. They may not be applicable to all sub-categories of stakeholders. In addition, whereas for airborne investments, up-to-date cost estimates from manufacturing industry were available for the ANSP investments this was not the case. There is a need for more detailed analysis of the cost of SESAR to ANSPs and of its integration in ANSP investment cycles. Cost inputs from the manufacturing ground industry will be important for this analysis.

The time lag between the upfront SESAR investments by the different stakeholders and the full realisation of benefits will present a risk to SESAR deployment. The risk is to create a last-mover advantage whereby each stakeholder would wait until all others have proceeded with SESAR investments. This should be addressed through the effective implementation of SESAR Deployment governance and incentive mechanisms.

This second edition of the European ATM Master Plan outlines the essential operational changes and technological changes that are required to contribute to achieving the SES performance objectives, preparing the Master Plan to become a key tool for SESAR deployment and providing the basis for timely and coordinated deployment of the efficient technologies and procedures.

The Master Plan provides the best actualised view on the products, technologies and operational procedures, which can be further industrialised and deployed in order to satisfy the needs of the European citizens.

Military Perspective

The European Commission's Single European Sky (SES) initiative, in particular its technical pillar the Single European Sky Air Traffic Management Research (SESAR) programme, is of the utmost importance for the future of aviation, including military aviation, in Europe.

SESAR will have a huge impact on the civilian and military aviation chain as a whole. The performance objectives set will require improved civil and military capabilities. For SES implementation support and interoperability purposes, military systems and procedures can be greatly impacted. There will be implications as regards the advanced flexible use of airspace, the building of functional airspace blocks, services to en-route operational air traffic and, for general air traffic, mixed mode operations.

From the outset, the military have been involved in the SESAR programme through the EUROCONTROL Military ATM Board. However, the participation of experts in this domain was limited, which reduced awareness and visibility in all Member States, in particular at the highest level.

Since 2010 the European Defence Agency and recently the European Union Military Committee have been involved in order to improve the involvement of their respective Member States at the highest level.

In the current phase of the programme, the civil aviation industry has almost 3,000 experts involved in the 300 identified technical projects. With a view to raising awareness and incorporating military expertise, EUROCONTROL established a Military Engagement Plan for SESAR. Currently six nations are actively involved, with approximately 100 part-time experts.

Every European Union State, including its military component, has already signed up to the SES initiative. However, greater commitment from military authorities to SESAR development and deployment is now essential to ensure continued military access to airspace for future operations and training exercises.

This document provides the decision-makers with the ***executive view*** they need for the adoption of the recently updated European ATM Master Plan as the main driver for the future development of Air Traffic Management in Europe.

Military Needs

The global military performance and deployment needs have been captured in the common ATM Master Plan and integrated in the different roadmaps. The following military needs were the drivers for the European ATM Master Plan update campaign:

Maintain military mission effectiveness: The deployment of SESAR must not degrade the effectiveness of the missions performed by the military. On the contrary, the aim should be to improve their effectiveness.

Civil-military interoperability at the lowest cost: The required improvement of the interoperability between civil and military systems has to be implemented at the lowest possible cost for MOD budgets.

Access to airspace through the concept of mission trajectory: Access to airspace will be improved, or will at least remain the same as today. For reasons of sovereignty, total priority can be demanded whenever required. Communications and data transmitted will also be confidential where necessary.

Improved airspace management through AFUA: Improved access to airspace has to be beneficial for all users. It must not work in just one direction, solely for the benefit of one party.

Recognition of equivalent level of performance: The performance of military equipment in communications, navigation and surveillance usually outstrips that of equivalent civil systems. However, the military run the risk of having difficulties to demonstrate through safety cases that they reach the required performance level. Then they might have to replace their equipment with civil-certified, and sometimes less capable, equipment. This would be expensive and counter-productive.

DEPLOYMENT VIEW

The selection of the military's essential operational improvements and their supporting technical enablers is primarily driven by military ATM and network performance requirements, encompassing the need for synchronised deployment by all airspace users.

Military ATM needs are covered in the concept of "mission trajectory", which details the operational ATM requirements for any flight planned and performed by military or governmental organisations.

As a prerequisite to optimising network performance, business and mission trajectories requesting access to the same airspace must be managed jointly. This operational improvement is supported by a higher level of interoperability between civil and military ATM/CNS infrastructures.

Deployment Baseline

- Due to the variety, specificities and long lead time for the procurement of military systems, the ongoing baseline deployment, with the aim of achieving common harmonisation before the first SESAR deployment (Step 1), is more demanding for the military than for other ATM partners.
- An important objective remains the harmonisation of Operational Air Traffic (OAT) rules and the sharing of airspace and aeronautical information at local, regional (FAB) and network level. These improvements are directly supporting a more efficient use of the available airspace capacity and will accelerate the deployment of more integrated trajectory management functions.
- In addition, State aircraft will continue to equip as mandated in published SES regulations, including the carriage of 8.33 channel spacing capability and Mode S for all aircraft types and certain other capabilities such as ADS-B Out and Data Link Services (CPDLC) for transport-type State aircraft.

