SESAR 2020 Exploratory Research: First Call for Research Projects

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Document History

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01.02.00	03 June 2015	Section 4.5	Maximum duration of a project is 24 months, as specified in Financial Decision.

1. INTRODUCTION

1.1. Scope

This document provides detailed guidance to the organisations wishing to respond to the first Call for Proposals of SESAR Exploratory Research projects launched under Part III "Societal Challenges" of the Horizon 2020 Research Framework Programme[1], and related to the Smart, Green and Integrated Transport activities.

The document sets the scene by presenting the challenges of ATM research in Europe, the organisation of the SJU SESAR 2020 Work Programme and the Work Breakdown Structure (WBS) of its Exploratory Research (ER) Pillar.

It should be noted that, while the SESAR 2020 ER Work Programme will be composed by several projects addressing Fundamental (e.g. ATM Excellent Science & Outreach) and ATM Application-oriented research that will be progressively launched through a number of Calls over SESAR 2020 Programme lifetime, the scope of first ER Call will be limited to a subset of the Topics foreseen by SESAR 2020 ER Work Programme.

This document provides the technical specifications for the selected Research Topics addressed by this first Call for Proposals. Furthermore, it provides the specific guidelines that are applicable to this Call, complementing the H2020 general guidelines that can be found on the H2020 Participants Portal[2].

1.2. ATM Research in Europe

The SESAR Joint Undertaking ("SJU"), was established under Council Regulation (EC) 219/2007 of 27 February 2007, Regulations as modified by Council Regulation (EC) 1361/2008 (SJU Regulation) and last amended by the Council Regulation (EC) 721/2014. of 16 June 2014 The SJU is henceforth responsible for "carrying out specific activities aimed at modernising the European air traffic management system by coordinating and concentrating all relevant research and development efforts in the Community". This includes long-term and innovative research activities.

The exploratory research topics proposed in this first ER Call for Proposals were selected after a consultation of the stakeholders of the European ATM research community (e.g. EC, SC members, SESAR 1 Work Package E (WP-E) research networks/projects, SESAR Industrial research program and others).

Arguments for a positive approach to long-term research and innovation in all branches of industry are well understood. In particular, the need to build the European economy on strong foundations of knowledge, research and innovation is reiterated in many European Union declarations and treaties, and is one of the keys to growth, jobs and prosperity[3]. This is as true for air transport and ATM as it is for other industries.

These objectives; together with the ATM Master Plan 4key drivers, formed the Foundation to the definition of the research topics presented in this Call for Proposals.

1.3. Horizon 2020 Transport Challenges

H2020 Transport Challenge *"Smart, green and integrated transport" objective is to achieve a European transport system that is resource-efficient, climate and environmentally friendly, safe and*

[1] OJ L 347/965 of 20.12.2013, p. 965-1041 (http://ec.europa.eu/research/participants/data/ref/h2020/legal_basis/sp/h2020-sp_en.pdf)
2 http://ec.europa.eu/research/participants/portal/desktop/en/funding/reference_docs.html.
3 COM(2010) 2020 final (EU2020 Strategy: http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF)
[4] https://www.atmmasterplan.eu

seamless for the benefit of all citizens, the economy and society"[5]. As such, this call for proposals concerns research topics in the context of ATM that will address the Research & Innovation needs for:

- A Resource-efficient transport system that respects the environment;
- Better mobility, less congestion whilst ensuring safety and security;
- A Global leadership of European transport industry;
- A Socio-economic and behavioural research and forward looking activities for policy making.

1.3.1. Flight Path 2050

The Report of the High Level Group on Aviation Research - Flight Path 2050 - Europe's Vision for Aviation, 2011[6] ('Flight Path 2050') foresees five challenges that aviation will have to face at the 2050 horizon:

- Meeting Societal and Market Needs (Challenge 1);
- Maintaining and Extending Industrial Leadership (Challenge 2);
- Protecting the Environment and the Energy Supply (Challenge 3);
- Ensuring Safety and Security (Challenge 4);
- Prioritising Research, Testing Capabilities and Education (Challenge 5).

ATM research is required to address all these challenges with a particular focus on challenge number 1 where the role of ATM is specifically described. ATM research should in particular provide innovative means to improve further air mobility in the intermodal transport system where 90% of travellers within Europe will be able to complete their journey, door to door within 4 hours[7].

ATM solutions will, at the same time, be required to meet the air transport capacity demand of 25 million flights per year8 together with a safety target of 10-7 per flight, a maximum arrival time delay of 1 minute and operational measures to meet the CO2 environmental operational target reduction of 12% per flight.

In addition, the role of ATM shall be designed to enable new concepts of air operations in a future environment, notably it shall be capable to handle and integrate safely air vehicles of the future (e.g. not excluding VTOL, RPAS, hypersonic, etc.) in the development of any new systems and technologies.

The research topics proposed in SESAR 2020 Exploratory Research are steered by the needs identified from the European ATM Master Plan, by the results from the current SESAR Programme, by WP-E research networks results and papers, by projects such as the Higher Level of Automation (HALA) and Complex World, by the relevant FP7 projects as well as the ambition set by documents such as Flight Path 2050 and its ACARE-Strategic Research and Innovation Agenda (SRIA9).

1.3.2. SESAR long-term and Innovative Research so far

SESAR WP-E is the existing ATM long-term and innovative research programme established under the first SESAR Programme. The objective of WP-E is to be a catalyst for the creation of a healthy body of European ATM and related CNS research capability and knowledge that will persist beyond the lifetime of the current SESAR development Programme.

5 http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-transport_en.pdf

6 http://ec.europa.eu/transport/modes/air/doc/flightpath2050.pdf

7 Cf. Flight Path 2050 goal No 2 – p. 11

8 Cf. Flight Path 2050 goal No 4 – p. 11

9 Ref 6: ACARE. (2014). ACARE Strategic Research and Innovation Agenda (SRIA). Volume 2. http://www.acare4europe.com/sria/exec-summary/volume-2

WP-E enables researchers to develop innovative ideas, concepts and technologies at Technology Readiness Levels (TRL) 1 and TRL 2. Thus, introducing their knowledge from other non-ATM disciplines (e.g. complexity science, economics, etc.) and applying it to the ATM domain.

WP-E aims at stimulating scientific research into ATM through the funding of research projects, research networks, SESAR Innovation Days events and SESAR Young Scientist award. WP-E established three Research Networks, as well as 40 Research Projects10 over the 2010-2016 period.

WP-E Projects provided results that can be carried upward through the R&I innovation pipeline. For additional information about WP-E project results and networks see SESAR magazine, issue 12, October 2014[11].They also provided the basis for preparing the SESAR2020 Exploratory Research Programme that can extend successful concepts and results as required.

A summary of the WP-E projects and the respective results can be found on the SJU Website.[12]

10 http://www.sesarju.eu/innovation-solution/exploratory-research/research-themes-and-projects
11 http://www.sesarju.eu/newsroom/brochures-publications/sesar-magasine-issue-12
12 SESAR Joint Undertaking website: http://www.sesarju.eu/

2. SESAR 2020 PROGRAMME

This section provides an overview of the overall SJU SESAR 2020 Programme. The overall Work Breakdown Structure addressing the Exploratory Research, the Industrial Research and Validation, the Very Large Scale Demonstrations and the Transversal Activities can be found in SESAR 2020 Research and Innovation Programme[13].

2.1. ATM research vision

"The SESAR Joint Undertaking for research and innovation is delivering solutions to modernise air traffic management, enabling high-performing aviation in Europe."

The Exploratory Research will contribute to SESAR 2020 Vision by:

"Driving the development and evaluation of innovative or unconventional ideas, concepts, methods and technologies; that can define and deliver the performance required for the next generation of European ATM system, and thus contributing to its successful evolution"

2.2. Research Challenges & Key Features of SESAR 2020 Programme

The research challenges for SESAR 2020 are built upon the work undertaken in the ongoing SESAR Programme and concentrate around the key features and content of the European ATM Master Plan[14], the stakeholder priorities and bringing the necessary skills and resources together to deliver the right research in an effective way.

This can be represented in the diagram below, where the SJU Mission/Vision is connected to grouped areas of activities focused around three front-line ATM service areas, supported by the required enabling technologies in the aviation infrastructure as well as exploiting and sharing of this infrastructure across all areas to achieve, for example, consistent information management.

As shown in the diagram above, some Programme activities need to be undertaken in a transversal manner to ensure the delivery of best-in-class, globally interoperable and high performing Air Transport for Airspace users & Citizens.

[13] http://www.sesarju.eu/sites/default/files/documents/reports/AWP2015_adb_adopted.pdf
[14] https://www.atmmasterplan.eu/download/29

Figure 1 Research Challenges & Key Features of SESAR 2020 Programme

For example:

- Master planning to ensure the maintenance of the EU ATM Master Plan and the viability of consequent deployment;
- ATM Design and Integration, with a particular focus on the Architecture and service orientation;
- Standardisation, Regulation & Interoperability;
- Air vehicle Integration, cost and environmental optimization;
- Total system performance management;

Another transversal need is to ensure that infrastructure developed to enable operations and services is delivered in such a way that technical services including communication, positioning, navigation, timing and information are shared across the whole community.

Not all research can be progressed at the same pace, nor is it beginning from the same level of understanding or will it deliver to the same expectation. Consequently the key features, above, remain a persistent target, aligned with Single European Sky (SES) while the actual research is matured over time and in accordance with research and industry best-practice.

2.3. Research Maturity

The Horizon 2020 rules establish technology readiness levels (TRL) as the maturity assessment approach for SESAR projects to apply.

The SESAR 2020 Programme is structured into three main research phases, beginning with Exploratory Research, then is further expanding within a Public-Private-Partnership to conduct Industrial Research and Validation, culminating in Demonstrating in Large Scale the concepts and technologies in representative environments to firmly establish the performance benefits and risks.

Phase 1: Exploratory Research is further broken down into two areas, the first covering the fundamental science and outreach, while the second investigates the initial applications of this science for ATM.

Phase 2: Includes Applied Research, Pre-Industrial Development and Validation. As a whole this phase is referred to as 'Industrial Research and Validation' as it is delivered through the Partnership.

Phase 3: Covers Very Large Scale Demonstrations (VLD) to help fill the gap between development and deployment phases and consists of demonstrating key SESAR concepts and technologies to raise awareness regarding SESAR activities related to ATM performance issues and their results as well as assessing full-scale deployment readiness.

The maturity assessment of the exploratory research results from ATM Excellent Science (Fundamental Scientific Research) pre-TRL 1 to TRL 1 to ATM Applications oriented research will be performed by the projects Gate organized by the SJU. At the project Gate, the SJU will verify the maturity assessment performed by the project. Once the project passes the gate, the project results will feed into the ATM Applications oriented research.

