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COMMISSION STAFF WORKING DOCUMENT

Revision of Council Regulation (EC) N°219/2007 of 27 February 2007 on the establishment of a Joint Undertaking to develop the new generation European air traffic management system (SESAR)

Accompanying the document

Proposal for a Council Regulation

amending Regulation (EC) N°219/2007 on the the establishment of a Joint Undertaking to develop the new generation European air traffic management system (SESAR) as regards the extension of the Joint Undertaking until 2024

{COM(2013) 503 final}

1. INTRODUCTION

The SESAR Joint Undertaking (hereinafter 'the Joint Undertaking' or 'the SJU') has been established in 2007 by the Council[1] as a public-private partnership (PPP) under Article 171 of the Treaty establishing the European Community (now Article 187 of the TFEU). The SJU has been assigned the task of ensuring the modernisation of the European Air Traffic Management (ATM)[2] system by coordinating and concentrating all relevant Research & Development efforts in the Union.

The SJU Regulation also defines the financing mechanism of the Joint Undertaking as well as the maximum contributions of its different members, including private undertakings. The SJU Regulation specifies that the maximum EU contribution is €700 million of which €350 million is paid from the budget of the Specific Programme Cooperation of the seventh programme for research and technological development (FP7) and €350 million from the budget of the Framework programme on the TEN-T.[3]

In accordance with its founding Regulation, the SJU shall cease to exist on 31 December 2016. However, the Regulation foresees that the duration of the SJU can be reviewed by the Council based on a proposal from the Commission.

The SJU has been subject to a number of evaluations/workshops/public consultations during the period 2007-2012. An overview of the results of the various evaluations is provided in appendix 1 of this report. The evaluation work has demonstrated the SJU's capacity to be more effective and efficient to execute EU research and development activities and demonstration programmes than if driven within FP7 R&D programme for which activities would be performed through calls for proposals. The consultations of stakeholders performed both by the SJU and the Commission confirmed this positive conclusion. The focus of these consultations was to obtain feedback on the way the SJU has implemented its tasks since its establishment, as well as to receive comments regarding the possible future evolution of the SJU's work in this field beyond 2013.

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1 Council Regulation (EC) 219/2007 of 27/02/2007

2 ATM is the aggregation of the airborne and ground-based functions (air traffic services, airspace management and air traffic flow management) required to ensure the safe and efficient movement of aircraft during all phases of operations.

3 Eurocontrol equally provides a third of the funding (€700 million) and the remaining third (€700 million) is provided by the other 15 members. While the EU contribution is in cash, Eurocontrol and other industry members' funding comprises both cash (minimum 5%) and in-kind contributions.

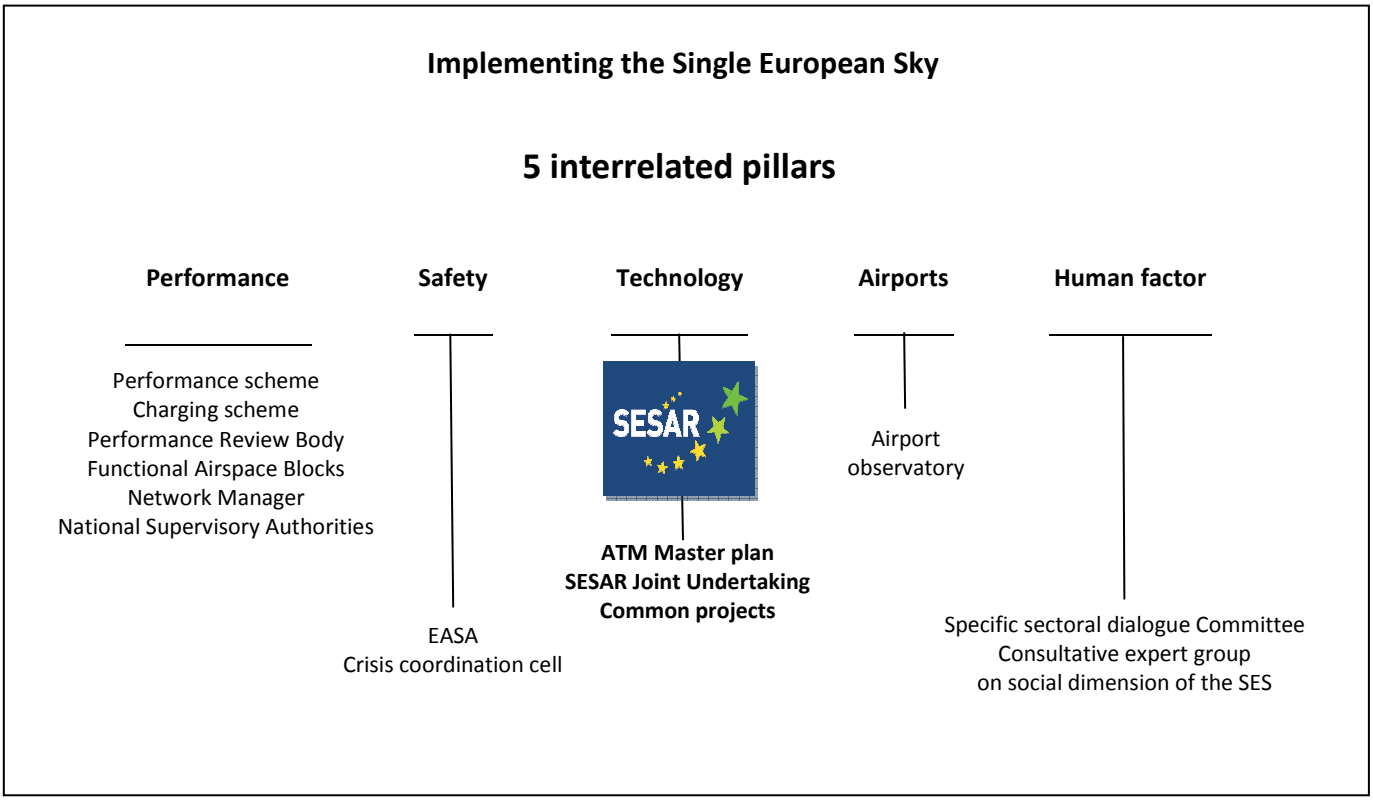
2. POLICY BACKGROUND

2.1. The Single European Sky, SESAR project and the SJU

2.1.1. The Single European Sky (SES) and its technological pillar – the SESAR project

Since 2004, the European Union (EU) gained competences in ATM leading to the EU framework. The Single European Sky (hereinafter 'the SES'), which consists of two major packages of legislation (SES I and SES II) as well as numerous supplementary Implementing Rules, was established in 2004[4] with a threefold goal: to enhance air traffic safety standards, to contribute to the sustainable development of the air transport system, and to improve the overall performance of the European ATM and air navigation services.[5] To achieve its objectives, the SES relies on 5 essential and interrelated pillars.

Figure :



4 Adoption of the SES regulations. The initiative was launched through a Communication in 1999 and followed-up with a High-Level Group in 2000.

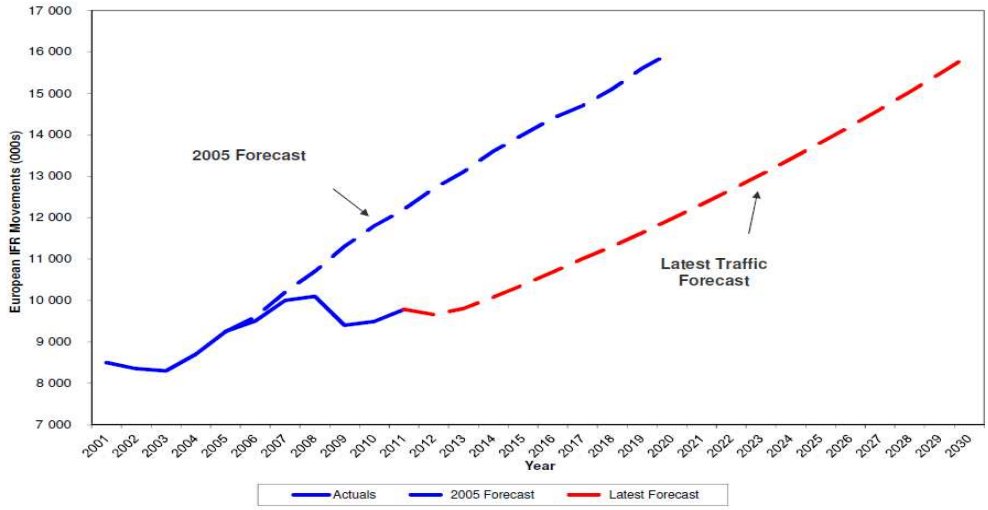
5 The high level objectives of the SES to be met by 2020 are to increase safety by a factor of 10 and reduce environmental impact by 10% per flight, to triple the current capacity and to reduce by half the costs of ATM services. These objectives are coherent with the "Vision 2020" goals established in 2001 by the "Group of Personalities" for European aeronautics research () and operationalized by the European Technology Platform ACARE (Advisory Council for Aeronautics research in Europe) in the Strategic Research Agenda

Source: European Commission

The project to modernise ATM in Europe to cope with sustained air traffic growth and air traffic operations under the safest, more cost- and flight-efficient and environmentally friendly conditions – the SESAR project – is the technological pillar of the SES.[6]

Because it is based on national sovereign airspace, ATM in Europe is still fragmented and dominated by national monopoly service provision and ageing local ATM systems.[7] ATM is of crucial importance to efficient air transport operations. As air traffic volumes have increased considerably and traffic for passengers and freight is expected to grow 5% per annum over the next 20 years (Figure 2), the fragmentation of ATM systems causes serious capacity problems and major delays for passengers and freight transport, needless fuel consumption and emissions, safety concerns and high operating costs.

Figure 1: European air traffic growth trend



Source: ATM Master Plan Edition 2[8]

The SESAR project aims at implementing a new concept of operations and ATM system, which represents a paradigm shift in today's ATM and will enable the achievement of the SES performance objectives.

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6 See Annex 2 of this report.

7 The European ATM network consists of hundreds of air traffic control sectors operated by more than 60 air traffic control centres where more than 16,700 air traffic controllers manage the traffic from/to 450 European airports and also from and to third countries. This complex structure manages more than 26,000 daily flights in the EU, accommodates approximately 38,000 daily flight hours and operates on a network of aviation routes optimised at national level but not yet at European level. See *Report from the Commission to the European Parliament on the implementation of the Single Sky legislation: time to deliver*, COM (2011) 731 final, 22.11.2011

8 IFR : Instrument Flying Rules

The SESAR concept is based on the principle that the users of the airspace and controllers define together, through a collaborative process and exchange of information, the optimal, predictable and timely flight path. Underlying this concept are innovative technologies and new operational procedures resulting from research, development and validation activities that are focussed on performance and deployment.

The SESAR project comprises three interrelated, continuous and evolving collaborative processes (Figure 3):

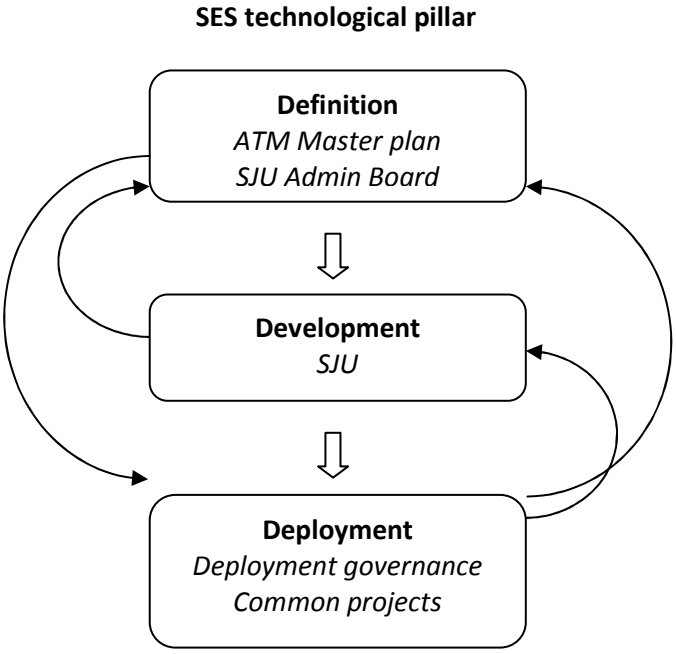
1. The first process is the *definition* of the content, the priorities and the development and deployment plans of the next generation of ATM systems contributing to the achievement of the SES performance targets.

2. The second process is the *development* and validation of the required technological systems, components and operational procedures of the SESAR concept of operations in accordance with the ATM Master Plan (see below). The development phase of the SESAR project is managed by the SESAR Joint Undertaking (SJU).

3. The final process is the *deployment* of the SESAR concept of operations resulting in a modernised ATM infrastructure composed of fully harmonised and interoperable components that guarantee high performing ATM in Europe. Deployment comprises the activities and processes related to the industrialisation and implementation of technologies and procedures developed and validated by the SJU.[9]

[9] Industrialisation refers to the standardisation and certification activities and the large-scale production by the ground and airborne equipment manufacturers. Implementation consists in the procurement, installation and putting into service of equipment and systems, including associated operational procedures, carried out by operational stakeholders.

Figure 2: Interrelationships between the three SESAR processes, from definition to deployment.