- Other important improvements such as RVSM, TCAS and FM immunity are not covered in SES Regulations but are highly recommended for optimum access to airspace, since exemption-based accommodation raises safety and ATC workload concerns.
- For the ground infrastructure, the migration to Internet Protocol networking solutions (e.g. PENS) and the emergence of the Aviation Message Handling System, replacing the Aeronautical Fixed Telecommunication Network, have already been the subject of SES regulatory provisions.
- Crisis management is already mandated (NM IR, establishment of the EACCC- European Aviation Crisis Coordination Cell, which has considered scenarios such as war/conflict and security). Recent operations over Libya have demonstrated the relevance of civil-military ATM crisis arrangements for cases where armed conflict impacts the network. Similarly, a 9/11 type of crisis, or a serious cyber attack on critical infrastructure would have an impact on ATM.

Time-based operations (Step 1)

- The main operational change will be the transition from OAT to mission trajectory with the sharing of trajectory data for cross-border operations, the implementation of common rules for the design of segregated areas and the progressive integration of ASM, ATC and ATFCM functions in support of airspace and trajectory management.
- These important changes will support the development of an efficient OAT transit service across Europe, the implementation of VPA principles for airspace design and the further deployment of free-route airspace procedures. The progressive integration of civil and military ATM procedures will offer opportunities for a defragmentation and rationalisation of the ground infrastructure.
- The processing of OAT flight plans must be harmonised throughout Europe and SESAR should provide technical solutions which provide better support for the en-route and network infrastructure.
- The implementation of robust security governance, including crisis management, and the deployment of gateways providing interoperability and security will enable information exchanges between the military ATM/CNS infrastructure and IP-based networks.
- In order to continue to have access to the most congested airports in Europe, the avionics of the military transport fleet will be impacted by new CNS requirements for initial 4D. This involves the uplink/downlink of clearances (CPDLC) and ADS-C trajectory data through ATN/VDL 2, enhanced situation awareness through ADS-B in/out and enhanced FMS performance.
- For other military aircraft, the impact of en-route PBN functionalities (e.g. RNP-1), which will be the subject of an SES Regulation, should be mitigated by demonstrating that military avionics provide an equivalent level of navigational performance and by providing harmonized potential exemptions.

Trajectory and performance based operations (Step 2 & 3)

- The progressive transfer of responsibilities from the controller to the pilot will initially impact the transport fleet. Other non-capable military aircraft might continue to receive ground support for their integration into the network.
- The implementation of dynamic mobile and flexible areas will constitute the major military contribution to the concept of “dynamic airspace configuration”.
- However, the multiplication of SWIM applications supporting the collaborative optimisation of business and mission trajectory profiles will impact the ground systems used for air operations planning and control. Additionally, all aircraft will need to benefit as much as possible from the re-utilisation of available capabilities, including data links capable of exchanging trajectory data, transponders able to support surveillance, as well as new separation modes and navigation configurations able to support advanced RNP. At a later stage, military mission systems must be capable of emulating FMS 4D functions.
- Enhanced civil-military standardisation and certification processes will make way for greater flexibility and cost efficiency in the deployment of the new capabilities required for network efficiency.
- Finally, the deployment of secure air-ground gateways will be a prerequisite for the integration of military aircraft into the SWIM environment.

ESSIP as SESAR Deployment Tool

The European ATM Master Plan essentially consists of three levels:

- Level 1: the ***executive view*** for the decision-makers (this document);
- Level 2: the ***planning view*** at management level (available on the ATM MP Portal);
- Level 3: the ***implementation view*** at expert level.

Level 3 is better known by the acronym ESSIP (European Single Sky Implementation Plan). ESSIP is therefore an integral part of the Master Plan and needs to be adopted and used by all military stakeholders as the SESAR deployment tool for the future development of aviation across Europe.

BUSINESS VIEW

Military costs have not been reviewed since the Definition Phase due to the unavailability of new validated data. However, the list of Essential Operational Changes in Step 1 shows that the main system changes will impact the ground infrastructure supporting airspace and mission trajectory management functions.

RISKS

A number of risks to the outcomes of the ATM Master plan have been identified. From the Military point of view, the most critical concerns are:

- **Interoperability and global harmonisation are not ensured (MP risk 4)**
  Civil and Military airspace users interests should be taken properly into consideration to ensure the synchronized application of operational and technical standards. A lack of interoperability would result in implementation delays and would affect the overall performance of the network.
- **Regulatory and standardisation needs are unable to support the deployment phase (MP risk 8)**
  Civil-military and military regulatory and standardisation arrangements must be in place to support the implementation of the programme. In particular, the civil-military standardisation activities should meet the military expectation that their ATM systems can demonstrate an equivalent level of performance.

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