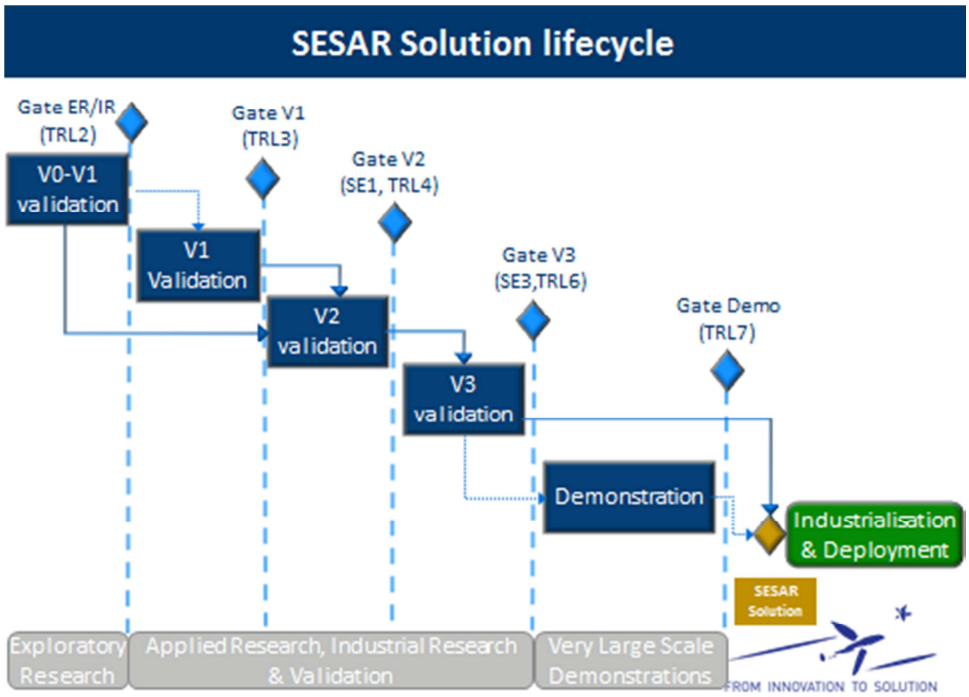

Figure 2 SESAR Solution life cycle

The level of achievement and consequent maturity at each level is described below:

Exploratory Research covers:

Pre-TRL1 Scientific Research: Fundamental exploratory research investigating relevant scientific subjects and conducting feasibility studies looking for potential application areas in ATM, concentrating both on out-reach to other disciplines as well as educating within.

TRL 1 Basic principles observed and reported: Exploring the transition from scientific research to applied research by bringing together a wide range of stakeholders to investigate the essential characteristics and behaviours of applications, systems and architectures. Descriptive tools are mathematical formulations or algorithms.

TRL 2 Technology concept and/or application formulated: Applied research. Theory and scientific principles are focused on very specific application area(s) to perform the analysis to define the concept. Characteristics of the application are described. Analytical tools are developed for simulation or analysis of the application.

Industrial Research & Validation (outside the scope of this Call) covers:

TRL 3 Analytical and experimental critical function and/or characteristic proof-of-concept: Proof of concept validation. Active Research and Development (R&D) is initiated with analytical and laboratory studies including verification of technical feasibility using early prototype implementations that are exercised with representative data.

TRL 4 Component/subsystem validation in laboratory environment: Standalone prototyping implementation and test with integration of technology elements and conducting experiments with full-scale problems or data sets.

TRL 5 System/subsystem/component validation in relevant environment: Thorough testing of prototyping in representative environment. Basic technology elements integrated with reasonably realistic supporting elements. Prototyping implementations conform to target environment and interfaces.

TRL 6 System/subsystem model or prototyping demonstration in a relevant end-to-end environment (ground or space): Prototyping implementations on full-scale realistic problems using partial integration with existing systems. While limited documentation is available, the Engineering feasibility is fully demonstrated in actual system application.

Very Large Scale Demonstration (outside the scope of this Call) covers:

TRL 7 System demonstration in an operational environment (ground, airborne or space): System demonstration in operational environment. System is at or near scale of the operational system, with most functions available for demonstration and test and with EASA proof of concept authorisation if necessary. Well integrated with collateral and ancillary systems, although limited documentation available.

3. SESAR 2020 EXPLORATORY RESEARCH INTRODUCTION

The mission of SESAR 2020 ER program is to turn Europe's ATM excellent science into a globally competitive advantage for the next generation of the European ATM system. It is therefore fundamental to drive developments of innovative and unconventional ideas and concepts as successful contributions for the evolution of ATM in Europe and worldwide.

The SESAR Programme currently includes research and innovation projects ranging in maturity from exploratory research through to large scale demonstrations.

The purpose of this Call for Proposals is to ensure the continuity of the ER activities by building upon and ensuring transition of SESAR1 WP-E projects into SESAR 2020 ER.

The SESAR 2020 ER Programme will ensure coherence across the full scope of ATM Research and avoid potential duplications or overlaps.

3.1. ER Link to the European ATM Master Plan

The European ATM Master Plan (MP)[15] is the overarching reference for SESAR 2020. However, while the European ATM Master Plan is targeting the 2030 horizon, SESAR 2020 ER extends beyond this timeframe and, thus, beyond the 'Performance-based Operations' described today.

SESAR Exploratory Research shall address and analyse any long-term research concept, technology or scientific scope gaps in responding to the European challenges in aviation and ATM for the evolution of a safe, competitive and sustainable future Aviation and ATM system.

In addition to covering the low maturity aspects of Performance-Based Operations, the SESAR 2020 ER Program will also identify research and innovation activities to meet the Flight Path 2050 goals for ATM. SESAR 2020 Exploratory Research Programme will contribute to the evolution of the ATM Master Plan in particular prolonging its research scope and targets beyond 2050.

The Exploratory Research 2020 primary mission and objectives are the following;

- To contribute to the ATM Master Plan 'Performance-based Operations'; towards long term objectives beyond 2035 (e.g. 2050 timescale);
- To contribute to the identification of innovative solutions not yet identified in the European ATM Master Plan but which would accelerate the realisation of the SES targets;
- To deliver sustainable healthy research activities across a range of research networks in Europe, within the domain of ATM exploratory research.

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

3.2. ER Principles

The key principles that apply to SESAR 2020 Exploratory Research are:

- To build upon the successful ATM European research activities inside as well as beyond the SESAR industrial Programme;
- To consider innovations/technologies coming from non-ATM sectors such as the automation, robotics or system engineering areas as well as in other safety critical industries, such as nuclear, space, etc.;
- To bring scientific, technology innovation and educational benefits to the ATM Community;
- To enable Academia, Research organisations and SMEs to undertake research activities that go beyond the main SESAR industrial Programme;
- To create a healthy network of European ATM research capabilities and knowledge that will strengthen European competitiveness and its workforce;
- To create a mechanism in order to monitor and assess the maturity of exploratory research results and their integration into the SESAR mainstream and future SESAR 2020 program as appropriate.

3.3. ER Calls for Proposals

The funding mechanisms and participation rules are fully aligned with Horizon 2020 rules.

Research and Innovation actions as well as Coordination support actions will be the major instruments.

Other instruments such as prizes and procurements will be used on a case by case basis (for example when a specific extension in a research project would be required or for the SESAR Young Scientist Award). In future Exploratory Research calls for proposals, prizes may be included in support to R&I actions in very specific cases[16].

There are planned to be multiple calls over the period to 2020 potentially with intervals of around 2 years between main calls and also allowing for ad-hoc calls to meet specific needs.

3.4. ER Budget

As indicated in Section VII of SJU 2015 Exploratory Research 2020 Financing Decision, the overall estimated co-financing budget over the period up to 2024 for SESAR 2020 Exploratory Research Programme is EUR 85 Million.

The overall Indicative co-financing budget for this first Call for Proposals is EUR 20.6 million.

[16] The foreseen Exploratory Research calls for proposals will be published on the Participant Portal as for any H2020 Work Programme call. Contracts will follow the H2020 model grants agreement.

3.5. Exploratory Research Work Breakdown Structure (WBS)

The Exploratory Research within SESAR 2020 will be organized around four areas: two research areas and two transversal areas, as presented in the figure below:

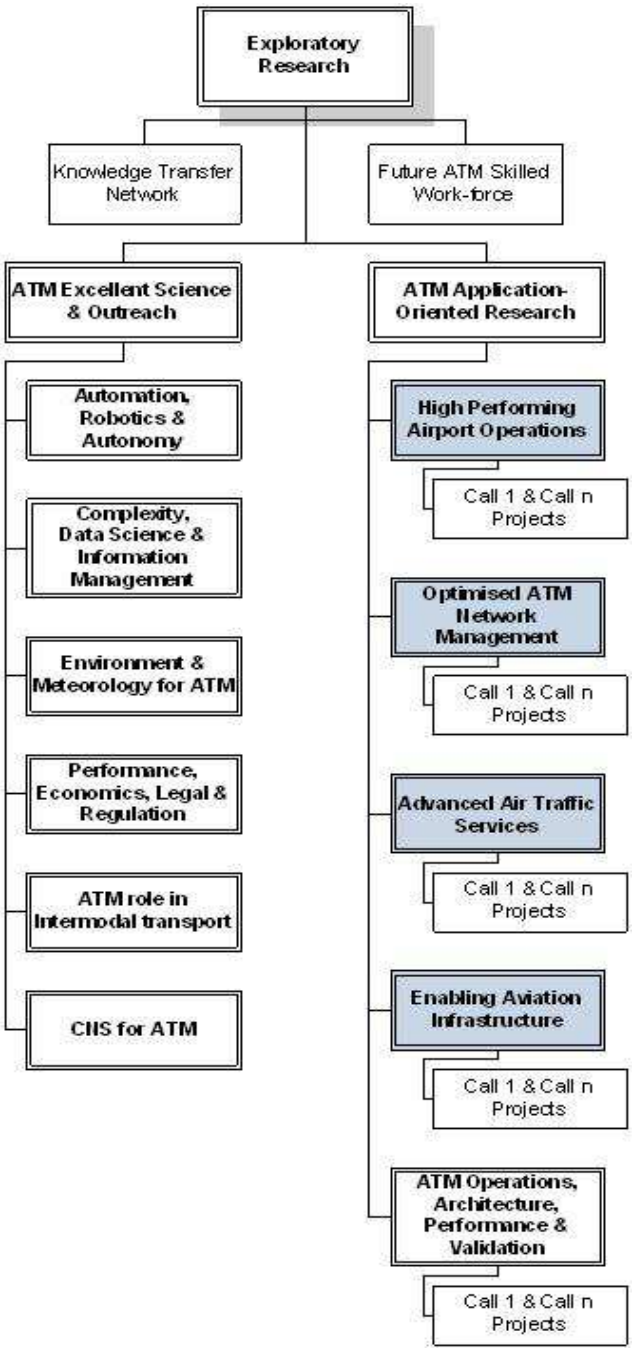

Figure 3 SESAR 2020 Exploratory Research Work Breakdown Structure

Exploratory Research is outside of the SESAR Public-Private-Partnership and is set-up through open calls using various instruments available within the Horizon 2020 rules.