Source: European Commission

However, only a timely, coordinated and synchronised deployment process will allow achieving the benefits expected from the SESAR concept.

The deployment process will close the loop of the SESAR lifecycle while, as shown above, feeding into the definition and development processes as adaptations to the operational reality may become necessary. The deployment process will allow SESAR to fully deliver its benefits from concept to implementation. It is about to be activated and for this purpose, the Commission will soon adopt an implementing Regulation that develops the concept of *common projects*[10] as deployment instruments and establishes governance and incentives mechanisms that will allow operational stakeholders to organise and accelerate deployment.

Common projects aim to deploy ATM functionalities that are identified in the ATM Master Plan as essential contributors to the improvement of the European ATM system's performance, that are mature for implementation, that demonstrate to have a global positive business case for the European ATM network and require a synchronised deployment..

To make the decision for industrialisation and deployment of SESAR Common Projects, large scale demonstrations are required. They will allow the validation of the SESAR concepts in a full operational environment. They will in particular focus on the validation of the

[10] Regulation (EC) 550/2004, Article 15a.

interoperability of the systems and constituents through demonstrations on multiple platforms and with various types of aircraft. They will therefore provide a realistic assessment of SESAR's contribution to improving the performance of the ATM network as well as the benefits for each stakeholder.

A major strength of the SESAR project is the collaborative and coordinated framework in which its definition, development and deployment processes are embedded, which constitutes an effective approach against the previous fragmentation of efforts and resources in this domain. On the basis of the current trends, ATM research and development is a global and competitive sector in which staying in the lead requires a concerted effort from Europe's research community. This framework attracts the aviation stakeholders who, for the first time and through the appropriate instrument, can work together and with the EU in a large scale modernisation project driven by the SES performance objectives and powered by a cooperative effort to concentrate and rationalise resources for achieving a better performing ATM system.

2.1.2. The ATM Master Plan – an evolving document

The first phase of the definition process ran from 2004 to 2008 and delivered the first edition of the European **ATM Master plan**. The ATM Master Plan is the agreed roadmap that connects ATM research and development activities with deployment scenarios to achieve the SES performance objectives. The initial version of the European ATM Master Plan, resulting from the first phase of the SESAR project's definition process, constitutes the basis for the development and deployment activities of the SESAR project. This initial Master Plan was endorsed by the Council on 30 March 2009. The most recent update of the ATM Master Plan, approved in 2012[11], identifies the "Essential Operational Changes" that need to be implemented in the following three main steps to lead to the full deployment of the new SESAR concept by 2030:

- Step 1 – time based operations - concentrates on unlocking latent capability particularly by improving information sharing to optimize network effects.

- Step 2 – trajectory based operations - develops the System Wide Information Management (SWIM) and initial trajectory management concepts to increase efficiency.

- Step 3 – performance based improvements - will introduce a full and integrated trajectory management with new separation modes to achieve the long term political goal of SES.

The ATM Master Plan is translated into a yearly work programme, itself further defined into work packages, designed by in collaboration with all stakeholders. The workprogramme is

[11] https://www.atmmasterplan.eu/

submitted for approval to the SJU Administrative Board. Currently, as the EU contribution had to be limited to the 2007-2013 financial perspectives, the SJU work programme up to 2016 focuses mainly on Step 1 (time based improvement) and to a large extent on Step 2 (trajectory based improvements) of the ATM Master Plan, leaving in particular Step 3 (performance based improvements) to be developed at a later stage. Each step will be developed to a validation stage, which excludes validation in full operational context and in a large scale context.

Each update of the ATM Master Plan reactivates the definition process, which adapts and refines the requirements of the new ATM systems to respond the evolving SES performance objectives and to the operational reality and feeds these requirements into the subsequent processes.

Therefore, in order to meet the ATM Master Plan objectives, R&I activities additional to those covered by the current SESAR work programme are required: the completion of Step 2 and Step 3 of the ATM Master Plan, including conflict management and automation, and trajectory and performance management. Equally, the progress made under the current work programme, will lead to further development: for example, given the progress made on remotely piloted aircraft systems' (RPAS) ATM integration which has now reached the development stage and the ATM broad scope of SESAR, RPAS ATM integration activities will be part of the extension phase of SESAR. And to prepare fully for deployment, large scale demonstrations need to be envisaged.

2.1.3. The SESAR Joint Undertaking (SJU)

Taking into account the number of actors who need to be involved in the process and the financial resources and technical expertise needed, the EU has set up in 2007 a legal entity, the SJU, in charge of ensuring the management of the funds assigned to the SESAR project during its development phase.

Objective

The SJU aims to ensure the modernisation of the European ATM system by coordinating and concentrating all relevant R&D efforts in the Union. In practice, the SJU is responsible for coordinating and managing the development activities of the SESAR project in accordance with the ATM Master Plan. In this respect, it is responsible for carrying out the following tasks:

- organising and coordinating the activities of the development phase of the SESAR project, in accordance with the ATM Master Plan;
- ensuring the necessary funding for the activities of the development phase of the SESAR project in accordance with the ATM Master Plan;

- ensuring the involvement of the stakeholders of the air traffic management sector in Europe;

- organising the technical work of research and development, validation and study, to be carried out under its authority while avoiding fragmentation of such activities;

- ensuring the supervision of activities related to the development of common products duly identified in the ATM Master Plan.

The SJU is also responsible for maintaining the ATM Master Plan. The SJU plays a vital role in the SESAR project ensuring continuity in its lifecycle. It brings new ATM concepts from ideas to the appropriate level of maturity for moving them to deployment. It produces, through collaborative research, development and validation processes, the material for deployment and at the same time it defines/refines, through the update of the ATM Master Plan, the needs for further evolution of the Union's ATM system. As the SJU work programme and activities are directly informed by the ATM Master Plan, they will understandably evolve accordingly over time in response to the ATM Master Plan updates as well as to maturing realities of the SES and SESAR itself.

Founding members and governance structure

The founding members are the European Union, represented by the European Commission, and Eurocontrol Organisation, represented by its Agency. 15 public and private enterprises and consortia were selected, through an open competitive procedure, as members of the SJU. These include air navigation service providers, ground and airborne manufacturing industry, aircraft manufacturers and airport operators[12]. The SJU is governed by the Administrative Board and the Executive Director. Associate partners of the SJU Members and Associate Partners of the SJU complement and complete the expertise brought by the SJU Members in specific ATM fields (for more details on the SJU governance structure, see the Statutes of the Joint Undertaking[13]).

The Administrative Board comprises representatives of the SJU members and of the military, the civil airspace users (commercial airlines, business aviation, and general aviation), the air navigation service providers, the equipment manufacturers, the airports, the professional staff and the research community at European level.

Scope of activities

The SJU Regulation defines a broad perimeter for the scope of its activities that may cover all relevant ATM R&D efforts in the Union.

12 http://www.sesarju.eu/players/partnership

13 Council Regulation (EC) No 219/2007

In practice, the main scope of activities of the SJU is defined by the ATM Master Plan. The SESAR programme represents around 300 projects which are grouped, into work packages, from exploratory research to demonstrations. Amongst these, Work Package E (WPE) deals with long term and exploratory research. The scope of WPE is to stimulate long-term research, creativity and innovation, to develop the scientific knowledge aimed at extending the SESAR vision and also to complement SESAR activities. WPE is steered by the Scientific Committee of the SJU together with the Executive Director, operationally managed by the SJU Programme Manager in charge and within the Programme Management system of the SJU, while Eurocontrol is providing the administrative support. WPE SESAR Long Term and Innovative Research themes are defined with the advice of the Scientific Committee. These research themes include legal aspects of paradigm shift; towards higher levels of automation in ATM; mastering complex systems safely; economics and performance.

In order to guarantee sound governance and independence of exploratory research, private partners do not contribute to the financing of WPE. Funding of WPE during the period 2007-2014 amounted to about EUR 20 million. As up to now, activities focused heavily on development, the exploratory research has been limited to its strict minimum, well below the usual research effort of previous framework programmes.

Furthermore, the SJU has become the EU's "technological ambassador" for promoting global ATM interoperability. The SJU carries out, for the EU side, the cooperative actions in the field of SESAR-NextGen interoperability under a Memorandum of Cooperation in civil aviation R&D between the EU and the USA.

Lessons learnt

Several sources indicate that the SJU is performing well and has had a positive impact on ATM R&I.: the *Mid-term Evaluation of the SESAR Joint Undertaking*[14] (July 2010), the internet public consultation held from 25 July 2012 until 17 October 2012, and the two consultative workshops held on 02 October 2012 and 23 November 2012.

The SJU mid-term evaluation concluded that the SJU performed well during the 2007-2009 period, both in terms of setting up and building its organisation as well as conducting its tasks. Although it was too early to assess the overall programme efficiency of the SJU, progress made during the evaluation period indicated that the Joint Undertaking / Public Private Partnership model as a legal entity established under the EC Treaty[15] had proven to be more effective and efficient to execute Community research and development activities and

[14] http://ec.europa.eu/transport/facts-fundings/evaluations/doc/2010_sesar_mid_term.pdf

[15] The EC Treaty provides for the possibility to establish Joint Undertaking (Art 171, now TFEU 187). The Joint Undertaking (JU) is the legal entity constituting the framework for the JTI activities. Each JU is adapted to the specificities of each JTI.

demonstration programmes than if driven within FP7 R&D programme for which activities would be performed through calls for proposals.

The SJU's key achievements noted by the evaluation were:

- Gathering and committing stakeholders on a common R&D programme;
- Developing the work programme that supports rationalisation and consistency, avoiding gaps and overlapping;
- Developing the required methods and tools for programme implementation;
- Initiating a number of projects within a short timeframe without compromising on the quality requirements and needs for coordination between work packages and projects.

The evaluation also notes some challenges facing the SJU at the time. The first one relates to maintaining its capacity to coordinate all work-packages and projects and validate the deliverables. The second focuses on communication processes and instruments, which should be further developed to meet the differentiated communication needs of the founding members, SJU members and other stakeholders, members and non-members of the Administrative Board.

The public consultation confirmed the SJU is performing well and has had a positive impact on ATM R&I. The SJU is seen as most influential in reducing fragmentation of ATM R&D efforts in Europe and logically in coordinating EU funded R&D in ATM and in technical progress on new ATM solutions. A majority of respondents also see the SJU improving or strongly improving the EU position in the global context of ATM modernisation programmes.

The SJU is viewed as being clearly most successful in three areas: ensuring the involvement of stakeholders of the ATM sector in Europe; guaranteeing the necessary funding for the development of the SESAR Project; and organising and coordinating the activities of the development phase of SESAR.

A very large majority still thinks that there is a continued need for EU intervention in the ATM area (94%), and that the SJU should be extended under Horizon 2020 (81%).

Respondents also mention improvement possibilities, but opinions vary greatly on what should precisely be bettered. Issues mentioned are e.g. the communication between and within stakeholders, the simplification of procedures, top-down *vs.* need driven approach, the use of existing ATM research facilities and networks.

Sources of financing

The funding needs of this first phase of development activities have been set at €2.1 billion, which is entirely financed by the SJU members. The EU provides a third of the necessary

funding from the FP7 (€350 million) and TEN-T (€350 million) Programmes. Eurocontrol equally provides a third of the funding (€700 million) and the remaining third (€700 million) is provided by the other 15 members. While the EU contribution is in cash, Eurocontrol and other industry members' funding comprises both cash (minimum 5%) and in-kind contributions.[16]

2.2. Horizon 2020: basis for SESAR project funding

On 6 October 2010, the Commission adopted the "Innovation Union" setting out a strategic approach to innovation. The Innovation Union is a "flagship" in the Europe 2020 Strategy. The Innovation Union announced that Europe's efforts will be focussed on challenges such as climate change, energy and food security, health and an ageing population. It will use public sector intervention to stimulate the private sector and to remove bottlenecks which stop ideas reaching the market. These include lack of finance, fragmented research systems and markets, under-use of public procurement for innovation and slow standard setting.

On 30 November 2011, the Commission adopted a proposal for the Horizon 2020 Framework Programme for Research and Innovation (2014-2020), which is the European financial instrument implementing the Innovation Union. As far as ATM is concerned, the transport programme proposed puts forward objectives that are fully in line with the deployment and further development of the SES. The need for innovative ATM technologies is recognized by Horizon 2020. Horizon 2020 stresses that innovative ATM technologies should contribute to a step-change in safety and efficiency with rapidly increasing demand, to improve punctuality, to shorten travel-related procedures at airports and to achieve resilience in the air transport system[17]. It also underlines that further support may be provided for joint undertakings funded under FP7[18] (e.g. SJU).

Horizon 2020, which is the successor of the FP7 Programme, is a €79.4 billion programme at current prices which has been the object of a fully-fledged Impact Assessment.[19] The proposed budget under Horizon 2020 includes a transport programme under "Societal Challenges" with a proposed budget of €6.7566 billion at current prices.[20]

The total cost of the SESAR programme, estimated at €1.6 billion over the period 2014-2024, cover the whole spectrum of R&I activities from exploratory research to demonstration, fully in line with the Horizon 2020 spirit of providing *seamless and coherent funding from idea to market* and of *supporting innovation and activities close to the market.* It is also consistent

16 See appendix III for more details

17 Resilience is the intrinsic ability of a system to adjust its functioning prior to, during, or following changes and disturbances, so that it can sustain required operations under both expected and unexpected conditions. Since humans are indispensable in all situations involving change, Resilience naturally has strong links with Human Factors and Safety Management.