It should be noted, however, that some research areas identified in this WBS (for instance, the Transversal Activities) will not be addressed by this first Call for Proposals.

The detailed scope covered by this Call for Proposals is summarized in Chapter 4 (Guidance for ER Proposals Preparation) and the technical specifications for the selected Topics are provided in Chapter 5 (Description of Research Activities).

3.6. Transversal Activities

3.6.1. Future ATM Skilled Workforce

The Transversal 'Future European ATM skilled force' area will in the foreseen future Calls for Proposals develop the mechanism to provide the required European ATM education & training as well as networking capability which can uniquely be created through SESAR in the ATM Community.

Please note that this activity is not included in this first Call for Proposals.

3.6.2. Knowledge Transfer Network (KTN)

The knowledge transfer network will be responsible for assessment, coordination and communication of the exploratory research results.

Please note that this activity is not included in this first Call for Proposals.

3.7. ATM Excellent Science & Outreach

ATM Excellent Science & Outreach aims at bridging ATM research with the wider research community and will provide the science necessary to support ATM change. The work will be performed not only within an existing ATM community but also by related research activities in other sectors and industries with the objective to look for potential applications into ATM.

The research performed under ATM Excellent Science & Outreach it is typically curiosity-driven and explores new and innovative research areas for ATM. This type of scientific research not only brings new knowledge, but also encourages young scientists to develop innovative ideas, concepts and theories for the future ATM evolution. This will bring mutual benefits to SESAR research activities and to the HORIZON2020 transport Commission's Work Programme[17].

Consequently, the purpose of this research area is two-fold:

- to investigate through research and innovation actions which new technologies, methodologies, concepts, or validation methods developed in non ATM sector could be introduced in the context of ATM and in particular serve the identified SESAR business needs and Flight path 2050 vision, or identify new ATM business opportunities;
- to assess the potential of ATM related technologies, processes, systems, environment, network architecture and management developed in the context of SESAR in particular to respond to other transport mode challenges.

ATM Excellent Science and Outreach includes research activities across the areas described in the following sections.

3.7.1. Automation, Robotics & Autonomy

The research activities under this theme will focus on automation with robotics being explored in terms of the application of higher levels of automation to the ATM system and researching whether and in what ways autonomy could be used to deliver operational benefits.

Automation could provide the key to significant performance improvements across many aspects of ATM. Indeed, ATM currently relies on high levels of human intervention for essential functions - in this respect it lags behind many other industries. Uptake of automation has been slow partly because the positive benefits of human cognitive abilities, especially in safety-critical situations, have provided strong arguments against change.

The challenge is therefore to propose automation solutions that have the capability to provide substantial and verifiable performance benefits whilst fully addressing safety concerns.

[17] http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-transport_en.pdf

As higher levels of Automation will result in increased importance of robotics, which deals with the design, construction and operation of highly automated systems, an 'unconstrained' approach should allow for a bolder vision and subsequently open the door for new conceptual possibilities.

Under this topic, there is substantial scope for learning from other industries.

The following Research Topic is addressed in this Call for Proposals:

- ER-01-2015: Automation in ATM

The technical specifications for this Topic are provided in Section 5.1.1.

3.7.2. Complexity, Data Science & Information Management

The research activities under this theme will address complexity science, data science and information management and their applications in ATM. Complexity science will deal with the application of complexity theory in the ATM domain and will therefore contribute to better understand how the ATM system works, in particular the interaction of its subsystems.

Data science is an emerging field of research in ATM concerned with managing and exploiting large data sets and its application to air traffic management. This will enable further exploitation of information management, knowledge creation and improved insight into optimizing planning and execution of ATM.

The following Research Topics are addressed in this Call for Proposals:

- ER-02-2015 - Data Science in ATM
- ER-03-2015 - Information Management in ATM

The technical specifications for this Topic are provided in Section 5.1.2.

3.7.3. Environment & Meteorology for ATM

The objective of the research activities under this theme is to benefit from the research activities and investments in these areas from outside of ATM and look at apply them to the environment and meteorology domains in the context of the future ATM evolution.

The following Research Topic is addressed in this Call for Proposals:

- ER-04-2015 - Environment & Meteorology for ATM

The technical specifications for this Topic are provided in Section 5.1.3.

3.7.4. Performance, Economics, Legal & Regulation

In recent years, the importance of understanding the evolution of the ATM service market structure, the need to minimize airborne costs, use of cost-effective new business and pricing models has become evident. The research performed under this area will contribute to the wider innovation and competitiveness of the European ATM industry, therefore contributing to Challenge 2 of FlightPath 2050.

The links between economics, the legal and the regulatory frameworks and the research performed in each subject are close; this means that the implications of change in one area have to be integrated across the whole, otherwise change in ATM can be unnecessarily blocked.

The following Research Topic is addressed in this Call for Proposals:

- ER-05-2015 - Economics and Legal Change in ATM

The technical specifications for this Topic are provided in Section 5.1.4.

3.7.5. ATM role in Intermodal Transport

The research activities under this theme will address the connection and dependence between ATM/Aviation and other transport modes, from the perspective of ATM. Consequently, it is envisaged that complementary research will be performed linking to activities launched by the EC and potentially

other transport areas (i.e. rail, road, water) to ensure interoperability and delivery of complementary services to realise cross-modal performance as described by the EU transport policy documents.

This Research Activity is not being addressed in this Call for Proposals.

3.7.6. CNS for ATM

Communication, Navigation and Surveillance (CNS) are not exclusively an ATM subject, therefore the study and use, or adaptation, of new technologies being developed outside ATM to needs identification and analysis of the safety, performance and security implications for the ATM system before a specific ATM application can be proposed.

This Research Activity is not addressed in this Call for Proposals.

3.8. ATM Application-Oriented Research

The ATM application-oriented research area will help mature new concepts for ATM that extend or go beyond those identified in the ATM master plan as well as help mature emerging technologies and methods to the level of maturity required to feed the applied research conducted in the Industrial Research and Validation phase of SESAR; thus connecting the ATM Exploratory Research to the ATM Applied Research in the context of the European ATM Master Plan.

3.8.1. High Performing Airport Operations

The research activities under this theme will include research into areas of enhanced runway throughput, integrated surface management, airport safety nets, total airport management and remote tower for multiple airports. As airports remain one of the most significant bottlenecks in ATM and therefore represent great potential for system-wide improvement it can be expected that a significant focus will be placed on realising improvements.

The following Research Topic is addressed in this Call for Proposals:

- ER-06-2015 - High Performing Airport Operations - Improved Visualisation and Awareness

The technical specifications for this Topic are provided in Section 5.2.1

3.8.2. Optimised ATM Network Management

The optimised ATM Network management theme will include research activities in the areas of advanced airspace management, advanced Dynamic Capacity balancing and optimised airspace user operations/UDPP. Innovative solutions are needed to better understand and improve the robustness (resistance to perturbations including meteo perturbations) and resilience (ability to recover) of the network.

This Research Activity is not addressed in this Call for Proposals.

3.8.3. Advanced Air Traffic Services

The research activities under Advanced Air Traffic Services will include research into enhanced arrivals & departures, separation management, enhanced air & ground safety nets and trajectory and performance based free routing. Separation needs to be resilient in the sense that if one system or agent fails or miscalculates or misses an event, another system or agent in the system will detect and assist. Future research into resilient separation is important. Operational concepts can often be underdeveloped and therefore, the establishment of viable operational sub- concepts or working practices will be beneficial in the context of guiding the future investments, including scenarios for economically interesting equipage update steps in the air, space and/or ground based improvements in ATM.

The following Research Topic is addressed in this Call for Proposals:

- ER-07–2015 - Separation Management and Separation Standards

The technical specifications for this Topic are provided in Section 5.2.2.

3.8.4. Enabling Aviation Infrastructure

It is essential to ensure that on-going development of aircraft and ground systems in SESAR Programme 2020 will focus on achieving globally-harmonized standards to ensure the world-wide applicability of these capabilities. Essential to achieving global agreement are the definitions of interoperability of information exchange (air-ground and air-air) as well as other air-to-air interactions (e.g. collision avoidance).

This will rely on closer working between aircraft systems, flight operations center systems and military mission management to ensure ATM performance delivery, supporting all types of air-vehicle types and missions and including weather effects, emissions, fuel saving, noise, air quality and contrail formation etc. Consequently areas that include, CNS, SWIM, Trajectory Management, Common Services, the human role and interactions and the Air Vehicle Systems should be considered in a coordinated way for application across the whole of ATM.

The following Research Topic is addressed in this Call for Proposals:

- ER-08–2015 Communication, Navigation and Surveillance

The technical specifications for this Topic are provided in Section 5.2.3.

3.8.5. ATM Operations, Architecture, Performance & Validation

This research area will focus on extending the SESAR operational concept, ensuring robust transition and evolution of architecture, the safety and security implications as well as ensuring the delivery of performance to meet future needs. Consideration must also be given to delivering suitable means of assurance for validation as well as evidence to support decision-making, case-based arguments and strategic thinking.

The results from the research activities under this topic will directly contribute to the overall SESAR 2020 transversal activities of ATM Design & Integration, Performance Management, Validation, Verification & Demo infrastructure and Master Plan maintenance.

The following Research Topics are addressed in this Call for Proposals:

- ER-09-2015 - Trajectory Based Operations
- ER-10–2015 - ATM Architecture
- ER-11–2015 - ATM Performance

The technical specifications for these Topics are provided in Section 5.2.4.

4. GUIDANCE FOR ER PROPOSALS PREPARATION

4.1. Target audience

This open Call for Proposals welcomes participation from all eligible entities including those not previously engaged in ATM and SESAR. The Eligibility Criteria for this Call are laid down in the SJU 2015 Exploratory Research 2020 Financing Decision[18].

4.2. Compliance with Horizon 2020

The application of Horizon 2020 legal framework[19] for Research and Innovation Actions is fully applicable for this Call for Proposals.

For all H2020 guidance and reference documents, applicants are invited to refer to the Participant Portal[20]. A list of all supporting documents and useful links is provided in Annex.

For a step-by-step guide, please consult the H2020 Online Manual[21] as well as the Annotated Model Grant Agreement[22].

4.3. Topics addressed in this Call for Proposals

The purpose of this Call for Proposals is to award grants for Exploratory Research Projects in the context of the two Work Areas described below.

The type of Action concerned under this Call is **Research and Innovation Action (RIA)**.

4.3.1. Work Area 1: ATM Excellent Science & Outreach Research

These are research actions primarily consisting of activities aiming to establish new knowledge and/or explore the feasibility of a new or improved technology, product, process, services or solution. For this purpose they are research focused and may include basic and applied research, technology development and integration, testing and validation on a small-scale prototype in a laboratory[23].

With reference to the SESAR 2020 ER Work Breakdown Structure for Work Area 1 presented in Chapter 3, only the 11 Topics identified below will be addressed by this first Call for Proposals.

Automation, Robotics & Autonomy

- ER-01-2015: Automation in ATM

Data Science & Information Management

- ER-02-2015: Data Science in ATM
- ER-03-2015: Information Management in ATM

Environment & Meteorology in ATM

- ER-04-2015: Environment & Meteorology in ATM

Economics & Legal Change in ATM

- ER-05-2015: Economics & Legal Change in ATM

The related technical specifications are provided in Section 5.1

[18] Ref Participants Portal – SJU ER Call for Proposals

[19] http://ec.europa.eu/research/participants/data/ref/h2020/legal_basis/rules_participation/h2020-rules-participation_en.pdf.

[20] http://ec.europa.eu/research/participants/portal/desktop/en/funding/reference_docs.html.

[21] http://ec.europa.eu/research/participants/portal/desktop/en/funding/guide.html.

[22] http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/amga/h2020-amga_en.pdf.

[23] http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex ga_en.pdf

4.3.2. Work Area 2: ATM Applications-Oriented Research

With reference to the SESAR 2020 ER Work Breakdown Structure for Work Area 2 presented in Chapter 4.3, only the Topics identified below will be addressed by this first Call for Proposals.

High Performing Airport Operations

- ER-06-2015: High Performing Airport Operations - Improved Visualisation and Awareness

Advanced Air Traffic Services

- ER-07-2015: Separation Management and Separation Standards

Enabling Aviation Infrastructure

- ER-08-2015: Communication Navigation and Surveillance

ATM Operations, Architecture, Performance & Validation

- ER-09-2015: Trajectory Based Operations
- ER-10-2015: ATM Architecture
- ER-11-2015: ATM Performance

The related technical specifications are provided in Section 5.2.

4.4. Maximum Co-financing Budget

The estimated budget for first Call for Proposals is 20.6 Million Euro. Subsequent calls for Proposals relating to Exploratory Research are foreseen in the coming years.

In this first call the projects across two work areas will be financed as follows:

Work Areas	Indicative Maximum Co-financing Budget per ER Proposal	Overall Maximum Co-financing Budget for this Call
Work Area 1: ATM Excellent Science & Outreach research	up to 600 K Euros	20,6 M Euros
Work Area 2: ATM Applications oriented research	up to 1 M Euros	

Table 1 Maximum Co-financing Budget Limitations

4.5. Duration of the Project

Projects resulting from this Call for Proposals will be limited in duration to a period of maximum 24 Months as indicated in the ER Call Financing Decision..

4.6. Content of the Proposals

Proposals must be clear and concise. Since Proposals will be judged solely on their written content they must clearly explain how they meet the requirements of these specifications.

The Financial Proposal Template and the Technical Proposals Template for this Call can be retrieved from the Participants Portal at the page dedicated for this Call for Proposals.

Please find in Chapter 8 (References) the list of available legal and guidance material.

4.6.1. Management structure and procedures

The proposal will describe the organisational structure and the decision-making / management procedures: In particular, the following items shall be addressed:

- Legal, financial and administrative management;
- Quality management;
- Production, review and approval of deliverables;
- Schedule management;
- Minutes of Meeting management;
- Progress Reporting and Actions management;
- Risk and Issues management;
- Cost management;
- Software management;
- Communication management;
- Handling of sensitive/confidential data;
- Documentation management;

The proposed Management Processes shall be consistent with the "Project Execution Guidance for SESAR 2020 Exploratory Research" document.

4.6.2. Requirements for data and/or expertise

The Proposal should clearly outline data, tools, simulators and equipment that will be needed for the successful completion of the Project, and explain how they will be obtained. Attention should also be given to the involvement of technical and ATM expertise that may be needed to ensure operational credibility of the research.

4.6.3. Interaction with the industry

Exploratory research projects that are executed by academia and/or research centers will be expected to build relationships with industry (supplier, operator or service provider) to ensure that preparations are in place for technology/knowledge transfer with a view to felicitating the transfer of Applied Research results to industrial partners.

4.7. Indicative timetable

An indicative timetable is provided in the table below.

Milestone	Deadline
Closing date for submission of Proposals	25 June 2015
Information on the outcome of the evaluation	Maximum 5 months from the closing date of submission
Indicative date for the signing of the grant agreement	Maximum 3 months from the date of informing the selected applicants on the positive outcome of the evaluation

Table 2 Indicative Timetable

4.8. Maximum possible rate of co-financing of the eligible costs

As indicated in Section VIII of the SESAR 2020 Exploratory Research Work Programme/Financing Decision, the rate of SJU co-financing for RIAs is 100 % of the eligible costs (cf. Article 28(4) of Regulation (EU) No 1290/2013[24]).

Indirect costs are subject to a flat-rate scheme of 25 % of the direct eligible costs.

4.9. Evaluation, Selection and Award

The SESAR2020 Exploratory Research projects will be evaluated based on a single stage process.

The evaluation and selection process will be carried out by SJU and H2020 independent experts.

4.9.1. Selection criteria

As specified in the SJU 2015 Exploratory research Financing Decision, proposals will be evaluated on the basis of the following Selection criteria:

- Financial capacity: In line with the Financial Regulation[25] as well as the SJU Financial Rules and the Rules for Participation. At the proposal stage, coordinators will be invited to complete a self-assessment using an on-line tool.
- Operational capacity: the award criterion 'Quality and efficiency of the implementation', will allow to evaluate whether the proposal demonstrates the operational capacity to carry out the proposed work based on the competence and experience of the individual participant(s).

24 http://ec.europa.eu/research/participants/data/ref/h2020/legal_basis/rules_participation/h2020-rulesparticipation_en.pdf

25 Regulation (EU, Euratom) No 966/2012 of The European Parliament and of the Council of 25 October 2012 on the financial rules applicable to the general budget of the Union and repealing Council Regulation (EC, Euratom) No 1605/2002 (OJ L 298 OF 26.10/.012, p. 1-96 - http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:298:0001:0096:EN:PDF)

4.9.2. Award Criteria

During the proposals evaluation, the Evaluation Experts will evaluate the received proposals on the basis of the criteria 'Excellence', 'Impact' and 'Quality and Efficiency of the implementation', which are addressed respectively in Chapter 1, 2 and 3 of the Technical Proposal Template.

These award criteria are further detailed in the following Table, in accordance with Article 15(4) of the Rules for Participation:

Type of Actions	**Excellence** *The following aspects will be taken into account, to the extent that the proposed work corresponds to the topic description*	**Impact** *The extent to which the outputs of the project should contribute at the European and/or International level to the expected impacts listed under the relevant topic*	**Quality & efficiency of the implementation** *The following aspects will be taken into account:*
Research Innovation Actions (RIAs)	**1.** Clarity of targeted breakthrough and its specific science and technology contributions towards a long-term vision for the future evolution of the European ATM system. **2.** Scientific interest, including a clear and complete description of the research questions to be addressed together with any relevant assumptions and the potential benefits to be derived from the Project. **3.** Scientific quality and appropriateness of the proposed methodology. **4.** Degree of innovation. Previous and current research is fully taken into account. Projects may propose research that follows on from existing projects, in this case bidders must carefully explain their assumptions, how they will access previous results etc. **5.** Data, tools, equipment and additional expertise have been identified and plausible ways and means to obtain these are explained. **6.** Clear explanation of possible outcomes and next steps towards implementation, especially with regard to industry links and the relationship to the SESAR Work Programme. In particular scientific excellence (key personnel, publications,.) and link with educational programmes.	**1.** Alignment with the work areas under this call. **2.** The potential for the Project to contribute the SESAR state-of-the-art and bring SESAR benefits (safety, capacity, environment, cost-effectiveness). **3.** Importance of the new ideas/concepts and technologies outcome with regards to its transformational impact on technology and/or society. **4.** Quality of measures for achieving impact on science, technology on the future evolution of the European ATM system, including quality of measures for linking with educational programmes.	**1.** The work breakdown is clear and consistent with the needs of the project and clarity of intermediate targets. **2.** Relevant expertise in the consortium. **3.** Appropriate allocation and justification of resources (person-months, equipment, budget).
	Weight: 60%	**Weight: 20%**	**Weight: 20%**
	Maximum Scoring: 60/100	**Maximum Scoring: 20/100**	**Maximum Scoring: 20/100**
	Threshold: 30/60	**Threshold: 10/20**	**Threshold: 10/20**

Table 3 Award Criteria

Evaluation scores will be awarded for each criteria, and not for the different aspects listed in Table 3. For full proposals, taking into account the weighting assigned to each of the three criteria (i.e. 60%, 20%, 20%):

1. The 'Excellence' criteria will be scored out of 60/100 with a minimum threshold of 30/60;
2. The 'Impact' criteria will be scored out of 20/100 with a minimum threshold of 10/20;
3. The 'Quality and Efficiency of the implementation' criteria will be scored out of 20/100 with a minimum threshold of 10/20.

Priority order for proposals with the same score

The following method will be applied for proposals with the same score.

As part of the evaluation, a panel review will recommend one or more ranked lists for the proposals under evaluation, following the scoring systems indicated above. One or more ranked lists will be drawn-up.

If necessary, the panel will determine a priority order for proposals which have been awarded the same score within a ranked list. Whether or not such a prioritisation is carried-out will depend on the available budget.

The following approach will be applied successively for every group of *ex aequo* proposals requiring prioritisation, starting with the highest scored group, and continuing in descending order:

(i) Proposals that address topics not otherwise covered by more highly-ranked proposals, will be considered to have the highest priority.

(ii) These proposals will themselves be prioritised according to the scores they have been awarded for the criterion 'Excellence'. When these scores are equal, priority will be based on scores for the criterion 'Impact'. When these scores are equal, priority will be based on scores for the criterion 'Quality and Efficiency of the Implementation'.

   a. If necessary, the panel may decide to further prioritise by considering how to enhance the quality of the project portfolio through synergies between projects, or other factors related to the objectives of the Call for Proposals or to Horizon 2020 in general. These factors will be documented in the report of the Panel.

   b. If a distinction still cannot be made, any further prioritisation will be based on the following factors, in order: size of the budget allocated to SMEs; gender balance among the personnel named in the proposal who will be primarily responsible for carrying-out the research.

(iii) The method described in point (ii) will then be applied to the remaining *ex aequos* in the group.

5. DESCRIPTION OF RESEARCH ACTIVITIES

5.1. Work Area 1: ATM Excellent Science & Outreach (Science to TRL 1)

The research performed under ATM Excellent Science & Outreach is typically curiosity-driven and explores unknown research areas. Referred to also as 'fundamental research', that not only brings new knowledge, but also encourages scientists to develop innovative ideas and concepts for the future ATM evolution. The proposed research areas are following-up and expanding the research continuity of the earlier WP-E calls for proposals under FP7/TEN-T Programmes. The proposed research topics are based on research gaps identified in SESAR 1 WP-E projects and research networks (e.g. HALA, Complex World) and ones identified by the main SESAR industrial research program.