18 COM(2011) 811 final - Proposal for a Council decision establishing the Specific Programme Implementing Horizon 2020 - The Framework Programme for Research and Innovation (2014-2020).

19 SEC(2011) 1427 final

20 The amounts referred to in this paragraph include both operational and administrative appropriations.

with the portfolio of activities of other EU bodies such as Clean Sky Joint Technology Initiative:

- exploratory research for an estimated amount of €100 million.

  Now that the deployment process is about to be launched, the balance of resources allocated to the different phases of the R&I cycle need to be reviewed to keep innovative ideas flowing in. In particular, more efforts need to be put into exploratory research, involving universities, research establishments and SMEs through "Centres of excellence" and "Blue sky research" activities.

- the completion of Step 2 and Step 3 of the ATM Master Plan for an amount of € 1.2 billion.

  This includes activities such as remotely piloted aircraft systems' (RPAS) ATM integration, which have now reached the development stage.

- large scale demonstrations, validating SESAR concepts in full operational context and in a large scale context, for an amount of €300 million.

  Large scale demonstration projects, which add a significant cost to the overall SESAR development phase, will allow the validation of the SESAR concepts in a full operational environment. They will in particular focus on the validation of the interoperability of the systems and constituents through demonstrations on multiple platforms and with various types of aircraft. This step is necessary to provide a realistic assessment of SESAR's contribution to the performance of the ATM network as well as the benefits for each stakeholder. Large scale demonstrations constitute the fundamental bridge inside the R&D to support an effective and timely deployment of SESAR: they are key to show that new systems are robust enough and they mitigate the risks associated to industrialisation decisions.

The deployment activities of the SESAR programme will not be implemented by the SJU and, consequently, will not be financed by Horizon 2020.

These financial estimates were primarily based on the experience gained so far in the SESAR programme and on extrapolations relating to the activities to be completed in SESAR extension:

  - Exploratory research was estimated on the basis of an eight years programme starting in 2017. It was based on current exploratory research activity cost extrapolated to include 10 research centres, project funding to support Step 3 and beyond activities, PhDs/dissemination and management funding.

- For Step 2 and Step 3, same validation cost allocations as for current SESAR projects were considered for an estimated number of projects required completing the ATM Master Plan.

- The RPAS ATM integration activities cost is an estimate based on a draft RPAS roadmap and experience gained on other SESAR projects. A definition phase of the RPAS ATM integration activities is planned to be completed by the end of 2013. The definition of the exact scope and effort to be dedicated to RPAS during the SJU extension phase will then be used to refine this cost estimate.

- Large scale demonstrations costs were estimated on the limited on-going large scale demonstration projects experience and taking due account of the extra ground/space/airborne equipment cost for the more advanced concepts of Step 3.

On this basis, the EU's contribution to the financing of SESAR under Horizon 2020 was estimated at up to €0.6 billion. This represents a decrease compared to the period of 2007 – 20014 where the total of the EU contribution to the SJU was €0.7 billion. [21] This EU contribution to the financing of the SESAR development activities has been estimated assuming that:

- Exploratory research, which by nature is highly financially risky, needs to be reinforced to feed in the long-term ATM development process. As long term outputs may go beyond the objectives of the ATM Master Plan, the SESAR programme and indeed the SES, the provision of €100 million is fully born by the EU.

- The remaining €1.5 billion is split into three equal shares between the European Union, Eurocontrol and the private sector. The net contribution from the private sector and Eurocontrol's contribution is €0.5 billion respectively.

The net contribution of €0.5 billion is expected from the private sector. Eurocontrol and the Commission as founding members would continue to co-finance the non-private sector input on an equal basis.

[21] During the period 2007-2013, the EU contribution to SESAR JU was financed jointly by FP-7 and by the TEN-T budget. This will no longer be the case for the period 2014-2020: as far and R&I is concerned, the Connecting Europe Facility, the successor programme for TEN-T programme, will only be allowed to finance deployment activities.

In light of the on-going discussions of the Multi-annual Financial Framework of the European Union for the period 2014-2020, the specific contributions of all funding members (EU, Eurocontrol, private sector) will have to be clarified.[22]

Also, Article 19 of the proposed Horizon 2020 Regulation explicitly indicates that the new framework programme may be implemented through new contractual public-private partnerships (PPPs) or existing joint undertakings funded under FP7 within the 2007-2013 financial perspectives. In particular, subject to the amendment of their basic acts, existing joint undertakings may receive further support from Horizon 2020, based on the evaluation of a set of criteria such as the added value of action at EU level or the scale of impact on industrial competitiveness, sustainable growth and socio-economic issues. [23]

3. PROBLEM DEFINITION

3.1. Problem analysis

It is clear from the above that the ATM Master Plan, which is the agreed roadmap to develop and validate the necessary technological systems, components and operational procedures of the SESAR project and is therefore part of SES policy objectives, determines the scope of research and innovation activities to be coordinated at EU level. Consequently, this ex ante evaluation does not relate to this aspect of scope, but relates to the implementing mechanism that should be put in place to ensure the coordination and management of the activities and funds necessary for the technological development of the SESAR project.

As indicated above, the SJU is responsible for coordinating and managing the development activities of the SESAR project in accordance with the ATM Master Plan. Pursuant to its founding Regulation, the SJU will cease to exist on 31 December 2016.

Indeed, the SJU was established in 2007 by Council regulation 219/2007 for a period up to December 2016 on the basis of a public-private partnership whereby the funding partners (the European Union & Eurocontrol) and the private sector (supply industry, airspace users, air navigation service providers) work closely together in a single European effort to avoid the past defragmented approach to research and innovation in the areas of air traffic management. This means that from 2017 on, the EU action is discontinued and the SJU is not automatically extended.

Continuity in coordinating all ATM related R&I efforts in the Union is not ensured beyond 31.12.2016 thereby putting at risk the achievement of the Single European Sky and the ATM related objectives of the 2011 White Paper on transport policy and of Horizon 2020.

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[22] All the figures mentioned here are subject to the finalisation of the 'Smart, green and integrated transport' societal challenge envelope in Horizon 2020. They are in current prices (2011) and include operational and administrative appropriations.

[23] COM(2011) 809 final.

If no action is undertaken, this situation will inevitably disrupt the current momentum of European ATM research that needs stable and long term support for its lengthy innovation cycles. It would also put an end to the existing stakeholder partnership that pools resources from both public and private levels, which would result in a return to the fragmentation of R&D efforts in the Union, constituting a negative signal to stakeholders and endangering the present and future investments in ATM R&I.

3.2. Needs assessment

3.2.1. The ATM community

The ATM community, comprising civil and military Air Navigation Service Providers (ANSPs), airspace users and airports, is required to comply with the SES performance objectives aiming to improve the safety and capacity of the ATM system, while reducing delays and operating costs, increasing the efficient use of resources (fuel, airport and airspace capacity), enhancing dynamic flight planning and optimising flight profiles. More specifically, advances in communication (air-ground and air-air linkages, interoperability across applications, etc.), navigation (improve flight profile accuracy from gate to gate, etc.) and surveillance (improve safety and security, etc.) are all necessary to ensure the transition to a modern ATM system.

To achieve the above mentioned compliance, the ATM community will need to agree on and dispose of the validated SESAR technologies and procedures, which are geared to achieving the SES performance objectives.

3.2.2. The European aerospace industry

The European aerospace industry's future depends to a large extend on the competitive edge it can derive from innovation and technological advancement. This industry, encompassing a wide range of activities from manufacturing aircraft or ground and airborne equipment to selling specific services, is a leading sector for the European economy that is committed to pursuing the SES performance objectives by providing state of the art ATM systems.

The timely development and deployment of SESAR technologies and procedures will boost Europe's innovation capacity and the competitiveness of its industry worldwide allowing the EU to have a strong voice in standardisation bodies. For the aeronautical supply industry, the market perspectives for ATM modernisation are worldwide. SESAR has enabled the EU to enjoy today a strong position on the international scene and has become a reference programme in the domain of modernisation of ATM systems. This has facilitated the launching of several cooperative projects and agreements with third countries, offering significant opportunities for European industry and employment and reinforcing European leadership in this domain.

3.2.3. The European Commission and the Members States

The implementation of the SES is crucial for meeting the objectives of EU's common transport policy, which aims at developing an efficient and sustainable transport system. The SES framework contributes to achieving this objective by modernising ATM services and infrastructure. The Commission has the responsibility to drive SES implementation process exercising regulatory and oversight functions. SESAR is one of the instruments that support the implementation of the SES.

For Member States, beyond the recognised drive towards pooling R&I resources in view of reaching the SES target, clear governance arrangements within European ATM allowing efficient decision making and reporting are considered crucial for the success of a large scale programme such as SESAR. The SES regulation packages and implementing rules provide the regulatory framework for SESAR's implementation, and Member States are closely involved in the deployment governance through the Single Sky Committee[24].

3.2.4. Academia, research community and SMEs

Exploratory research supports both research and education in ATM and related sectors, where universities, research centres and innovative SMEs play a fundamental role. Based on the current experience and as a result of the consultations process with the research community, it appears that these actors require longer-term organisational and financial stability in order to generate the best environment for the development of the highest value ideas.

3.2.5. Passengers

Since SESAR aims at shorter flight times (10 min. on average per flight), improving the predictability and punctuality on arrival and departure, increasing safety and reducing fares (up to €5 per ticket on average), passengers are clear beneficiaries of a modernised European ATM system.

3.2.6. EU citizens

Since SESAR aims at managing air traffic management more efficiently notably with appropriate flight paths around the airports and shorter en-route flight tracks, the health of EU citizens will ultimately benefit from the reduction of air pollutants and noise around airports and the environment will benefit from the reduction of greenhouse gas emissions.

4. OBJECTIVES AND INDICATORS

The objectives of the EU action should be viewed as a hierarchy consisting of 3 interrelated levels (general, specific and operational) where the time horizon differs for each level.

[24] Regulation (EC) 549/2004, Article 5.1.

4.1. General objective and linked indicators

By preparing and supporting the timely deployment of the SESAR concept in accordance with the ATM Master Plan, the general objective of the proposed initiative is to contribute to achieving the SES performance targets by 2020 and beyond, namely:

- to enable a 3-fold increase in capacity which will also reduce delays both on the ground and in the air;
- to improve safety by a factor of 10;
- to enable a 10 % reduction in the effects flights have on the environment and;
- to provide ATM services to the airspace users at a cost of at least 50% less.

"As early as 2008, the definition phase of SESAR concluded that, with SESAR's contribution, SES could achieve the following targets by 2020:

- 73% increase in capacity from 2004;
- Associated improvement in safety so that the total number of ATM induced accidents and serious or risk bearing incidents will not increase despite traffic growth;
- 10% reduction per flight in environmental impact compared to 2005; and
- 50% reduction in cost per flight compared to 2004."[25]

SESAR contribution to the high-level goals set by the Commission are continuously reviewed by the SESAR Joint Undertaking and kept up to date through future versions of the ATM Master Plan. [26] As a direct consequence of this continuous review and based on early results from the development phase, SESAR is now targeting for Step 1 to enable[27], as compared to 2005 performance:

- 27 % increase in airspace capacity and 14% in airport capacity;
- Associated improvement in safety so that the total number of ATM-induced accidents and serious or risk bearing incidents does not increase despite traffic growth generated by

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25 *The European Roadmap for Sustainable Air Traffic Management – European ATM Master Plan (Edition2)*, SESAR (Oct. 2012), p. 17.

26 *Ibid.*

27 The ATM Master Plan establishes for each of its three concept steps the associated SESAR performance targets contributing to the overall SES high level goals. Step 1 targets have been agreed, Step 2 targets are to be refined, whereas Step 3 targets are still to be defined. Step 1 and most of Step 2, whose R&D activities should be completed by end 2016, will only contribute partially to the SES performance targets. A significant part of the SESAR improvements required to meet the SES performance targets by 2020 is expected from Step 3.

SESAR (i.e. through air-space and airport-capacity increase). In an absolute term, 40% of reduction in accident risk per flight hour is allocated to SESAR;

- 2.8 % reduction per flight in gate to gate greenhouse gas emissions;
- 6 % reduction in cost per flight[28].

4.2. Specific objective and linked result indicators

The specific objective is to ensure the concentration and coordination of all relevant ATM R&I activities in the EU to implement the ATM Master Plan.

The result indicators related to this specific objective are:

- The measurement of the actual consumption effort by partners;
- The status of completion against the ATM Master Plan;
- The general status of independencies between projects;
- The status of issues and relevance of action plans; and
- The number of SESAR research prototypes or operational procedures that have reached the maturity phase.

4.3. Operational objective and linked output indicators

The operational objective of the action is to provide an efficient implementing instrument that ensures coordination and concentration of all relevant ATM R&I efforts in the EU. In this respect, the following aspects need to be taken into account:

- Pooling and coordinating R&I public and private investments in a cooperative spirit and bringing together the key actors from ATM sector across Europe in order to implement the ATM Master Plan;
- To enhance the exchange of knowledge between actors and disciplines; and
- To gather the necessary critical mass of resources necessary to validate the concepts of operation resulting from research results.

The output indicators reflecting the efficiency of the instrument put in place in ensuring partnership and focused efforts are:

- The assessment of stakeholders' involvement in projects;

[28] *The European Roadmap for Sustainable Air Traffic Management – European ATM Master Plan (Edition2)*, SESAR (Oct. 2012).