5.1.1. Automation, Robotics & Autonomy

5.1.1.1. ER-01-2015 – Automation in ATM

Specific challenge: **Automation in ATM** hold the key to significant performance improvements across many aspects of ATM, which today relies on high levels of human intervention. Uptake of automation has been slow partly because the benefits of human cognitive abilities, especially in safety-critical situations, have provided strong arguments against change. The current spur of innovation in robotics and autonomy, within advanced industrial and service sectors, may extend more traditional notions of automation to potentially open up new fields of research. Since there is expected to be a significant increase in the numbers and types of aerial vehicles in operation, including remotely piloted vehicles, the scope for a new generation of autonomous automation solutions is significant.

The challenge is therefore to develop automation solutions that have the capability to provide substantial and verifiable performance benefits whilst fully addressing safety and security concerns. Research should fully take into account expected future technical and institutional developments together with forecast. In addition, the SESAR-sponsored HALA! Network[26] has been considering key issues of higher-levels of automation for ATM and its output should be considered as useful reference material

Scope: Proposals for research in this area should take an ambitious view of automation. Projects may look to build upon the existing legacy, or they could take a clean-sheet approach to design an ATM system that requires human intervention in a supervisory or control mode rather than in a direct operating mode. The latter 'unconstrained' line of attack should allow a bolder vision and open the door for new conceptual possibilities. Under this topic, there is substantial scope for learning from other transportation modes and other industries, particularly where robotics and autonomy are concerned.

Research may address any part of the ATM system from strategic planning through airport operations (including small and medium airports) to tactical air traffic control and collision avoidance. Research is also needed to support the integration of new and diverse aircraft types, including remotely piloted vehicles. The integration of RPAS or highly autonomous aerial vehicles provides a number of automation challenges requiring new supervision and control paradigms which could extend to such developments as multiple simultaneous control and swarm dynamics.

Other related aspects that can also be considered within the scope of this topic include notably:

- non-physical autonomous systems such as software designed to monitor the safety, integrity and performance of complex socio-technical systems, and
- new approaches to optimization applied to different aspects of ATM operations.

Increased dependence on automation makes it important to consider automation failure scenarios, system resilience and the challenge of maintaining a skilled and competent workforce. There will be a need to address some of the human performance issues for ATC similar to those that are known to

26 HALA! SESAR Research Network. Retrieved December 3, 2014, from http://www.hala-sesar.net/

affect flight-crew performance in the glass cockpit. These include the need to prevent the risks associated to moving the human operator into a monitoring role: stress, lack of attention, loss of situational awareness and de-skilling. Research may look into potential strategies to mitigate these risks, like the use of adaptable or adaptive automation schemes in order to both prevent controller de-skilling and maintain minimum workload levels that will ensure controllers' attention stays engaged at all times.

An improved understanding of complex failure modes due to automation degradation, and its consequences on ATM performance, in SESAR's system of systems could lead to new methodologies and architectural guidance for future design of fail-safe complex environments in the presence of high automation.

Expected impact: This research will be expected to demonstrate and quantify the potential for higher levels of automation and integration with operations at lower automation levels to provide benefits in safety, capacity, efficiency and security of ATM operations. Potential for improved cost-effectiveness or contributions to decision-support techniques notably during emergency situations may also be important outcomes.

Type of action: Research and Innovation Action (RIA).

5.1.2. Data Science & Information Management

Data Science in ATM will study the potential application of the rapidly maturing techniques in complexity science and data science for the ATM domain. Complexity science deals with the application of complexity theory in the ATM.

Information Management in ATM will study the management and distribution of all types of information in ATM systems, including flight deck and cabin, with particular attention to scalability, stability and error promulgation that relate to the inherent conflict between consistency, availability and partition tolerance in a distributed computer based global ATM system.

5.1.2.1. ER-02-2015 - Data Science in ATM

Specific challenge: The ambition of this topic is to explore the potential of the rapidly maturing techniques in complexity science and data science for the ATM domain. Slow adoption of new procedures and automation tools in ATM is an indication that system complexity is no longer mastered; a better understanding of interdependence and feedback mechanisms between components and of parameters that control the overall performance of the socio-technical ATM system of systems is urgently needed.

In addition, massively collaborative environments for information sharing as envisaged for the future ATM system entail many risks. Generic solutions are being researched in computer science which now need to be demonstrated for specific ATM applications.

Scope: The range of research that could be covered in this topic is broad and topics mentioned here are indicative. Research proposals may target SESAR concepts and systems currently being implemented or could address timeframes up to those of the Flightpath 2050 vision document.

Over the last four years, the SESAR-sponsored ComplexWorld network[27] has brought together scientists from complexity science with ATM researchers. Collaboratively they identified **four promising areas for complexity research:**

(1) characterisation of uncertainty in ATM;

(2) detection of emergent behaviour;

(3) resilient design; and

(4) development of non-classical performance metrics.

[27] ComplexWorld. (2014). Complex World . http://www.complexworld.eu/

In addressing these and building upon the relevant WP-E results, the focus should be on exploiting complexity science's modelling and analysis techniques such as network theory or agent-based modelling, at the appropriate scales (in time and space).

The availability of 'big data' offers a range of research opportunities for data science in ATM. Focusing on automating the extraction of knowledge from raw, heterogeneous and incomplete sources, techniques such as data mining, visualisation, stream processing, learning or scalable analytics may dramatically improve decision support and performance monitoring. A multi-disciplinary approach involving both data and complexity scientist is encouraged.

The advent of concepts such as collaborative decision-making, trajectory exchange and, more generally, system-wide information sharing raise issues not present in the peer-to-peer architectures that prevail in the current ATM systems. Essential operational aspects of SWIM are covered in the mainstream SESAR Work Programme, but further research is needed to address, inter alia, collaboration in the presence of competition, 'value' or 'optimal amount' of information, availability and security of cloud architectures in the context of SWIM and the future evolution of the European ATM system.

Expected impact: Successful research in this topic will improve the quality and availability of knowledge for decision making (both strategically and in real-time), will lead to more agile ATM system designs, to a more secure and widely usable SWIM infrastructure and offer benefits for exchanging passengers/freight information seamlessly between different transport modes. These developments will enable a range of performance benefits across the entire ATM system.

Type of action: Research and Innovation Action (RIA).

5.1.2.2. ER-03-2015 - Information Management in ATM

Specific Challenge: The development and introduction of operational concepts that require close collaboration between diverse actors and therefore require a more intense system wide information sharing, e.g. trajectory based operations, raise a number of new challenges when compared to traditional peer-to-peer architectures. There is strong commitment to system-wide information management (SWIM) in SESAR and a number of important developments are near implementation, but it is a dynamic field which provides regular opportunities for innovative approaches.

Scope: Research shall at a minimum address the management and distribution of all types of information in ATM between all stakeholders, with particular attention to the challenges of scalability, stability and error promulgation that relate to the inherent conflict between consistency, availability and partition tolerance in a distributed computer system like global ATM (CAP Theorem). It may also include new paradigms for the analysis of unstructured data, data streaming and non-concurrent data integration. This research will be expected to address the challenges of the distribution and management of all types of information in ATM between stakeholders.

Cyber-security is a major concern with such large quantities of information circulating in an aviation environment that, by using the internet, is connected to the external world. Innovative strategies may be explored to cope with security breaches designed to destroy, interrupt or corrupt information.

The quantity of data and information in ATM (weather conditions, aeronautical, flight, and trajectory) is increasing by orders of magnitude and studies are needed to see how elements of the system should cope with this continually increasing stream of information and, indeed, whether it is desirable in some areas. In this respect data science is emerging as a multi-disciplinary field, blending skills from scientific domains such as statistical physics, network theory or complexity theory, with techniques from computer science such as data mining, data indexing and visualization. This may be applied to data using new techniques and processes to extract and filter knowledge from raw, heterogeneous and incomplete data sources and hence dramatically improve accessibility and relevance to the end user.

The potential of using Ontology engineering models in a networked environment, and this in relation to the ATM Information Reference Model (AIRM) with various semantic resources (e.g. models) co-existing to form a semantic web, is one of those possible new developments. In the context of ATM, a better understanding is required of the benefits and disadvantages of using more modular, well separated and smaller models, as opposed to large monolithic models. Governance of these models and their corresponding information exchange services (evolution in a multi-stakeholder environment) is an important aspect of that.

There is also work to be done on understanding and presenting the impact of uncertainty of integrated information into the ATM decision-making process. For example meteorological forecasts will improve over time with better models and increased computer power but will always have a degree of uncertainty. Improving management of the potential impact of uncertainty in a multi-stakeholder environment would allow for better integration.

Expected impact: Improved data and information management is an important foundation for emerging SESAR concepts. High quality information that is correctly managed and presented to its clients in the ATM system will result in improvements in safety and efficiency of operations. These are key objectives in SESAR, which is seeking to substantially improve efficiency, with consequent positive impacts on environment, and higher levels of safety.

Type of action: Research and Innovation Action (RIA)

5.1.3. ER-04-2015 - Environment & Meteorology for ATM

Environment & Meteorology in ATM research activities will aim to better understand the impact of aviation on the environment and the ways in which ATM can reduce these effects. Research activities may address research aimed at developing 4D trajectories that are optimised to take account of all environmental considerations. Research activities under meteorology for ATM will also study enhanced meteorological capabilities and their integration into ATM planning processes for improving ATM efficiency.

Environmental Research

Specific challenge: Air traffic management has an important role to play in reducing the environmental impact of aviation, in addition to the improvements to be derived from new aircraft and engine technologies. Research is needed to better understand the impact of aviation on the environment and ways in which ATM can reduce these effects.

The maturity of models available to describe these is at the moment variable for ATM. It is a challenge to develop 4D trajectories that are optimised to take account of all environmental considerations and to understand the overall environmental perspective, given the dynamic and complex nature of the ATM system.

RPAS will most likely be operated in non-segregated airspace in the near future and operating characteristics and mission design mean that their environmental impact may be quite different from that of other traffic. For example noise annoyance close to populated areas or increased contrail formation due to long endurance operations at very high altitudes.

Scope: Some tools to model the environmental impact of aviation in different phases of flight have reached a certain maturity (e.g. local noise models) whilst other impacts are not yet well described (e.g. contrail formation). Building on existing work, modelling capabilities should be improved where needed to allow a multi-dimensional environmental impact assessment. It may be that new metrics are necessary to describe environmental impacts in some dimensions, with the European citizen the ultimate focus of attention (including social and long-term health).

The Advisory Council for Aeronautics Research in Europe (ACARE)[28] has set out a number of specific environmental targets. These new targets need to be studied to assess how they will affect ATM operations and performance.

Expected impact: This environmental research has the potential to enhance our understanding of the environmental impacts of ATM operations and how they can be minimized during different phases of flight. More specifically, projects will contribute to the environmental objectives defined by ACARE Working Group 3.

Type of action: Research and Innovation Action (RIA).

[28] http://www.acare4europe.com/

Meteorology

Aviation is fundamentally affected by weather, and advances in the understanding and prediction of local and global meteorological effects will increase the efficiency and safety in the system. Enhanced meteorological information and capabilities made available system-wide have great potential as long as ATM is able to integrate the information fully into its decision making process.

Specific challenge: Research into enhanced meteorological capabilities and their integration into the ATM planning processes has great potential for improving ATM efficiency, e.g. through robust planning less vulnerable to unforeseen changes in weather; or through improved air-ground trajectory synchronisation. This requires understanding of the potential of different types of weather-related information that could be used in ATM operations taking into account the inherent uncertainty of meteorological information.

Scope: Research may investigate the vulnerability of the ATM system to local weather phenomena, with existing knowledge taken into account. Research may also investigate the levels of which weather uncertainty impacts 4D (or more) trajectories. Research to understand the impact of global and/or long-term phenomena such as climate change, global warming, changes in the frequency and severity of extreme weather or ash-cloud formation on ATM operations may also be considered.

Expected impact: This research will contribute significantly to enhancing ATM efficiency by integrating meteorological information. It will also lead to a better understanding of the resilience of the ATM system to local and global weather phenomena.

Type of action: Research and Innovation Action.

5.1.4. ER-05-2015 - Economics and Legal Change in ATM

Economics & Legal Change in ATM will study the economics and legal changes in ATM. These may originate from evolving market pressures, the emergence of new market entrants, innovation in business models or they may be a consequence of regulation. Research activities may study the relative efficacy of changes and the possibility to shorten the R&I lifecycle, driven by regulation compared with those derived from natural or forced economic incentives. A better understanding of costs, benefits and impacts of changes, actual and planned, is desirable.

Specific challenge: Large parts of the European aviation and air traffic management industry are undergoing significant changes in their institutional and economic structures originating from evolving market pressures, the emergence of new market entrants and innovation in business models. A better understanding of the drivers, costs, benefits and impacts of changes throughout the ATM industry's value-chain is desirable.

This holistic perspective should particularly take account of passenger, societal and environmental perspectives to ensure a complete impact assessment. A particular challenge is to better understand the relative efficacy of changes driven by regulation compared with those that derived from natural or forced economic incentive. The balance between these is not fully understood and justifies fresh research initiatives.

An understanding of the aviation market challenges and dynamics should be used as the foundation for devising well-reasoned change scenarios for the ATM sector, exploring innovative opportunities for growth, driving value, shaping new businesses and designing operating models for the future, all with the purpose of delivering sustainable, resilient and high-performance ATM services at affordable costs.

Scope: The range of research that could be covered in this topic is broad and topics mentioned here are only indicative. Research proposals may target existing SES economic, regulatory and legal frameworks within the timeframes set-out in the Flightpath 2050 vision document.

Current methods used to analyse costs and benefits of proposed changes to ATM have a number of limitations as many impacts linked to business, societal or environmental points of view are not yet systematically factored in or monetised in a coherent manner. Also, interactions between interrelated changes are not fully considered. Multi-stakeholder and multi-criteria decision analyses may inform, in a more meaningful way, on suitable economic incentives or regulatory instruments balanced across different stakeholder groups.

Demand on the ATM system peaks at certain times of the day and in certain regions; a more homogeneous demand distribution better exploits existing capacity across the ATM system. Research

could assess the degree to which economic incentives and variable pricing mechanisms can be used to support demand-capacity balancing. These instruments could also address environmental challenges in aviation, for example as part of future environmental schemes.

Technology is a significant driver for innovation towards maximising business value. This can include innovative ways for aligning technology investment and business needs, notably by promoting economies of scale through the utilisation of state-of-art technology developed in other industrial sectors or adoption of open rather than proprietary standards, to speed-up the diffusion and adoption of novel technologies, reduce R&I cycles or accelerate and lighten certification processes.

Lessons learned from other industries regarding liberalisation, privatization, unbundling in monopolistic and defragmentation in supra-national markets can be applied to the ATM sector. Potential areas of application could include analyses of some facets of the proposed SES legislation, or the ensuing performance scheme, to ascertain potential unintended effects: for example, the introduction of passenger rights regulations, which strengthen the position of passengers, may lead to flight cancellations that are less costly for airlines relative to maintaining delayed flights. Such indirect effects of regulations could be subject to further analysis building upon already existing WP-E projects results (e.g. POEM).

Expected impact: This research should support the ATM industry to better and more reactively adapt to changes in its business, operational and policy environment, enhancing business and service value, reducing the risks and significantly heighten the implementation success of its change program. In addition research in this topic has the potential to improve cost-efficiency of the ATM system through well-targeted economic and regulatory instruments.

Type of action: Research and Innovation Action (RIA).

5.2. Work Area 2: ATM Applications-oriented Research (From TRL1 to TRL2)

ATM Application-Oriented Research encourages innovative and visionary ideas that will contribute to SESAR 2020 Research and Innovation (R&I) cycle.

The ATM application-oriented work area will help mature new concepts for ATM beyond those identified in the ATM master plan as well as help mature emerging technologies and methods to the level of maturity required to feed the applied research conducted in the Industrial Research and Validation phase of SESAR; thus connecting the ATM Exploratory Research to the ATM Applied Research in the context of the European ATM Master Plan.

After a maturity assessment of the ATM Applications-oriented research projects their results will be transferred, if applicable, into SESAR 2020 industrial research.

In this first call exploratory research projects will be needed in areas of high performing airport operations, optimised ATM network management, Advances Air Traffic Services (ATS), enabling aviation infrastructure and ATM operations, architecture and performance.

5.2.1. High Performing Airport Operations

High Performing Airport Operations will study the improved visualisation and awareness for airport operations. As the pressure increases on airports, new technologies are emerging that may offer significant potential for improved situational awareness for tower controllers. Research activities will address new ways of displaying and presenting data on aircraft, vehicles and infrastructure in a manned airport visual control room (local or remote). The main impact of this research will be increased safety on the surface and in the air in the vicinity of the airport as well as cost savings.

5.2.1.1. ER-06-2015 - High Performing Airport Operations - Improved Visualisation and Awareness

Specific challenge: Airports are a key part of the ATM network and airport capacity is identified as one of the major bottlenecks to aviation growth in Europe. As the pressure increases on airports, new technologies are emerging that may offer significant potential for improved situational awareness for tower controllers. In particular, an extension of applications and technologies developed for remote tower operations, already well advanced in the SESAR Programme, may offer solutions for use in conventional environments with significant potential for safety improvements.

Scope: This research concerns new ways of displaying and presenting data on aircraft, vehicles and infrastructure in a manned airport visual control room. It may build on technologies being developed for remote tower operations or state-of the art from other domains (e.g. security) to present additional or augmented information on existing or new types of display including, for example, head-up displays.

Integration of sensor inputs with a 3D airport model has already been explored and the technique shows potential for use in ATM. For ground movements, existing 2D remote tower solutions may provide sufficient coverage and image quality to support advanced 3D tracking. This capability could potentially be used as a supplementary non-cooperative surveillance system for input to A-SMGCS on larger airports. In small airports, where surface movement radar is deemed too expensive, 3D modelling could provide a cost effective alternative. In all cases such techniques could be used to cover blind spots and be decision support tools during shortfall conditions.

Projects may investigate methods to increase the robustness of algorithms for computing object position, speed, direction and size. Projects may explore the combination of 2D object recognition algorithms and 3D information with behaviour models for better prediction of potential incursions. Such an implementation should provide for robust and trustworthy input to alarm systems that can reliably distinguish false-positives and be integrated with existing safety nets.

With appropriate distribution of 2D cameras and other basic sensors at small airports, a 3D model can be developed to provide precise positioning for objects – a potential quick-win for both remote and non-remote tower systems. The technique could be extended to provide aerial surveillance and tracking enhancements for larger and more complex airports. Projects may study optimal camera and positioning to achieve these outcomes, together with their integration across other sensors that may already be available.

New and precise 3D airport computer models can lead to further developments of operational interest. For example, when linked to recent developments in meteorological models, wake vortex information could somehow be presented directly in the video stream to support optimal separation on approach.

Expected Impacts

The main impact of this research will be increased safety on the surface and in the air in the vicinity of the airport as well as cost savings. Other potential benefits for airport operations may be increased resilience and maintenance of capacity in poor conditions. It could be useful to larger airports that may currently implement A-SMGCS, but since the sensors will be relatively low-cost and independent it could be most useful for smaller airports that cannot afford expensive and complex systems.

Type of action: Research and Innovation Action (RIA)

5.2.2. Advanced Air Traffic Services (ATS)

Research activities in ATS include research activities into approaches to enhance and integrate departure and arrival processes, develop tools to support separation management, improve air & ground safety nets and systems to support flight planning with no reference to pre-defined waypoints. All improvements need to be considered from cost-benefit and performance perspectives, in order to make sure that SESAR proposals are economically viable. In this first research projects linked to separation management TMA and en-route, enhanced air & ground safety nets and trajectory & performance based free routing will be needed.

5.2.2.1. ER-07–2015 - Separation Management and Separation Standards

Separation Management and Separation Standards will study the aspects of separation management and separation standards, given the emerging SESAR environment, in order to make best use of available airspace resources.

Specific Challenge: Keeping aircraft separated from each other is one of the core functions of ATM. In the SESAR concept, ground automation supports air traffic controllers in their task to provide separation management. Separation management starts by strategically limiting the density of potential separation conflicts (i.e. limiting complexity), but is ultimately ensured tactically by keeping aircraft separated at or above defined separation minima. The use of accurate and timely trajectory information in support of automation tools allows more effective strategic separation management; however the separation standards themselves, which ultimately limit capacity, remain unchanged.

The exploratory research challenge is to define potential new separation standards and separation management techniques that will allow aircraft to be more closely spaced. Any newly proposed separation scheme needs to be assessed against the risk of collisions and the probability of disruptive wake vortex encounters.

Scope: Exploratory Research projects should investigate the overall principle of separation management in ATM and propose innovative and adapted separation schemes, both in terms of the definition of separation minima and the mechanism for assuring separation[29]. Collision and wake-encounter risk assessments should be done in support of any proposed changes to the minima, though it should be noted this subject is not addressing collision avoidance itself. Assessments should also be made investigating the risk of infringement of any revised minima where aircraft are now spaced more closely together. Specific areas for investigation could include the following:

The use of Time-Based Separation (TBS) on final approach has already been validated in SESAR. In headwind conditions TBS are lower than Distance Based Separation (DBS) thus maintaining capacity that would otherwise be reduced. At higher altitudes, winds are usually stronger, which may result in a bigger difference between TBS and DBS than in final approach. Exploratory research projects may analyse the potential use and benefits of TBS in environments other than final approach[30]..