- The assessment of how the SJU focuses on projects with most added values;
- The measurement of the project management efficiency;
- The measurement of the quality of resources planning in ATM R&I; and
- The existence of test and validation processes of SESAR products to ensure a robust business model.

All data collection and assessments will be carried out in the frame of the monitoring and evaluation measures laid out in chapter 7. Future monitoring and evaluation.

5. ALTERNATIVE DELIVERY MECHANISMS AND RISK ASSESSMENT

5.1. Identification of options

In order to address the problem identified above, and in light of the findings of the evaluation, stakeholders' consultations and workshops, the Commission has envisaged the following options:

5.1.1. Option 0 (baseline) - Collaborative research under Horizon 2020

Under the baseline option no further EU action is undertaken in relation to the SJU, which will expire as initially set out on 31 December 2016 after having completed its current work programme. All remaining activities of Step 2 and the activities of Step 3 of the ATM Master Plan would need to be implemented through collaborative research under Horizon 2020 and managed by the European Commission or delegated to an Executive Agency.

5.1.2. Option 1 - Integration of EU coordination and concentration in Eurocontrol

Here, Eurocontrol, the Pan-European Organisation for the Safety of Air Navigation, takes over the coordination of all activities required to finalised Step 2 and Step 3 of the ATM Master Plan.

5.1.3. Option 2 - Contractual Public-Private Partnership (PPP)

This option foresees a contractual PPP between the industry and the Commission, focused on completing the ATM Master Plan activities. Contractual PPPs are ad-hoc and flexible arrangements between the industry and the Commission, allowing a fast start-up of activities and rapid implementation of programmes relevant to the needs of a specific industry.

5.1.4. Option 3 - Extension of the SJU

In this last option, the existing structure set up to coordinate and programme the development and validation of SES performance compliant technologies and procedures is extended, in view of completing the activities foreseen in the ATM Master Plan. As already mentioned, the

activities that will start to be deployed as of 2014 and in the future years result from the work performed by the SJU and its Members on Step 1 and Step 2 of the ATM Master Plan. The SJU will play a key role to ensure that the results are packaged in view of their adoption by the Commission as Common Projects and made available to the entitity(ies) that will be selected as deployment manager in 2014. The extension of the SJU further supports, on the one hand, the R&I needs highlighted in the Master Plan to research and develop around the most advanced part of Step 2 and the full scope of Step 3 of the Master Plan and, on the other hand, the bridge between development and deployment with the production of proposals for deployable Common Projects.

5.2. Methodology for comparing the options

The envisaged alternative delivery mechanisms will be assessed in a qualitative manner pursuant to the following methodology.

The first axis of comparison between these options focuses on:

- Their ability to reach the operational, specific and general objectives as defined above (effectiveness)
- The degree of conformity between objectives and activities of the ATM Master Plan and the activities of the instrument underlying the option (relevance) and
- Their ability to achieve results at reasonable costs (efficiency) and
- An assessment of risks.

The second axis of comparison, in the case of a PPP (options 2 and 3) will consist in a complementary assessment checking to what extent the following Horizon 2020 eligibility criteria are fulfilled[29]:

Box 1: Eligibility criteria of Horizon 2020

Existing joint undertakings may receive further support from Horizon 2020, based on the evaluation of certain criteria:

1. They address Horizon 2020 objectives;
2. They meet the criteria laid down in Horizon 2020:
   a) the added value of action at Union level;
   b) the scale of impact on industrial competitiveness, sustainable growth and socio-economic issues;

[29] COM(2011) 810 final

c) the long-term commitment from all partners based on a shared vision and clearly defined objectives;

d) the scale of the resources involved and the ability to leverage additional investments in research and innovation;

e) a clear definition of roles for each of the partners and agreed key performance indicators over the period chosen.

Finally, in case of the extension of the SJU, an additional criterion applies requiring that it has shown to have made significant progress under the FP7.

Cost-effectiveness of relevant qualitatively assessed options is discussed in Chapter 6.

5.3. Comparing the options

The comparison of the options below is proportionate to the scope of the problem identified.

5.3.1. Policy option 0: Collaborative research under Horizon 2020

Horizon 2020[30] covers a wide range of activities and different participation rules may apply to different parts of the programme. Its operational aspects are currently being finalised, so for the purpose of this evaluation, when referring to Horizon 2020, the procedures and rules from the 7th Framework Programme for Research (FP7) are used. Under FP7, for the R&I programme in transport, the European Commission announces annual "work programmes", which include the schedule of the "calls for proposals" that will be published during the year. Each call for proposals covers a specific research area. Proposed projects are submitted by consortia made up by a range of actors, from industry and academia, coming from a minimum of three different Member States or associated countries. The Commission selects the best proposals and awards financial support to the projects. The conditions for granting the EU financial support is governed through grant agreements with each consortium. The Commission or a delegated Agency manages these grant agreements.

First axis of comparison

Effectiveness

The development of new ATM capability at low/medium Technology Readiness Level[31] (TRL) would be effective under Horizon 2020. However, a wide range of technologies would be generated through a number of non-coordinated individual projects or a set of individual projects which are subject to the process of open calls for proposals. In the short-term, these

30 http://ec.europa.eu/research/horizon2020/index_en.cfm?pg=h2020

31 Scale of TRL ranging from 1 to 9: TRL1 expresses the technology readiness of basic principles and observed (exploratory and applied research) up to TRL9 a successful operational experience which is fully tested, validated and demonstrated in its operational environment. Next step would be industrial deployment.

projects would not be of substantial contribution to the implementation of the ATM Master Plan, which would inevitably incur a delay in its achievement.

Besides the low success rate of calls for proposals (in Framework Programmes, a proposal has a 20-30% chance in succeeding in receiving a grant), there is a very high level of uncertainty on how much the results of stand-alone and low/medium TRL projects will be further developed and integrated in R&I to actually lead to deployment.

Another issue is how the results obtained in individual projects would be collected, analysed and processed within EC project management structures to ensure that they feed in the ATM Master Plan. This is a demand that goes beyond the current approach to European research and innovation within the Commission and would therefore require gathering expertise and skills for this new task. Again, there is a risk that building up the resources to answer this demand would delay achieving the ATM Master Plan.

This option potentially holds an accumulation of delays at different levels such as the coordination of results, the development of technologies and the preparation for deployment. It is estimated, for the purpose of the present analysis that these delays would amount to 5 years compared to the current deployment plan of the SESAR concept.

Timing and risk assessment are key issues here for the industry. If the research results are not sufficiently tested, validated and demonstrated, they will not be incorporated into the next phase of the product development leading to a delay in their implementation.

Furthermore, the responsibility for the maintenance of the ATM Master Plan would need to be reassigned.

Relevance

Under Horizon 2020 the industry and research stakeholders can provide their input through various consultation mechanisms and platforms, but do not formally decide on the content of the work programmes. The EC would have to strive to develop work programmes and design calls that respond to the ATM Master Plan demands. This would inevitably take time and, given the complexity of the issues at hand and the need for a coordinated network approach in the R&I, activities are unlikely to follow the ATM Master Plan's rigorous timing.

Efficiency

Assuming that the work programme is aligned with the ATM Master Plan as best as possible, the Commission would still need to provide substantial efforts to accompany and coordinate the development process with the industry to ensure the continuity because of the number of projects and because of the uncertainties in terms of results and the elusive link between research results and deployment.

Also, the costs of winding down the SJU would need to be added to the costs incurred in programming, managing projects and activities within Horizon 2020, which show that this option is far from efficient in terms of financial and organisational means.

5.3.2. Integration of EU coordination and concentration of ATM R&I in Eurocontrol (Option 1)

Eurocontrol is an intergovernmental organisation made up of 39 countries, including the 27 EU Member States and the European Union. Founded in 1960, it is a civil-military organisation that has developed into a vital European repository of air traffic management excellence, both leading and supporting ATM improvements across Europe. Eurocontrol is committed to the SES, is founding member of the SJU and plays a leading role in several SESAR work packages (e.g. ATM Master Plan maintenance).

Under this scenario, Eurocontrol would take over the coordination of the all remaining activities of Step 2 and of all the activities of Step 3 as defined in the ATM Master Plan. This new role would need to be aligned with the existing high level agreement[32] defining the collaboration between Eurocontrol and the European Union. The management of EU funds by Eurocontrol would demand a delegation agreement pursuant to the financial rules of the Commission.

First axis of comparison

Effectiveness

Considering the need for strong governance in ATM R&I and for continuity, Eurocontrol would have to be able to take over very smoothly during the overlapping period 2014-2016 and ensure the buy-in and commitment of all stakeholders in a similar manner as the SJU. This implies setting up dedicated cooperative decision and management processes, to concentrate and coordinate all ATM R&I in Europe. The feasibility of setting up such arrangements would need to be adapted to Eurocontrol's governing rules and regulations, which are in some aspects substantially from the EU internal control and management framework (no audit from the European Court of Auditors, no reporting to the budget authority ...).

A delegation agreement under the Financial Regulation would need to be established between the EC and Eurocontrol to provide a clear cooperative framework to manage EU R&I funds. However, because this approach implies the delegation of authority to Eurocontrol, such a framework has little flexibility and requires a complex process to certify Eurocontrol's accounting and management systems and a substantial administrative effort to follow-up and monitor the implementation of the agreement. Moreover, the current rules governing Eurocontrol do not allow it to manage grants.

[32] COM (2012) 0438 final

Relevance

Considering SESAR's future development activities, a conflict of interest could stem from Eurocontrol's role as a coordinator of R&I activities and its involvement in their implementation. Moreover, Eurocontrol has expressed its interest to continue its participation in an extended SJU as founding member[33]. This confirms that, while Eurocontrl considers participating to the extended SJU subject to the agreement of its governing body, they do not express the will to act as implementation instrument of the SESAR programme. Considering all the aforementioned elements, this does not appear a viable option to further explore.

Efficiency

The overlap period (2014 – 2016) between Eurocontrol's take over and the end of the SJU activities would challenge the principle of single governance for the SESAR project and necessitate coordination efforts to steer the development processes of the SES technological pillar. This leads to the conclusion that a seamless transition from the SJU to Eurocontrol would be costly in financial and organisational terms and would jeopardise the timely delivery of the ATM Master Plan objectives. In addition, Eurocontrol has not established assurance systems such as those in place in the EU and in the SJU, such as ex-post project audits and assurance activities, value for money audits, etc. which will require the establishment of new activities and know how before being effective.

Here as well, the costs of winding down the SJU would need to be added to the costs incurred in organising the coordination efforts, managing projects and results, with an obvious negative impact in terms of financial and organisational efficiency.

5.3.3. Contractual PPP (Option 2)

Under FP7, research contractual public private partnerships (cPPPs) are effectively new cross-thematic programmes in that they bring together research topics from different themes. They differ from the standard FP7 Co-operation programme themes in the engagement of both the industry and the Commission in the preparation of the annual work programme and call formulation, and in the co-ordinated multi-theme nature of the calls. So far, cPPPs have produced multi-annual roadmaps aligning research topics to the current needs of their respective industries and focussing on outcomes which could result in market available systems within 3-5 years. The emphasis here is on the speed of delivery to the market, which is regarded by industry as a highly beneficial aspect of the research cPPP actions[34].

However, in the existing cPPPs, the Commission – industry partnership is not officially formalised, which would prevent a SESAR cPPP to take ownership of the ATM Master Plan.

[33] Letter of 12 October 2012 from Eurocontrol's Director General to the DG MOVE Director General

[34] *Interim assessment of the research PPPs in the European Economic Recovery Plan*, European Commission (2011).

These partnerships differ from the current Joint Technology Initiatives (JTIs) in that they use the standard FP7 rules, facilitated for a fast start-up and short implementation time. The Commission services launch calls for proposals and manage projects in the framework of successive annual work programmes following the similar procedures as under collaborative research (Option 0).

First axis of comparison

Effectiveness

In terms of development of technologies, this option could provide good progress. Nonetheless, the technological breakthrough and new concept of operations necessary to implement the ATM Master Plan are complex and demand a coordination that goes beyond prioritising R&I activities (*upstream*). If there is general consensus that the coordination between the Commission and industry in cPPPs has led to better defined objectives in multi-annual roadmaps, simplification[35] and brought together a wide range of industrial stakeholders[36], this cooperative approach would here need to be taken further to integrate R&I results and achievements, demonstration projects, as well as making the link with deployment (*downstream*). As the standard rules for calls for proposals apply here as well, the arguments developed above for collaborative research (option 0) in terms of results coordination also apply. The cPPP's would therefore include an effective results management, linked to the ATM Master Plan adaptation process and the preparation of deployment. Whatever the set up created, this would undoubtedly cost time and resources.

Relevance

A certain level of coordination with the ATM Master Plan could be expected from the cPPP, although the commitment of the private partners to the research agenda outlined in the ATM Master Plan and to the SES would have to be formalised, as cPPPs governance arrangements have so far been developed on an ad hoc basis. It would also be advisable to broaden the industry-Commission association to a representation of ATM users and service providers in an adequate governance structure, to prepare effectively the deployment process.

Efficiency

The ATM Master Plan is a long term plan requiring robust planning of public and private funds to keep R&I activities on track. The private partners involved in cPPPs cover the costs of their internal governance and their participation in research programming activities and potentially in research projects, activities being project based funded from a variety of sources. This endangers a comprehensive programmatic approach that the ATM Master Plan demands and that can guarantee the industry longer term commitment.

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35 *Ibid.*

36 *Partnering in Research and Innovation*, COM(2011) 572 final.

And here as well, the costs of winding down the SJU would be added to the costs incurred in setting up a new cPPP, programming activities and managing projects, activities and possibly results within Horizon 2020. This of course impacts negatively on this option's efficiency in terms of financial and organisational means.

Second axis of comparison

As far as Horizon 2020 criteria for cPPPs are concerned:

- EU Added value: Member States or private stakeholders would not be able, by themselves to leverage and pool together resources, coordinate and steer at EU level SESAR research and development activities towards deployment and actively involve stakeholders. Furthermore, the involvement of the EU will guarantee that the Commission represents the public interest and has the institutional responsibility to drive the process of implementing the SES exercising regulatory and oversight functions. The Commission's leading role in bringing the aviation stakeholders to cooperate and rationalise their resources for modernising ATM, while preserving their driving role, will allow better use of EU and private resources. This will also guarantee coherence of the modernisation of the European ATM system and fair competition on the ATM market. EU intervention in the development of SESAR technologies and procedures will ensure that the EU ATM infrastructure is more strongly driven by European objectives and network benefits.

- The scale of impact on industrial competitiveness, sustainable growth and socio-economic issues are likely to be reduced as the time to set up the cPPP could cause a delay in reaching targets, hence reaping markedly less benefits (as explained in macro-economic impact of SESAR study[37]).

- The long-term commitment from all partners based on a shared vision and clearly defined objectives would need to be carefully defined, as governance arrangements within cPPPs have so far not been formalised, as opposed to Joint Technology Initiatives.

- The scale of resources involved and the ability to leverage additional investments in R&I: so far, cPPPs have been project based funded, following FP7 standard rules. This falls short of what the SESAR project demands, i.e. a guaranteed commitment from partners, in cash and in kind, with the clear objective of finalising the ATM Master Plan activities.

[37] *Assessing the macroeconomic impact of SESAR* (2011)

5.3.4. Extension of the SJU (Option 3)

In this option, coordination and programmatic responsibilities are executed through an existing EU body with a focus on developing and validating SES performance compliant technologies and procedures.

First axis of comparison

Effectiveness

Within the SJU, all relevant stakeholders are involved in decision making processes and share responsibilities. The extension of SJU would enable stakeholders to strengthen relationships with centres of excellence and deepen strategic partnerships. It would seek relationships with partners with specific expertise as needs arise. Additionally, the link with the market is strong here, as suppliers are part of the SJU membership, which in the context of the timely deployment of SESAR may bring a definite advantage in setting up the needed demonstration activities.

The partnership and large scale projects are built around the SES objectives and according to the ATM Master Plan. The coordination, programming and execution of the SESAR related R&I and validation activities are the SJU's responsibility. This ensures continuity and avoids fragmentation of R&I through the single governance structure supported by an effective decision making process, reactive to the needs of R&I phases. Mutual interdependencies and coordination mechanisms between participants and projects and coherence with overarching European concept exist and the system architecture is ensured through multilateral contractual agreements. Additionally, this option allows the overall management and monitoring procedures of the partnership assessing its effectiveness to be underpinned with monitoring processes at each activity or project level. This second layer of monitoring includes regular reviews that ensure that, in all projects, risk mitigation action plans are on track and effective.

By focussing research and development activities on deployment and actively involving stakeholders, the SJU provides an optimal response to the needs of the airspace users and service providers. However, it is important to ensure that the SJU will deliver the expected results on time to reduce risks for the deployment phase.

Furthermore, by undertaking the public-private partnership approach at EU level, it is possible to ensure that the SES objectives of high societal relevance such as safety and decarbonisation are integrated and internalised in the Programme. This approach has allowed leveraging and pooling funding and know-how and reducing fragmentation created by similar national and regional projects, harnessing the skills and innovation capacity of the private sector within appropriate risk sharing arrangements.

Relevance

The existing SJU structure and the single governance supported by active decision making is adapted to the needs of R&I phases, which reflect the evolution of the ATM Master Plan. This close follow up of the ATM Master Plan is also reflected in the fast reactivity of this implementation instrument through continuous monitoring, feedback and update of the three interconnected processes undertaken by the SJU (see Figure 3) to fully integrate the 3 interrelated processes of the SESAR project and where projects are not a stand-alone initiative but rather interconnected.

Efficiency

The SJU has well established governing and management processes that may need to be adapted, taking into account the experiences and lessons learnt, but not completely redefined. Since this option has the biggest innovative impact, transferring new ATM technologies from lab into products in the short timeline of the ATM Master Plan, it enhances the overall effectiveness of public funding and improves the risk to opportunity ratio for the industry investment. In this context, this option addresses adequately the timely deployment of SESAR.

Second axis of comparison

The compliance of the SJU with the Horizon 2020 criteria for existing PPP under FP7 is demonstrated below:

- The extension of the SJU addresses Horizon 2020 objectives: the need for innovative ATM technologies is recognized by Horizon 2020, as it stresses that innovative ATM technologies should contribute to a step-change in safety and efficiency with rapidly increasing demand, to improve punctuality, to shorten travel-related procedures at airports and to achieve resilience in the air transport system[38]. Equally, the implementation and further development of the SES should be supported with solutions for increased automation and autonomy in ATM and aircraft control, better integration of air and ground components, and novel solutions for the efficient and seamless handling of passengers and freight throughout the transport system. In the context of SESAR development, the SJU fully addresses the H2020 objectives.

- The EU added value of action at EU level: see previous option. Also, EU action is clearly justified in the context of the SES policy and regulations, the general objective being to eliminate internal market barriers in the skies. Prior to the SES policy, progress towards efficiency, cost effectiveness, positive environmental impact, etc. in aviation had been slow, which was partly attributed to an unsystematic approach. Consequently, as SES policy is as valid now as it was when first set up, the leading role of the EU within the

[38] Resilience is the intrinsic ability of a system to adjust its functioning prior to, during, or following changes and disturbances, so that it can sustain required operations under both expected and unexpected conditions. Since humans are indispensable in all situations involving change, resilience naturally has strong links with human factors and safety management.

SES policy is as essential today as it was then. The SES policy addresses issues that go beyond national and industry sectors interests or indeed beyond their remit. Therefore, on their own, Member States, as well as industry sectors, will not be able to address the above mentioned problems. Aviation is a truly European and international market that requires common solutions in terms of policy, but also from a technological (interoperability) and business perspective.

- The scale of impact on industrial competitiveness, sustainable growth and socio-economic issues: to stay at the forefront of global competition with a strong technological base and industrial capabilities, increased strategic investments in ATM research and innovation development are required. The successful mastering and deployment of enabling technologies by European industry is a key factor in strengthening Europe's productivity and innovation capacity and ensuring Europe has an advanced, sustainable and competitive economy, global leadership and ability to develop effective solutions to societal challenges. The European ATM manufacturing industry is still mostly organised on a national scale, where systems are produced according to local requirements. This has resulted in the fragmented situation currently existing, in very high unit costs and in scarcity of funds to invest into technological innovation. These conditions undermine ATM industry competitiveness at a global scale, where the USA competitors – e.g. – can benefit of higher public funding and one single, large market.

  According to a study carried out in 2011[39], and subject to the timely delivery of the R&I results, the deployment of SESAR could bring substantial economic, social and environmental benefits with an estimated impact of €428 billion. By pooling resources, involving all ATM stakeholders, properly managing conflict of interest, the SJU ensures the accomplishment of the SESAR Programme, which is essential for the achievement of the SES goals (see section 2).

  Furthermore, the SJU has enabled the EU to enjoy today a strong position on the international scene and has become a recognised reference in the domain of modernisation of ATM systems, allowing the EU to have a strong voice also in standardisation bodies.

- The long-term commitment from all partners based on a shared vision and clearly defined objectives: the SJU today is composed of 2 founding Members and 15 Members representing all ATM stakeholders: military, airspace users, ANSPs, manufacturing industry, airports, staff associations, scientific institutions. In addition to that, the SJU involves 18 Associate Partners of the SJU Members and 8 Associate Partners of the SJU, performing activities that complete the Programme.

  During a public consultation held in 2012, current Members have unanimously expressed their support to an extended SJU, thus showing a long-term commitment to the SESAR programme to reinforce its contribution to the SES policy, as its technological pillar, to

[39] *Assessing the macroeconomic impact of SESAR,* SESAR Joint Undertaking (2011)

continue working with the objectives of bridging the gap between ATM R&I and industrialisation and of contributing to addressing the challenges with regard to SESAR deployment.

- The scale of resources involved and the ability to leverage additional investments in R&I: currently, the SJU manages an investment of €2.1 billion over the period covered by the current Multi-Annual Financial Framework (2007-2013). Each founding Member is providing €700 m, an additional €700m is provided by industry.

  The nature of the SESAR programme is such that it requires a large federated effort over a certain period of time. As regards the return on investment, it can only be measured on the medium and long term, considering the historical implementation in the ATM sector.

  In managing the development phase of the SESAR programme, the SJU support a large-scale multinational research activity. It brings together private and public partners to define common objectives to combine funding and knowledge in order to fulfil those objectives that will have impacts of societal relevance.

  Cooperation between private and public partners at European level can yield significant added value by creating incentives for increased spending in ATM R&I. By joining forces, industry can accomplish far more than by doing it alone.

  More specifically, Integrated Flight Trials and Demonstration Activities can be quoted as an example of key component in the R&I cycle, as they bridge the gap between development and deployment, showing on a large scale the benefits of the Programme in day-to-day operations and build confidence on the SESAR outcomes amongst ATM community.

- A clear definition of roles for each partners and agreed performance indicator over the period chosen: it is expected that in the context of the implementation of the SESAR Programme 2, some changes to the current Membership may occur. The SJU Regulation includes the provisions for the establishment of the Membership, its enlargement and changes, which occur through ad hoc public procurement procedures.

  In terms of Programme Management, adequate mechanisms will be put in place in order to ensure that the activities complementing the core partnership and Large Demonstration activities are managed with the most appropriate approach. At the same time the SJU will set up a single governance structure for the coordination and concentration of the resources.

  The role of the different partners and the performance indicators will be the results of the selection procedure that will be in place once the SJU extension is established. As the SJU is operating as technological arm of the Single European Sky, the performance indicators to which it has to contribute are defined within the SES, which is currently the case.

- Progress under FP7 is evidenced by the Mid-Term Evaluation of the SJU (2010). In accordance with Article 7 of the Regulation 219/2007, the Commission evaluated the implementation of the regulation after three years, the results obtained by the SJU, its working methods as well as its general financial situation. The evaluation concluded that the SJU performed well both in terms of setting up and building its organisation as well as conducting its designated tasks. More specifically, the evaluation assessed the SJU's effectiveness as high as the SJU has produced the required outputs and results, e.g. organising and coordinating activities in accordance with the ATM Master Plan and the management of funding, the mobilising of funds, the involvement of stakeholders, the involvement of SMEs, the organising of technical work avoiding fragmentation.

5.4. Risk assessment

The risks associated with the options mentioned in the previous section are mapped in Table 1. In the table, an event or a series of events, which reduce confidence in the ATM Master Plan and consequently may represent a potential obstacle towards the implementation of SESAR and reaching the SES objectives are summarised along with the mitigation actions that reduce the likelihood of each risk.

Table 1 – Assessment of risks associated to the SESAR implementation tool and mitigation measures.

Risk	Description	Option impacted	Cause	Outcome	Probability	Impact	Mitigation
1	Dispersed R&I activities across Europe of ATM System.	Option O Option 2	• Lack of coordination, fragmentation of R&I activities and results, • No involvement of R&I partners in planning nor in synchronisation of activities, • No commitment from stakeholders to political objectives (SES).	• Delays in delivering performance targets and Master Plan, • Reduced of expected benefits, • No implementation of quick wins to solve blocking points.	High	Very negative: delay in performance delivery of the SESAR Concept; loss of confidence potential benefit of new system leading to users' reluctance to buy in.	• Establish appropriate governance and leadership within EC or Agency, • Implement performance based approach, • Develop partnerships between all actors, develop networks, • Involve all stakeholders in the decision making process, • Ensure adequate funding and correct mechanism for incentives, • Monitor the needs and business plans of all stakeholders and update ATM Master Plan accordingly, • Update H2020 work programmes regularly to reflect the modifications of the ATM Master Plan.
2	Implementation tool is too loose to ensure successful implementation of new ATM System.	Option 1 Option 2	• Lack of ownership of the SESAR programme from the main users (Airspace users, ANSPs, Airport operators), • High degree of R&I fragmentation, • Lack of coordination, fragmentation of R&I activities and results, • No or little involvement of R&I partners in planning nor in synchronisation of activities, • Limited partnerships between stakeholders.	• Timely decisions cannot be made on the investment needed, • Delays on products delivery, • Reduced of expected benefits, • No implementation of quick wins to solve blocking points. • ATM Master Plan milestones are targets are not met.	High	Very negative: the SESAR programme does not deliver on time as governance structure cannot successfully execute the Master Plan.	Empower all network users who assess their commitment to the SESAR concept by involving them in the SESAR governance structure.

3	Investment by key stakeholders cannot be secured.	Option O Option 1 Option 2	• Lack of long term financial commitment from policy makers leading to lack of long term financial commitment from the industry, • Overall costs exceed the anticipated budget, • Long pay back periods typical to the sector.	• SESAR fails due to a lack of investment.	High to very high	Extremely negative: the SES objectives are jeopardised.	• Ensure close coordination between R&I activities and performance targets, • Involve all affected stakeholders in the Master Plan process, • Set up sound and robust funding mechanisms.
4	Shortcomings in meeting design and performance targets.	All	• Insufficient focus on Concept elements critical to providing expected results, • Unsuitable coordination structure, • Lack of integration of the performance based approach, • Technology and sub system based on incorrect/unclear system requirements, • Inability to manage R&I activities to ensure timely delivery of adequate products and solutions to meet the business needs of the users of the network, • Poor prioritisation of R&I activities leading to ineffective use of funds. • No appropriate process monitoring the implementation of SESAR performance , • Projects risk monitoring not systematic and ineffective, • Stakeholders not committed to the SESAR programme,, • No enforcement mechanism to support the performance scheme,.	• Future European ATM system does not deliver the required performance improvements, • Required elements of the SESAR Concept are not addressed, • Refinement and rescheduling of activities increase costs, • Additional costs leading to budgetary issues. • Multiple and heterogeneous targets, objectives, reporting, failure to deliver SESAR Concept,, • Increased delays in flights, • The European competitiveness and GDP will be affected	High	Very negative: significant impact on SESAR delivery.	• Perform validation activities to identify critical steps from the start to allow the appropriate planning of the R&I activities. • Ensure that the SESAR Concept and associated R&I initiatives are updated in the event that R&I results do not sufficiently contribute to the performance targets. • Ensure that R&I activities develop mature equipment to enable timely development of ATM sub-systems. • Prioritise R&I activities to develop the adequate technologies. • Establish processes for coordination of R&I and standardisation. • Proactively manage and finance development of standards. • Provide early definition of performance requirements and assessment of future technology capabilities. • SESAR implementation tool geared towards performance delivery and monitoring achievement of performance targets, • Performance enforcement mechanism and systematic project monitoring processes in place.

5	The regulatory framework is unable to support the implementation of the SESAR programme. [The time scale for the activation of the ATM Master Plan will depend on the SES regulatory agreement. However, this regulatory framework cannot be put in place without a clear agreement on the technology that will be used, specifying the roles and responsibilities of each actor. Technical and operational changes proposed by SESAR must be tested against the current SES regulatory landscape.]	All	• Lack of resources with the necessary skills and knowledge in the various actors involved, • Lack of information to identify the changes required to the regulatory framework, • Lack of coordination between the various political levels involved.	• Delay to the implementation of the SESAR Concept compromises the improvement in performance, • Regulatory fragmentation leads to the coexistence of several systems, which in turn incurs an increase in costs.	Medium	Very negative: delay delivery of SESAR.	Early involvement of the regulator to facilitate the design of the regulatory framework and the appropriate set up of regulatory authorities.

5.5. Summary of the qualitative assessment of the alternative delivery mechanisms

Based on the qualitative comparison of alternative delivery mechanisms in section 5.3, and the risk assessment in section 5.4, the table below provides an overview of how the different options perform.

Option	Effectiveness	Efficiency	Relevance	Risks (H/M/L)	Compliance with Horizon 2020 criteria (+/neutral/-)	Overall Assessment
Baseline	- -	- -	- -	- -	+	- -
Eurocontrol	-	-	-	-	**N/A**	-
Contractual PPP	-	-	-	-	-	-
SJU	+ +	+ +	+ +	-	+	+ +

Legend: = : baseline or equivalent to the baseline
+ to ++ : low to high improvement compared to the baseline
- to - - : low to high worsening compared to the baseline

In light of the above, the qualitative assessment of the proposed options shows that option 3, that is the extension of the SJU represents the best option in terms of effectiveness, relevance, efficiency and risks to continue coordinate ATM R&I beyond 2016. The SJU also complies with H2020 criteria relating to existing joint undertakings created under FP7.

6. COST-BENEFIT ANALYSIS

As mentioned in Chapter 5, the most relevant option, the extension of the SJU (Option 3), identified under the qualitative assessment is subjected to a cost-effectiveness assessment in comparison with the baseline scenario (Option 0). First the benefits produced by each of the two options are presented, then the costs associated with them and finally costs and benefits are brought together to calculate the net benefits of each option.

6.1. Benefits of Option 0 and Option 3

For the purpose of this analysis, the timely delivery of the SESAR concept is taken as the benchmark for the benefits assessment of each option. In section 6.1.1, the GDP impact of SESAR is outlined and in section 6.1.2, the specific macro-economic impacts of each option are examined.

6.1.1. Impact of SESAR on GDP

According to the study "*Assessing the macroeconomic impact of SESAR*"[40] the timely, effective and efficient implementation of SESAR would account for a cumulative positive impact of €419 billion on Europe's GDP over the period of 2013 to 2030, in comparison with a scenario in which ATM is not modernised. This includes:

- a direct impact of €171 billion (increased added value for direct players such as airlines, airports, ANSPs, aircraft and avionics/ATM manufacturers);
- an indirect impact of €108 billion (increased added value for the suppliers of the direct players);
- an induced impact of €139 billion (increased spending by employees who are directly or indirectly affected by SESAR).

Moreover, according to the macro-economic model used, any negative departure from the timeline for implementing SESAR set out in the ATM Master Plan would put the mentioned benefits at risk. A 10-year delay in implementing SESAR would lead to a reduction in economic benefits of €268 billion, compared to the SESAR on-time scenario.

6.1.2. Macro-economic benefits of the options

The study mentioned above assesses and quantifies the economic, social and environmental impact of implementing SESAR for Europe. Its results are based on an analytical and deductive approach to understand how the operational and technological changes enabled by the SESAR programme (i.e. improved services, more fuel efficient and energy optimised point-to-point and more direct flight trajectories, minimum CO_2 operations) will impact the various stakeholders directly or indirectly involved in air traffic management.

Based on the results of this study, the macro-economic impacts for the two policy options can be estimated. This estimation relies on the following assumptions:

- Discount rate: the values calculated for the impact on GPD are discounted in order to reflect their net present value. As recommended by the EU[41] and Eurocontrol[42], a discount rate of 4% is used.
- Air Traffic Forecast: in the present assessment the traffic forecast used is the same as in the macroeconomic study on SESAR of 2011[43], i.e. an estimate of 16,09 million flights by 2030 (about 5% lower than the most likely scenario).

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40 *Assessing the macroeconomic impact of SESAR* (June 2011) - http://www.sesarju.eu/tags/macroeconomic

41 *EU Impact Assessment Guidelines* (2009).

42 *Standard Inputs for EUROCONTROL Cost Benefit Analyses* (2012).

43 *Assessing the macroeconomic impact of SESAR,* (June 2011) - http://www.sesarju.eu/tags/macroeconomic

- SESAR implementation is on time under Option 3 (Extension of the SJU) as the SJU is currently on track, and as this option is the best to avoid disruption of the present R&I momentum and preserve concentration and coordination of the R&I efforts

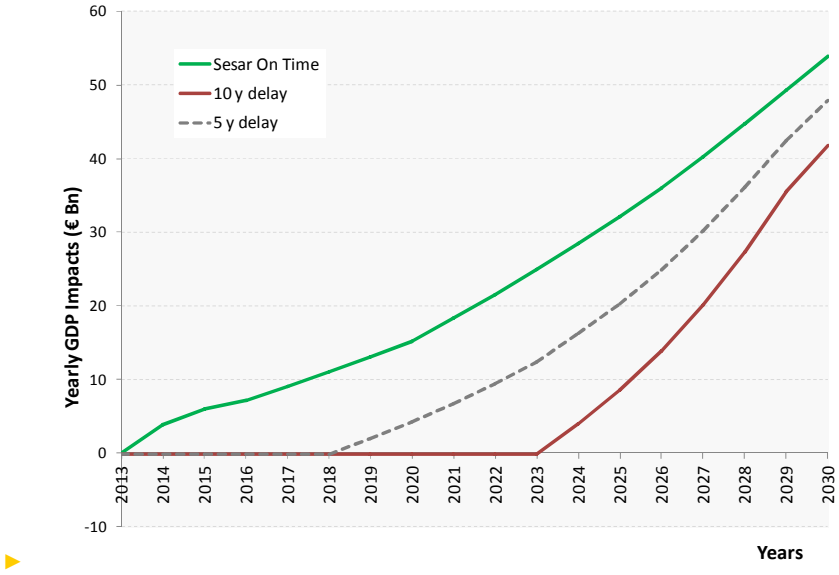
Baseline (policy option 0)

Based on the qualitative analysis and on the results of the consultation processes, the discontinuation of coordinated R&I focused on contributing to achieving SES performance objectives would require longer development and validation timelines.

Following the discontinuation of the SJU and the transfer of the SJU programme under Horizon 2020, it is expected that the Horizon 2020 will have to develop additional absorption capacity of ATM activities. As these activities previously managed and coordinated by the SJU will require organisational, management and as well coordination efforts in European ATM, it is likely that the handover will incur a delay in the deployment of the new ATM concept and that delay is estimated of 5 years. Consequently, assessing the macro-economic impact of the baseline scenario (on GDP) should derive from the available data on the macro- economic impact of a 5 year delay.

The data available on overall GDP impacts envisage two scenarios: on-time deployment and 10 year delay. This gives the possibility to construct an estimate of macroeconomic impacts for the years in between. By extrapolating the difference in GDP between the two scenarios, we obtain an estimate for the year in the middle, which represents a 5 year delay. The graph below illustrates this estimate:

Figure 3: Comparison of Yearly GDP Impact for SESAR on time vs. SESAR delayed



Policy Option 3: SJU extension and on time deployment of new SESAR ATM system

In terms of impact on GDP, Policy Option 3 is based on the scenario "SESAR on time" as shown in Figure 7 by the solid green line.

The graph shows the difference in benefits between the two options. The baseline scenario (solid brown line) does not provide any benefit in the first five years, while Policy Option 3 produces benefits as of year 2013.

Based on our assumptions, these yearly values are added to obtain the total benefits for the period up until 2035[44]. In this time frame, the baseline scenario reaches **€264 billion** in total discounted benefits, while Policy Option 3 accounts for a total of **€403 billion** in discounted benefits.

Table 3: Cumulative discounted benefits (in term of GDP) - € bn

Policy Options / Years	Baseline Scenario	Policy Option 1
2028	100,41	208,31
2030	147,61	262,31
2035	264,36	403,11

6.2. Description of costs

The following investment costs have been identified for the purpose of this analysis:

- The winding down of the SJU,
- The transfer of ATM R&I efforts from SJU to Horizon 2020,
- The R&I efforts to develop SESAR (2014-2020),
- The investments in infrastructure (SESAR deployment).

6.2.1. Costs relating to winding down the SJU

It is assumed here that for two years after 2014, the costs of the SJU will actually remain the same. The actual winding down cost will actually depend on the SJU staff statutes, and those vary widely.

For the purpose of this assessment, it is estimated that the total cost of winding down the SJU is €6 million. This estimation is based on the current personnel cost of the SJU[45], which it is assumed will undergo a linear decrease to two thirds in 2017 and one third in 2018. The cost will be 0 from 2019 onward.

[44] Cumulative discounted benefits are increasing (for the period 2013- 2030) but with a decreasing annual growth rate. We suppose this reduction is confirmed for the period 2030 - 2035 (i.e. annual growth rate fall at a rate based on average of past decrease).

[45] *Budget 2012*, SESAR Joint Undertaking (Dec. 2011)

Policy option 3 considers an extension of the SJU until 2024. We estimate the total cost of winding down the SJU after 2024 as the same as above.

6.2.2. Transfer of ATM R&I efforts from SJU to Horizon 2020: Collaborative research projects managed by EC

It is assumed here that Horizon 2020 takes over the SJU work programme, and the following management and administrative costs are based on FP7 data. It is considered that the operational costs associated to the transfer of activities to Horizon 2020 would be **€54 million** spread over the period of 2014-2024.

Indeed, according to the experience in managing FP7, the EC has used **€285 million** to cover the management and administrative costs for an overall FP7 Transport budget of **€**4.244 billion of EC contribution. This means that the total costs for FP7 transport budget is **€8.5 billion** (considering an average EC contribution rate of 50%). Therefore, the **€54 million** of administrative costs pertained to the transfer of R&I activities to Horizon 2020 are found by extrapolating **€1.6 billion** (total costs of future SJU working programme) with **€**8.5 billion (FP7 working programme).

6.2.3. Costs relating to R&I efforts to develop SESAR (2014-2020)

Taking into account the activities to be performed beyond the current SJU work programme a high level exercise has been undertaken to provide the initial estimates of future SJU costs.

These estimates are based on the following assumptions:

- the work to be performed to achieve the ATM Master Plan targets. As already mentioned, this analysis considers the completion of Step 2 and Step 3;
- the unit costs and their structure based on the costs of the current Members and Projects' composition;
- the breakdown between the different phases of applied and pre-industrial research (i.e. V1/V2/V3) derived from the ongoing Programme;
- the level of horizontal activities is proportionally in line with the current Programme;
- implementation of lessons learnt in terms of programme management, in particular less complexity, better prioritisation, simplification;
- maintain and foster Innovation and Scientific Excellence in Europe (LTR), bringing back the level of activities in this stream of research to ensure that new ideas/research would have space and opportunities to be adequately considered, while maintaining competitiveness against other parts of the world;

- bridge R&I and Implementation through Large Scale Demos, in particular, with the extensive involvement of different manufacturers of the airborne industry and Airspace Users and to answer interoperability aspects.

The total estimated cost of these activities is estimated to be €1.6 billion and is distributed along the different streams of R&I as represented below:

- Exploratory research(V0) €100M = 6%
- Applied research(V1-V2) €742M = 47%
- Pre-industrial development (V3) €436M = 28%
- Large scale demos €300M = 19%

As presented in section 2.2., the total costs (€1.6 billion) of the future SJU programme would be shared between the founding members (EC, Eurocontrol and industry): €0,5 - €0,5 - €0,6 billion respectively. The SJU administrative cost is included and estimated at 5% of the total costs (€80 million).[46] [47] [48]

For the period of 2014-2020, representing 7 years of R&I activities, the annual average costs is expected to be €217 million.

In the case that the SJU is not being extended (Policy Option 0), the current R&I initiatives will continue to exist but new initiatives will fall under Horizon 2020. We estimate the cost of EC contribution at 50% or €108.5 million yearly for the same period.

[46] As reported on page 49 of the Provisional Annual Accounts 2012, according to the budget, the administrative costs of implementing SESAR currently amount to 37.3 million EUR, representing 2.5% of the operational costs. It is expected that by the end of the Programme the administrative costs will reach around 5% of the operational costs as planned and contractually established.

[47] As regards building costs, as reported on page 41 of the Provisional Annual Accounts 2012, the annual full cost of the SJU premises – including guard services, cleaning, insurance, taxes etc are around EUR 0,9 million per year. The SJU rental contract is construed in a manner to allow the SJU to continue using the current premises, or to terminate its use in the case of non-extension.

[48] SESAR JU currently employs 42 FTE of which 27 temporary agents, 4 contractual agents, 7 seconded form Members 1 seconded from Eurocontrol and 3 national experts. In addition, as part of its contribution in kind – included in the amounts reported in annex III, Eurocontrol has out-posted at the SJU premises a Unit dedicated to the SESAR Programme of maximum 20 FTE, the Programme Support Office (PSO). At the end of 2012, 16 FTE were part of this unit. The extension of the SJU will require maintaining the current staffing level to ensure the adequate implementation of the Programme 2. It is possible that during the 2014 – 2016 period ad hoc additional needs of temporary staff to follow up the phasing out and phasing in of the two different Programmes may be necessary. These specific needs will be assessed once the design of the Programme 2 will become more specific and detailed. It seems reasonable to assumed here that an addition of 3 FTEs will be sufficient for three years.

6.2.4. Costs relating to investments in infrastructure (SESAR deployment)

The SJU aims at developing the new SESAR concept according to the Master Plan. It will prepare the deployment of new technologies but the actual deployment is not under its remits. The new ATM system must be adopted by the stakeholders.

To calculate the cost of investment in SESAR infrastructure, we start from the latest version of the ATM Master Plan which contains a first estimate of the civil investment cost for the relevant stakeholders up until 2030[49]. The total cost for the period 2014-2030 is estimated at about €22 billion. The estimation relates to Airspace Users, ANSPs and Airport Operators and the infrastructure investment is due for any option.

When considering Policy Option 3 the estimated investments of the revised ATM Master Plan are used and considered being on time. In this estimation, about 60% (or €13.2 billion) of the total investments has been done linearly up to 2024, the remaining investments (40%) are spread in a comparable way over the period 2024-2030.

As per the 5 years delay pertained to Option 0, we assume investments follow a slower pace compared to Option 3. The level of 60% of the investment cost will be off-set five years later, i.e. in 2029. The total period considered is extended to 2035 and the remaining 40% divided in a linear way over 2030-2035.

6.2.5. Overview of total costs

In absolute terms, all costs are the same for both options except for the transfer of R&I efforts which would incur additional expenses under Option 0.

From the table below, it can be seen that total costs for Option 3 is lower (€23.606 million) compared to Option 0 totalising €23.660 million.

Table 4: Cumulative total costs

Costs description (in Million Euros)	2020		2025		2030		2035	
	Option 0	Option 3	Option 0	Option 3	Option 0	Option 3	Option 0	Option 3
· Transfer of R&I efforts	54							
Winding down the R&I efforts (SJU)	6			6				
· R&I efforts (2014-2020)	1600	1600						
Investments in infrastructure (SESAR deployment)				13200	13200	8800	8800	
Total costs	**1660**	**1600**	**0**	**13206**	**13200**	**8800**	**8800**	**0**

6.3. Conclusion of the cost-benefit analysis

The costs and benefits associated with Option 3 (extension of SJU) are compared for the period 2013-2035 with those of the baseline scenario, the transfer of ATM R&I activities under collaborative research in Horizon 2020.

[49] These figures are based on the version of the ATM Master Plan (v2.3) as it was available at the moment the study was performed.

Table 4 summarises the cumulative benefits for the period 2013-2035 for the two options. By 2035, benefits are lower for the baseline scenario (around **€264 billion**) than for Option 3 (**€403 billion**).

The policy options have slightly different costs associated with them, as described in the previous section. Cumulative costs are the lowest for the Option 3 **(€23.6 billion**), while Option 0 expected costs are **€23.66 billion**.

A cost-benefit analysis brings together the net benefit value of each Policy Option. The table below shows the costs, benefits and net benefits for both options.

Table 5: Costs, Benefits and Net Benefits (in billions)

CBA (Billion euros)	Option 0	Option 3
Costs	23.66	23.6
Benefits	264	403
Net benefits	240.34	379.4
% costs vs benefits	9.0	6

Clearly, as shown in Table 5, the costs represent a small percentage (ranging from 9% to 6%) when compared to the benefits. From these results, it can be concluded that policy option 3, i.e; an extension of the SJU, is more attractive in terms of a cost-benefit analysis as the net benefits are significantly higher.

7. FUTURE MONITORING AND EVALUATION

The future monitoring will be built according to the performance framework ensuring that R&I activities are contributing to the ATM Master Plan (see 4. Objectives and indicators). These monitoring principles apply to the preferred option (Policy Option 3).

The monitoring and evaluation build on existing monitoring processes which include:

- Every three years from the start of the activities of the SJU and at least one year before expiry of the tem of the JU, the Commission will carry out evaluations on the implementation of the Regulation.

- Annual and multi-annual work programmes to inform the EC and possibly SJU members, alongside Annual Activity Reports, including financial statements. Pursuant to Regulation 219/2007, the Administrative Board, chaired by the representative of the European Union (i.e. the Director General of DG Mobility and Transport), is responsible for approving annual work programmes and activity reports.

- Administrative Board meetings, in which SJU reports to the EC and its members. The EC would continue to have appropriate access to all committees and working groups established at all levels in the SJU.

- Monitoring at SJU programme level. In terms of performance monitoring, the SJU produces a number of reports which are collected from the projects via reporting templates and from the SESAR Release Reports. The objective of the Programme monitoring and reporting is to measure and compare results at different levels, from different viewpoints and for various audiences.

- Monitoring of risks will also give specific attention to the research phases (real time demonstrations with all possible risks attached) and to the research areas.

- Specific monitoring for the large Scale demonstrations, including organisation and monitoring of the results.

8. CONCLUSIONS

The ex-ante evaluation for the extension of the SESAR Joint Undertaking has been performed since its present set up does not ensure continuity in coordinating all ATM related R&I efforts in the Union beyond 31.12.2016.

A qualitative assessment of 4 alternative delivery mechanisms of coordinated EU ATM R&I has been performed:

- Option 0 (baseline) - Collaborative research projects under Horizon 2020;

- Option 1 - Integration of EU coordination and concentration in Eurocontrol

- Option 2 - Contractual Public-Private Partnership (PPP)

- Option 3 - Extension of the SJU

This qualitative assessment has shown that the extension of the SJU represent the best option in terms of effectiveness, relevance, efficiency and risks to continue coordinating ATM R&I beyond 2016. This option is also the most suitable in contributing to the general objective of achieving the SES performance targets through the timely deployment of the SESAR concept in accordance with the ATM Master Plan.

The several sources - the Mid-term Evaluation of the SJU (July 2010), the internet public consultation held from 25 July 2012 until 17 October 2012, and the two consultative workshops held on 02 October 2012 and 23 November 2012 - have contributed in drawing lessons from the past and have given a valuable insight of stakeholders opinions. A very large majority of the stakeholders considered that the SJU has delivered significant added value in the realisation of the keys objectives and the extension of SJU beyond 2016 is largely supported by the stakeholders. Also, the view was shared by stakeholders that a non-extension of the SJU would cause a delay of close to 5 years in the realisation of the objectives of SESAR programme.

The cost-benefit analysis undertaken in this report compares the extension of the SJU (option 3) with the baseline scenario. It demonstrates that for both options, costs only represent a small percentage (ranging from 9% to 6%) when compared to the benefits. It concludes that policy option 3, i.e. an extension of the SJU, would bring a better return on investment.

This evaluation therefore concludes that the extension of the SJU beyond 2016 is the preferred action.

ANNEX 1 – RESULTS OF MID-TERM EVALUATION, PUBLIC CONSULTATION, WORKSHOPS, AND LESSONS LEARNED

Several sources indicate what has been learned from the exercise of the "first" SJU: the *Mid-term Evaluation of the SESAR Joint Undertaking*[50] (July 2010), the internet public consultation held from 25 July 2012 until 17 October 2012, and the two consultative workshops held on 02 October 2012 and 23 November 2012.

SJU mid-term evaluation

The SJU mid-term evaluation concluded that the SJU performed well during the 2007-2009 period, both in terms of setting up and building its organisation as well as conducting its tasks. Although it was too early to assess the overall programme efficiency of the SJU, progress made during the evaluation period indicated that the Joint Undertaking / Public Private Partnership model as a legal entity established under the EC Treaty[51] had proven to be more effective and efficient to execute Community research and development activities and demonstration programmes than if driven within FP7 R&D programme for which activities would be performed through calls for proposals.

The SJU's key achievements noted by the evaluation were:

- Gathering and committing stakeholders on a common R&D programme;
- Developing the work programme that supports rationalisation and consistency, avoiding gaps and overlapping;
- Developing the required methods and tools for programme implementation;
- Initiating a number of projects within a short timeframe without compromising on the quality requirements and needs for coordination between work packages and projects.

The evaluation also notes some challenges facing the SJU at the time. The first one relates to maintaining its capacity to coordinate all work-packages and projects and validate the deliverables. The second focuses on communication processes and instruments, which should be further developed to meet the differentiated communication needs of the founding members, SJU members and other stakeholders, members and non-members of the Administrative Board.

[50] http://ec.europa.eu/transport/facts-fundings/evaluations/doc/2010_sesar_mid_term.pdf

[51] The EC Treaty provides for the possibility to establish Joint Undertaking (Art 171, now TFEU 187). The Joint Undertaking (JU) is the legal entity constituting the framework for the JTI activities. Each JU is adapted to the specificities of each JTI.

The public consultation

A total of 52 responses were received in the frame of the public consultation on the potential extension of the SJU. 62% of the total of respondents declared themselves as having an interest in air traffic management and aviation. More than four in five respondents were involved in the SESAR Joint Undertaking (SJU). There was a 71% - 29% split between organisations (37 responses) and individuals (15 responses). Countries of residence most cited were Spain, Belgium, Germany, Italy and France.

The main result of this public consultation is that the vast majority of the respondents acknowledge that the SJU is performing well and has had a positive impact on ATM R&I. The SJU is seen as most influential in reducing fragmentation of ATM R&D efforts in Europe and logically in coordinating EU funded R&D in ATM and in technical progress on new ATM solutions. A majority of respondents also see the SJU improving or strongly improving the EU position in the global context of ATM modernisation programmes.

The SJU is viewed as being clearly most successful in three areas: ensuring the involvement of stakeholders of the ATM sector in Europe; guaranteeing the necessary funding for the development of the SESAR Project; and organising and coordinating the activities of the development phase of SESAR.

Although respondents identify the added value of the SJU and its achievements in ATM R&I, a very large majority still thinks that there is a continued need for EU intervention in the ATM area (94%), and that the SJU should be extended under Horizon 2020 (81%).

Respondents also mention improvement possibilities, but opinions vary greatly on what should precisely be bettered. Issues mentioned are e.g. the communication between and within stakeholders, the simplification of procedures, top-down *vs.* need driven approach, the use of existing ATM research facilities and networks.

Consultation workshops

Two workshops were held in the frame of the consultation process on the SJU extension under Horizon 2020. The first one took place on 2 October 2012. It was aimed at organisations directly involved in SESAR and gathered 28 participants from the manufacturing industry, ANSPs, research institutes and universities, Eurocontrol, the SJU and the Commission. Airports and airspace users were excused. The second workshop took place on 23rd Nov. 2012. It targeted a wider public, and 56 participants from the aviation sector, including airports and airlines attended.

In both workshops, participants were in principle in favour of an extension of the SJU under Horizon 2020: the SJU is working, its strong point being that it gathers all ATM R&D relevant actors and manages well a productive, if complex, collaboration. Many supported a request for additional financial means. There was a general agreement to keep the focus on R&I activities, but it was suggested to include more large scale demos. It was noted that the scope of activities of the SJU has already broadened, e.g. they now include UAS, which was not the case at the beginning. A

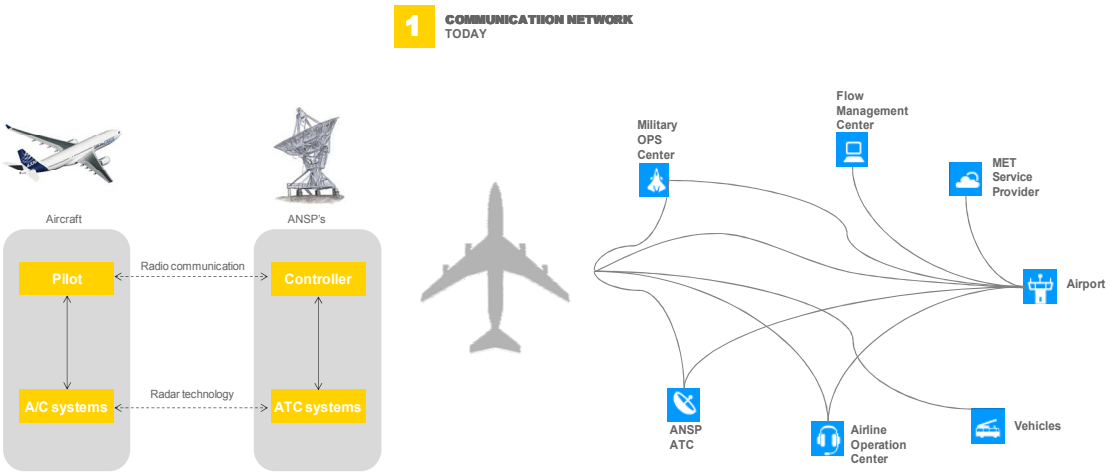
point of discussion was the confusion between the notion of a legal extension in time for the SJU and the timelines of the "SESAR project" as defined in the regulation. Some have taken the progress along the timeline of the SESAR project to mean that the SJU will in the next phase become involved in deployment. It was generally agreed that improvements or changes in scope and governance could be addressed within the frame of the current regulation.

In the second workshop, the membership in "SJU II" was discussed, and some participants expressed their interest to re-commit for the next financial round. Should the membership application process be reopened, the view was that it would benefit from past experiences and be a quicker process. Discussions on financial needs and repartition were not conclusive.

ANNEX 2 - TECHNOLOGICAL CONTRIBUTION TO THE SES

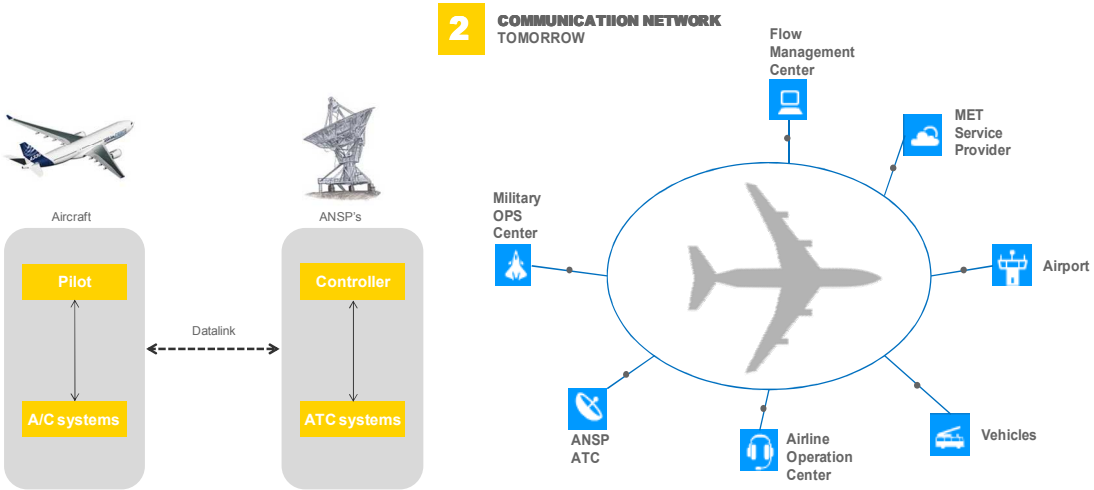
The institutional changes in ATM organisation and operations brought about by the SES are not sufficient to achieve the full implementation of the SES. These institutional changes need to be complemented and supported by modern and harmonised technologies and procedures that will enable greater punctuality, improve services and safety, optimise fuel consumption, reduce CO2 emission and allow more direct flight trajectories. The SESAR project, through its definition, development and deployment processes, will deliver a new and global interoperable concept of ATM where operations will be built around a continuous sharing of data between aircraft, air navigation service providers and airports (see Figures 4 and 5).

Figure 4: Current ATM concept



The future ATM system will rely on a network communication environment based on datalink technology, as illustrated in Figure 5.

Figure 5: SESAR concept of operations



Coordinated and focussed development of technologies and procedures is at the heart of the ATM modernisation that will achieve the SESAR concept (Figure 5). Coordinated and focussed development is also at the heart of the interactive cycle that translates the needs identified in the definition process into validated technologies and procedures that feed into the deployment process (see Figure 3).

The current SESAR development phase (2007-2016) is at full speed and has started to deliver validated results for the first phase of deployment. As mentioned above, the current work programme of the SJU covers Step 1 and part of Step 2 of the ATM Master Plan. By 2016 the SJU expects to deliver the totality of Step 1 and approximately 80% of Step 2. Moreover, although the current SJU work programme broadly covers the full R&I cycle, it mainly focusses on pre-industrial developments. Therefore, the deployment of the SESAR concept still requires coordinated development and validation activities to complete Step 2 and to fully address Step 3 of the ATM Master Plan.

Now that the deployment process is about to be launched, the balance of resources allocated to the different phases of the R&I cycle could be reviewed to keep innovative ideas flowing in. In particular, more efforts could be put into exploratory research, involving universities, research establishments and SMEs through “Centres of excellence” and “Blue sky research” activities. Large scale demonstration activities focused on performance benefits, on conducting integrated and coordinated advanced validation and on demonstration activities showing readiness for deployment and for operational and/or technological transition.

Lastly, as a future programme set from 2014 and operating for up to 10 years cannot be fixed once at the outset, provisions would need to be made to allow promising results from exploratory research to evolve in applied research, development and preparation for deployment thus accommodating an evolution of the topics contributing to the SES.

ANNEXE III: CONTRIBUTIONS FROM EUROCONTROL AND FROM OTHER MEMBERS

As reported on page 25 of the Provisional Annual Accounts 2012 of the SJU (see attachment), this is the amount in terms of contributions received and recognized by the SJU at the end of 2012. This means that the work performed by Eurocontrol and the Other Members in 2012 in the form of in-kind contribution is not included, but the information provided in the additional lines:

Contributions received and recognized/accepted by the SJU at 31 December 2012

	IN CASH contribution (up to now)	Net IN KIND contribution (up to now)	Gross IN KIND contribution (up to now)
EU	267 265 000	-	-
EUROCONTROL	75 044 910	102 560 441	102 560 441
MEMBERS	12 739 085	121 833 258	243 666 516

Contributions estimated to be received in 2012 and not yet recognized by the SJU

	IN CASH contribution (up to now)	Net IN KIND contribution (up to now)	Gross IN KIND contribution (up to now)
EU	-	-	-
EUROCONTROL	1 380 664	84 615 386	84 615 386
MEMBERS	-	78 444 396	156 888 792

Total

	IN CASH contribution (up to now)	Net IN KIND contribution (up to now)	Gross IN KIND contribution (up to now)
EU	267 265 000	-	-
EUROCONTROL	76 425 574	187 175 827	187 175 827
MEMBERS	12 739 085	200 277 654	400 555 308
Total	356 429 659	387 453 481	587 731 135

ANNEXE IV: CURRENT EVALUATION AND MONITORING SYSTEM

1. SJU Programme Management Monitoring

The SJU Programme Management Framework is organised around three main domains: "Initiation and Planning", "Execution and Control", "Monitoring". Both the SJU and Programme participants act at various levels.

The "Monitoring" domain covers all activities focussing on the measurement and monitoring of the Programme. It is composed of:

- **Progress reporting** to monitor in a qualitative and quantitative manner the progress and the forecast of the Projects, including the status of their risks.

- **System Engineering Data Management** to support the production of deliverables by structuring and characterisation of system engineering information using standard templates.

- **Programme Management Measurement** to monitor the SESAR solutions development, so that the necessary controls can be done and deviations of targets can be identified with the aim to trigger corrective actions when deemed necessary.

For the purpose of the ex-ante evaluation, Progress reporting and Programme Management Measurement will be further detailed below. As the "System Engineering Data Management" specifically refers to the production of programme deliverables, will not be developed further in this context, but more information can be found in the Programme Management Plan.

Progress Reporting

To ensure proper monitoring and control, the Programme collects and consolidates information from Work Packages and Projects on their progress. The SJU validates the progress of the overall Programme and initiates corrective actions on time, effort and/or quality where necessary.

The principle of reporting on the progress of the activities is established in the MFA; the content of the reporting is detailed in the following section.

Content of the reports

- Accurate effort consumption report at the Project level (quarterly basis)

  Every quarter, SJU Members report accurate actual effort consumption to date at the Project level (for both completed tasks and work in progress) to the SJU. This report is used as an indication of the level of effort an organisation has spent on each Project.

- Interim / Final Financial Statements (yearly basis)

Each year, every Member shall submit the Interim Financial Statements including the eligible costs incurred for the Projects during the financial year.

- Project Progress Report (quarterly basis)

  Each R&D Project is subject to monitoring and control by the SJU with an objective to steer the Programme towards achieving the SESAR objectives. This is based on periodic Project progress reports, which cover the following parts:

  - A summary status which gives an executive statement on the progress made and key issues;
  - Achievements made in the last reporting period, i.e. milestones, control gates, and key data on tasks;
  - Completion status per the task level;
  - Top 5 risks in order of criticality and/or priority;
  - Significant issues (classified as "Amber") or gross deficiencies (classified as "Red") for the successful outcome of the project, with their status and corrective actions;
  - Main targets and events over the next reporting period.

- Work Package Progress Report (quarterly basis)

  The Work Package Progress Report provides information, under the form of a set of indicators, covering the following topics:

  - Status of completion against plan,
  - General status of dependencies between projects
  - Level of risk (net criticality),
  - Status of issues and relevance of action plans,
  - Status of change requests impacting the Project,

The Work Package Leader, responsible for the specific Work Package, is expected to comment on these indicators and to set up action plans to mitigate risks for Projects with negative indicators.

- Interim Project Report (in principle once a year)

  The Interim Project Report provides an update on:

- The objectives of the Project, an overview of the work towards these objectives including
    - a detailed status of the Deliverables in the reporting period,
    - foreseen activities within the next planned reporting period,
    - identified risks and issues, and related actions with their completion status,
    - the achievement of the Deliverables and an explanation of the discrepancies between the planned and the actual work carried out in the Deliverables in the reporting period;
- A specific section on the potential contribution of the Project to the development of new Standards and Norms Proposals in the Project as the case may be;
- An estimate of the effort consumption within the reporting period;
- A publishable summary of the first point hereinabove.

Reporting calendar

The reporting calendar is as follows:

- Actual effort consumption at the Project level: preferably by the end of third week of January, April, July, October and in any case not later than end of third week of February, May, August, November;
- Interim / Final Financial Statements: in the beginning of year following financial year (as defined in the MFA);
- Interim Project Report: 4 weeks before the Project Control Gate;
- Project progress report: end of second week of January, April, July, October;
- Work Package progress report: end of last week of January, April, July, and October.

Programme management measurement

The SESAR programme is monitored so that the necessary controls can be done and deviations of targets can be identified with the aim to trigger corrective actions when deemed necessary.

There are different domains of measurements (see further in this section) which are done at different levels (Programme, Release, Validation Exercise, Project, Deliverables etc.), from different viewpoints (organisational breakdown, work breakdown, operational breakdown) and in function of various programme participants and stakeholders.

Historical measurements are stored and used to monitor trend information over a period of time. The frequency of performance measurement and reporting depends on the type of information needed and is characterised by its availability and frequency of its update.

The measurements are consolidated in dashboards. Each dashboard is supported by detailed reports that have as main objective to facilitate the understanding and ease problem investigations.

Monitoring the Programme execution

To monitor the execution of the Programme, the SJU measures the actual progress achieved compared to the planned progress and this is done by monitoring. For example, it calculates the level of completeness, it assesses the milestone achievements, checks the actual delivery rate of deliverables and the actual level of consumption of resources.

Monitoring the quality of deliverables

To monitor the quality of deliverables of a specific project, the SJU assesses those deliverables against a set of satisfaction criteria. Measurements used for this domain are the following:

The number of deliverables per assessment status, which shows how the quality of deliverables is assessed,

Compliance of the deliverables with the SJU Satisfaction criteria, which refines the understanding of the quality of the project deliverables.

Monitoring of project management

To monitor the overall quality of the project management and the especially the compliance with the SESAR programme management plan, the SJU monitors:

Project and WP quarterly progress reports,

Project management compliance against a set of criteria. This includes the follow up and well execution of corrective actions, where necessary.

Project dependency synchronisation status, which shows how the projects relate to each other.