The speed at which aircraft fly in the TMA is usually slower than en-route. Minimum Radar Separation (MRS) is usually 3NM in the TMA and 5NM in en-route environments, however, this difference is not directly related to the speed at which aircraft fly (i.e. the 5NM minimum is applied in en-route regardless of aircraft speed). The principle of discriminating between aircraft flying at different speeds, in order to investigate if new speed-based separation minima would be safe for aircraft that fly slower could be assessed. Unlike TBS, these newly-defined speed-based minima would be applicable under all wind conditions.

Separation minima currently in use are defined either as a lateral or as a vertical minimum. Exploratory research projects may investigate the possibility of defining separation minima that combine lateral and vertical minima. Combined separation minima would specify lateral and vertical separation minima that are individually below the existing vertical and lateral minima, but when attained simultaneously still achieve safe separation between aircraft (e.g. 1 NM and 500 feet).

Historically, radar surveillance performance was the basis for the definition of separation minima. New surveillance technologies may enable a revision of such minima based on surveillance performance. Exploratory research projects may look into the possibility to define lower separation minima based on the actual surveillance performance which could be achieved through any combination of radar, ADS-B and Wide-Area Multilateration[31]

The concept of Performance Based Navigation (PBN) brings with it the capability of clearly defined and predictable navigation performance. Projects may investigate the contribution that PBN and the associated navigation applications, specifications and technologies could make to the revision of separation minima.

Expected impact:

Reduced separation minima will allow for an increase of airspace capacity, which is one of the key objectives of SESAR.

Type of action: Research and Innovation Action (RIA)

29 CM - 0604 - Separation Management using RBTs and 3D RNP specifications
30 AUO 0506 - Improved air safety using onboard detection via e.g. LIDAR of wake turbulence detection
31 AUO0505 - Improved Air Safety using data exchange via e.g. ADS-B for Wake turbulence prediction

5.2.3. Enabling Aviation Infrastructure

5.2.3.1. ER-08–2015 Communication, Navigation and Surveillance

Communication, Navigation and Surveillance will study the use, or adaptation, of new technologies being developed outside ATM to support ATM CNS needs including analysis of the safety, performance and security implications for the ATM system.

Research projects are expected to perform assessment of the benefits and risks resulting from an integrated CNS infrastructure in particular with regard to redundancy and performance needs.

Specific challenge: Communication, navigation and surveillance (CNS) systems are the building blocks on which air traffic management operates. Despite many activities in the CNS domain there remain a number of areas where more fundamental research is needed.

The use, or adaptation, of new technologies being developed outside ATM to support ATM CNS needs should be considered including analysis of the safety, performance and security implications for the ATM system. Technology lead times in ATM along with certification requirements should be taken into account. More flexible system architectures for ground and airborne systems should be considered in this context (e.g. building on integrated modular avionics and an open interface approach to ground system development) to help unlock us from legacy technologies. Research projects are expected to perform an assessment of the benefits and risks from an integrated CNS infrastructure in particular with regard to redundancy and performance needs.

Scope: The full range of research that could be covered in this topic is broad and topics mentioned here are indicative. Projects may target implementation in the mid-term or could address timeframes up to those of the Flightpath 2050 vision document.

Many aspects of CNS are currently characterised by lack of integration: multiple technologies are used where it could be possible to merge into one, both within and across domains. This has the potential to generate substantial cost savings and efficiencies and, crucially, improvements in security. Studies could address the integration, interoperability and openness of such an approach for the long term, exploiting synergies, reducing costs and optimising spectrum usage. Furthermore, spectrum is a limited natural resource and increasing demands are putting aviation under pressure. Research could show how the industry can move towards a more spectrum-efficient approach to CNS with a holistic view of the full life-cycle.

In the communications domain future innovative data-link technologies (e.g. high-bandwidth) for ATM going well beyond current ATM developments and taking into account research and development outside ATM should be studied. This should include technology options suitable for the airport domain, continental airspace and oceanic and remote areas (including high latitudes and polar region). Research proposals are expected to address the research issues related to resistance/prevention to jamming and spoofing.

In the navigation domain innovative research ideas, concepts and technologies for small aircraft are need, as a suitable back-up/continuity system for GNSS (e.g. affordable inertial systems and use of ‘other’ signals (signals of opportunity) for navigation integrity. The options for advanced alternative PNT systems should also be considered. Furthermore the transition from barometric to geometric (GPS) altitude for collision avoidance issues can be studied. In addition the re-examination of both vertical and horizontal separation practices are needed in the light of improved navigation accuracy (better than declared RNP performance).

In surveillance domain research projects can address the Surveillance Performance analysis and Quality of Services (QoS) leading to a “performance based surveillance” approach that facilitates adoption of new technologies. Furthermore, research ideas are needed in the assessment of future role of non-cooperative technologies with global coverage (e.g. satellite-based, etc.) for ATM.

Expected impact: This research will demonstrate and quantify the potential for CNS developments to improve the efficiency and performance of the ATM system at many levels.

Successful research in this topic will have the potential to generate high positive benefits for ATM in terms of resource efficient and fit-for-purpose CNS capabilities as well as improvements in security.

Type of action: Research and Innovation Action

5.2.4. ATM Operations, Architecture, Performance & Validation

The results from the research activities under this topic will directly contribute to the SESAR 2020 transversal activities of ATM Design & Integration, Performance Management, Validation, Verification & Demo infrastructure and Master Plan contribution.

5.2.4.1. ER-09-2015 - Trajectory Based Operations

Trajectory Based Operations (TBO) is a key element of future ATM operating concepts. It is expected to provide the flexibility needed by airspace users to optimize their operations while simultaneously ensuring the predictability needed at ATM network level for maximum overall performance. It is therefore essential to fully understand the benefits and limitations of the TBO approach.

Specific challenge: Trajectory Based Operations (TBO) is a key element of future ATM operating concepts. It is expected to provide the flexibility needed by airspace users to optimise their operations while simultaneously ensuring the predictability needed at ATM network level for maximum overall performance. TBO starts with pre-departure planning and continues through to real-time air traffic control. One of its foundations is improved trajectory information sharing so it defines an approach for coordinating trajectory changes and constraints. It also sets forth the extent to which trajectory adherence is required to support the specific functions of the layered planning approach upon which the ATM network is built.

Scope: Research is needed to explore a number of fundamental questions related to TBO. A framework is required that can model a system combining trajectories emanating from multiple and diverse airline users and feeding into the different ATM functions at different layers in the network. In this way it should be possible to establish a theoretical optimum and to determine the sensitivity of the system to variations and perturbations. While it may be relatively straightforward to identify an optimum for a single airline (prioritisation based on inter-flight constraints, airframe dependencies, crew and so on) the combined system-wide view is far less obvious and highly complex, especially taking into account different degrees of collaboration or, in the real world, competition between airlines.

In developing the theoretical framework, the challenge of defining an approach that can lead to the best outcome in practice should also be kept in mind. To what extent can a solution be constructed from pre-agreed criteria, when and to what extent does it require active coordination between the various stakeholders? How much should the system be automated taking into account requirements for resilience, what kind of algorithms should be implemented? How much predictability is needed to make the system work and what are the expected benefits from it?

Projects will find solutions that balance flexibility and the requirement for trajectory conformance. They must consider convergence and stability, analysis of non-linear phenomena in multi-user real-time communications, emergent behavior and non-determinism, as well as error propagation. The chosen approach must allow convergence to a stable and robust set of trajectories, taking into account inherent uncertainties in all parts of the ATM system. Projects may further investigate the extent to which flexibility is desirable by comparing system-wide and airline-specific performance that can be achieved relative to a system that requires rigid conformance with pre-planned trajectories.

It is anticipated that research in this topic will emphasise modelling approaches rather than real-time human-in-the-loop simulation.

Expected impact: TBO is a key part of future concepts (SESAR, NextGen, ICAO). It is therefore essential to fully understand the benefits and limitations of the approach. This is particularly true since the technology needed to support TBO could be extremely costly. A clear understanding of the real benefits and operational application of TBO techniques can help direct further research in this area.

Type of action: Research and Innovation Action (RIA)

5.2.4.2. ER-10–2015 - ATM Architecture

ATM Architecture will study innovative approaches to analysing ATM architecture. Research activities are expected to help better understanding and modeling how architectural and design choices influence the ATM system and its various behaviours. This may be done using existing or novel approaches from systems analysis, architecture or complexity science.

Specific challenge: The architecture of the overall ATM system is vast and complex; it has evolved piecemeal over many decades with no single 'design authority'. Introducing change into this system is often difficult since it needs to take into account the many tight interdependencies that exist across the technical subsystems together with incumbent operational and institutional frameworks. A consequence of this situation is the difficulty to know the full implications of introducing change in any part of the system or on the system as a whole. Failure to properly understand this could mean that changes are introduced that result in uncontrolled system-wide degradation. This could be a particular concern with the increasing dependence on automation.

The challenge is therefore to better understand and model how architectural and design choices influence the ATM system and its various behaviours. This may be done using existing or novel approaches from systems analysis, architecture or complexity science.

Scope: Proposals for research activities on ATM system design and architecture may start by capturing the characteristics of today's system, using an existing or novel method, or may take a 'clean sheet' approach, exploiting the benefits of an unconstrained perspective. In either case it may be possible to learn lessons from other industries that have used new devices such as, for example, participatory design.

Research projects may propose innovative ideas for ATM system design incorporating flexibility, agility and resilience applying formal mathematical approaches at early phases of system design, or for modelling change. Furthermore, research projects may seek to provide a better understanding of the degree of coupling (loose/tight) among the different ATM subsystems, the nature of these interdependencies and their impact on the overall ATM system. New approaches should normally build on Service Oriented Architecture (SOA) principles, with multiple service levels and tailored service provision. Agility should allow the ATM system to scale and adapt to meet different requirements for different times and places. Projects may also investigate the potential use of open-source and commercial off the shelf solutions. Finally, new designs should take into account security threats.

Research is needed to study the possibilities for developing a harmonised technical infrastructure for ANS, including operational and economic impacts. Harmonized infrastructure is a prerequisite for developments such as virtual centers and for the possible opening of the ANS market. Research projects may assess the potential benefits, analyse how the harmonization could be introduced through regulation, incentives and EC grants. It should address transition and standardization aspects as well as the restructuring of ANS and associated cost.

Projects should be careful not to spend time re-doing previous work on architecture that has been done in SESAR or elsewhere.

Expected Impact: This research will support the ATM industry into better understanding of the need to study the possibilities for developing a harmonised technical infrastructure for ANS, including operational and economic impacts. Or the research projects may seek to provide a better understanding of the degree of coupling (loose/tight) among the different ATM subsystems, the nature of these interdependencies and their impact on the overall ATM system. Type of action: Research and Innovation Action (RIA)

5.2.4.3. ER-11–2015 - ATM Performance

ATM Performance will study new effective methodologies and tools for micro and macro modelling of performance in ATM, capable of capturing the interdependencies between different Key Performance Areas (KPAs). Research activities may also cover the modelling and analysis of the current performance drivers underpinning each and every stakeholder's business model as well as their interactions. Projects may also propose innovative metrics and indicators capable of easily and comprehensively capturing the performance impact of ATM operations on the different stakeholders, as well as the tools, methods and procedures to collect and process the relevant data.

Specific Challenge: The European Air Traffic Management Network (EATMN) is part of the EU critical infrastructure and up to 2004 evolved in an uncoordinated process of deployment. The Single European Sky (SES) initiative was launched with the aim of incrementally restructuring this network to improve its performance in terms of safety, cost efficiency, capacity and flight efficiency, improving the quality of services to airspace users through operational and technical interventions.

To achieve this EATMN a significant change in the way Air Navigation Services (ANS) are regulated, operated, consumed and financed is now undergoing. This evolution is driven by EU-wide

performance targets, proposed and monitored through the performance scheme (Commission Implementing Regulation (EU) No 390/2013) within an agreed methodological framework for performance targeting, measuring, base-lining and benchmarking in ATM.

In the face of the evolving approach in the provision of ANS either under monopolistic, competitive or cooperative conditions, the performance scheme should also develop in terms of effectiveness and proportionality and adapt to existing and new business models.

Scope: Projects in this topic could investigate new effective methodologies and tools for micro and macro modelling of performance in ATM, capable of capturing the interdependencies between different Key Performance Areas (KPAs).

The solutions proposed will be independently reviewed by the Performance Review Body (PRB) and will be tested against current data and analysis and compared with current methods, in order to prove their effectiveness in performance planning or monitoring. Also, innovative methods and techniques for effective target setting and benchmarking of ANSP performance, capable of accurately capturing the impact of endogenous and exogenous factors, will be of interest.

Projects can also cover the modelling and analysis of the current performance drivers underpinning each and every stakeholder's business model as well as their interactions. In addition, the performance impact of new business models and, conversely, the way performance needs could stimulate changes in business models could be studied, e.g. implied by the evolution of the provision of ANS from a monopoly towards an open market, capitalising on the lesson learned from other comparable industries (e.g. electricity industry, postal services, etc.).

Projects may propose new metrics and indicators capable of easily and comprehensively capturing and steering the performance of ATM operations. These metrics and indicators should be integrated with the current performance indicators applying to the different stakeholders. They should propose as well the tools, methods and procedures to collect and process the relevant data supporting the needs of national supervisory authorities and other stakeholders.

In particular, projects may explore promising new performance indicators for operational efficiency, based on aircraft operators' needs. They should benchmark a fuel-efficient, on-time, predictable flight operation. The objective of such indicator would be to measure the actual situation versus an optimal goal, i.e. the deviation (the "delta") between actual trajectories and the optimal trajectories. The optimal trajectory is the one defined by the airspace user and reflecting its business needs, taking into account a number of parameters: time constraints of the network, capabilities of the aircraft, weather and other parameters (ANS charges, etc.), and aiming at conducting the flight as cost-efficiently as possible. The deviation may be characterised with two indicators: Delta Fuel Burn of actual vs. optimum and Delta of block time actual vs. planned.

Also of interest would be research projects investigating the application to ATM of methods and best practices borrowed from other fields for the collection and aggregation of mixed qualitative and quantitative validation results.

Expected Impacts: Research in this area should contribute to the improvement of the performance approach for RP3 onwards (2020) and show details of benefit delivery. It should also shed new insights in the performance mechanisms underpinning ATM, airports, and the improved interaction with the user community to improve prediction of need and use of scarce resources. The expected impact of the exploratory research projects is improved collaborative contributions to the European ATM Performance Programme.

Type of action: Research and Innovation Action (RIA).

6. COMPLIANCE TO SJU PROGRAMME/PROJECT MANAGEMENT

The selected ER projects will have to comply in a tailored manner to the defined interfaces and institutionalised approach applicable to the SESAR 2020 Programme.

This is required to allow the SJU to run the Programme and monitor and control the projects across SESAR 2020 Pillars (Exploratory Research, Industrial Research and Large Scale Demonstration projects). This will allow transiting results from Exploratory Research to subsequent phase, establishing a Research and Innovation pipeline for ATM.

6.1. Project Execution Guidance for Exploratory Research projects

The SJU Project Execution Guidance for SESAR 2020 has been tailored for the Exploratory Research projects. A draft "Project Execution Guidance for SESAR 2020 Exploratory Research" document can be found on the Participants Portal.

The selected ER projects will be expected to apply the guidelines Project Execution Guidance and in particular:

- As a first project deliverable, deliver a Project Management Plan for SJU approval. This plan will include a schedule compliant to the schedule guidelines;
- Use standard SJU templates and guidelines for producing the project deliverables;
- Formally hand over the final deliverables to the SJU for a quality assessment prior to their approval;
- Deliver a Bi-annual Progress Report providing a qualitative summary of the work performed according to H2020 guidelines;
- Deliver a publishable report of the research activities that can be used for transition to subsequent development stages and when applicable a self-assessment of the TRL (Technology Readiness Level) achieved at the end of the project according to the guidance provided by the SJU in the "Project Execution Guidance for SESAR 2020 Exploratory Research" document. The SJU will verify the maturity achieved in order to establish the appropriate transition of the results to subsequent phases.
- Contribute to the project closure.

6.2. Meetings

The following Meetings are foreseen, in particular:

- the 'Project Kick-off meeting which will take place shortly after contract signature. This will be organised at the SJU or Coordinator's premises or through web conferencing;
- the Project Intermediate Review meeting, which will be planned approximately half-way through the Project. This meeting will held at the SJU or Coordinator's premises and will aim at steering the project in order to achieve the expected quality and maturity at the project Close-out meeting;
- the Project Close-out meeting, following the submission of all contractual deliverables, normally at the SJU;
- for Application-Oriented projects, an ER/IR Gate will be held if the Close-out meeting concludes that the results are ready to be transferred to Industrial Research (a joint Close-Out/Gate meeting will be possible as long as the publishable report demonstrates the project readiness to the Gate).

In addition, the project is expected to contribute and present (initially on its objectives and finally on the achieved results) at the SESAR Innovation Days.

7. LIST OF ACRONYMS

AAT	Aeronautics and Air Transport
ACARE	Advisory Council for Aeronautics Research in Europe
ADS	Automatic Dependent Surveillance
AIRM	ATM Information Reference Model
ATM	Air Traffic Management
A-SMGCS	Advanced Surface Movement, Guidance and Control Systems
ANS	Air Navigation Services
ATS	Advanced Air Traffic Services
CNS	Communications, Navigation & Surveillance
CSA	Coordination and Support Actions
DBS	Distance Based Separation
ER	Exploratory Research
EC	European Commission
ECAC	The European Civil Aviation Conference (www.ecac-cearc.org)
EATMN	European Air Traffic Management Network
FRAM	Functional Resonance Analysis Method
FP7	Framework Programme 7
GNSS	Global Navigation Satellite System
ICAO	International Civil Aviation Organization
KPA	Key Performance Areas
MRS	Minimum Radar Separation
MP	Master Plan
QoS	Quality of Services
PBO	Performance-based Operations
PBN	Performance Based Navigation
PATS	Personal Air Transport System
POEM	Passenger –Oriented Enhanced Metrics
RIA	Research and Innovation Action
RNP	Required Navigation Performance
RPAS	Remotely Piloted Aircraft Systems
SES	Single European Sky
SESAR	Single European Sky ATM Research
SC	Scientific Committee
SME	Small and Medium sized Enterprises
SOA	Service Oriented Architecture
SJU	SESAR Joint Undertaking
SWIM	System Wide Information Management

TBO	Trajectory Based Operations
TBS	Time-Based Separation
TMA	Terminal Manoeuvring Area
TRL	Technology Readiness Levels
UDPP	User Driven Prioritisation Process
VTOL	Vertical Take-off and Landing
WP-E	Work Package E
WBS	Work Breakdown Structure

8. REFERENCES

Documents available on Participants Portal webpage dedicated to this Call for Proposals

1. Second draft of the SESAR 2020 R&I Programme ed. 0.21 dated 07 July 2014
2. SJU 2015 'Exploratory Research 2020' Financing Decision
3. Project Execution Guidance for SESAR 2020 Exploratory Research
4. Financial Proposal Template for this Call
5. Technical Proposal Template for this Call
6. SJU Self-evaluation Form
7. SJU 2020 Model Grant Agreement

Other SJU relevant documentation:

8. SESAR Joint Undertaking website:
   http://www.sesarju.eu/
9. SJU 2015 Annual Work Programme:
   http://www.sesarju.eu/sites/default/files/documents/reports/AWP2015_adb_adopted.pdf?issuusl=ignore
10. Consolidated SJU Regulation:
    http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02007R0219-20140101&from=EN

HORIZON 2020 documentation

11. Horizon 2020 Specific Programme:
    http://ec.europa.eu/research/participants/data/ref/h2020/legal_basis/sp/h2020-sp_en.pdf
12. H2020 Annotated Model Grant Agreement (this is the main H2020 guidance document):
    http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/amga/h2020-amga_en.pdf
13. Regulation establishing Horizon 2020:
    http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1291&qid=1425649916992&from=EN
14. H2020 Rules for Participation:
    http://ec.europa.eu/research/participants/data/ref/h2020/legal_basis/rules_participation/h2020-rules-participation_en.pdf
15. Commission's H2020 work programme - Introduction:
    http://ec.europa.eu/research/participants/portal/doc/call/h2020/common/1617601-part_1_introduction_v2.0_en.pdf
16. Commission's H2020 work programme - 11. Smart, green and integrated transport_v.2.0:
    http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-transport_en.pdf
17. Commission's H2020 work programme general annexes:
    http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-ga_en.pdf

18. Horizon 2020 Specific Programme
http://ec.europa.eu/research/participants/data/ref/h2020/legal_basis/sp/h2020-sp_en.pdf

19. Guide for proposal submission and evaluation:
http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/pse/h2020-guide-pse_en.pdf

20. Guide for beneficiary registration, validation and financial viability check:
http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/lev/h2020-guide-lev_en.pdf

21. Guidance on evaluation of some H2020 aspects:
http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/pse/h2020-evaluation-faq_en.pdf

22. Guideline on Third country participation in H2020:
http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/3cpart/h2020-hi-3cpart_en.pdf

23. List of H2020 Associated Countries:
http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/3cpart/h2020-hi-list-ac_en.pdf?_=58655886

24. EU international cooperation in research and innovation:
http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/3cpart/h2020-hi-int-coop_en.pdf

25. Guidelines on Open Access to Scientific Publications and Research Data:
http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf

26. Guidelines on Data Management:
http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-data-mgt_en.pdf

27. Reference documents on the Participant Portal:
http://ec.europa.eu/research/participants/portal/desktop/en/funding/reference_docs.html

28. H2020 on-line manual:
http://ec.europa.eu/research/participants/portal/desktop/en/funding/guide.html

29. Directorate-General for Mobility and Transport, European Commission:
http://ec.europa.eu/transport/index_en.htm

30. EU2020 Strategy:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF