European Commission

Impact Assessment Study for Institutionalised European Partnerships under Horizon Europe

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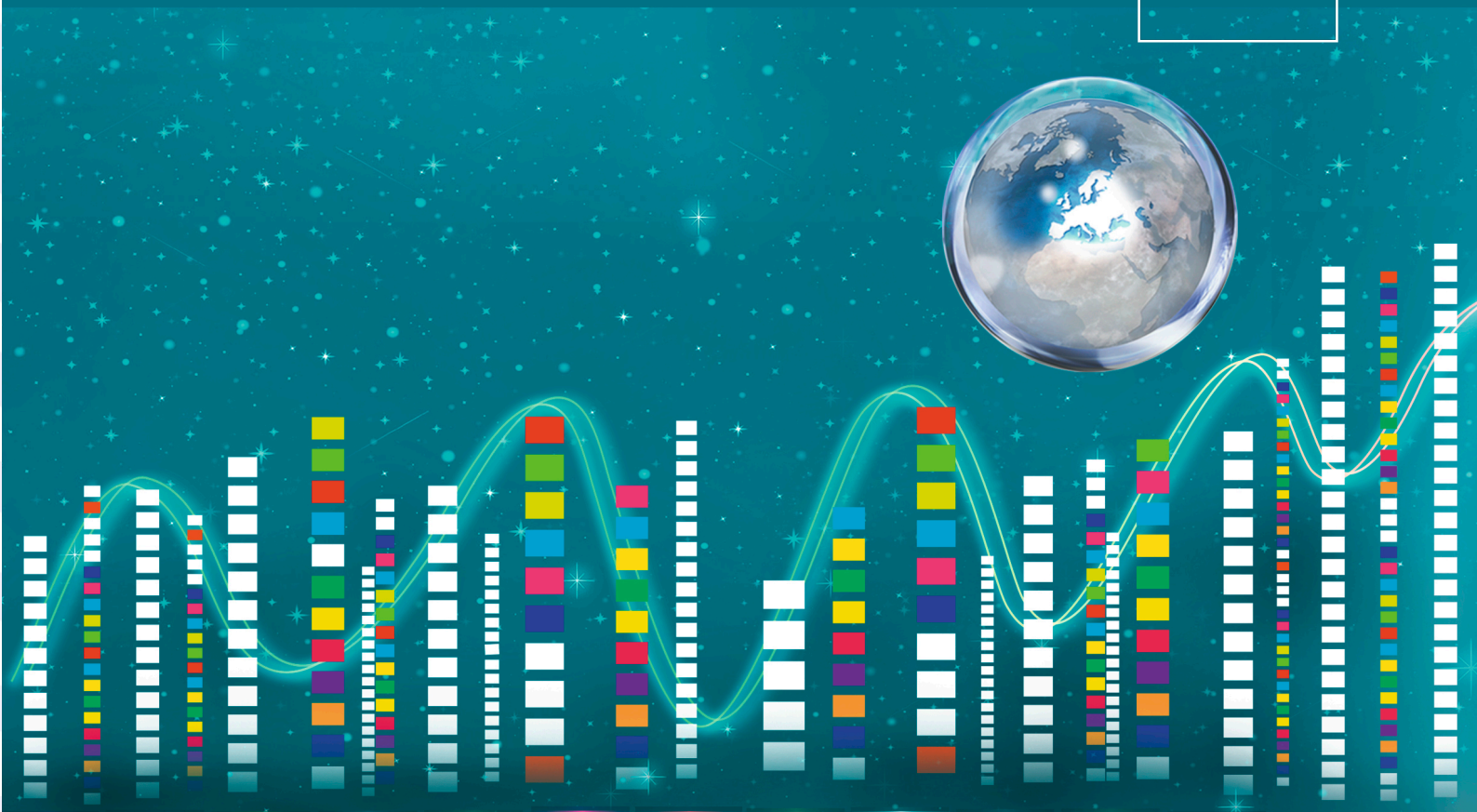
Report



Research and Innovation

Impact Assessment Study for Institutionalised European Partnerships under Horizon Europe

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EUROPEAN COMMISSION

Impact Assessment Study for Institutionalised European Partnerships under Horizon Europe

In collaboration with

2020 Directorate-General for Research and Innovation EN

Table of Contents

Introduction

This Impact Assessment Study had the primary objective to support and provide input to the impact assessments of the first set of 13 European Institutionalised Partnerships based on Articles 185 and 187 of the Treaty on the Functioning of the EU (TFEU) that are envisaged to be funded under the new Framework Programme for Research and Innovation, Horizon Europe.

In addition, the Impact Assessment Study team contributed to future European policymaking on the overall European Partnership landscape by means of a horizontal analysis of the coherence and efficiency in the implementation of European partnerships. The purpose of this analysis was to draw the lessons learned from the implementation of the impact assessment methodology developed for this study and to formulate recommendations for the refinement and operational design of the criteria for the selection, implementation, monitoring, evaluation and phasing-out for the three types of European Partnerships. Finally, an impact modelling exercise was conducted in order to estimate the potential for longer-term future impacts of the candidate Institutionalised European partnerships in the economic and environmental sustainability spheres.

Technopolis Group was responsible for the overall coordination of the 13 specific impact assessment studies, the development of the common methodological framework, and the delivery of the horizontal analysis. It also conducted specific analyses that were common to all studies, acting as a 'horizontal' team, in collaboration with CEPS, IPM, Nomisma, and Optimat Ltd. For the implementation of the individual impact assessment studies, Technopolis Group collaborated with organisations that are key experts in specific fields covered by the candidate Institutionalised European Partnerships. These partner organisations were Aecom, Idate, Steer, Think, and Trinomics. Cambridge Econometrics took charge of the impact modelling exercise.

The Impact Assessment Study was conducted between July 2019 and January 2020. The 13 Impact Assessment Studies were conducted simultaneously, based upon a common methodological framework in order to maximise consistency and efficiency. The meta-framework reflected the Better Regulation Guidelines and operationalised the selection criteria for European Partnerships set out in the Horizon Europe Regulation. The 'Horizontal analysis of efficiency and coherence of implementation' was conducted in the same time period, building upon the information available on the 44 envisaged European Partnerships landscape as in May 2019, complemented with information on five envisaged European Partnerships as decided by the European Commission in October and November 2019.

This final report contains the reports of all individual impact assessment studies and the 'horizontal' analyses. It is structured in two parts, reflecting the two strands of analysis:

PART I. Impact Assessment Studies for the Candidate Institutionalised European Partnerships

1. Overarching context to the impact assessment studies

This report sets out the overall policy context and methodological framework underlying the impact assessment studies for the candidate Institutionalised European Partnerships. It describes the changes in approach to the public-private and public-public partnerships under Horizon Europe compared to the previous EU Framework Programmes. An example is the requirement that all envisaged European Partnerships be implemented as either co-programmed, co-funded or institutionalised. The impact assessment studies will consider these three scenarios as the different options to be assessed, in compliance with the Better Regulation guidelines and against the functionalities that the candidate partnerships are expected to fulfil. The report describes the common methodological framework to assess the envisaged initiatives accordingly. The report also presents the landscape of European Partnerships at the level of Horizon Europe Pillar 2 clusters, which lay the grounds for all

of the impact assessment studies except the candidate Institutionalised European Partnership for Innovative SMEs.

2. EU-Africa Global Health Candidate Institutionalised European Partnership

This initiative focuses on research and innovation in the area of infectious diseases, with a particular focus on sub-Saharan Africa. It will address the challenges of a sustained high burden of infectious diseases in Africa, as well as the (re)emergence of infectious diseases worldwide. Its objectives will thus be to contribute to a reduction of the burden of infectious diseases in sub-Saharan Africa and to the control of (re)emerging infectious diseases globally. It will do so through investments in relevant research and innovation actions, as well as by supporting the further development of essential research capacity in Africa. The study concluded that an Institutionalised Partnership under Art. 187 of the TFEU is the preferred option for the implementation of this initiative.

3. Candidate Institutionalised European Partnership on Innovative Health

This initiative focuses on supporting innovation for health and care within the EU. It will address the EU-wide challenges raised by inefficient translation of scientific knowledge for use in health and care, insufficient innovative products reaching health and care services and threats to the competitiveness of the health industry. Its main objectives are to create an EU-wide health R&I ecosystem that facilitates translation of scientific knowledge into innovations; foster the development of safe, effective, patient-centred and cost-effective innovations that respond to strategic unmet public health needs currently not served by industry; and drive cross-sectoral health innovation for a globally competitive European health industry. The study concluded that an Institutionalised Partnership based on Article 187 of the Treaty on the Functioning of the EU (TFEU) is the preferred option for the implementation of this initiative.

4. Candidate Institutionalised European Partnership in High Performance Computing

The initiative focuses on coordinating efforts and resources in order to deploy a European HPC infrastructure together with a competitive innovation ecosystem in terms of technologies, applications, and skills. It will address the challenges raised by underinvestment, the lack of coordination between the EU and MS, fragmentation of instruments, technological dependency on non-EU suppliers, unmet scientific demand, and weaknesses in the endogenous HPC supply chain. The initiative has as its main objectives to enhance EU research in terms of HPC and related applications, continued support for the competitiveness EU HPC industry, and fostering digital autonomy in order to ensure long-term support for the European HPC ecosystem as a whole. The study concluded that an Institutionalised Partnership is the preferred option for the implementation of this initiative as it maximises benefits in comparison to the other available policy options.

5. Candidate Institutionalised European Partnership in Key Digital Technologies

This initiative focusses on enhancing the research, innovation and business value creation of European electronics value chains in key strategic market segments in a sustainable manner to achieve technological sovereignty and ultimately make European businesses and citizens best equipped for the digital age. It will address the risks of Europe losing the lead in critical industries and services and emerging KDTs. It will also tackle Europe's limited control over digital technologies that are critical for EU industry and citizens. It has as main objectives to strengthen KDTs which are critical for the competitive position of key European industries in the global markets, to establish European leadership in emerging technologies with high socioeconomic potential and to secure Europe's technological sovereignty to maintain a strong and globally competitive presence in KDTs. The study concluded that the Institutionalised Partnership is the preferred option for the implementation of this initiative.

6. Candidate Institutionalised European Partnership in Smart Networks and Services

This initiative focuses on the development of future networks infrastructure and the associated services. This includes bringing communication networks beyond 5G and toward 6G capabilities, but also the development of the Internet of Things and Edge Computing technologies. It will address the challenges raised by Europe delay in the deployment of network infrastructure and failure to fully benefit from the full potential of digitalisation. It has as main objective to ensure European technological sovereignty in future smart networks and digital services, to strengthen the uptake of digital solutions, and to foster the development of digital innovation that answers to European needs and that are well aligned with societal needs. The study concluded that an institutionalised partnership under article 187 is the preferred option for the implementation of this initiative.

7. Candidate Institutionalised European Partnership in Metrology

This initiative focuses on metrology - that is the science of measurement and the provision of the technical infrastructure that underpins accurate and robust measurements throughout society; measurements that underpin all domains of science and technology and enable fair and open trade and support innovations and the design and implementation of policy and regulations. It will address challenges in the fragmentation of national metrology systems across Europe and the need to meet ever-increasing demands on metrology infrastructure to support the measurement needs of emerging technologies and important policy domains in climate, environment, energy and health. The main objective of the initiative is to establish a sustainable coordinated world-class metrology system in Europe that will increase and accelerate the development and deployment of innovations and contribute to the design and implementation of policy, regulation and standards. The study concluded that an A185 Institutionalised Partnership is the preferred option for the implementation of this initiative.

8. Candidate Institutionalised European Partnership on Transforming Europe's Rail System

This initiative focuses on the development of a pan-European approach to research and innovation in the rail sector. It will address the challenges raised by the lack of alignment of research and innovation with the needs of a competitive rail transport industry and the consequent failure of the European rail network to make its full contribution to European societal objectives. It will also strengthen the competitiveness of the European rail supply industry in global markets. Accordingly, the objectives of the initiative are to ensure a more market-focused approach to research and innovation, improving the competitiveness and modal share of the rail industry and enhancing its contribution to environmental sustainability as well as economic and social development across the European Union. The study concluded that an institutionalised partnership under article 187 is the preferred option for the implementation of this initiative.

9. Candidate Institutionalised European Partnership for Integrated Air Traffic Management

This initiative focuses on the modernisation of the Air Traffic Management in Europe - an essential enabler of safe and efficient air transport and a cornerstone of the European Union's society and economy. The proposed initiative will address the challenges raised by an outdated Air Traffic Management system with a non-optimised performance. The current system needs to be transformed to enable exploitation of emerging digital technologies and to accommodate new forms of air vehicle including drones. The objective is therefore to harmonise European Air Traffic Management system based on high levels of digitalisation, automation and connectivity whilst strengthening air transport, drone and ATM markets competitiveness and achieving environmental, performance and mobility goals. This would create €1,800b benefits to the EU economy if the current initiative can

be built on and accelerated. The study concluded that an Institutionalised Partnership under Art. 187 TFEU is the preferred option for the implementation of this initiative.

10. Candidate Institutionalised European Partnership on Clean Aviation

This imitative focuses on further aeronautical research and innovation to improve technology leading to more environmentally efficient aviation equipment. It will address the challenges raised by the growing ecological footprint of aviation and the challenges and barriers faced by the aviation industry towards climate neutrality. It will also strengthen the competitiveness of the European aeronautical industry in global markets. Accordingly, the objectives of the initiative are to ensure that aviation reaches climate neutrality and that other environmental impacts are reduced significantly by 2050, maintain the leadership and competitiveness of the European aeronautics industry and ensure safe, secure and efficient air transport of passengers and goods. The Impact Assessment study assessed the options for implementation that would allow for an optimal attainment of these objectives. The study concluded that an institutionalised partnership under Art. 187 TFEU is the preferred option for the implementation of this initiative.

11. Candidate Institutionalised European Partnership on Clean Hydrogen

The report assesses the impact of potential initiatives to support, through research and innovation, the growth and development of clean hydrogen, among which an Institutionalised European Partnership is one of the options assessed. The existing challenges for clean hydrogen include the limited high-level scientific capacity and fragmented research activities, the insufficient deployment of hydrogen applications, and consequently weaker EU scientific and industrial value chains. Environmental, health and mobility pressures are also driving the need for cleaner hydrogen generation, deployment and use. An initiative for clean hydrogen must have as a main objective the strengthening and integration of EU scientific capacities, to support the creation, capitalisation and sharing of knowledge. This is necessary to accelerate the development and improvement of advanced clean hydrogen applications, the market entry of innovative competitive clean solutions, to strengthen the competitiveness of the EU clean hydrogen value chains (and notably the SMEs within them), and to develop the hydrogen-based solutions necessary to reach climate neutrality in the EU by 2050. The study concluded that an Institutionalised Partnership under Art. 187 TFEU is the preferred option for the implementation of this initiative.

12. Candidate Institutionalised European Partnership on Safe and Automated Road Transport

This initiative focuses on Connected, Cooperative and Automated Mobility: the use of connected and automated vehicles to create more user-centred, all-inclusive mobility, while also increasing safety, reducing congestion and contributing to decarbonisation. With current road traffic collisions and negative local and global environmental impacts not reducing quickly enough, it will address the challenges raised by the current fragmentation of research across the field, and the threat to European competitiveness if the research agenda does not advance quickly enough. The initiative will focus on strengthening EU scientific capacity and economic competitiveness in the field of CCAM, whilst contributing to wider societal benefits including improved road safety, less environmental impact, and improved accessibility to mobility. The study concluded that a co-programmed partnership is the preferred option for the implementation of this initiative.

13. Candidate Institutionalised European Partnership for a Circular Bio-based Europe

This initiative focuses on intensifying research and innovation allowing to replace, where possible, non-renewable fossil and mineral resources with biomass and waste for the production of renewable products and nutrients, in order to drive forward sustainable and climate-neutral solutions that accelerate the transition to a healthy planet and respect

planetary boundaries. It will address the challenges raised by the fact that the EU economy does not operate within planetary boundaries, is not sufficiently circular and is predominantly fossil based. It will also address the insufficient research and innovation (R&I) capacity and cross-sectoral transfer of knowledge and bio-based solutions, as well as risks posed to the European bio-based industry's global competitiveness. The study concluded that Institutionalised European Partnership based upon Article 187 TFEU is the preferred option for the implementation of this initiative.

14. Candidate Institutionalised European Partnership for Innovative SMEs

The initiative is envisaged as a continuation of the Eurostars 2 programme which is managed by the Eureka network. The initiative focuses on international collaborative R&D of innovative companies, facilitated through a network of national funding organisations as included in the Eureka network. The funded projects are bottom-up and involve small numbers of project partners. The candidate partnership addresses a niche issue namely limited opportunities for international bottom-up collaboration. The partnership provides thus an opportunity for SMEs for international R&D collaboration but does not address specific technological, social, or environmental challenges. Its main objective is to improve the competitiveness of European SMEs through collaborative funding. The study concluded that a co-funded partnership is the preferred option for the implementation of this initiative.

PART II. Horizontal studies

1. Horizontal Analysis of Efficiency and Coherence in Implementation

The focus of this report is on the coherence and efficiency in the current European Partnership landscape under Horizon Europe and the potential to enhance efficiency in the European Partnerships' implementation.

European Partnerships are geared towards playing a pivotal role in tackling the complex economic and societal challenges that constitute the R&I priorities of the Horizon Europe Pillar II and are in a unique position to address transformational failures. Multiple potential interconnections and synergies exist between the candidate European Partnerships within the clusters, but few are visible across the clusters.

As for the improvement of the efficiency in implementation of institutionalised partnerships under Art. 187, potential efficiency and effectiveness gains could be achieved with enhanced collaboration. An option for a common back-office sharing operational implementation activities is worth exploring further through a detailed feasibility study in order to assess whether efficiency gains can be made. Ideally this would be co-designed as a common Partnership approach, leading to a win-win situation for all partners.

2. Impact Modelling of the Candidate Institutionalised European Partnerships

This report presents the results of the use of a macroeconomic model to assess the economic and environmental impacts of the preferred options identified in the individual 13 impact assessment studies. The model used is E3ME. It includes explicit representation for each EU Member State with a detailed sectoral disaggregation.

The impact modelling estimated the impacts of the envisaged initiatives at an aggregated as well as individual level. In total, 14 macroeconomic models have been run, one per reviewed initiative with a time horizon of 2035 and one that combines all initiatives with a time horizon of 2050. The results of each of these models were compared with those of a baseline scenario, which corresponds to a situation where the initiatives would be funded through regular Horizon Europe calls rather than European Partnerships.

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Part I. Impact Assessment Studies for the Candidate Institutionalised European Partnerships

1. Overarching Context to the Impact Assessment Studies

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Introduction

This report sets out the overall policy context of the impact assessment studies for the candidate Institutionalised European Partnerships and the methodological framework that was developed for the impact assessment studies.

It describes the changes in approach to the public-private and public-public partnerships under Horizon Europe compared to the previous EU Framework Programmes. An example is the requirement that all envisaged European Partnerships be implemented as either co-programmed, co-funded or institutionalised. The impact assessment studies will consider these three scenarios as the different options to be assessed, in compliance with the Better Regulation guidelines and against the functionalities that the candidate partnerships are expected to fulfil. The report describes the common methodological framework to assess the envisaged initiatives accordingly.

The report also presents the landscape of European Partnerships at the level of Horizon Europe Pillar 2 clusters, which lay the grounds for all of the impact assessment studies except the candidate Institutionalised European Partnership for Innovative SMEs. This analysis is presented in more depth in the report on the 'Horizontal analysis of efficiency and coherence of implementation' in Part II of the Impact Assessment Study report.

The report is structured around two main headings:

- Chapter 1: Background and context to European Partnerships in Horizon Europe and focus of the impact assessment– What is decided
- Chapter 2: The Candidate European Partnerships under Horizon Europe – What needs to be decided

Table of Contents

Table of Figures

List of Tables

1 Background and context to European Partnerships in Horizon Europe and focus of the impact assessment– What is decided

1.1 The political and legal context

1.1.1 Shift in EU priorities and Horizon Europe objectives

Horizon Europe is to be set in the broader context of the pronounced **systemic and holistic approach** taken to the design of the new Framework Programme and the overarching Multi-annual Financial Framework (MFF) 2021-27.

The future long-term budget will be a budget for the Union's priorities. In her Political Guidelines for the next European Commission 2019 – 2024, the new President of the European Commission put forward six overarching priorities for the next five years, which reach well beyond 2024 in scope: A European Green Deal; An economy that works for people; A Europe fit for the Digital Age; Protecting our European way of life; A stronger Europe in the world; and A new push for European democracy. These priorities build upon A New Strategic Agenda for 2019–2024, adopted by the European Council on 20 June 2019, which targets similar overarching objectives. Together with the United Nations Sustainable Development Goals (SDGs), they will shape future EU policy responses to the challenges Europe faces and will steer the ongoing transitions in the European economy and society,

The MFF 2021-27 strives to provide a framework that will ensure a more coherent, focused and transparent response to Europe's challenges. A stronger focus on European added value, a more streamlined and transparent budget, more flexibility in order to respond quickly and effectively to unforeseen demands, and above all, an effective and efficient implementation are among the key principles of the MFF. The objective is to strengthen the alignment with Union policies and priorities and to simplify and reform the system in order to "unlock the full potential of the EU budget" and "turn ambitions into reality". Investment from multiple programmes is intended to combine in order to address key crosscutting priorities such as the digital economy, sustainability, security, migration, human capital and skills, as well as support for small businesses and innovation.[1]

These principles underlying the MFF 2021-27 are translated in the intent for Horizon Europe "to play a vital role, in combination with other interventions, for creating new solutions and fostering innovation, both incremental and disruptive." [2] The new Framework Programme finds its rationale in the daunting challenges that Europe is facing, which call for "a radical new approach to developing and deploying new technologies and innovative solutions for citizens and the planet on a scale and at a speed never achieved before, and to adapting our policy and economic framework to turn global threats into new opportunities for our society and economy, citizens and businesses."

In the Orientations towards the first Strategic Plan for Horizon Europe, the need strategically to prioritise and "direct a substantial part of the funds towards the areas where we believe they will matter the most" is emphasised. The Orientations specify, "Actions under Pillar II of Horizon Europe will target only selected themes of especially high impact that significantly contribute to delivering on the political priorities of the Union."

Figure 1, below, which gives an indicative overview of how the EU political priorities are supported under Horizon Europe, shows the major emphasis placed on contributing to the priority 'A European Green Deal', aimed at making Europe the first climate-neutral

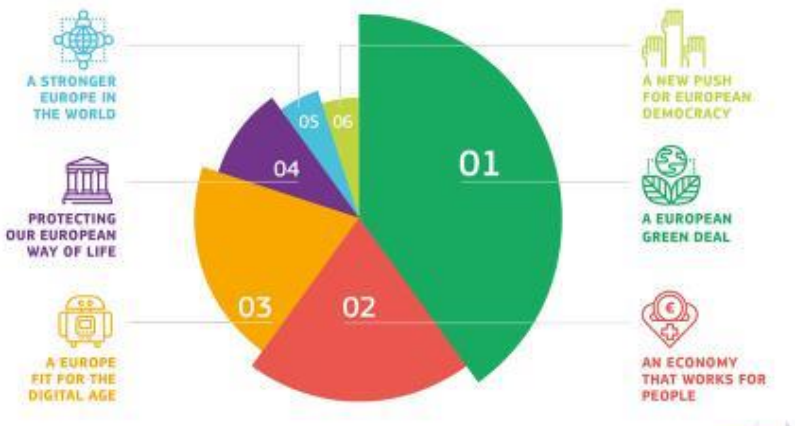
[1] EC (2018) *A Modern Budget for a Union that Protects, Empowers and Defends. The Multiannual Financial Framework for 2021-2027*. Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2018) 321 final

[2] EC (2019), *Orientations towards the first Strategic Plan for Horizon Europe*.

continent in the world. At least 35 % of the expenditure from actions under the Horizon Europe Programme will address the Sustainable Development Goal 13: Climate Action.

Especially the R&I activities funded under Pillar II, including seven Partnership Areas (see below), are expected to contribute to the attainment of these objectives in an interconnected manner.

Figure 1: Targeted impacts under Horizon Europe by priority



Note: Preliminary, as described in the General orientations towards the first Strategic Plan implementing Horizon Europe.
Source: European Commission (2019) Orientations towards the first Strategic Plan for Horizon Europe, December 2019.

1.1.2 Renewed ambition for European Partnerships

Reflecting its pronounced systemic nature aimed at 'transformation' of the European R&I system, Horizon Europe intends to make a more effective use of these partnerships with an **ambitious approach** that is impact oriented and ensures complementarity with the Framework Programme. The **rationalisation** of the partnership landscape, both in terms of number of partnership forms and individual initiatives, constituted a first step in the direction of the strategic role that these policy initiatives are expected to play in the context of Horizon Europe. Future partnerships are expected to "provide mechanisms to consistently aggregate research and innovation efforts into more effective responses to the policy needs of the Union".[3] The expectation is that they will act as **dynamic change agents**, strengthening linkages within their respective ecosystems and with other related ecosystems as well as pooling resources and efforts towards the common objectives in the European, national and regional landscape. They are expected to develop *close synergies* with national and regional programmes, bring together a *broad range of actors* to work towards a common goal, translate *common priorities* into concrete roadmaps and coordinated activities, and turn research and innovation into *socio-economic results and impacts*.

The exact budget dedicated to European Partnerships under Horizon Europe will be agreed only upon decisions on the multiannual financial framework (MFF) 2021-2017 and the overall budget for Horizon Europe. In December 2017, the Council nevertheless introduced the principle of a "possible capping of partnership instruments in the FP budget".[4] Accordingly, it reached the common understanding, with the European Parliament, that "the majority of the budget in Pillar II [€52.7bn] shall be allocated to actions outside of

[3] European Commission (2019) *Orientations towards the first Strategic Plan implementing the research and innovation framework programme Horizon Europe*. Co-design via web open consultation. Summer 2019.

[4] Council of the European Union (2017) *From the Interim Evaluation of Horizon 2020 towards the ninth Framework Programme*. Council conclusions 15320/17.

European Partnerships" (Article 8.2(a) of the Common Understanding on the proposal for a regulation establishing Horizon Europe).[5]

1.1.3 Key evolutions as regards the partnership approach

The European R&I partnerships were initially conceived as a means to increase synergies between the European Union and the Member States (Article 181 of the Treaty on the Functioning of the European Union TFEU). Their objectives were to pool the forces of all the relevant actors of R&I systems to achieve breakthrough innovations; strengthen EU competitiveness; and, tackle major societal challenges. The core activities of the European partenrships consist therefore of building critical mass mainly through collaborative projects, jointly developing visions, and setting strategic agendas. They help accelerate the emergence of a programming approach in European R&I with the involvement of all relevant actors and provide flexible structures for partnerships that can be tailored to their goals.[6]

In the consecutive Framework Programmes up to the current Horizon 2020, the partnerships and their forms have mushroomed, leading to an increasing complexity of the partnership landscape. The Horizon 2020 interim evaluation highlighted that the overall landscape of EU R&I funding had become overly complex and fragmented, and a need to improve the partnerships' openness and transparency. The Lamy report suggested that the European Partnerships should focus on those areas with the greatest European Added Value, contribute to EU R&I missions and would need a simplified and flexible co-funding mechanism.

The Competitiveness Council conclusions of December 2017 called on the Commission and the Member States to jointly consider ways to rationalise the EU R&I partnership landscape. In 2018, the ERAC Ad-hoc Working Group on Partnerships concluded, "the rationalisation of the R&I partnership landscape is needed in order to ensure that the portfolio of R&I partnerships makes a significant contribution to improving the coherence, functioning and quality of Europe's R&I system and that the individual initiatives are able to fully achieve their potential in creating positive scientific and socio-economic impacts and/or in addressing societal challenges".

Horizon Europe has taken on board these concerns. The Impact Assessment of Horizon Europe gave a clear analysis of the achievements of Partnerships so far as well as the expectations for the new generation of Partnerships. Greater transparency and openness of the partnerships were considered as essential, as well a clear European added value and long-term commitments of the stakeholders involved.

A list of criteria to decide how European Partnerships will be selected, implemented, monitored, evaluated and phased-out was attached as an Annex III to the proposal to establish Horizon Europe (as revised by the partial political agreement). The rationalisation of the Partnership portfolio in Horizon Europe is expected to allow for a reduction from the current 120 to between 45 and 50 partnerships.

[5] Council of the European Union (2019) *Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rule for participation and dissemination*. Common understanding 7942/19.

[6] European Commission (2011) Partnering in Research and Innovation. Communication from the Commission COM(2011) 572 final.

1.1.4 Overview of legal provisions

The Horizon Europe Regulation (common understanding) defines 'European Partnership' as "an initiative where the Union, prepared with early involvement of Member States and/or Associated Countries, together with private and/or public partners (such as industry, universities, research organisations, bodies with a public service mission at local, regional, national or international level or civil society organisations including foundations and NGOs), commit to jointly support the development and implementation of a programme of research and innovation activities, including those related to market, regulatory or policy uptake." It stipulates that "parts of Horizon Europe may be implemented through European Partnerships".

The Horizon Europe Regulation (common understanding) also stipulates that the European Partnerships are expected to adhere to the "principles of Union added value, transparency, openness, impact within and for Europe, strong leverage effect on sufficient scale, long-term commitments of all the involved parties, flexibility in implementation, coherence, coordination and complementarity with Union, local, regional, national and, where relevant, international initiatives or other partnerships and missions." The provisions and criteria set out for the selection and implementation of the European Partnerships reflect these principles.

1.1.5 Overview of the eight Partnership areas

The Horizon Europe Regulation also identifies the following "Areas for possible institutionalised European Partnerships on the basis of Article 185 TFEU or Article 187 TFEU":

- Partnership Area 1: Faster development and safer use of health innovations for European patients, and global health.
- Partnership Area 2: Advancing key digital and enabling technologies and their use, including but not limited to novel technologies such as Artificial Intelligence, photonics and quantum technologies.
- Partnership Area 3: European leadership in Metrology including an integrated Metrology system.
- Partnership Area 4: Accelerate competitiveness, safety and environmental performance of EU air traffic, aviation and rail.
- Partnership Area 5: Sustainable, inclusive and circular bio-based solutions.
- Partnership Area 6: Hydrogen and sustainable energy storage technologies with lower environmental footprint and less energy-intensive production.
- Partnership Area 7: Clean, connected, cooperative, autonomous and automated solutions for future mobility demands of people and goods.
- Partnership Area 8: Innovative and R&D intensive small and medium-sized enterprises.

Considering the realm of these partnership areas, potential synergies exist with the future **missions**. Horizon European introduced these cross-discipline and cross-sector policy instruments as part of its core objective of stimulating further excellence-based and impact-driven R&I. In contrast with the challenges targeted in Horizon 2020, the missions aim at the achievement of well-defined goals to provide solutions, within a specified timeframe, to scientific, technological, economical and/or societal problems. As part of the preparation of Horizon Europe, the European Commission set up five boards to formulate the future missions in the following areas:

- Adaptation to climate change including societal transformation

- Cancer
- Healthy oceans, seas, coastal and inland waters
- Climate-neutral and smart cities
- Soil health and food

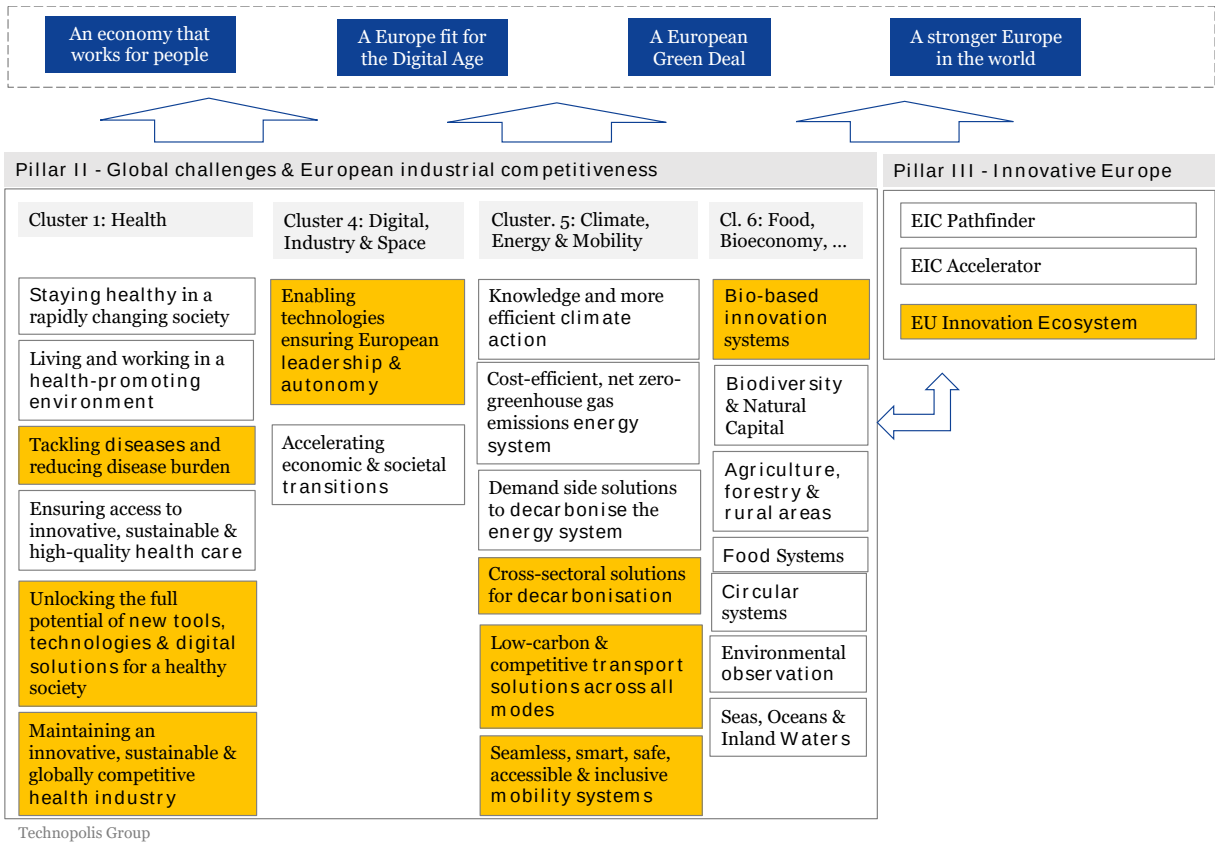
1.2 Typical problems and problem drivers

The European Partnerships are integral part of the framework programme and its three-pillar structure. They are predominantly funded under Pillar 2 "Global Challenges and European industrial competitiveness" and four of its thematic clusters. These clusters cover sectors and technologies, in which research and innovation activities are deemed of crucial importance in solving pressing scientific, societal or economic challenges and ensuring the scientific, technological and industrial leadership of Europe. Only one European Partnership, targeting innovative and R&D intensive SMEs, will instead act under Pillar 3 "Innovative Europe".

The European Partnerships are intended to contribute to the attainment of the pillars' and clusters' **challenges and R&I priorities**. Overarching EU policy priorities addressed are predominantly the European Green Deal, a people-centred economy, the fit for the Digital Age, and a stronger Europe in the world.

In Figure 2, below, the R&I priorities in the Pillars II and III to which the candidate *Institutionalised* Partnerships intend to contribute are highlighted in yellow.

Figure 2: Contribution of Candidate European Institutionalised Partnerships to the Horizon Europe priorities in Pillars II and III



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The European Partnerships under Horizon Europe most often find their rationale in addressing **systemic failures**. Their primary function is to create a platform for a strengthened collaboration and knowledge exchange between various actors in the European R&I system and an enhanced coordination of strategic research agenda and/or R&I funding programmes.

The concentration of efforts and resources and pooling of knowledge, expertise and skills on common priorities in a view of solving complex and multi-faceted societal and economic challenges is at the core of these initiatives. Enhanced cross-disciplinary and cross-sectoral collaboration and an improved integration of value chains and ecosystems are among the key objectives of these policy instruments. In the light of Horizon Europe, the aim often is to drive system transitions and transformations.

Especially in fast-growing technologies and sectors such as ICT, the envisaged European Partnerships also react on emerging opportunities and address systemic failures such as shortage in skills or critical mass or cross-sectoral cooperation along the value chains that would hamper attainment of future European leadership and/or strategic autonomy.

Transformational failures addressed aim at reaching a better alignment of the strategic R&I agenda and policies of public and private R&I funders in order to pool available resources, create critical mass, avoid unnecessary duplication of research and innovation efforts, and leverage sufficiently large investments where needed but hardly achievable by single countries.

Market failures are less commonly addressed and relate predominantly to enhancing industry investments thanks to the sharing of risks.

1.3 Description of the options

The proposal for a regulation establishing Horizon Europe[7] stipulates that parts of the Horizon Europe Framework Programme may be implemented through European Partnerships and establishes three implementation modes: Co-programmed European Partnerships, Co-funded European Partnerships, and Institutionalised Partnerships in accordance with Article 185 TFEU or Article 187 TFEU.

1.3.1 Baseline option – Traditional calls under the Framework Programme

Under this option, strategic programming for research and innovation in the field will be done through the mainstream channels of Horizon Europe. The related priorities will be implemented through traditional calls under the Framework Programme covering a range of activities, but mainly calls for R&I and/or innovation actions. Most actions involve consortia of public and/or private actors in ad hoc combinations, some actions are single actor (mono-beneficiary). There will be no dedicated implementation structures and no further support other than the Horizon Europe actions foreseen in the related Horizon Europe programme or cluster.

Strategic planning mechanisms in the Framework Programmes allow for a high level of flexibility in their ability to respond to particular needs over time, building upon additional input in co-creation from stakeholders and programme committees involving MS. The broad scope of the stakeholders providing their input to the research agenda, however, implies a lower level of directionality than what can be achieved through the partnerships. Often, the long-term perspective of the stakeholder input is limited, which risks reducing strategic capacity in addressing priorities.

The Horizon Europe option also implies a lower level of EU budgetary long-term commitment for the priority. Without a formal EU partnership mechanism, it is also less likely that the stakeholders will develop a joint Strategic Research Agenda and commit to its implementation or agree on mutual financial commitments beyond the single project participation.

[7] Proposal for a Regulation of the European Parliament and of the Council stablishing Horizon Europe - the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination - Common understanding', March 2019

1.3.2 European Partnership

All European Partnerships will be designed in line with the new policy approach for more objective-driven and impactful partnerships. They are based on the common criteria in Annex III of the Horizon Europe Regulation, with few distinguishing elements for the different forms of implementation. All European Partnerships will be based on an agreed Strategic Research and Innovation Agenda / roadmap agreed among partners and with the Commission. For each of them the objectives, key performance and impact indicators, and outputs to be delivered, as well as the related commitments for financial and/or in-kind contributions of the partners will be defined ex-ante.

Option 1 - Co-programmed European Partnership

This form of European Partnership is based upon a *Memorandum of Understanding* or a *Contractual Arrangement* signed by the European Commission and the private and/or public partners. Private partners are typically represented by one or more industry association, which also functions as a back-office to the partnership. It allows for a *high flexibility* in the profile of organisation involved, objectives pursued, and/or activities implemented.

Co-programmed European Partnerships address *broader communities* across a diverse set of sectors and/or value chains and where the actors have *widely differing capacities and capabilities*. They may encompass one or more associations of organisations from industry, research, NGOs etc as well as foundations and national R&I funding bodies, with no restriction on the involvement of international partners from Associated and non-associated third countries. Different configurations are possible: private actors only, public entities only, or a combination of the two.

The basis, as for all European Partnerships, is the rationale is to create a *platform for 'concertation'*, i.e. in-depth and ongoing consultation of the relevant actors in the European R&I system for the co-development of a strategic research and Innovation agenda, typically covering the period of the next 10 years. The primary ambition is to generate *commitment to a common strategic research and innovation agenda* (SRIA). For the private actors involved, this would allow for a de-risking of their R&I investments and provide predictability of investment paths, for the public actors, it serves as a means to: inform national policy-makers on EU investments and allows for coordination and alignment of their efforts to support R&I in the field at the national level.

The *level of 'additionality is possibly lower than for other partnerships*. There is no expectation of a legally binding commitment from the partners to taking an integrated approach in their individual R&I implementation and it is based on 'best efforts'. However, the Union contribution to the partnership is defined for the full duration and has a comparable level of certainty for the partnerships than in the other forms of implementation. The priorities for the calls, proposed by the partnership members for integration in the Framework Programme Work Programmes, are subject to further input from Member States (comitology) and Commission Services. The full implementation of the Union contribution in the Framework Programme implies that the full array of Horizon Europe funding instruments in the related Pillar can be used, ranging from RIAs to CSAs and including grants, prizes, and procurement.

Option 2 – Co-funded European Partnership

The Co-funded Partnership is based on a Grant Agreement between the Commission and the consortium of partners, resulting from a call for a proposal for a programme co-fund action implementing the European Partnerships in the Horizon Europe Work Programme. Programme co-fund actions provide co-funding to a programme of activities established and/or implemented by entities managing and/or funding research and innovation programmes. Therefore, this form of implementation only allows to address public partners

at its core (comparable to the Article 185 initiatives below), while industry can nevertheless be addressed by the activities of the partnerships, but not make formal commitments and contributions to it. The expectation is that these entities would cover most if not all EU Member States (MS). Also 'international' funding bodies can participate as partners, which creates the potential for an efficient interaction with strategic international partners. Legal entities in countries that are not part of the programme co-fund consortium, are usually excluded from funding under the calls launched by the consortium.

The basic rationale for this partnership option is to bring MS together to invest at scale in key R&I issues of general and common interest. The joint programme of activities is agreed by the partners and with the EU and typically focuses on societal grand challenges and specifically, areas of high public good where EU action will add value while reflecting national priorities and/or policies. The ultimate intent is to create the greatest possible impact by pooling and/or coordinating national programmes and policies with EU policies and investments, helping to overcome fragmentation of the public research effort. Member States that are partners in this partnership become the 'owners' of the priority and take sole responsibility for its funding. Commitments of the partners and the European Union are ensured through the Grant Agreement.

Based on national programmes, this partnership option shows a particularly high level of flexibility in terms of activities to be implemented - directly by the national funding bodies (or governmental organisation "owning" institutional programmes), or by third parties receiving financial support (following calls for proposals launched by the consortium). The broad range of possible activities include support for networking and coordination, research, innovation, pilot actions, and innovation and market deployment actions, training and mobility actions, awareness raising and communication, dissemination and exploitation, any relevant financial support, such as grants, prizes, procurement, as well as Horizon Europe blended finance or a combination thereof.

Option 3 – Institutionalised European Partnership

This type of Partnership is the most complex and high-effort arrangement and will be based on a Council Regulation (Article 187) or a Decision by the European Parliament and Council (Art 185) and implemented by dedicated structures created for that purpose. The legal base for this type of partnership limits the flexibility for a change in core objectives, partners, and/or commitments as these would require amending legislation.

The basic rationale for this type of partnership is the need for a strong integration of R&I agenda's in the private and/or public sectors in Europe in order to address a strategic challenge or realise an opportunity. The focus is on major long-term strategic challenges and priorities beyond the framework of a single Framework Programme where collective action – by private and/or public sectors – is necessary to *achieve critical mass* and *address the full extent of the complexities* of the ecosystem concerned.

The long-term commitment expected from the European Union and its partners is therefore much larger than for any of the other options, given the considerably higher investment in the preparation and implementation of the Partnership. As a result, this type of partnership can be selected only if other parts of the Horizon Europe programme, including other forms of European Partnerships, would not achieve the objectives or would not generate the necessary expected impacts. The commitment for contributions by the partnership members is expected to be at least equal to 50% and may reach up to 75% of the aggregated European Partnership budgetary commitments.

The partnership members have a high degree of autonomy in developing the strategic research agenda and annual work programmes and call topics, based on a transparent and accessible process, and subject to the approval of the Commission Services. The choice of topics addressed in the (open) calls are therefore strongly aligned with the needs defined. Normally, the strategic priorities are fully covered by the annual work programmes in the

partnership, even though it is in principle possible to keep certain topics for calls in the FP thus complementing the activities in the partnership. The full integration in the Framework Programme implies that the full array of Horizon Europe funding instruments in the related Pillar can be used, ranging from RIAs to CSAs and including grants, prizes, and procurement.

Two forms of Institutionalised Partnerships are of direct relevance to this study, influencing the constellation of partners involved.

Institutionalised Partnerships based upon Art 185 TFEU

Article 185 of the TFEU allows the Union to participate in programmes jointly undertaken by Member States and limits therefore the scope of partners to Member States and Associated Third countries. This type of Institutionalised Partnership aims therefore at reaching the greatest possible impact through the integration of national and EU funding, aligning national strategies in order to optimise the use of public resources and overcome fragmentation of the public research effort.

It brings together R&I governance bodies of most if not all EU Member States (legal requirement: at least 40% of Member States) as well as Associated Third Countries that designate a dedicated legal entity (Dedicated Implementation Structure) for the implementation. By default, membership of non-associated Third Countries is not foreseen. Such membership is possible only if it is foreseen in the basic act and subject to conclusion of an international agreement. Eligibility for participation and funding follows by default the rules of the Framework programme, unless a derogation is introduced in the basic act.

Institutionalised Partnerships under Art. 187 TFEU

This type of Institutionalised Partnership aims at reaching the greatest possible impact by integrating the strategic R&I agendas of private and/or public actors and by leveraging the partners' investments in order to tackle R&I and societal challenges and/or contribute to Europe's wider competitiveness goals.

It brings together a stable set of partners with a strong commitment to taking a more integrated approach and requires the set-up of a dedicated legal entity (Union body, Joint Undertaking) that carries full responsibility for the management of the partnership and implementation of the calls.

Different configurations are possible: partnerships focused on creating strategic industrial partnerships where, most often, the partner organisations are represented by one or more industry associations, or in some cases individual private partners; partnerships coordinating national ministries, public funding agencies, and governmental research organisations in the Member States and Associated Countries; or a combination of the two (the so-called tripartite model). By default, membership of non-associated Third Countries is not foreseen. Such membership is possible only if it is foreseen in the basic act and subject to conclusion of an international agreement. Eligibility for participation and funding follows by default the rules of the Framework programme, unless a derogation is introduced in the basic act.

2 The Candidate European Partnerships under Horizon Europe – What needs to be decided

2.1 Portfolio of candidates for Institutionalised Partnerships under Horizon Europe

2.1.1 The process for identifying the priorities for Institutionalised Partnerships under Horizon Europe

In May 2019, the European Commission consulted the Member States on a list of 44 possible candidates for European Partnership which it had identified as part of the preparation of the first Strategic Planning of Horizon Europe. This list was also part of the

Orientations towards the first Strategic Plan implementing Horizon 2020[8] which served as a basis for an Open Public Consultation from July to October 2019. In October and November 2019, the European Commission and the Member States agreed on increasing the number of candidate European partnerships to 49. Subsequent discussions until the adoption of Horizon Europe will focus on ensuring the overall consistency of the EU partnership landscape and its alignment with the EU overarching priorities and on defining the precise implementation modalities.

In parallel, the European Commission completed inception impact assessments on the candidate institutionalised European partnerships. Stakeholders had the opportunity to provide their feedback on these inception impact assessments in August 2019. A web-based open public consultation to collect opinions on all candidate institutionalised partnerships (but the candidate EuroHPC partnership) was organised between September and October 2019.

2.1.2 Overview of the overall landscape of candidate European Partnerships subject to the impact assessment

Figure 3, below, gives an overview of all European Partnerships that are currently envisaged for funding under Horizon Europe. The candidate Institutionalised Partnerships that are the subject for this impact assessment study are coloured in dark orange.

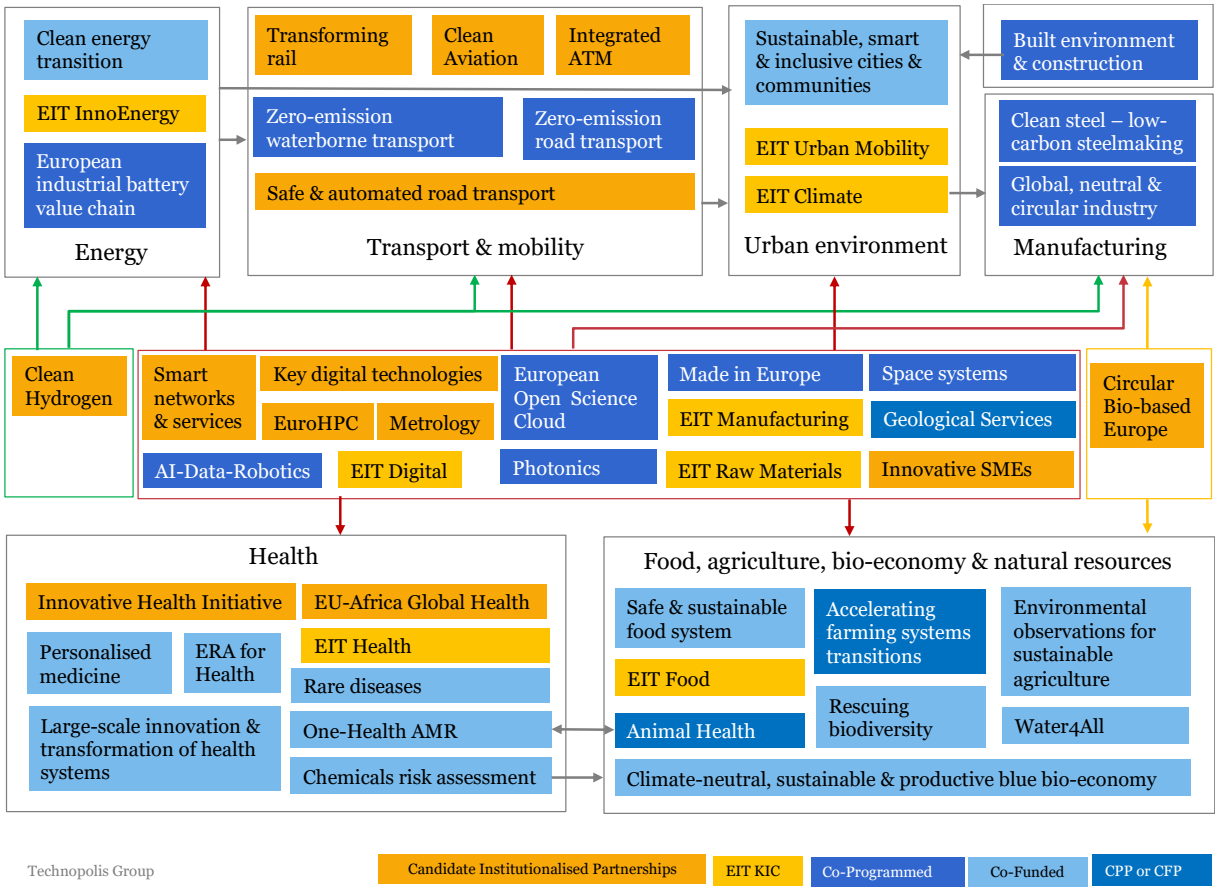
The European Partnerships can be categorised into two major groupings: *'horizontal' partnerships* focused on the development of technologies, methods, infrastructures and resources/materials, and *'vertical' partnerships* focused on the needs and development of a specific application area, be it industrial or societal.

The diagram below shows the central position of the **'horizontal' partnerships** in the overall landscape, developing methodologies, technologies or data management infrastructures for application in the other priority areas. These 'horizontal' partnerships are predominantly proposed as Institutionalised or Co-programmed Partnerships, in addition to a number of EIT KICs. The European Open Science Cloud (EOSC) partnership, for example, will support research partnerships by providing an infrastructure for the storage, management, analysis and re-use of research data.

The upper banner of the diagram groups the **industry-oriented 'vertical' partnerships**. Under Horizon Europe, they have in common a pronounced focus on enhancing sustainability. In this context, the banner includes also one of the most recent agreed-upon partnerships focused on the urban environment. This partnership illustrates the introduction under Horizon Europe of *challenge-oriented* cross-cluster partnerships. Multiple interconnections are envisaged among the 'vertical' partnerships in the different industry sectors covered. In the transport sector, the partnerships are predominantly proposed as Institutionalised Partnerships. In the other sectors, we see a mix of Co-Programmed Partnerships and EIT KICs. There are only two Co-Funded Partnerships.

[8] Orientations towards the first Strategic Plan implementing the research and innovation framework programme Horizon Europe, Co-design via Web Open Consultation (2019), see more here https://ec.europa.eu/research/pdf/horizon-europe/ec_rtd_orientations-towards-the-strategic-planning.pdf

Figure 3: Landscape of European Partnerships under Horizon Europe (2019)



The lower banner includes the '**vertical' partnerships in the societal application areas**. Striking is the dominance of the Co-Funded Partnerships (to be noted that in the Food/agriculture cluster, the partnership type still needs to be decided for several envisaged partnerships). We also note the limited interconnections that are envisaged between the two areas. An exception is the newly envisaged cross-cluster European Partnerships 'One Health AMR'.

2.2 Assessing the necessity of a European Partnership, possible options for implementation and their cost-effectiveness

In this section we set out the methodological framework that underpins the impact assessment studies. In line with the Better Regulation Guidelines, the impact assessment is intervention logic-based and impact-oriented.

The impact assessment allowed also for the conduct of the 'necessity test' for a European Partnership as set out in the Horizon Europe regulation. Pivotal in this context was the identification of the Horizon Europe calls as Option 0 as well as Baseline Option, allowing for a comparative analysis of the three partnership forms (Options 1-3) along all of the assessment dimensions – in relation to each other as well as to the Horizon Europe calls. The options assessment therefore incorporated the required 'necessity test'.

2.2.1 Assessment of the selection criteria

The common methodological framework that we defined for the 13 individual Impact Assessment studies reflects the approach defined in the Better Regulation guidelines. It also integrates the specific criteria for the use of the different types of European Partnerships as they are defined in the Horizon Europe Common Understanding (Article 8 and Annex III). Specifically this regards the **selection criteria** which have to be demonstrated as a minimum in order to justify the necessity of a European Partnership instead of regular Horizon Europe calls only and the implementation criteria in Article 8

1(a), (b) and (c) with certain elements distinguishing the use of the different partnership implementation modes (Table 1).

Table 1: Horizon Europe selection criteria for the European Partnerships

Common selection criteria and principles	Specifications
More effective (Union added value) clear impacts for the EU and its citizens	• delivering on global challenges and research and innovation objectives
	• securing EU competitiveness
	• securing sustainability
	• contributing to the strengthening of the European Research and Innovation Area
	• where relevant, contributing to international commitments
Coherence and synergies	• within the EU research and innovation landscape
	• coordination and complementarity with Union, local, regional, national and, where relevant, international initiatives or other partnerships and missions
Transparency and openness	• identification of priorities and objectives in terms of expected results and impacts
	• involvement of partners and stakeholders from across the entire value chain, from different sectors, backgrounds and disciplines, including international ones when relevant and not interfering with European competitiveness
	• clear modalities for promoting participation of SMEs and for disseminating and exploiting results, notably by SMEs, including through intermediary organisations
Additionality and directionality	• common strategic vision of the purpose of the European Partnership
	• approaches to ensure flexibility of implementation and to adjust to changing policy, societal and/or market needs, or scientific advances, to increase policy coherence between regional, national and EU level
	• demonstration of expected qualitative and significant quantitative leverage effects, including a method for the measurement of key performance indicators
	• exit-strategy and measures for phasing-out from the Programme
Long-term commitment of all the involved parties	• a minimum share of public and/or private investments
	• In the case of institutionalised European Partnerships, established in accordance with article 185 or 187 TFEU, the financial and/or in-kind, contributions from partners other than the Union, will at least be equal to 50% and may reach up to 75% of the aggregated European Partnership budgetary commitments

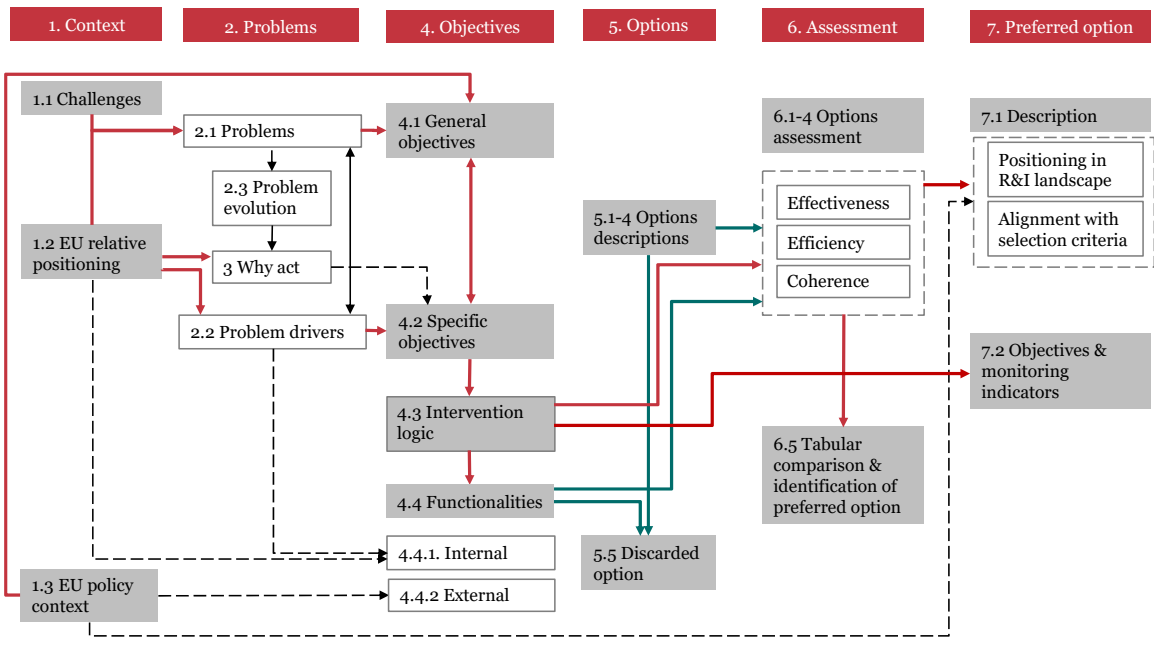
The **Better Regulation guidelines** remained the primary point of reference for the 13 individual Impact Assessment studies. The different steps of the IA process were carried out in a consistent manner in the 13 individual IA studies, supported by horizontal analyses (i.e. common to all studies) such as bibliometrics/patent analysis, social network analysis, the partnership portfolio mapping and analysis, as well as the analysis of the Open Public Consultation data.

The **selection criteria** for the European Partnerships related to effectiveness and coherence fit reasonably well in the Better Regulation impact assessment structure. More problematic was the coverage of the other three criteria groupings, i.e. the criteria of Openness and Transparency, Additionality and Directionality, and the Ex-ante demonstration of commitment.

The solution was the introduction of a section on the **'Functionalities of the initiative'**, in which set out our view on *how* the initiative should *concretely* respond to the selection criteria of 'coherence and synergies', 'openness and transparency' and 'additionality and directionality' in order to reach its objectives. We focused on those aspects that are not covered in other sections of this report, such as coherence and synergies, and covered those elements that from our analysis of the partnership options resulted being **key distinguishing features** of the partnership options, i.e. the composition of the partnership ('openness', including from a geographical perspective), the type of activities implemented ('flexibility'), and the level of directionality and integration of the stakeholders' R&I strategies needed ('directionality and additionality').

The logical process is summarised in Figure 4, below. The diagram shows how the 'functionality' sections constituted an important passage from the objectives and intervention logic sections to the options assessment. Building upon information collected in the previous sections (context, problem and objectives analysis) and in combination with the description of the available options, the description of the desirable 'functionalities' allowed for, on the one hand, the identification of the discarded option(s) and, on the other hand, the options assessment against coherence and against the selection criteria of 'Openness and Transparency' and 'Additionality and Directionality'. In the final chapter of the Impact Assessment report, the alignment of the preferred option with the criteria for the selection of European Partnerships was described, emphasising the outcomes of the 'necessity test'.

Figure 4: Flow of the analysis



Notes: the numbers indicate the related chapters or sections in the Impact Assessment reports

2.2.2 Methodological approach

Overview of the methodologies employed

The understanding of the overall context of the candidate institutionalised European Partnerships relies on a desk research partly covering the main impacts and lessons learned

from their predecessor partnerships (if any). This was complemented with a set of quantitative analyses of the Horizon 2020-funded partnerships, or in case these did not exist, the H2020-funded projects in the field. The analyses included a portfolio analysis, a stakeholder and social network analysis in order to profile the actors involved as well as their co-operation patterns, and an assessment of the partnerships' outputs (bibliometrics and patent analysis). A cost modelling exercise was performed in order to feed into the efficiency assessments of the partnership options (see below).

Public consultations (open and targeted) supported the comparative assessment of the policy options. Each study interviewed up to 50 relevant stakeholders (policymakers, business including SMEs and business associations, research institutes and universities, and civil organisations, among others). They also used the results from the Open Public Consultation organised by the European Commission (Sep – Nov 2019) and the feedback on the Inception Impact Assessments of the 13 candidate institutionalised European Partnerships that the European Commission received in September 2019.

The timing of the Impact Assessment studies, in parallel to the negotiations between the European Commission and the existing Joint Undertakings on the specific implementation of the rules for the future European Partnership, as well as the ongoing discussions within the existing partnership on their future research directions, has set potential limits to the validity of the input and feedback collected from the stakeholders during the consultations.

A more detailed description of the methodology is provided in the Annexes C of each impact assessment report.

Method for identifying the preferred choice

The four policy options were compared along a range of key parameters. The comparison along these parameters was carried out in an evidence-based manner. A range of quantitative and qualitative evidence was used, including ex-post evaluations; foresight studies; statistical analyses of Framework Programmes application and participation data and Community Innovation Survey data; analyses of science, technology and innovation indicators; econometric modelling exercises producing quantitative evidence in the form of monetised impacts; reviews of academic literature on market and systemic failures and the impact of research and innovation, and of public funding for research and innovation; sectoral competitiveness studies; expert hearings; etc.

Options assessment related to effectiveness and coherence

On the basis of the evidence collected and gathered, the Impact Assessment study teams assessed the effectiveness of the retained policy options along three dimensions corresponding to the different categories of likely impacts: scientific, economic and technologies, and societal (including environmental) impacts. The Impact Assessment study teams considered to which extent the retained policy options fulfilled the desirable 'functionalities' and were therefore likely to produce the targeted impacts. This analysis resulted in a scoring of the policy options along a three-point scale.[9] Instead of a compound score, the assessment of the effectiveness of the policy options concluded on as many scores as there are expected impacts.

Likewise, the impact assessment study teams attributed scores (using the same approach as above) reflecting the potential of each retained policy option for ensuring coherence with programmes and initiatives within (internal coherence) and beyond (external coherence) Horizon Europe.

[9] Scores vary from + to +++, where + refers to low potential for presenting a low potential for reaching the likely impacts, ++ to a good potential, and +++ to a high potential.

Scores were justified in a consistent and detailed manner in order to avoid arbitrariness and spurious accuracy. A qualitative or even quantitative explanation was provided of why certain scores were given to specific impacts.

When assessing the respective efficiency of the retained policy options, the Impact Assessment study teams considered the scores related to effectiveness and the identified costs to conduct a "value for money" (or cost-effectiveness) analysis. They accordingly attributed a comparative score to each of the options ranging from 1 (option with the highest costs) to 3 (options with the lowest costs).

Options assessment related to efficiency

A standard cost model

The 'horizontal' team has reviewed the cost categories and costs for each of the four policy options, at some length. Our first model used published data from past partnerships and Horizon 2020 calls working with the Commission's standard accounting codes (Title 1, Title 2, Title 3). The analysis revealed wide-ranging differences in costs across partnerships and functions, which was thought to be too complex to be helpful to the current exercise. As a result, we created a static, common model using average costs as a means by which to indicate the order of magnitude of effort and thereby reveal the principal differences between each of the policy options.

The model was developed jointly with the European Commission services and is presented in the study Data report (D1.2), along with an explanation of the data sources used and the assumptions made.

It is important to note that the costs identified are theoretical and do not reflect the actual costs of any existing individual partnership. In light of this fact, and to avoid any risk of misunderstanding, we have transposed the financial estimates into a qualitative presentation using + / - system in order to compare the various cost elements for each policy option with the equivalent costs for the baseline policy options (see Table 2).

The principal differences in costs as compared with regular Horizon Europe calls relate to the European Partnerships' one-off costs (e.g. developing the proposal and Strategic Research and Innovation Agenda), additional supervision by the European Commission and any additional programme management effort. The main difference between the three types of European Partnership are twofold: (i) the extent to which a partnership will need to run a limited or comprehensive programme management unit and (ii) the extent to which a new partnership may benefit from a pre-existing programme management unit that will greatly reduce or eliminate the set-up costs that would apply to a wholly new partnership.

Table 2: Intensity of additional costs compared with HEU Calls (for Partners, stakeholders, public and EC)

Cost items	Option 0	Option 1	Option 2	Option 3 -Art. 185	Option 3 -Art. 187
Preparation and set-up costs					
Preparation of a partnership proposal (partners and EC)	0	++	++	++	++
Set-up of a dedicated implementation structure	0	0	0	Existing: + New: ++	Existing: ++ New: +++
Preparation of the SRIA / roadmap	0	++	++	++	++

Cost items	Option 0	Option 1	Option 2	Option 3 -Art. 185	Option 3 -Art. 187
Ex-ante Impact Assessment for partnership	0	0	0	+++	+++
Preparation of EC proposal and negotiation	0	0	0	+++	+++
Running costs (Annual cycle of implementation)					
Annual Work Programme preparation	0	+	0	+	+
Call and project implementation	0	0 In case of MS contributions: +	+	+	+
Cost to applicants	Comparable, unless there are strong arguments of major differences in oversubscription				
Partners costs not covered by the above	0	+	0	+	+
Additional EC costs (e.g. supervision)	0	+	+	+	++
Winding down costs					
EC	0	0	0	0	+++
Partners	0	+	0	+	+

Notes: 0: no additional costs, as compared with the baseline; +: minor additional costs, as compared with the baseline; ++: medium additional costs, as compared with the baseline; +++: higher costs, as compared with the baseline

Rationale for the comparative scoring on 'overall costs' and 'cost-efficiency' in the scorecard

In the scorecard analysis, the scores related to the set-up and implementation costs will allow the study teams to consider the scale of the expected benefits and thereby allow a simple "value for money" analysis (cost-effectiveness).

Table 3 shows how we translated the cost analysis into a series of numerical scores.

Table 3: Cost-efficiency matrix

	Option 0: Horizon Europe calls	Option 1: Co-programmed	Option 2: Co-funded	Option 3: Institutionalised
Overall cost	3	2	1	1
Cost-efficiency	3	3	2	2

For the 'overall cost' dimension, we assigned a score 1 to the option with the highest additional costs and a score 3 to the option with the lowest additional costs compared to the baseline. This was based on the following considerations:

- **Horizon Europe regular calls** will have the lowest overall cost among the policy options and have therefore been **scored 3** on this criterion, using a scale of 1-3 where 3 is best (lowest additional costs). This adjudged score is based on two facts: firstly, that Horizon Europe will not entail any additional one-off costs to set up or discontinue

the programme, where each of the other policy options will require at least some additional set-up costs; and secondly, that Horizon Europe will not require any additional running costs, where each of the other policy options will involve additional efforts by the Commission and partners in the carrying out of necessary additional tasks (e.g. preparing annual work programmes).

- A **co-programmed partnership** (Option 1 - CPP) will entail slightly higher overall costs as compared with the baseline policy option and has therefore been given a **score of 2**, using a scale of 1-3 where 3 is best (lowest additional costs). There will be some additional set-up costs linked for example with the creation of a strategic research and innovation agenda (SRIA) and additional running costs linked with the partners role in the creation of the annual work programmes and the Commission's additional supervisory responsibilities. A CPP will have lower overall costs than each of the other types of European Partnership, as it will function with a smaller governance and implementation structure than will be required for a Co-Funded Partnership or an Institutionalised Partnership and – related to this – its calls will be operated through the existing HEU agencies and RDI infrastructure and systems.
- The **Co-Funded Partnership (**Option 2 – CFP) has been **scored 1** on overall cost, using a scale of 1-3 where 3 is best (lowest additional costs). This reflects the additional set-up costs of this policy option and the substantial additional running costs for partners, and the Commission, of the distributed, multi-agency implementation model.
- The **Institutionalised Partnership** (Option 3 - IP) has been **scored 1** on overall cost, using a scale of 1-3 where 3 is best (lowest additional costs). This reflects the substantial additional set-up costs of this policy option – and in particular the high costs associated with preparing the Commission proposal and negotiating that through to a legal document – and the substantial additional running costs for the Commission associated with the supervision of this dedicated implementation model.

In relation to **cost-efficiency**, we considered that while there is a clear gradation in the overall costs of the policy options, the cost differentials are less marked when we take into account financial leverage (co-financing rates) and the total budget available for each of the policy options, assuming a common Union contribution. From this perspective, there are only one or two percentage points that split the most cost-efficient policy options – the baseline and CPP policy options – and the least cost-efficient – the CFP and IP. We have therefore assigned a score of 3 to the baseline Option 0 and CPP options for cost-efficiency (no or minor additional costs, as compared with the baseline) and a score of 2 for the CFP and IP policy options (medium additional costs, as compared with the baseline).

Scorecard analysis for the final options assessment

The scorecard analysis built a hierarchy of the options by individual criterion and overall. The scorecard exercise supported the systematic appraisal of alternative policy options across multiple types of monetary, non-monetary and qualitative dimensions. It also allowed for easy visualisation of the pros and cons of alternative options.

Each option was attributed a value of 1 to 3, scoring the adjudged performance against each criterion with the three broad appraisal dimensions of effectiveness, efficiency and coherence.

Scores were justified in a consistent and detailed manner in order to avoid arbitrariness and spurious accuracy. A qualitative or even quantitative explanation was provided of why certain scores were given to specific impacts, and why one option scores better or worse than others.

The scorecard analysis allowed for the identification of a single preferred policy option or in case of an inconclusive comparison of options, a number of 'retained' options or hybrid. The final selection is a policy decision.

2.3 Cross-partnership challenges in Horizon Europe clusters

In this section we set the envisaged and candidate partnerships in the context of the Horizon Europe clusters and the related higher-level EU policy objectives and priorities. We focus on the evolution of the policy context including the new European Green Deal/climate neutrality objectives, the Horizon Europe Framework relevant to this cluster, and the link to the relevant Sustainable Development Goals. Seeing the focus on the Pillar II clusters, this section excludes the candidate *Institutionalised Partnership for Innovative SMEs*.

2.3.1 Cluster 1 – Health

Research and innovation (R&I) actions under this cluster will aim at addressing the major socio-economic and societal burden that diseases and disabilities pose on citizens and health systems of the EU and worldwide.

The R&I activities funded under the Pillar II Cluster Health aim at contributing to the achievement of the Sustainable Development Goal 'Ensuring healthy lives and promoting well-being for all at all ages' resulting from investments in research and innovation focused on three overarching EU policy objectives: 'An economy that works for people', 'A Europe fit for the Digital Age', and 'A European Green Deal' (see Figure 5, below). The Horizon Europe proposal for a regulation defined the areas for possible institutionalised European partnerships on the basis of Article 185 TFEU or Article 187 TFEU as "*Partnership Area 1: Faster development and safer use of health innovations for European patients, and global health".*

At the core in this cluster are the R&I orientations that aim at ensuring that citizens *stay healthier throughout their lives* due to improved health promotion and disease prevention and the adoption of healthier behaviours and lifestyles, the development of *effective health services* to tackle diseases and reduce their burden, and an improved access to *innovative, sustainable and high-quality health care*. These objectives require an unlocking of the full potential of *new tools, technologies and digital solutions* and ensuring a *sustainable and globally competitive health-related industry* in the EU, allowing for the delivery of, e.g. personalised healthcare services. Last but not least, the citizens' health and well-being need to be *protected from environmental degradation and pollution*, addressing a.o. climate-related challenges to human health and health systems.

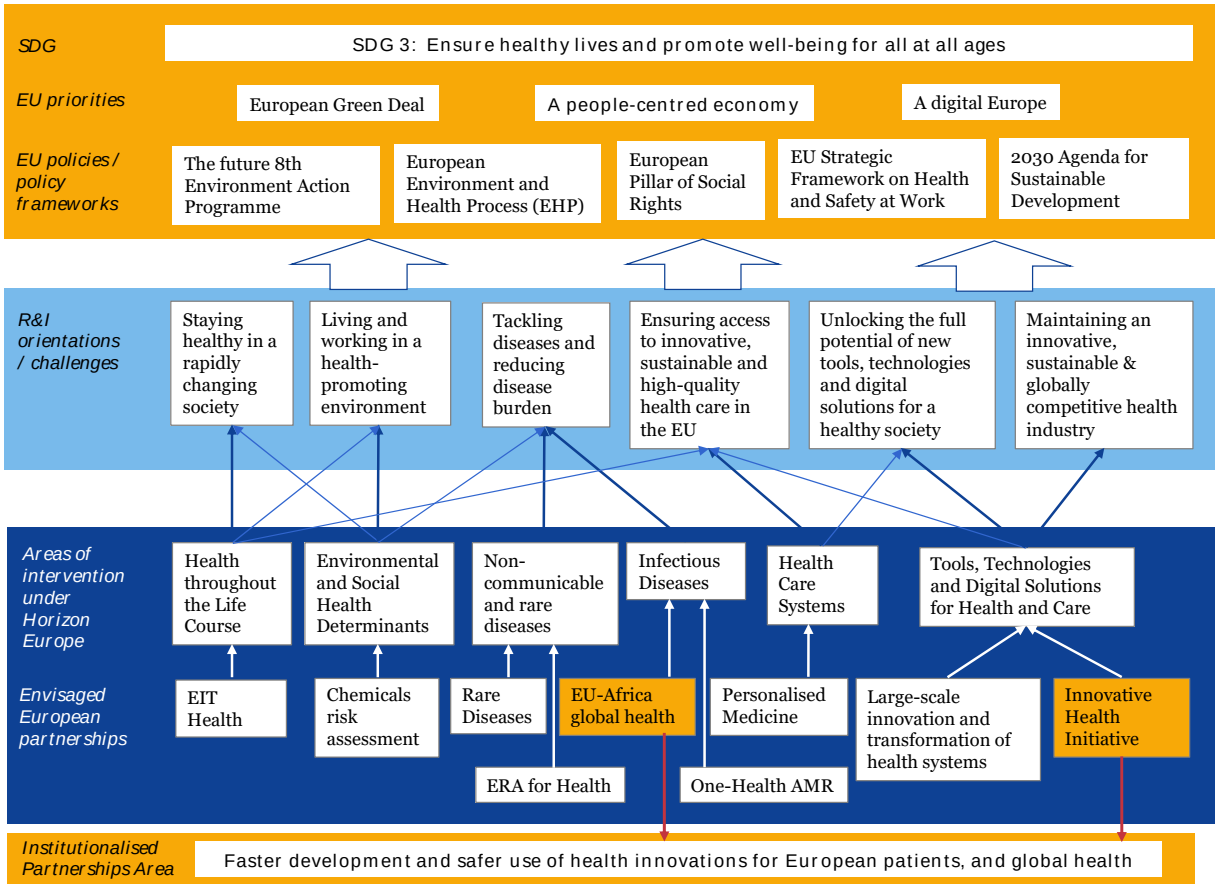
Figure 5, below, shows that the portfolio of envisaged European Partnerships in this cluster[10] aims to contribute to all of the R&I orientations in this cluster. However, there is a pronounced focus on the 'tackling diseases and reducing the disease burden' objective, addressed by five out of the ten partnerships (amongst which there is one candidate Institutionalised Partnership). The objectives focused on an improved exploitation of digital solutions and competitiveness of the EU health-related industry are addressed by two partnerships amongst which one is a candidate Institutionalised Partnership.

In this context, it should be noted that the portfolio of European Partnerships in this cluster predominantly encompasses Co-funded Partnerships, focused on joining the R&I programmes and investments at the national level. There is therefore overall a limited level of involvement of the private sector in the development of the SRIAs (i.e. as partners of the envisaged partnerships), be it from the supply or user side in the value chains. The only exceptions are the Innovative Health Initiative and the EIT KIC Health. European Partnerships also provide limited support for the assessment of environmental and social health determinants, uniquely addressed from a chemical risks perspective.

[10] As proposed in the Horizon Europe 'Orientations towards the first Strategic Plans', dd. December 2019

The description of the interconnections between the partnerships in this cluster and the ones funded in the context of other clusters, provided in the reports of the individual impact assessment studies, sheds more light on this topic.

Figure 5: R&I priorities and higher-level objectives of the Horizon Europe Cluster 1 – Health



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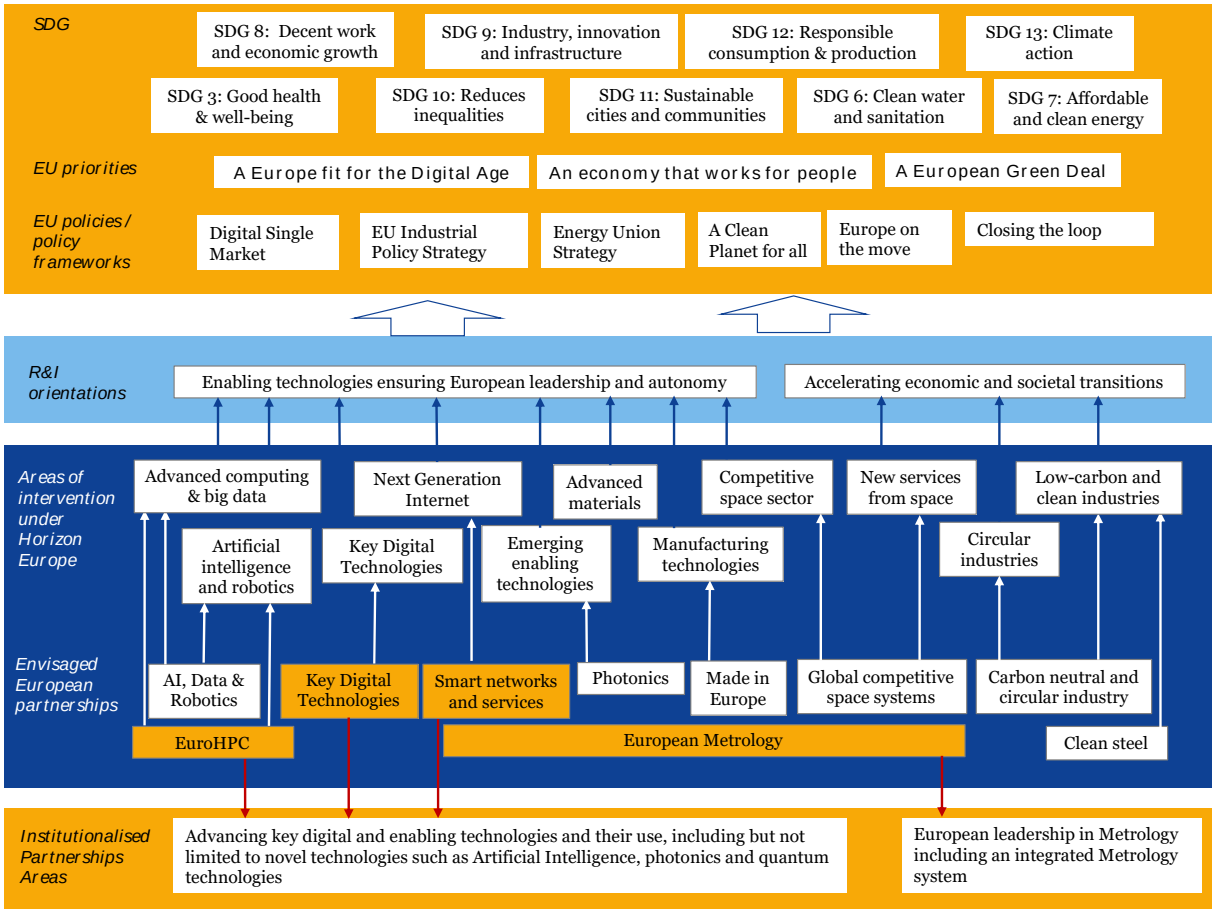
2.3.1 Cluster 4 – Digital, Industry and Space

In this cluster the focus is on the digitisation of European industry and on advancing key enabling, digital and space technologies which will underpin the transformation of our economy and society at large. The overarching vision for R&I investments in this cluster is "a European industry with global leadership in key areas, fully respecting planetary boundaries, and resonant with societal needs – in line with the renewed EU Industrial Policy Strategy." The expected effects on the European economy and society imply that the R&I activities under this cluster will contribute to various Sustainable Development Goals and respond to three key EU policy priorities: 'A European Green deal', 'A Europe fit for the digital age', and 'An economy that works for people' (Figure 6).

The cluster pursues three objectives: 1) ensuring the competitive edge and sovereignty of EU industry; 2) fostering climate-neutral, circular and clean industry respecting planetary boundaries; and 3) fostering social inclusiveness in the form of high-quality jobs and societal engagement in the use of technologies. A human-centred approach will be taken, i.e. technology development going hand in hand with European social and ethical values.

The key R&I priorities are grouped in two general categories: (I) Enabling technologies ensuring European leadership and autonomy; and (II) Accelerating economic and societal transitions (these will be complemented by priorities of other clusters). European Partnerships envisaged to support the R&I in the specific intervention areas are mainly co-programmed partnerships. Exceptions are the three candidate Institutionalised Partnerships in the digital field and the candidate Institutionalised Partnership in metrology, reflecting their related Partnership Areas.

Figure 6: R&I priorities and higher-level objectives of the Horizon Europe Cluster 4 – Digital, Industry and Space



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Multiple convergences exist between the technologies that are covered in the first strand of the priorities in this cluster, i.e. "enabling technologies ensuring European leadership and autonomy". In their function of 'enabling' technologies, they will also make critical contributions to the attainment of the desired 'transitions' in the 'vertical' industry sectors targeted in the second strand of priorities in this cluster as well as in the other clusters. A major contribution from this perspective can be expected from the four candidate Institutionalised Partnerships as well as from the 'Made in Europe' partnership, focused on manufacturing technologies.

2.3.2 Cluster 5 – Climate, Energy and Mobility

The main objectives of this cluster are to fight climate change, improve the competitiveness of the energy and transport industry as well as the quality of the services that these sectors bring to society. This is supportive of several Sustainable Development Goals including affordable and clean energy (SDG7); industry, innovation & infrastructure (SDG9); sustainable cities & communities (SDG11); sustainable consumption & production (SDG12); and climate action (SDG13). The cluster is most closely aligned to the EU priority for 'A European Green Deal' but also has synergy with two of the other five priorities; 'An economy that works for people' and 'A Europe fit for the Digital Age'. This extends across various policies including a Clean Planet for all, the Energy Union strategy, Single European Railway Area, European ATM Master Plan, Single European Sky, and Europe on the Move (Figure 7).

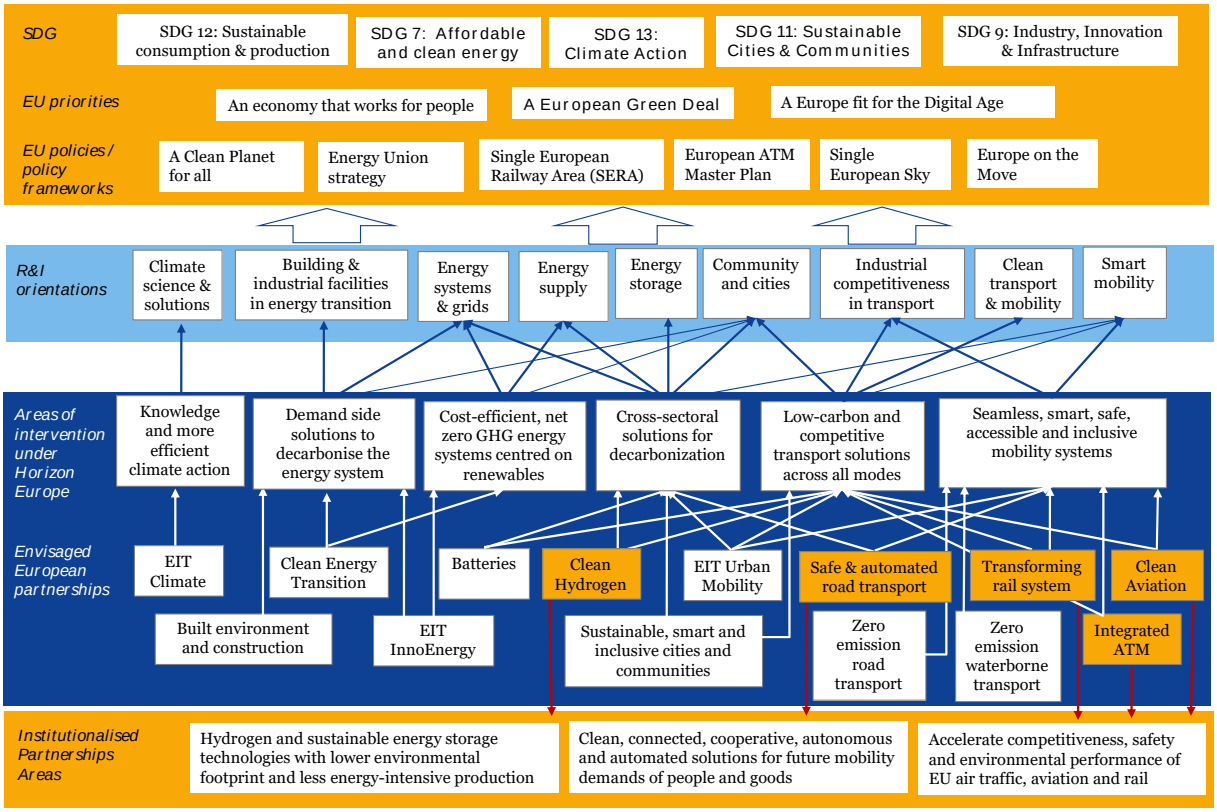
The cluster is directly relevant to several of the areas for possible institutionalised European partnerships on the basis of Article 185 TFEU or Article 187 TFEU, namely:

- Partnership Area 4: Accelerate competitiveness, safety and environmental performance of EU air traffic, aviation and rail

- Partnership Area 6: Hydrogen and sustainable energy storage technologies with lower environmental footprint and less energy-intensive production
- Partnership Area 7: Clean, connected, cooperative, autonomous and automated solutions for future mobility demands of people and goods

Cluster 5 is structured under six areas of intervention under Horizon Europe and nine R&I orientations. Figure 7, below, shows the portfolio of envisaged European Partnerships that are relevant to this cluster and their link to the areas of intervention.

Figure 7: R&I priorities and higher-level objectives of the Horizon Europe cluster Climate, Energy and Mobility



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There are 14 candidate Partnerships that align with this cluster of which eight are possible Institutionalised Partnerships, including five Article 187 initiatives and three EIT-KICs. There are no candidate Article 185 Partnerships in this cluster. The other partnerships are envisaged as either Co-programmed and/or Co-funded Partnerships.

The diagram above shows the strong orientation of the possible Institutional Partnerships towards the mobility area and more limited direct synergies between the envisaged Partnerships and the 'climate science & solutions' priority. Of course, the climate change challenge underpins the whole of this cluster, except where the focus is on industrial competitiveness, but this will also be at least partially dependent on innovation related to clean energy and mobility products and services.

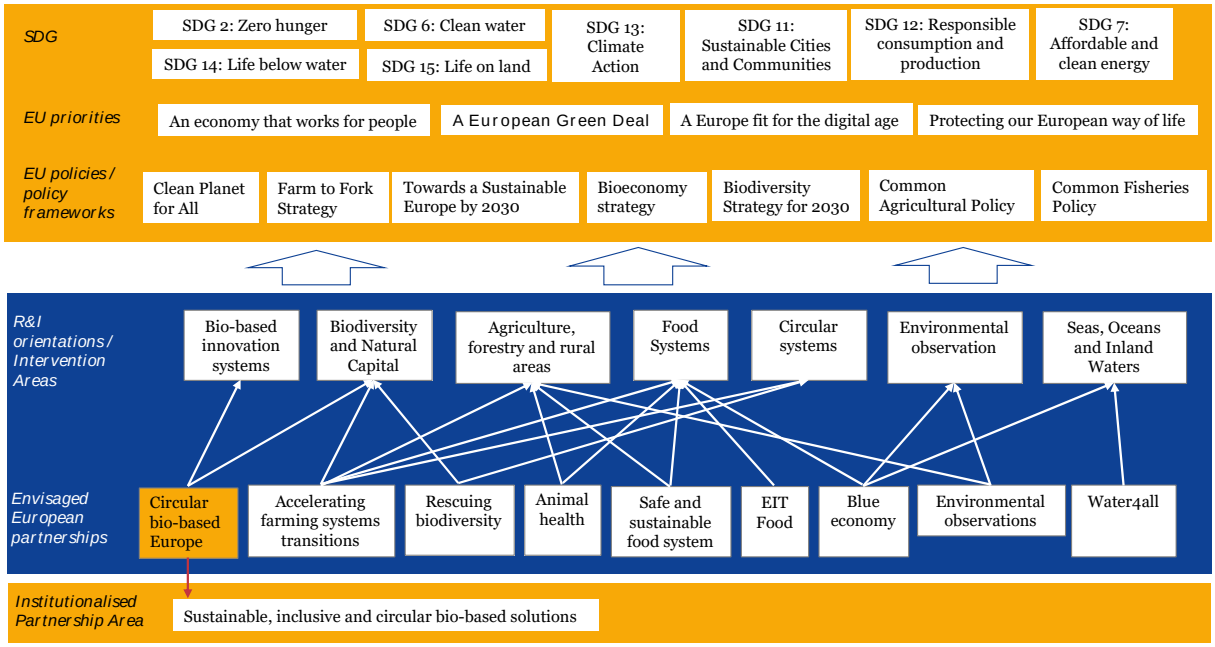
2.3.3 Cluster 6 – Food, Bioeconomy, Natural Resources, Agriculture and Environment

The key objective of Cluster 6, 'Food, Bioeconomy, Natural Resources, Agriculture and Environment' is to advance knowledge, expand capacities and deliver innovative solutions to accelerate the transition towards the sustainable management of natural resources (such as biodiversity, water and soils). The cluster has a large realm and aims to address a wide range of challenges relating to climate change, biodiversity and ecosystems, natural resources, and the production and consumption patterns that may affect them. It encompasses a single area for possible institutionalised European Partnerships aimed at the development of "sustainable, inclusive and circular, bio-based solutions".

The R&I activities funded under the Pillar II Cluster 6 contribute first and foremost to the 'European Green Deal'. More precisely, they will be instrumental to the announced climate change actions, the Biodiversity Strategy for 2030, the "Farm to Fork Strategy", the zero-pollution ambition, the New Circular Economy Action Plan, and the comprehensive strategy on Africa and trade agreements. However, through cooperation with the other clusters, Cluster 6 may make some contribution to the other EU overarching policy priorities. The R&I activities funded under this cluster therefore aim to contribute to the achievement of several United Nations SDGs including: SDG 2: Zero hunger; SDG 6: Clean water and sanitation; SDG 7: Affordable and clean energy; SDG 11: Sustainable cities and communities; SDG 12: Responsible consumption and production; SDG 13: Climate action; SDF 14: Life below water; and, SDG 15: Life on land.

Cluster 6 is structured around six targeted impacts and seven research and innovation orientations, as shown in Figure 8, below. The R&I activities funded under this cluster aim to (1) develop solutions for mitigation of, and adaptation to, *climate change*; (2) halt the *biodiversity* loss and foster the restoration of *ecosystems*; (3) encourage the sustainable (and circular) management and use of *natural resources*; (4) stimulate inclusive, safe and health *food and bio-based systems*; (5) a better understanding of the determinants of *behavioural, socio-economic and demographic changes* to accelerate system transformation; and, (6) improve solutions for *environmental observations and monitoring systems*.

Figure 8: R&I priorities and higher-level objectives of the Horizon Europe Cluster 6 – Food, Bioeconomy, Natural Resources, Agriculture and Environment



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The European Commission envisages nine partnerships under Cluster 6, two of which would be institutionalised (Circular bio-based Europe and EIT Food), four would be either co-programmed or co-funded (Animal Health; A climate-neutral, sustainable and productive Blue Economy; Safe and Sustainable Food Systems for People, Planet and Climate; Water4All), and three would be co-funded (Accelerating Farming System Transition; Agriculture for Data; Rescuing Biodiversity to safeguard life on Earth).

There is seemingly a good balance between the three types of partnerships. However, industry may have some interest in being involved in the design of the Strategic Research and Innovation Agendas regarding living labs and other research infrastructure ('Towards more sustainable Farming' envisaged partnership) to develop solutions for accelerating the transition of farming systems, and technologies to collect agriculture data.

The proposed portfolio of European Partnerships covers the full range of R&I orientations under Cluster 6.

All but one of the proposed partnerships contribute to orienting R&I activities towards the development of food systems that will ensure both sustainable and healthy diets and food and nutrition security for all. The food system has an impact on several challenges. It directly relates to nutrition and diets, access to food, food security, and has an influence on the use of natural resources, water and soil pollution, climate change. Food waste is a key component of circular systems and biomass has strong potential to offer bio-based energy solutions. Finally, the transformation of food systems should take into consideration demographic changes and the accelerating urbanisation (which reduces lands available for food production but offers opportunities for new types of agriculture such as urban farming).

Two R&I orientations are covered by less than half of the proposed partnerships: Environmental Observations (even though achievement in this area could make significant contribution to the other areas) and Bio-based innovation systems (which is nevertheless at the core of the candidate institutionalised partnership for a circular bio-based Europe).

EUROPEAN COMMISSION

Part I. Impact Assessment Studies for the Candidate Institutionalised European Partnerships

9. Candidate Institutionalised European Partnership for Integrated Air Traffic Management

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Abstract

This document is the final report of the Impact Assessment Study for the candidate Institutionalised European Partnership for integrated Air Traffic Management under Horizon Europe.

This initiative focuses on the modernisation of the Air Traffic Management in Europe - an essential enabler of safe and efficient air transport and a cornerstone of the European Union's society and economy. The proposed initiative will address the challenges raised by an outdated Air Traffic Management system with a non-optimised performance. The current system needs to be transformed to enable exploitation of emerging digital technologies and to accommodate new forms of air vehicle including drones.

The objective is therefore to harmonise European Air Traffic Management system based on high levels of digitalisation, automation and connectivity whilst strengthening air transport, drone and ATM markets competitiveness and achieving environmental, performance and mobility goals. This would create €1,800b benefits to the EU economy if the current initiative can be built on and accelerated.

The study concluded that Institutionalised Partnerships under Art. 187 TFEU is the preferred option for the implementation of this initiative.

Executive Summary

This document is the final report of the Impact Assessment Study for the candidate Institutionalised European Partnership for integrated Air Traffic Management under Horizon Europe. The study was conducted by Think Research from July to December 2019, under coordination of Technopolis Group. The methodological framework for this study (described in the report on the overarching context to the impact assessment studies) reflects the Better Regulation Guidelines and operationalises the selection criteria for European Partnerships set out in the Horizon Europe Regulation. This report contains the findings of this specific study.

The focus of the initiative is modernisation of air traffic management (ATM) services in Europe by delivering technical and operational modernisation to address the future challenges of a digital ATM system characterised by higher levels of autonomy. This initiative will build upon the activities of the SESAR Joint Undertaking, an Institutionalised Partnership under Article 187 of TFEU, that has managed all R&I in ATM under 7th Framework Programme and Horizon 2020.

ATM is an essential enabler of free movement of people and goods within the internal market; a cornerstone of the European Union's society and economy. The current ATM infrastructure is the result of historical evolutions at a national level leading to a fragmented system with limited interoperability between States. This leads to inefficiencies, particularly for emerging challenges – reducing environmental impact and air traffic delays; introducing new digital technologies; the; accommodation of traffic growth and the accommodation of new air vehicles. The key problem in ATM is that as the outdated infrastructure cannot easily exploit emerging digital technologies, the European ATM system is becoming saturated and leading to significant levels of delay.

R&I in integrated ATM has three general objectives.

- Harmonisation of EU ATM based on high levels of digitalisation, automation and connectivity to enable efficient collaboration between service providers.
- Strengthening the competitiveness of EU air transport, drone and ATM markets.
- Achievement of environmental, performance and mobility goals.

Successfully achieving these objectives could create €1,800b of benefits for the EU economy.

However, modernisation of ATM in Europe requires a common vision and direction to replace the current fragmented national systems with a new collaborative platform at EU level that has consensus of the ATM industry and Member States.

As the core of the proposed initiative is therefore the ambitious modernisation of European ATM, the R&I that must be supported by the full range of ATM stakeholders and based on a well-defined and agreed research agenda – Edition 2020 of the European ATM Master Plan. It is also clear that the R&I efforts must be expanded and accelerated to deliver a new collaborative and distributed infrastructure for ATM in a timely manner.

The relevant policy options for this assessment were Horizon Europe calls (Option 0), Co-programmed Partnerships (Option 1), and Institutionalised Partnership under Article 187 (Option 3). Our conclusion is that Option 3 is the preferred option which provides greater effectiveness by maximising leverage effects and enabling acceleration of R&I by harnessing the momentum and knowledge of the current partnership. It would further improve coherence through an independent support function, able to steer R&I and provide global voice for Europe.

Résumé exécutif

Ce document est le rapport final de l'étude de support à l'analyse d'impact de la proposition de partenariat européen institutionnalisé pour la gestion intégrée du trafic aérien dans le cadre d'Horizon Europe. Cette étude a été menée par Think Research et coordonnée par Technopolis entre juillet et décembre 2019. Le cadre méthodologique de cette étude (décrit dans le rapport sur le contexte général des études de support aux analyses d'impact) tient compte des lignes directrices pour une meilleure réglementation et opérationnalise les critères de sélection des partenariats européens définis dans le règlement d'Horizon Europe. Le présent rapport contient les résultats spécifiques à cette étude.

L'intérêt de cette initiative est de moderniser d'un point de vue technique et opérationnel les services de gestion du trafic aérien (GTA) en Europe afin de relever les défis futurs d'un système GTA numérique caractérisé par des niveaux d'autonomie supérieurs. Cette initiative tirera parti des activités de l'entreprise commune SESAR, un partenariat institutionnalisé au titre de l'article 187 du TFUE, qui a géré l'ensemble de la R&I en matière de GTA dans le cadre du 7e programme-cadre et d'Horizon 2020.

La GTA est un catalyseur essentiel de libre circulation des personnes et des biens au sein du marché intérieur, l'un des fondements de la société et de l'économie de l'Union européenne. L'infrastructure GTA actuelle est le résultat d'évolutions historiques à l'échelle nationale, ce qui a donné lieu à un système fragmenté limitant l'interopérabilité entre États. Cela entraîne des inefficacités, notamment pour les défis émergents, comme la limitation de l'impact environnemental et des retards dans le trafic aérien, l'introduction de nouvelles technologies numériques, l'adaptation nécessaire en raison de la croissance du trafic et l'hébergement de nouveaux avions. Le problème principal dans la GTA est que, puisque l'infrastructure désuète ne peut pas exploiter facilement les technologies numériques émergentes, le système GTA européen se sature et entraîne des niveaux de retard conséquents.

La R&I dans la GTA intégrée poursuit trois objectifs généraux.

- L'harmonisation de la GTA au sein de l'UE par des niveaux élevés de numérisation, d'automatisation et de connectivité pour assurer une collaboration efficace entre les prestataires de service.
- Le renforcement de la compétitivité du transport aérien, des drones et des marchés GTA de l'UE.
- L'accomplissement des objectifs environnementaux, de performance et de mobilité.

Si ces objectifs sont atteints, l'UE pourrait bénéficier de 1.800 milliard € de retombées économiques.

Cependant, la modernisation de la GTA en Europe nécessite une vision et une orientation communes pour remplacer les systèmes nationaux fragmentés actuels par une nouvelle plate-forme collaborative à l'échelle européenne qui fait consensus dans le secteur GTA et les États membres.

Étant donné que l'essentiel de l'initiative proposée est la modernisation ambitieuse de la GTA européenne, la R&I doit être soutenue par l'ensemble des intervenants GTA et se fonder sur un programme de recherche bien défini et convenu : l'édition 2020 du Plan directeur GTA européen. Il est aussi évident que les efforts en matière de R&I doivent être étendus et accélérés pour mettre en place en temps voulu une nouvelle infrastructure collaborative et distribuée pour la GTA.

Les options stratégiques pertinentes pour cette analyse étaient les appels à projets d'Horizon Europe (option 0), les partenariats co-programmés (option 1) et les partenariats institutionnalisés au titre de l'article 187 (option 3). Nous en avons conclu que l'option 3

était l'option à favoriser, puisqu'elle assurait la meilleure efficacité en optimisant les effets de levier et en permettant d'accélérer la R&I en tirant parti de la dynamique et des connaissances créées par le partenariat actuel. Cela permettra d'améliorer encore davantage la cohérence grâce à une fonction de soutien indépendante, capable de diriger la R&I et de faire entendre une voix commune à toute l'Europe.

Table of Contents

List of Figures

List of Tables

Glossary

AI	Artificial intelligence
ANSP	Air Navigation Service Provider
ATM	Air Traffic Management
CEF	Connecting European Facility
CF	Co-funded Partnership
CP	Co-programmed Partnership
CSA	Coordination and Support Actions
DAE	Digital Agenda for Europe
DEP	Digital Europe Programme
DSM	Digital Single Market strategy
EP	European Partnerships
FAA	Federal Aviation Authority
GANP	Global Air Navigation Plan
IA	Innovation Action
ICAO	International Civil Aviation Organisation
IP	Institutional Partnership
MFF	Multi-annual Financial Framework
MoU	Memorandum of Understanding
MS	Member States of the European Union
R&I	Research and Innovation
RIA	Research and Innovation Action
SES	Single European Sky
SESAR	Single European Sky ATM Research
SDGs	Sustainable Development Goals
TFEU	Treaty of Functioning of the European Union
TRL	Technology Readiness Level
UTM	Unmanned Air System Traffic Management

1 Introduction: Political and legal context

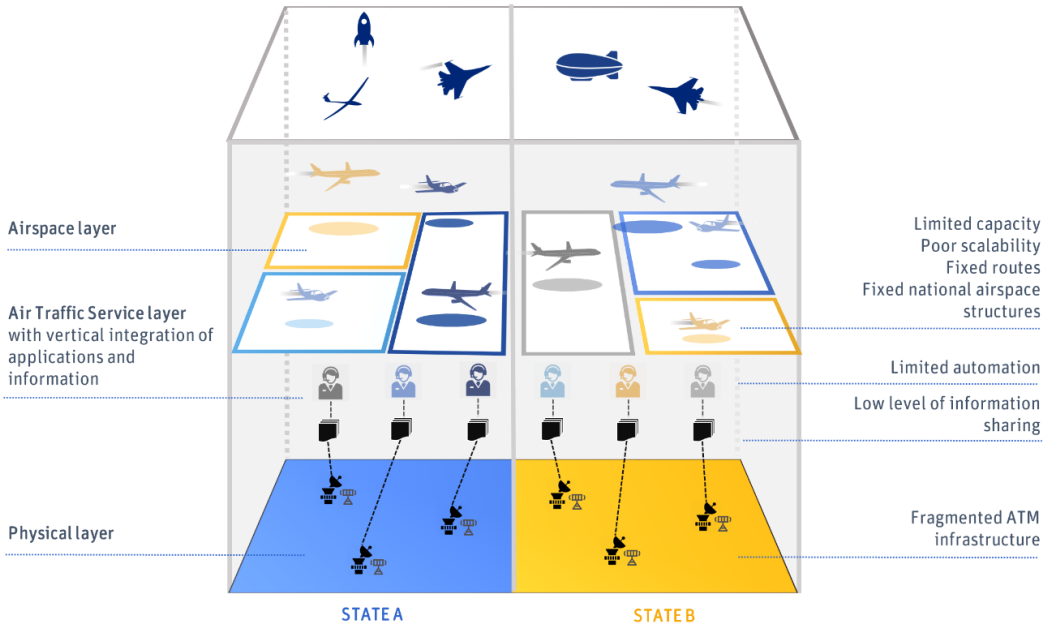
This part presents the impact assessment of the candidate Institutionalised Partnership for integrated Air Traffic Management, which is one of the initiatives that will implement the Commission's vision for the period beyond 2020 under the Horizon Europe Pillar II, specifically the Cluster 5 "Climate Energy and Mobility". It is one of the envisaged European Partnerships in the Partnership Area 4 "accelerate competitiveness, safety and environmental performance of EU air traffic, aviation and rail".

1.1 Emerging challenges in the field

Free movement of people and goods within the internal market is a cornerstone of the EU's society and economy. Mobility is also key in ensuring the economic, social and territorial cohesion of Member States (MS) enshrined in the Lisbon Treaty as a fundamental objective of the Union.

Air Traffic Management (ATM) is an essential enabler of air transport consisting of "the aggregation of the airborne and ground-based functions required to ensure the safe and efficient movement of aircraft during all phases of operations".[1] National air navigation service providers control airspace based largely on national boundaries. Each State's airspace is organised as one or more flight information regions, each with a dedicated control centre (as depicted in Figure 1).

Figure 1: Schematic of the current ATM architecture



Source: A proposal for the future architecture of the European airspace, SJU, 2019.

The current ATM infrastructure is the result of historical operational and technical evolutions primarily at national level which has led to a fragmented system with limited interoperability between states.[2] As will be explained in Section 2, this leads to inefficiencies, particularly when considering the introduction of new solutions to achieve harmonisation at EU level. The main future challenges are summarised in Table 1

[1] Regulation (EC) No 549/2004 of the European Parliament and of the Council of 10 March 2004 laying down the framework for the creation of the single European sky (the framework Regulation).

[2] A proposal for the future architecture of the European airspace, SJU, 2019.

Table 1: Overview of the challenges emerging

Social	Need to reduce air traffic delays and consequent cost to society, and environmental impact as traffic grows
Technical and technological	New digital ATM system based on a distributed architecture, new ways of structuring airspace and increased automation; The need for the development of suitable technological solutions to integrate drones into the airspace and support the growth of this new market; Advances in artificial intelligence, machine learning, climate science and other techniques with high potential to improve ATM operations.
Economic	Modernisation of ATM to support EU growth and competitiveness in three key areas: • Accommodation of increasing demand for air transport, allowing Europe to remain an attractive hub for air transport (against emerging hubs, e.g. in Middle East); • Fostering the growth of a European drone industry and market, securing European leadership in the field; • Competitiveness of the EU ATM industry globally, and accelerate the time-to-market of innovative solutions.
Environmental	Need to accommodate aviation growth in a manner that as far as possible reduces the environmental footprint; From an ATM perspective, ensuring that all aircraft are able to fly safely the route with the optimal environmental footprint.
Political, policy and regulatory framework	Technical and technological challenges require regulatory change to foster innovation; • Defragmenting the European airspace and service provision whilst respecting the overall principle of national airspace sovereignty; • Lead the global change in ATM.

Source: Think Research Ltd.

1.2 EU relative positioning

1.2.1 Competitive positioning of Europe in the field

This section sets out recent European achievements in ATM R&I, first from a scientific perspective and then from an industrial perspective. These achievements are due largely to the work of the existing partnership, the SESAR Joint Undertaking, which is described in the subsequent section.

The scientific results in the field of ATM R&I in Europe are captured in the 86 papers published (in the period 2014-2019).[3] A number of these papers have been presented at conferences (which are indexed in SCOPUS), as in some of the disciplines that are participating in the ATM, conferences are of more importance than the publications in journals. The three main, peer-reviewed conferences focussing on ATM are:

- ***ATM Seminar***, organised biannually, jointly by the Federal Aviation Administration and EUROCONTROL, aimed at established researchers (www.atmseminarus.org).

[3] Think analysis based on querying SCOPUS database for the source of funding SESAR Joint Undertaking (as European ATM research in the past 12 years has been pooled under the current initiative).

- ***International Conference on Research in Air Transportation***, organised biannually, jointly by the Federal Aviation Administration and EUROCONTROL (www.icrat.org).
- ***SESAR Innovation Days***, organised by the SESAR Joint Undertaking, every year (https://www.sesarju.eu/sesarinnovationdays).

The ATM Seminar confers awards for best paper in each session and best conference paper. In the last two editions, half of the awards were won by European researchers. The research produced in European ATM is considered of high scientific value when assessed across the indicators that are important in the field – participation and awards received at these main conferences.

These scientific results have supported Europe achieve a leading role in the development and exploitation of ATM systems. The ATM market is a small niche market – the global market was only $3.43b in 2017[4] - five of the seven leading companies in the field are European.

One of the EU flagship projects is the development and deployment of Remote Towers[5] which is dominated by SAAB and Frequentis from Europe, and Searidge which is jointly owned by the UK air navigation service provider.

Part of Europe's success are the strong inputs provided to global standards at the International Civil Aviation Organisation (ICAO) - the United Nations body responsible for aviation and ATM. Collective work carried out at European level during the European ATM Master Plan update campaigns[6] is synchronised and consistent with the updates of ICAO's Global Air Navigation Plan (GANP). This ensures that Europe speaks at ICAO with a single and powerful voice. As a result, the GANP now follows the approach and structure of the European ATM Master Plan[7]. Furthermore, European positions in ICAO are now coordinated by the European Commission[8] and have high visibility at the main decision making bodies of ICAO (the General Assembly and Air Navigation Conferences).

Through working closely with other countries, in particular the Federal Aviation Authority in the USA, Europe has ensured that the global ATM modernisation plans[9] are fully consistent with the European plans encapsulated in the European ATM Master Plan.[10] This is critical for global exports – whilst Europe and the US are innovators in ICAO, the other 168 contracting States are largely followers – adopting solutions agreed at the ICAO level. A positive, coordinated and innovative approach in ICAO helps Europe develop and export ATM systems that can enable sustainability goals worldwide.

[4] Frost and Sullivan identify Thales, Indra, Leonardo, Saab and Frequentis as world leaders in ATM; alongside Harris and Raytheon from the US. Source: Global Commercial Air Traffic Management Market, 2017-2025, Frost and Sullivan, May 2017 (MDC-22).

[5] Remote tower is a technology that enables the air traffic service that are normally performed from the airport control tower to be performed at a remote location using camera technology to replicate the air traffic controllers view. The initial deployments were in Europe, and this expertise is now driving global deployment.

[6] The European ATM Master Plan is both the Strategic Research and Innovation Agenda for ATM and a blueprint for ATM modernisation. The Master Plan is discussed more fully in Appendix D.

[7] ICAO (2019) 2016–2030 Global Air Navigation Plan (GANP), Sixth edition.

[8] Coordination goes beyond the EU Member States to cover all 44 States of the European Civil Aviation Conference .

[9] ICAO (2019) 2016–2030 Global Air Navigation Plan (GANP), Sixth edition.

[10] European ATM Master Plan, Edition 2020, SJU.

1.2.2 Support for the field in the previous Framework Programme

Within the previous Framework Programme, all R&I for integrated ATM was organised by the SESAR Joint Undertaking, an Institutionalised Partnership established under Article 187 of the Treaty of Functioning of the European Union (TFEU).

The SESAR Joint Undertaking manages the R&I element of the wider SESAR project which in turn is part of the European Commission's Single European Sky (SES) initiative aimed at modernisation of ATM. Further details of the overall SESAR project and the SESAR Joint Undertaking are provided in Appendix D.

The aim of the SESAR Joint Undertaking was defined by the 2007 regulation[11] as:

- To ensure the modernisation of the European air traffic management system by coordinating and concentrating all relevant research and development efforts in the Community.

Since its inception in 2008, the SESAR Joint Undertaking has successfully coordinated European ATM R&I. The success of SESAR is best illustrated by the European ATM Master Plan, culminating in the 2020 edition[12], and the SESAR Solutions Catalogue.[13] To date 63 ATM solutions have been developed - and deployed at over 300 locations across Europe.[14,15]

The European ATM Master Plan acts as strategic research and innovation agenda for the partnership. The first version of European ATM Master Plan was developed prior to the establishment of the SESAR Joint Undertaking and endorsed by the European Council in 2009. Since then the European ATM Master Plan has been regularly updated by the SESAR Joint Undertaking following widespread stakeholder consultation. Each version requires approval of Member States through a positive opinion of the Single Sky Committee.[16]

There have been four editions of the European ATM Mater Plan[17]. Each subsequent edition has incorporated the R&I results, changes in EU policy and economy. In addition, each version has widened the scope in accordance with emerging challenges within ATM. The latest edition specifically:

- Addresses new challenges: tackling the steady increase in traffic demand, which is forecast to continue in the long term, incorporate unmanned aviation safely and efficiently into the airspace, enabling the emergence of new business models, while supporting the sustainability of aviation.
- Defines ways to accelerate the digital transformation of the ATM infrastructure to accommodate new aerial vehicles, which are set to become more autonomous, connected and intelligent.

[11] As defined by Council Regulation (EC) No 219/2007 of 27 February 2007 on the establishment of a Joint Undertaking to develop the new generation European air traffic management system (SESAR), as amended.

[12] European ATM Master Plan, Edition 2020, SJU.

[13] SESAR Solutions Catalogue 2019 Third Edition, SJU, 2019.

[14] Guidance Material for SESAR Deployment Programme Implementation Monitoring View 2019, SDM, September 2019.

[15] Interactive map available at: https://www.sesardeploymentmanager.eu/single-european-sky-deployment/.

[16] The Single Sky Committee is the comitology committee for the Single European Sky.

[17] Details of each edition of the European ATM Master Plan are presented in Appendix D.

In addition, SESAR Joint Undertaking has a strong voice demonstrating EU leadership in ATM in a competitive global landscape.[18] Indeed, the SESAR Joint Undertaking played a key role in the development of global plans at ICAO level and in maintaining international interoperability of ATM systems through coordination with the Federal Aviation Authority (FAA) and other similar initiatives.[19]

The SESAR Joint Undertaking has also supported the European Commission's development of aviation and ATM policy through key studies performed at the request of DG-MOVE, including datalink communications[20] and U-space.[21]

Previous evaluations identified two key weaknesses of the SESAR Joint Undertaking:[22]

- Limited exploitation of advanced external R&I and internal exploratory research in the core programme. This illustrates a potential issue with the limited membership of the SESAR Joint Undertaking not enabling the beneficiaries of exploratory research to continue on the topic in the core programme.
- Limited progress on key enablers where there is limited industry consensus (for example, next generation datalinks and flight data processing), highlighting the need for greater emphasis on transformational technologies.

In 2018, the SESAR Joint Undertaking performed a study on behalf of the European Parliament and European Commission to develop a proposal for a Future Airspace Architecture.[23] Whilst the proposal is largely based on solutions from current R&I referred to in the European ATM Master Plan, it also represents a step change in ambition, requiring both more transformational technologies and faster deployment of digital enablers to support enhanced automation and virtualisation. A Transition Plan[24] for the implementation of the Airspace Architecture Study was delivered by the SESAR Joint Undertaking in September 2019, offering a series of concrete and short-term measures to put the implementation of the study into motion.

1.3 EU policy context beyond 2021

As set out in the report on the overarching context to the impact assessment studies, the R&I activities funded under the Pillar II Cluster Climate, Energy and Mobility aim at contributing to the attainment of at least three of the six main ambitions for Europe: 'A European Green Deal', 'a people-centred economy' and 'A Digital Europe'. It is supportive of several of the Sustainable Development Goals, particularly Climate Actions (SDG13), Sustainable Cities and Communities (SDG11) and Industry Innovation and Infrastructure (SDG9).[25]

Since 2004, "the European Union (EU) has gained competences in air traffic management (ATM) and the decision-making process has moved away from an intergovernmental

[18] Interim Evaluation of the SESAR Joint Undertaking (2014-2016) operating under Horizon 2020, Experts Group Report.

[19] Section 2.5 of SESAR Joint Undertaking Single Programming Document 2019-2021, SJU, 2019.

[20] Source: https://www.sesarju.eu/newsroom/brochures-publications/vdlm2-%E2%80%93-measurements-analysis-and-simulation-campaign-elsa-study

[21] Source: https://www.sesarju.eu/U-space

[22] Interim Evaluation of the SESAR Joint Undertaking (2014-2016) operating under Horizon 2020, Experts Group Report.

[23] A proposal for the future architecture of the European airspace, SJU, 2019.

[24] Future Architecture of the European Airspace: Transition Plan, SJU, 2019.

[25] Information on ATM contribution to SDGs is presented in **Error! Reference source not found.**.

practice to the EU framework. The EU's main objective is to reform ATM in Europe in order to cope with sustained air traffic growth and operations under the safest, most cost- and flight-efficient and environmentally friendly conditions".[26]

For the ***mobility sub-cluster,*** the analysis of potential synergies between the envisaged and candidate partnerships is shown in Figure2. There are a relatively high number of candidate partnerships in different mobility application areas (i.e. air, rail and road transport). It also highlights the twin challenges of digitalisation and decarbonisation for future mobility and thus the potential synergies with the energy and digital sub-clusters. Figure 2 also illustrates that the European Open Science Cloud partnership will provide 'horizontal' (infrastructural) support to collaborative research and innovation within each envisaged partnership in Cluster 5, while also facilitating exchange and re-use of research data for the integration of new technologies into energy and mobility solutions.

What is less clear from this graphic is the lack of a cross-modal perspective approach to mobility across the four prospective partnerships as their titles imply different objectives and stakeholders. There are, however, several fairly obvious areas where there is surely scope for collaboration, if not rationalisation. These would include:

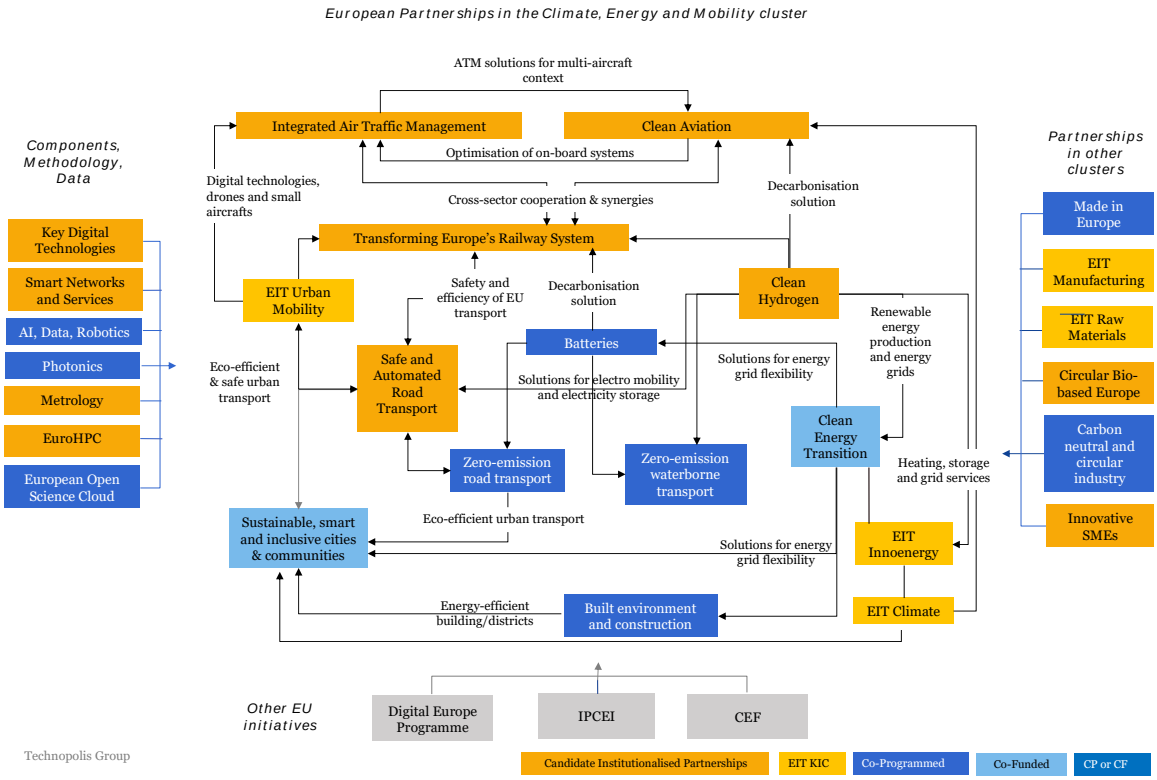
- 'integrated Air Traffic Management' will have dependencies on 'Clean Aviation' but also has wider objectives related to a people-centred economy.
- 'Safe and Automated Road Transport' and 'Zero-emission Road Transport' may have some common industry stakeholders (i.e. vehicles) but one is orientated towards the digital industries and the other with the energy industries.
- 'Zero-emission Road Transport' and 'Zero-emission Waterborne Transport' have supply chain synergies and challenges, particularly in relation to heavier duty applications.

This would suggest that the more recent candidate Co-funded Partnership on 'Sustainable, Smart and Inclusive Cities & Communities' could play a strategic role in fostering cross-modal activities and encouraging collaboration.

Another question is the extent to which the national/regional R&I funding agencies would be prepared to participate directly in partnership projects as this could enable better commercialisation links between the generally the projects with technology readiness levels (TRL) that are funded by the public sector and provide a stronger market pull.

[26] Source: https://ec.europa.eu/transport/modes/air/ses_en. Details of the Single European Sky are presented in Appendix C.

Figure 2: Potential synergies between the envisaged and candidate partnerships in the Mobility sub-cluster



At a more technical level, as the next generation of ATM will be more automated and take greater advantage of digital technologies such as big data and artificial intelligence (AI), future ATM R&I therefore needs to be coherent with wider R&I on:

- *Air Transport* (for example the candidate partnership on Clean Aviation). In particular there needs to be mutual awareness and collaboration between airborne and ATM R&I roadmaps to ensure synchronisation and thus maximisation of benefits, in particular on environment.
- *Multi-modal transport* (for example the candidate partnership on Transforming Europe's Railway system). In particular the ATM system needs to be aware of performance requirements to support multi-modal transport – the level of predictability to enable through-ticketing, and the data exchange requirements to enable luggage reconciliation.
- *Digital technologies* (for example Key Digital Technologies, Smart Networks and Services, AI, Data and Robotics) and climate science including the latest information on climate change and its impacts. In particular ATM needs to be aware of and adapt to the ATM context the evolution of technologies for data manipulation and distribution, cyber security, and legal aspects (e.g. on data ownership, responsibility and liability issues) of advanced decision making including big data and artificial intelligence.

2 Problem definition

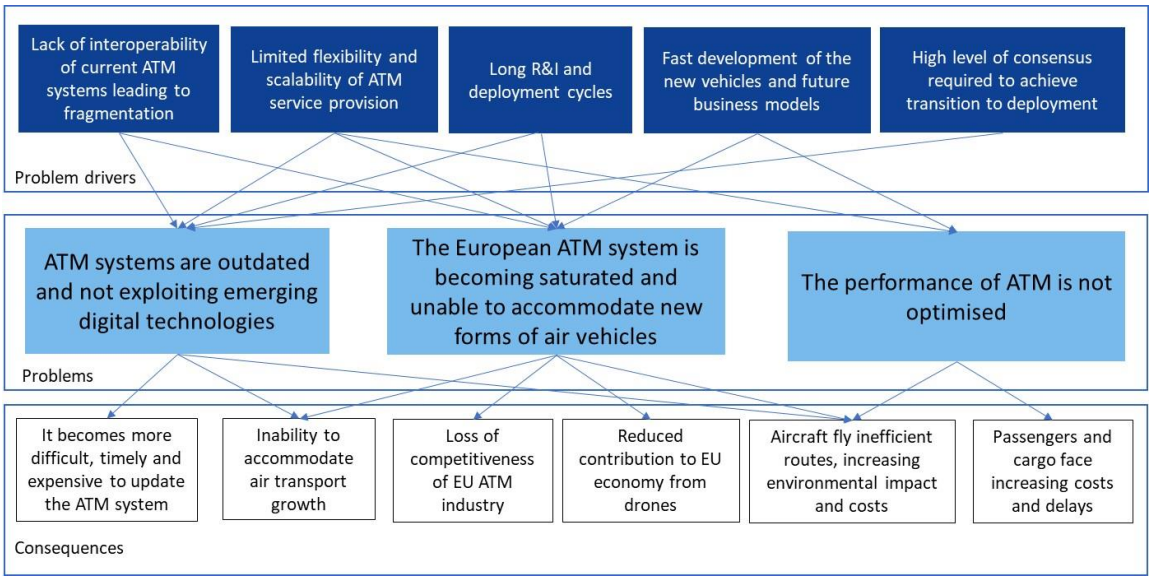
This section provides a discussion of the problems to be addressed in relation to the emerging challenges presented in Section 1.1, drawing on evidence from desk research and the findings of the stakeholder consultation undertaken as part of this study.[27]

[27] The methodology for stakeholder interviews is presented in Appendix B.

In line with the objectives of the Horizon Europe, the problems and objectives are analysed in terms of scientific impact, economic/technological impact including competitiveness of the industry and societal including environmental impact.

A problem tree portraying related problems, their drivers and the potential consequences if the problems are not addressed is presented in Figure 3 and described in detail in the following sections.

Figure 3: Problem tree for the initiative for integrated Air Traffic Management



Source: Think Research Ltd.

2.1 What are the problems?

2.1.1 ATM systems are outdated and not exploiting emerging digital technologies

Europe's ATM infrastructure is often referred to as fragmented.[28] This is the result of years of bespoke developments by national air navigation service providers leading to the proliferation of different systems with fragmented planning, piecemeal procurement, and duplication of support activities.

Current deployment activities include the implementation of VDL Mode 2 which is an air-ground datalink developed in the 1960s and the Aeronautical Telecommunications Network based on the 1980s Open Systems Interconnect protocols rather than the current Internet Protocols (IP)[29]. It is likely that these technologies will be not able to support ATM requirements beyond 2025[30] and replacements are urgently needed.

As such, the current systems are outdated, and as similar technologies are no longer used in other fields require effectively obsolete skills for their maintenance. Further it is difficult to introduce emerging digital technologies – particularly where the benefits can only be accrued by a synchronised deployment across the EU.

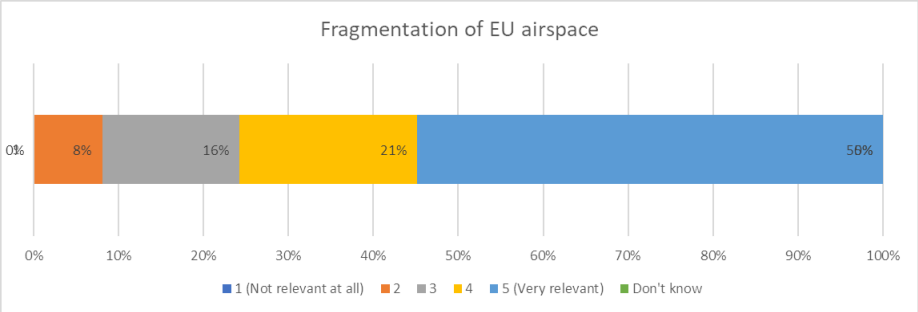
[28] Single European Sky: a changed culture but not a single sky, Special Report 18/2017, European Court of Auditors.

[29] Report on the DLS Implementation status in Europe, SDM, August 2018.

[30] VDL2 Mode 2 Capacity and Performance Analysis. SJU, November 2015.

Open public consultation:[31], [32] Almost 80% of stakeholders declared that fragmentation of EU airspace is relevant (21%) or very relevant (58%) problem to be addressed by research and innovation efforts at EU level. The distribution of answers is similar across all stakeholder groups.

Figure 4: Stakeholder opinion on the importance of fragmentation of EU airspace, results of Open public consultation (N=62)



Source: data from Open public consultation, elaboration by Technopolis and Think.

The responses from the two campaign groups provided a response that for these groups this problem is very relevant (90% of responses) or relevant (10%).

Interviews:[33] Stakeholders across all categories directly or indirectly referred that the main problems of ATM are fragmentation of R&I and, consequently, operations.

Advances in the artificial intelligence, machine learning techniques, satellite navigation (including Galileo), earth observation and atmospheric sciences, just to mention some, offer yet untapped potential for improving the procedures or offering new solutions for ATM stakeholders. Furthermore, the digitalisation and automation in transport are opening up opportunities for improving efficiency, opening of new services, change of business models. This will require digital transformation of aviation, rethinking of the ATM data provision, the framework on data sharing and cybersecurity, as well as the checks on the cost-efficiency of the proposed solutions.

The need to modernise the existing system though the application of emerging technologies such as digitalisation, automation and big data was a recurrent theme amongst the interviewed and throughout all the stakeholder categories.

These types of solutions are the key to ATM modernisation in order to increase:[34]

- Interoperability (i.e. ability of different systems to communicate with each other)

[31] The open public consultation refers to a pubic consultation refers to an on-line survey conducted by the European Commission Full results are presented in the study data report. There were 88 responses to the open public consultation for integrated Air Traffic Management partnership. Out of these, 66 were declared as genuine individual responses, while 22 responses were attributed to two campaign groups. The stakeholder groups used by the analysis were based on ownership and size of organisations which is not relevant to the ATM value chain.

[32] The European Commission received 28 responses to the inception impact assessment for integrated ATM. The responses are aligned with the stakeholder responses to the open public consultation and the interviews performed for this report. Therefore, we only refer to this feedback once more in the report.

[33] 50 interviews were conducted as part of the integrated ATM project; the methodology is presented in Appendix B. The results of the stakeholder interviews are collected in the study data report. Note that stakeholder grouping in Data Report is different from that of the Open public consultation – here the stakeholders are divided by their role in the ATM value chain, not by the type of organisation as in public consultation.

[34] A proposal for the future architecture of the European airspace, SJU, 2019.

- Flexibility (i.e. ease of changing how the service is provided)
- Scalability (i.e. providing the service where it is needed, in the amounts needed)

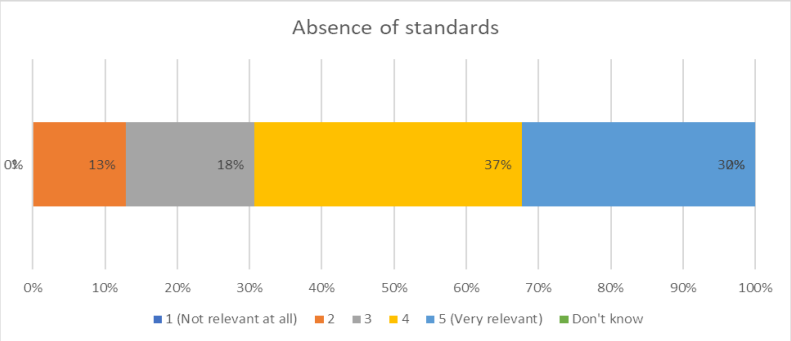
These new forms of solutions need to support harmonisation of service provision and therefore there is a need for coordinated research at EU level resulting in a single agreed solution for Europe. As was seen prior to SESAR, national R&I programmes aimed at solving local problems, do not necessarily address the harmonisation needs and result in duplication of efforts on similar topics.[35]

An important part of harmonisation efforts is the creation and availability of common standards and for ATM solutions.[36] Agreed standards enable any manufacturer to produce interoperable and harmonised solutions that can then be certified according to the related regulations. The coordinated research and innovation actions that take into account the development of standards and regulations, facilitate the acceleration of the innovation deployment.

Open public consultation

The results of the open public consultations reveal that majority of individual stakeholders consider the absence of standards as one of the problems in uptake of air traffic management innovations. Majority of academic and half of business association stakeholders do not consider this problem as relevant. The campaign composed of aerospace manufacturers does not consider this to be the problem, while the other campaign composed of different stakeholder types indicates that the absence of standards is relevant as a problem.

Figure 5: Open public consultation results on the absence of standards (N=62)



Source: Open public consultation data, elaboration by Technopolis and Think.

Most of the interviewed stakeholders expressed a view that there is a need to better connect research activities and the deployment, to overcome the difficulty of getting the research results approved for deployment. A stronger involvement of standardisation bodies (e.g. EUROCAE) and EASA (as a regulator) in the R&I was cited as a way of accelerating the innovation uptake by airspace users, ANSPs, U-space community, ATM institutions, suppliers, SMEs, and staff. Academic and airport stakeholders underlined the need to connect better the R&I with pre-industrialisation and deployment.

[35] R&I prior to SESAR is described in Appendix C.

[36] The role of standards is discussed further in **Error! Reference source not found.**.

2.1.2 The European ATM system is becoming saturated and unable to accommodate new forms of air vehicles

Competitiveness of the air transport sector

The competitiveness of the European air transport sectors requires the ATM infrastructure to be able to accommodate increasing demand for air transport in a safe and environmentally friendly manner. In this way, Europe will be able to remain an attractive hub for air transport (against emerging hubs in the Middle East.[37]

However, the current European ATM infrastructure is reaching its limit in terms of ability to manage an ever increasing volume of different types of air traffic[38] - in 2018, air traffic delay attributable to the ATM system doubled.[39] With sustained traffic growth forecasted for the next 17 years resulting in a total traffic increase of 50%[40] there is a risk that the level of delay could be 15 times higher if the current rate of capacity growth is not increased.[41]

Figure 6 depicts the predicted levels of delay and congestion in 2035 if flexible, scalable and interoperable ATM solutions are not defined and implemented.

Figure 6: The predicted levels of delays by 2035

Source: A proposal for the future architecture of the European airspace, SJU, 2019.

When the capacity limit is reached, in order to maintain safety, additional constraints are imposed on flights (e.g. delaying or re-routing flights to avoid the saturated zone), resulting in delayed and longer flights which impact negatively on the environmental and performance goals of ATM.[42]

Enabling new economic activity based on drones

Another part of this problems lies in the emergence of new types of air vehicles: very low level drones, military medium altitude long endurance unmanned aircraft systems, automated air taxis, super-high altitude (FL600+) operating aircraft, next generation supersonic aircraft, electrically propelled aircraft.

These markets are currently suppressed due to the lack of a traffic management concept and infrastructure that will allow the safe introduction of services and functionalities to

[37] See for example: https://www.iata.org/en/about/worldwide/europe/competitiveness/

[38] **Error! Reference source not found.** provides further details of the limitations of the current ATM system.

[39] PRR2018: ATFM delay in 2018 was 1.74 minutes per flight; in 2017 it was 0.82 minutes per flight.

[40] European Aviation In 2040 Challenges Of Growth, Annex1 Flight Forecast to 2040, EUROCONTROL, 2018.

[41] A proposal for the future architecture of the European airspace, SJU, 2019.

[42] In 2019, horizontal flight efficiency increased from 2.83% to 2.95% (https://www.eurocontrol.int/prudata/dashboard/vis/2019/) as a result of measures to reduce delay by diverting traffic from congested areas (https://www.eurocontrol.int/news/seven-measures-counteract-severe-delays).

support these operations in both new (e.g. urban) and current airspace. The current rules for professional drone use are restrictive and vary between EU Member States.[43]

This concept of harmonised access for drones is referred to as U-space in Europe. Whilst U-space may build on ATM legacy, it is a new business and may have a positive and disruptive nature if new entrants are supported.

Future challenges in European ATM have diverse nature. Through all the categories and especially in the U-Space community, stakeholders agree that there are key emerging markets such as drones, U-Space and other airspace vehicles that need to be accommodated in the current system. Airspace users, SMEs, staff and supplier stakeholder groups did not directly cite the inclusion of drones, but did endorse the European ATM Master Plan as a good strategic agenda.

Some studies foresee 20% of total flight time to be remotely or optionally piloted[44] by 2050 in Europe. Millions of small drones are envisioned to fly within the next 10 years.[45] The scale of the future use of drones in Europe is foreseen to include about 7 million consumer leisure drones, and a fleet of 400,000 drones for commercial and government missions, estimating that the European drone market will reach a value of €10b annually by 2035 and over €15b annually by 2050.[46]

Figure 7: Implications of drone research aimed at integration in ATM

Source: European Drones Outlook study, 2016, SJU.

2.1.3 The performance of ATM is not optimised

The ATM system can contribute to reducing aviation emissions by providing sufficient capacity and flexibility to enable aircraft to safely fly environmentally optimised trajectories. ATM can influence roughly 6% of aviation's emissions in Europe.[47] The average excess CO_2 emissions has remained stable at around 6% over the last six years (see Figure 8), even though traffic has increased - this reflects the progress already made by SESAR technology deployment, such as free route airspace as well as continuous climb and descent operations.

[43] See for example: https://dronerules.eu/en/professional

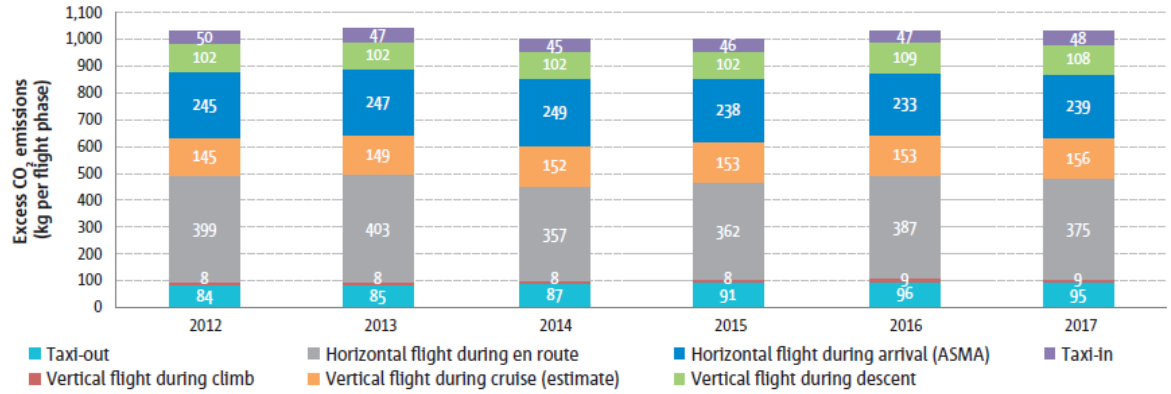
[44] European Drones Outlook Study – Unlocking the value for Europe, SJU, 2016.

[45] Arweiss et al,: "Unmanned Aircraft Systems (UAS) Traffic Management (UTM) National Campaign II, 2018.

[46] European Drones Outlook Study – Unlocking the value for Europe, SJU, 2016.

[47] European Aviation Environmental Report 2019, EASA.

Figure 8: Breakdown of gate-to-gate excess CO2 emissions for an average flight in Europe



Source: European Aviation Environmental Report 2019, EASA.

With current air traffic forecasts, the predictions are that without additional capacity, aircraft will be required to fly longer routes to avoid congested areas, thus creating an additional 30 to 60 million tonnes of CO_2 over the period 2019-2035.[48]

In addition, achieving safe and secure integration of all air vehicles (manned and unmanned) is needed to support environmental and performance optimisation of trajectories. The European Green Deal is referring to the needed reductions of aviation emissions: "In aviation, work on adopting the Commission's proposal on a truly Single European Sky will need to restart, as this will help achieve significant reductions in aviation emissions."[49]

Increased performance of the ATM system will also improve passenger experience of air travel. In 2018, 334 million passengers were impacted by delays and resulting cancellations, costing the EU economy €17.6b.[50]

2.2 What are the problem drivers?

The key problem drivers affecting R&I performance in the field of Air Traffic Management in Europe are discussed in more detail in the following paragraphs.

2.2.1 Lack of interoperability and fragmentation of current ATM systems

ATM infrastructure and services are provided by the States' air navigation service providers, over their territories.[51] The current infrastructure is the result of historical operational and technical evolutions, primarily conducted at the national level, which have led to today's fragmented system.

The cost of fragmentation of European ATM and communication and navigation services carries a high cost - around €900m - €1,400m annually, approximately 20-30% of the annual costs of air navigation service provision.[52]

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[48] G.3.2 of A proposal for the future architecture of the European airspace, SJU, 2019.

[49] European Commission (2019), COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS, The European Green Deal, COM(2019) 640 final.

[50] Source: https://a4e.eu/europes-inefficient-airspace-cost-the-eu-e17-6-bn-in-2018-334-m-passengers-affected1/

[51] This is the set-up for all the States members of ICAO. ICAO, Convention on International Civil Aviation, and its Annexes.

[52] Report commissioned by the Performance Review Commission - The impact of fragmentation in European ATM/CNS, Prepared by Helios Economics and Policy Services.

Initiatives such as SES and SESAR have led to improved interoperability and harmonisation but have not yet overcome this underlying fragmentation to enable truly seamless airspace operations.[53]

To date however SESAR has focussed on maturing solutions that optimise specific elements of ATM and has made limited progress on key enablers where there is limited industry consensus (for example, next generation datalinks and flight data processing) highlighting the need for greater emphasis on transformational technologies.[54]

Interoperability was highlighted by many interviewees from ANSP, ATM institutions, Member States, SESAR Joint Undertaking executives, staff, suppliers and U-space community stakeholder groups, as one of the key R&I needs and current problems of ATM. The responses show they believe that defragmentation is required in order to achieve interoperability, amongst others.

2.2.2 Limited flexibility and scalability of ATM service provision

The fact that each provider organises its resources and capacity locally (through airspace organisation and staff availability), results in fragmented use of resources at the European level. This limits flexibility for routing, flexibility for allocation of controllers, and leads to an ATM system with poor scalability, where scalability is the capability to provide air traffic services at the right time (including peak times), in the right place.

As air traffic grows, it becomes more important to be able to take a network (or pan-European) view. This is because as some portions of current EU ATM network are running close to their capacity, any unplanned perturbation results in significant disruptions and consequent delays. "The analysis showed that the European core area where traffic density is highest remains the problem area".[55] As an example, the flight delays due to weather (as an example of unplanned perturbation) increased by over 100% in 2018 when compared to 2017. Severe weather events are likely to become more frequent as the effects of climate change are becoming more evident.[56],[57]

Some stakeholders in the categories of service providers and suppliers mentioned that a key need is to develop a network centric system that is scalable, resilient and flexible to quickly adapt to external changes or new technologies. A system with these characteristics would solve the problem of airspace capacity which is strongly linked with other ATM inefficiencies.

2.2.3 Long R&I and deployment cycles

ATM research is subject to long deployment cycles, as it often takes decades from the inception of a concept to its deployment (e.g. it took about 15 years from the inception of the Time Based Separation concept[58] until its initial deployment, and this is one of the faster examples).

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[53] Single European Sky: a changed culture but not a single sky, Special Report 18/2017, ECA.

[54] Interim evaluation of the SESAR Joint Undertaking (2014-2016) operating under Horizon 2020. Expert Group Report, European Commission (2017).

[55] Performance Review Report: "An Assessment of Air Traffic Management in Europe during the Calendar Year 2018", Performance Review Commission, 2018.

[56] Donat MG, et al., 2011. Reanalysis suggests long-term upward trends in European storminess since 1871. Geophysical Research Letters.

[57] Hov Ø, et al., 2013. Extreme weather events in Europe: preparing for climate change adaptation, Norwegian Meteorological Institute.

[58] Time Based Separation is a procedure aimed at more efficient management of arrivals into busy airports. See: EUROCONTROL Specification for Time-Based Separation (TBS) support tool for Final Approach - Ed. 1.0.

ATM is heavily regulated: the safety and security-critical nature of the infrastructure is one of the reasons behind slow uptake, as each innovative solution needs to be proven not to decrease safety, or security and that it complies with national, regional and world-wide standards.

This in turn requires constant assessment of solutions as they are developed and matured across the TRLs. This can be a lengthy and often expensive processes of collecting safety evidence, as no ATM procedure or tool can be implemented if it is not approved by either a local or European regulatory body.

Innovation processes in ATM are long, and during those extended time periods the solution under development evolves, due to the changing environment (i.e. economy, price of fuel, travel demand).[59] Innovations that are "robust", in the sense of being solutions that address the changing requirements have the best chance of reaching deployment.

The need to accelerate innovation in ATM has been cited often in recent years, most recently in the Wise Persons Group's report.[60] In order to address these challenges, R&I that is flexible and involves and coordinates all the stakeholders is needed.

The majority of stakeholders, across all stakeholder groups, indicated that deployment needs to be accelerated by paying more attention: to implementation challenges, change management for deployment, and gaps between R&I and industrialisation. This statement from an R&D organisation stakeholder describes succinctly the issues around length of R&I and deployment cycles: "*What often slows down the implementation is the development of standards and the regulatory approval. The direction and focus is really important to have – a good idea with a follow up plan (up to implementation) can bring about the innovation in ATM. Good idea without a follow up plan is not good, as is not good having a bad idea with the follow up plan. So, the screening of the ideas and results, and how they proceed through the research and development process is important.*"

2.2.4 Fast development of the new vehicles and future business models

New forms of air vehicles are emerging at an unprecedented rate – in particular drones and air taxis for urban air transport. At the moment, the infrastructure that would allow for, and safely manage this type and magnitude of operations does not exist. The USA, China and Europe are looking into the necessary concepts to develop an unmanned air vehicle traffic management (UTM) system.[61]

The fast evolution of drones – in terms of operational roles and platform capabilities creates new issues for the ATM system. The majority of drone operations (e.g. small drones that do not have the range to reach the altitudes in controlled airspace) are not expected to take place in traditional controlled airspace.[62] Instead, they will take place in what is currently referred to as uncontrolled airspace which is populated by general aviation flying by visual flights rules, and urban airspace which is not traditionally flown over but for which

[59] Bolić, T., 2012. Innovation Adoption and Adaptation in Air Traffic Control – Interaction of Organizations. Journal of Sociotechnology and Knowledge Development.

[60] Report of Wise Persons Group on the future of the Single European Sky, 2019.

[61] In the USA: https://utm.arc.nasa.gov/index.shtml, https://www.faa.gov/uas/research_development/traffic_management/; In China https://rpas-regulations.com/wp-content/uploads/2018/06/1.2-Day1_0910-1010_CAAC-SRI_Zhang-Jianping_UOMS-_EN.pdf; In EU: https://www.sesarju.eu/U-space

[62] European ATM Master Plan: Roadmap for the safe integration of drones into all classes of airspace, SJU, 2018.

drones require access – for example for aerial photography, crowd surveillance or domestic deliveries.

This leads to three different issues:

- How best to accommodate drones in controlled airspace, where they will be expected to operate in accordance with current rules and regulations, but where the varying levels of performance of the air vehicle can cause control/safety issues?
- How best to accommodate drones in uncontrolled airspace where they will need technological solutions to detect and avoid manned aircraft? Again, the size and performance of the drones is critical to design solutions.
- How best to integrate multiple drones into urban airspace in a safe manner acceptable to the local population?

Creating a European U-space infrastructure will require significant R&I[63] in various areas of technology (e.g. conflict detection and resolution between the drones, the communication between the drones, their operators and other involved actors), interfaces with air traffic management, security and cyber reliance, along with the availability of authorised & safe testing environments. That the size and performance of drones is constantly changing makes these issues even harder to address– particularly for an industry that has seen only limited change in aircraft operating performance in the past several decades.

ATM institutions and the U-space community stated that new markets such as drones develop quicker than the ATM solutions. In this area, the lack of coordinated R&I included in the ATM programme, would leave Europe behind other regions, like China and USA, which are investing heavily in drones and UTM research and development.

2.2.5 High level of consensus required to achieve transition to deployment

From an organisational perspective ATM is heterogeneous – in that the value chain is composed of multiple different actors with different objectives and ownership.[64] A decision to implement a new technology would need to be accepted by all the involved organisations to ensure interoperability across Europe. This often involved airlines where aircraft capability is involved and airports. Therefore, a high level of consensus from all the ATM stakeholders – airspace users (including new operators of drones), air navigation service providers, airports, regulatory and standardisation bodies users - is required to achieve the R&I and prepare the transition to deployment.

There were comments across all stakeholder groups that framework programmes prior to the SJU had a fragmented nature. They consider this proof that, in ATM, European network benefit is only achieved if there is coordination across all ATM stakeholders to develop and maintain consensus.

2.3 How will the problem(s) evolve?

As explained above, the European ATM systems are outdated and are not exploiting emerging digital technologies. If the problem is not addressed at EU level, national programmes may re-emerge on an ad-hoc basis to solve specific local issues leading to increased fragmentation[65]. Furthermore, the scientific results would not facilitate the

[63] Section 4.2.4 of European ATM Master Plan: Digitalising Europe's Aviation Infrastructure. SJU, 2019.

[64] See Appendix E for further details of the ATM value chain.

[65] See Appendix D for further details on ATM R&I prior to SESAR.

uptake of the innovation (i.e. needed evidence for standardisation and regulatory approval) and therefore would be less likely to be deployed to eventually overcome the problem at EU level, thus making it **more difficult, time consuming and expensive to update the ATM system**.

Increased fragmentation, will lead to:

- An inability to accommodate air transport growth;
- Aircraft flying inefficient routes, increasing environmental impact and costs;
- Passengers and cargo facing increasing costs and delays;
- Reduced contribution to EU economy from drones.

The magnitude of consequences are described in more detail below.

Inability to accommodate air transport growth: With the predicted growth rate in the range of 2.7% for 2018–35,[66] without the R&I efforts on de-fragmenting the airspace and providing the tools to do so efficiently, the European ATM system will not be able to cope with the demand. Following simulation of the Network Manager for the Airspace Architecture Study in the context of an as-is scenario at the 2035 horizon, the predicted levels of delays by 2035 are 8.5 minutes average delay per flight in 2035[67] which is unprecedented. Most of the centres providing the air navigation service would be congested, thus not being able to accommodate traffic growth.

Reduced contribution to EU economy from drones: Drones provide new capabilities for government and defence applications, as wells as for commercial business opportunities. The spread and development of the civil drones is dependent on their ability to operate in various areas of the airspace requiring significant R&I on drone traffic management.[68] In case these requirements are not addressed, the estimated value of European drone market would be reduced by €10b annually by 2035 and over €15b annually by 2050.[69]

Aircraft will fly inefficient routes, increasing environmental impact: Furthermore, the lack of capacity would impose inefficient routes on flights, increasing environmental impact (additional 30 to 60 million tonnes of CO_2 over the period 2019-2035),[70] and costs to airlines and passengers.

Passengers and cargo will face increasing costs and delays: The outdated ATM systems would not be able to accommodate the foreseen growth of air transport, which could result in delays, and related costs, 15 times higher than today.[71]

It is likely that European-developed ATM solutions would be less attractive globally if Europe itself does not act as a shop window for the effectiveness, thus impacting the **competitiveness of the EU ATM industry**.

[66] EUROCONTROL (2018) European Aviation In 2040 Challenges Of Growth.

[67] A proposal for the future architecture of the European airspace, SJU, 2019.

[68] Including technological solutions for conflict avoidance and better communications between the drones and other actors, security & cyber reliance, along with the availability of authorised & safe testing environments.

[69] European Drones Outlook Study – Unlocking the value for Europe, SJU, 2016.

[70] G.3.2 of A proposal for the future architecture of the European airspace, SJU, 2019.

[71] Executive Summary of A proposal for the future architecture of the European airspace, SJU, 2019.

3 Why should the EU act?

3.1 Subsidiarity: Necessity of EU action

All identified problems described in Section 2 are currently being addressed at the EU level:

- Policy: Single European Sky legislative package;
- Coordinated R&I: through the SESAR Joint Undertaking and;
- Synchronised deployment: through the SESAR Deployment Manager.

Recent European Court of Auditors reports[72],[73] found that these policy, R&I and deployment initiatives have started to work, but that more efforts are needed in order to realise the full benefits of ATM modernisation.

It is therefore necessary to accelerate efforts such that the European ATM system is transformed into a digital, scalable and resilient network, through an approach coordinated at EU level.

This can only be achieved by a transformation of the current patchwork of national systems to a modern collaborative and distributed platform,[74] evolving from bespoke, products-based systems to a service, collaborative and adaptable network approach. This will require significant R&I to develop and validate transformative technologies with a high degree of consensus from both Member States and the industry.[75]

Stakeholders through all the categories indicated that action from the EU was required to provide coordination and harmonisation across the ATM value chain. EU leadership will ensure European network benefits with a geographically distributed adoption of the latest technology. Suppliers, R&D organisations and SMEs) noted the need for long term benefits justify investment and overcome their individual interests and develop solutions based on a common architecture rather than develop their own products in isolation.

3.2 Subsidiarity: Added value of EU action

A modernised, digital and efficient ATM system will be capable of supporting aviation growth in a sustainable manner in line with EU policies including the European Green Deal[76]. **It is estimated that, for the period up to 2050, a harmonised European ATM system could generate over €1,800b in benefits for Europe.[77]**

Due to the scale and cross-border nature of the problems only action at EU level can improve results in such a fragmented sector. Through such action EU competitiveness, Europe's innovation capacity and the position of EU industry in the global market could be improved.

Realising the benefits will largely depend on the ability of the sector to create the conditions to shorten the innovation life cycle for infrastructure modernisation. If these conditions are

[72] Single European Sky: a changed culture but not a single sky, Special Report 18/2018, ECA.

[73] The EU's regulation for the modernisation of air traffic management has added value – but the funding was largely unnecessary, Special Report 11/2019, ECA.

[74] A proposal for the future architecture of the European airspace, SJU, 2019.

[75] Further details on the necessary transformational technologies are provided in Table 2.

[76] European Commission (2019), COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS, The European Green Deal, COM(2019) 640 final.

[77] See Table 44 in Appendix F for a detailed breakdown.

not created, the transformation will likely take significantly longer with negative implications for the environment, jobs and growth in Europe.

Stakeholders across all the categories indicated the need for EU funding on ATM research to provide directionality and coherence due to the cross-border nature of operations and the need for interoperability.

4 Objectives: What is to be achieved?

R&I actions at EU level aim at addressing climate change, supporting sustainable economic growth and the competitiveness of businesses and industries, to enable better public services and better quality of life. The impacts of the investment in the R&I is usually "greater when efforts have both a rate and a direction".[78] This is reflected in the specific objectives of Horizon Europe which state the need to "strengthen the impact of R&I developing, supporting and implementing Union policies and support the access to and uptake of innovative solutions in European industry, notably in SMEs, and society to address global challenges, including climate change and the Sustainable Development Goals."

The integrated Air Traffic Management initiative belongs to the second pillar of Horizon Europe – Global Challenges and European Industrial Competitiveness, more specifically to the Climate, Energy and Mobility cluster. The main objectives of this cluster are to fight climate change, improve the competitiveness of the transport industry, and the quality of the services it brings to society.

4.1 General objectives

In order to tackle the problems identified in Section 2, it is important to clarify the objectives of EU action in the field of research and innovation. We have identified three general objectives, described below, corresponding to the main problems discussed in Section 2.

Harmonisation of EU ATM based on high levels of digitalisation, automation and connectivity

To be efficient, ATM requires a high level of interoperability and harmonisation; particularly in Europe which has high traffic density and relatively small volumes of airspace per provider.[79]

This in turn requires the introduction of higher levels of digitalisation, automation and connectivity in ATM and changing the current ATM infrastructure into a distributed architecture enabling collaboration between service providers.[80]

This will require significant R&I activities that blend the knowledge and expertise from different scientific/engineering fields with the operational experience of various ATM stakeholders. The scientific and technological results of these activities need to be of high quality to be ready for operational uptake. Another important concern is that research needs to take into account the changes this will bring to the way of working in ATM, so that the educational paths for acquiring new skills can be developed, to impact positively on the employability and the quality of jobs.

[78] Orientations towards the first Strategic Plan for Horizon Europe Revised following the co-design process, Version of 31 October 2019.

[79] Comparison Of Air Traffic Management-Related Operational Performance U.S./Europe, 2019, prepared by European Commission, EUROCONTROL, U.S. Department of Transportation, Federal Aviation Administration.

[80] A proposal for the future architecture of the European airspace, SJU, 2019.

To ensure that a harmonised EU solution is developed, coordinated EU R&I is required.

Strengthen competitiveness of EU air transport, drone and ATM markets

Modernised ATM that provides flexible and scalable service to all airspace users would result in €80b of annual recurring benefits[81] for Europe. The drone activity market has a potential contribution to EU GDP of €30b from the developed drone industry.[82]

The technological developments needed to seamlessly integrate drones, other new vehicles and higher level automation technologies are important for ensuring competitiveness and sustainable growth. They also support the ability to address the European values, if these are not reflected in foreign technology (as is the case with the social media today, for example).

Frost and Sullivan[83] estimate the current value of the ATM market at US $3.58b per annum with compound annual growth rate of 4.8% leading to a value of US $5.21b by 2025. EU industry are leaders in this area; but require global agreements to be able to access the market. ATM R&I that takes into account the development of standards, which are the basis of global agreements, would strengthen the EU ATM competitiveness.

Support achievement of environmental, performance and mobility goals

Modernised ATM that is flexible and scalable can enable the most environmentally friendly trajectories for all airspace users, with estimated savings of 28 million CO_2 tonnes per year.[84]

Modernised ATM that has the flexible capacity would be able to accommodate the foreseen traffic growth. In this case accommodation would reduce delays, thus reducing costs for airspace users and improving the quality of service offered to the citizens. Effective deployment of R&I results could reduce travel delay by 14.5 million hours [85]per annum.

4.2 Specific objectives

In order to achieve the general objectives, we defined six specific objectives. These specific objectives respond to the problem drivers discussed in Section 2.2. The relationship between the general and specific objectives is shown in Figure 9.

[81] European ATM Master Plan, Edition 2020, SJU.

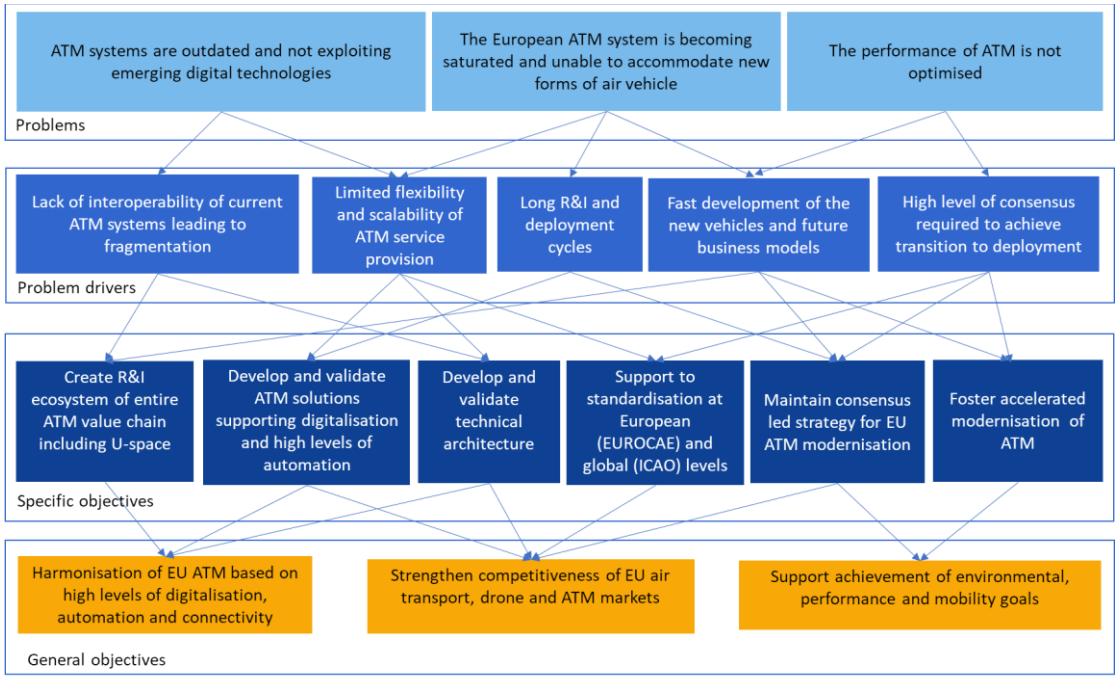
[82] European Drones Outlook Study – Unlocking the value for Europe, SJU, 2016.

[83] Frost and Sullivan (2017). Global Commercial Air Traffic Management Market, 2017-2025, May 2017.

[84] European ATM Master Plan, Edition 2020, SJU.

[85] European ATM Master Plan, Edition 2020, SJU.

Figure 9: Objectives tree for the initiative for integrated Air Traffic Management



Source: Think Research Ltd.

Create R&I ecosystem of entire ATM value chain including U-space

The development of an R&I ecosystem along the entire ATM and U-space value chains will enable the collaboration and coordination needed to ensure that a single harmonised EU ATM system is developed, for both manned and unmanned operations. The ecosystem will be able to address the issues of change management needed for operation of modernised ATM, creating foundations for knowledge transfer and upskilling.[86]

Integration of efforts within the eco-system is essential for ensuring that advanced solutions have both the industrial and operational support to affect a timely deployment.

The partnership should bring together the key stakeholders of the value chain in order to agree on the key European issues whilst keeping it manageable. It is important, as commented by some stakeholders across all the categories, to cover the UTM value chain and include other actors such as business aviation, regulators, communication service providers and satellite communication service providers, and, as said by all, a strong involvement of EASA and standardisation bodies.

Develop and validate ATM solutions supporting high levels of automation

The core objective is to perform the R&I necessary to develop and validate the ATM solutions required to support modernisation. A step change is required from current ATM R&I with a focus on transformation and breakthrough technologies that support distribution and high levels of automation. Table 2 summarises the main breakthrough technologies as identified in the European ATM Master Plan.

[86] Recommendation 3 of Final Evaluation of the SESAR Joint Undertaking (2014-2016) operating under FP7.

Table 2: Key transformations to achieve the future airspace architecture

Key Transformations		
	Connected and automated ATM	The future ATM system will deliver hyper connectivity between all stakeholders (vehicle-to-vehicle, vehicle-to-infrastructure) via high bandwidth, low latency fixed and mobile networks. Highly automated systems with numerous actors will interact with each other seamlessly, with fewer errors making the system scalable and even safer than today.
	Air-ground integration and autonomy	The progressive move towards autonomous flying enabled by self-piloting technologies requires a closer integration between vehicle and infrastructure capabilities so that the infrastructure can act as a digital twin of the aircraft.
	AI for aviation	Tomorrows aviation infrastructure will be more data intensive and thanks to the application of machine learning, deep learning and big data analytics we will be able to design an ATM system that is smarter and safer by constantly analysing and learning from the ATM environment.
	U-space and urban air mobility	A digitally native traffic management system will ensure the safe and secure integration of drones in the airspace especially in urban areas, taking into account new and existing air vehicles and autonomous operations. One of the most challenging use cases from U-space will be to enable urban air mobility, which is expected to advance autonomous technologies in a number of areas.
	Virtualisation and cyber-secure data sharing	Service provision will be decoupled from the physical infrastructure, enabling air traffic and data service providers, irrespective of national borders, to plug in their operations where needed in a secure manner.
	Capacity-on-demand and dynamic airspace	Technology will enable the dynamic reconfiguration and the activation of cross-border capacity-on-demand services to maintain smooth traffic services at busy times.
	Civil/military interoperability and coordination	Dual-use technologies such as those for communications, navigation and surveillance, and other solutions that allow real-time exchange trajectory information will improve the predictability of military operations and overall network capacity.

Source: European ATM Master Plan 2020, SJU 2019

It is also necessary, to ensure that the outputs of the R&I are supported by safety, security, human factors, performance, environmental, and business cases demonstrating that they are mature for transfer to the deployment (potentially via the Connecting Europe Facility).

Develop and validate technical architecture[87]

Achieving the economic objectives of ATM modernisation requires coordinated deployment of the R&I results. The required R&I results are mature ATM solutions that represent breakthrough technologies and require widespread pan-European deployment.

A unique European-wide architecture would promote harmonisation and enable accelerated deployment of the ATM solutions supporting high levels of automation for all airspace users. Furthermore, adherence to a common architecture will simplify the process for

[87] Further details of the importance of architecture are provided in **Error! Reference source not found.**.

identifying the need for standards and developing performance requirements for individual solutions such that they contribute to the overall operational objectives.

This would eventually enable new business models in ATM[88] and drone industries, and consequently new economic activity.

The European ATM Master Plan sufficiently describes R&I needs in the long term, and the Airspace Architecture Study enabled prioritisation of R&I in the shorter term.

Support to standardisation at European (EUROCAE) and global (ICAO) levels[89]

As noted above, achieving the economic objectives of ATM modernisation requires coordinated deployment of the R&I results. The required R&I results are mature ATM solutions that represent breakthrough technologies and require widespread pan-European deployment.

Developing and validating standards requires evidence to be gathered that a proposed solution can operate in a safe and interoperable manner. This evidence is best collected through the R&I process and in particular during large scale demonstration activities that test interactions with the human.

At the European level therefore, a key R&I role is to provide evid/ence to support standardisation and operational approval of the developed ATM solutions. This can be achieved by R&I beneficiaries directly supporting standardisation activities at the European level (including EUROCAE[90] and EASA). This has the advantage of supporting dissemination of the results beyond the R&I beneficiaries to all affected stakeholders and therefore support the consensus building required to achieve the timely deployment.

Many stakeholders in the categories of ANSPs, ATM Institutions and SESAR Joint Undertaking agree that European R&I ATM has currently a strong position worldwide due to having built over years a coordinated programme that has allowed them to have discussions at ICAO level and be an example for other parts of the world. Interviewees in all the categories except for academia, airports, R&D organisations and SMEs also noted that closer cooperation and involvement of EASA and EUROCAE would support narrowing of the gap between the R&I and industrialisation phases.

At the global level, the objective is to ensure the EU ATM solutions are globally recognised. This requires a proactive role within ICAO to ensure ATM solutions are recognised within the Global Air Navigation Plan.[91]

Maintain consensus led strategy for EU ATM modernisation

Achieving societal objectives from ATM modernisation also requires coordinated deployment of the R&I results in order to accelerate deployment. The European ATM Master Plan Edition 2020[92] is the strategic research and innovation agenda identify both R&I and deployment needs to achieve effective ATM modernisation. It is important that the Master

[88] One possibility being investigated is the emergence of a new types service provider called ATM Data Service Provider, with the role of ensuring the availability of a common data layer, to promote interoperability and flexibility of ATM service provision. Further details are provided in **Error! Reference source not found.**.

[89] Further details of the importance of standards are provided in **Error! Reference source not found.**.

[90] EUROCAE is a leader in the development of globally recognised industry standards for aviation; (https://www.eurocae.net/)

[91] ICAO (2019) 2016–2030 Global Air Navigation Plan (GANP).

[92] European ATM Master Plan 2020, SJU 2019.

Plan is maintained to take account of emerging challenges, the R&I results, society expectations as well as the expectations of those investing in the eventual deployment of developed solutions.

The Master Plan should continue to set the performance objectives that R&I solutions need to fulfil in order to achieve the environmental and societal goals. It should also act as a vehicle for developing and maintaining consensus of both industry and Member States – the maintenance process therefore requires a comprehensive open and transparent process to ensure all affected stakeholders are able to contribute to update campaigns.[93]

There were comments from stakeholders that have been long time in the industry such as in ANSPs, ATM Institutions, suppliers and Member States that agree framework programmes previous to the SJU had a fragmented nature and were a proof that, in ATM, European network benefit is only achieved if there is coordination, direction under consensus from the whole industry at EU level.

Foster accelerated modernisation of ATM

Achieving societal objectives from ATM modernisation also requires coordinated deployment of the R&I results in order to accelerate deployment. The objective is to develop links with programmes designed to deploy ATM solutions (e.g. programmes using Connecting Europe Facility funds), and to support standardisation and regulatory approval activities. These links would support faster transfer of R&I into products and ultimately deployment. The deployment of modernised ATM can further improve the quality of service offered by ATM through reducing travel time, decreasing delays, improving travel predictability, and reducing environmental impacts through the ability to fly more environmentally friendly trajectories.

The majority of stakeholders, across all stakeholder groups, stated that it is very relevant (59%), or relevant (22%) for the partnership to "focus more on the development and effective deployment of technology". The stakeholders from the two identified campaigns stated that it is very relevant (73%) or relevant (22%).

Stakeholders across all the stakeholder groups noted the need to close the gap between R&I and deployment in order to support pull through of breakthrough technologies.

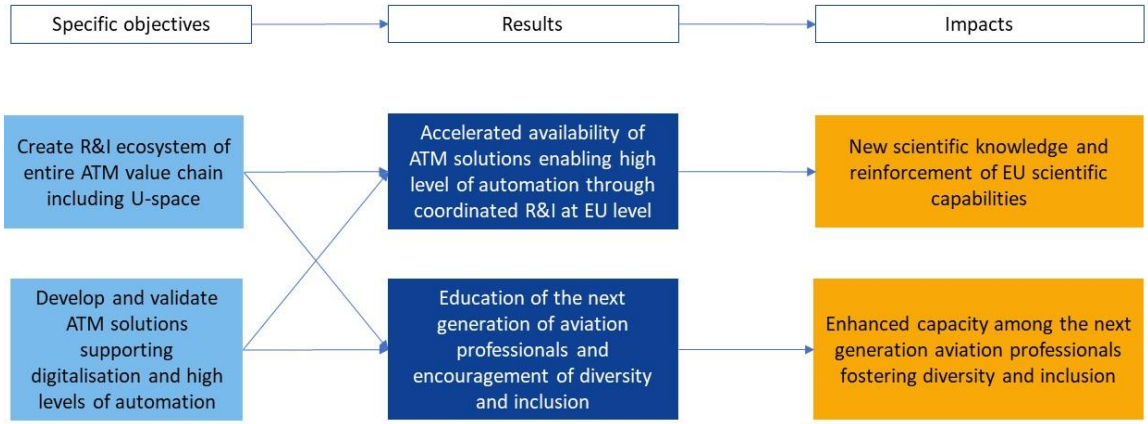
4.3 Intervention logic and targeted impacts of the initiative

4.3.1 Likely scientific impacts

The initiative is likely to lead to two key scientific impacts, as illustrated in Figure 10 and further described below.

[93] Recommendation 1 of Final Evaluation of the SESAR Joint Undertaking (2014-2016) operating under FP7.

Figure 10: Impact pathway leading to scientific impacts



Source: Think Research Ltd.

New scientific knowledge and reinforcement of EU scientific capabilities: The main scientific results required from the initiative are the advanced ATM solutions, that include transformational technologies, supporting digitalisation and high levels of automation (see Table 2).

For the ATM solutions to be fit for purpose and enable the step-change in ATM, they need to include new scientific methods (e.g. big data, automation, artificial intelligence).

The entire ATM value chain, including U-space, needs to be involved. R&I activities related to the development of ATM solutions need to involve experts from various scientific and engineering disciplines (e.g. development of air traffic controller decision support tools involves ATM experts, transport engineers, computer science, human factors, end-users, regulators, etc.).

Thus, the R&I ecosystem that develops and validates highly technological ATM solutions is likely to contribute to the development of new scientific knowledge and reinforcement of EU scientific capabilities. This impact should start being visible over the medium term and should continue even after the end of the R&I.

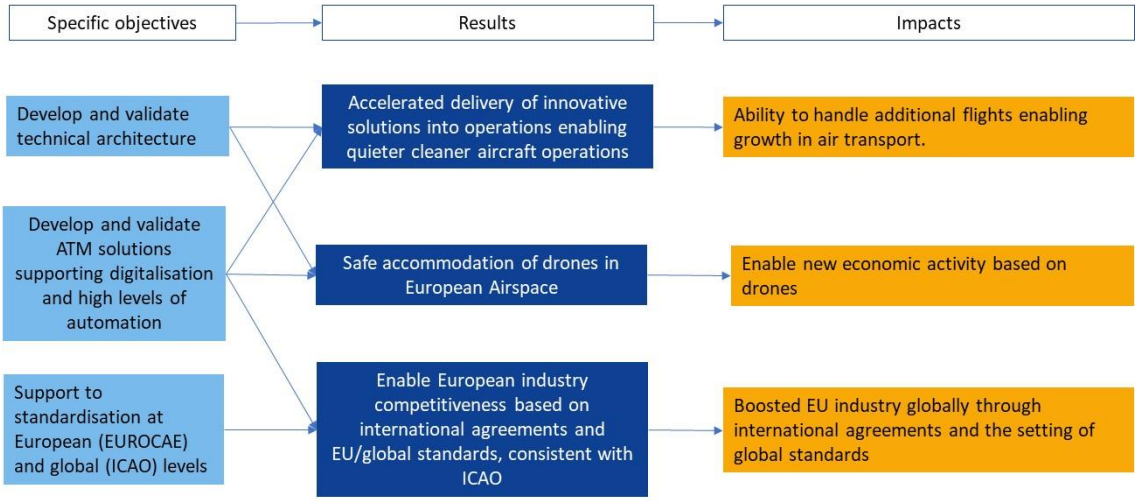
Stakeholders stated that in their view the initiative for integrated ATM is very relevant (40% of respondents) or relevant (39%) to deliver the impact on new scientific knowledge and reinforcement of EU scientific capabilities. Distribution of answers is the same across all the stakeholder groups. The two identified campaigns state that this is very relevant (90% of respondents), or are neutral (10%).

Enhanced capacity among the next generation aviation professionals: In order to be able to develop the needed ATM solutions, and to facilitate the best performing ATM in the future, the next generation of ATM professionals need to be aware of this science. Apart from performing research, the goal of academia in general is promoting knowledge transfer to the next generation of professionals through the involvement of Ph.D. students and post-docs in the R&I research activities. This eventually enhances the capacity among the next generation of aviation professionals, which will likely have a strong impact on the education of the next generation of aviation professionals. This impact should start being evident at the medium term and continue throughout the lifetime of the initiative. The main impacted stakeholders are academia and company staff, being able to expand their knowledge base and skill sets.

4.3.2 Likely economic/technological impacts

The likely key economic/technological impacts of the initiative are mapped in Figure 11.

Figure 11: Impact pathway leading to economic/technological impacts.



Source: Think Research Ltd.

The results linked with these specific objectives are:

- At the end of the R&I, a validated architecture for a modernised European ATM system supporting all forms of airspace users should be available. This would permit accelerated delivery of innovative solutions into operation, and new economic activity based on drones.
- Validated ATM solutions support interoperable, flexible, scalable and secure ATM. Properly validated solutions, with developed business, performance, human performance, safety and security cases would allow for accelerated delivery of innovative solutions and enable new economic activity for drones.
- International (ICAO) Global Plans are consistent with EU plans. Development of technical architecture should be accompanied by the development of standards, which should be then shared at the global level, to ensure that EU standards are included in global modernisation plans.

Majority of stakeholders, across all stakeholder groups, stated that in their view the initiative for integrated ATM is very relevant (68% of respondents) or relevant (19%) to provide increased EU aviation industry competitiveness. The respondents from two identified campaigns finds this impact very relevant (91%), or relevant (9%).

Stakeholders, across all stakeholder groups, stated that in their view the initiative for integrated ATM is very relevant (48% of respondents) or relevant (39%) to boost EU industry globally through international agreements and the setting of global standards. Majority of respondents from two identified campaigns finds this impact very relevant (86%), or relevant (14%).

The economic impacts have been evaluated as part of the recent European ATM Master Plan update campaign[94] and are summarised in Table 3.

[94] Master Plan Companion Document on the Performance Ambitions and Business View. 1.0, SESAR, 2019.

Table 3: Likely economic impacts

Likely impacts	Quantification Method	Value
Ability to handle additional flights enabling growth in air transport	Direct benefits of ATM value chain Cumulative Benefit from 2019 to 2050	€510b
Enable new economic activity based on drones	Direct benefits of the U-space value chain Cumulative Benefit from 2019 to 2050	€350b
Boosted EU industry globally through international agreements and the setting of global standards	Grow market share to 70% of the global market of approximately €4b per annum Cumulative Benefit from 2019 to 2050	€84b

Source: Master Plan Companion Document on the Performance Ambitions and Business View. 1.0, SESAR, 2019.

With the predicted growth rate in the range of 2.7% for 2018–35,[95] the R&I efforts will enable the European ATM system to accommodate growing air traffic demand through provision of needed capacity, where and when needed. By provision of the adequate capacity, aircraft will be able to fly routes that result in better environmental footprint, and better overall performance (e.g. lower delays, ensured safety levels).

Enabled new economic activity based on drones is a long-term economic impact, creating new economic activity and jobs. It would primarily involve new airspace users, and providers of air navigation services dedicated to these users.

The specific objective to support standardisation at European (for example by EUROCAE) and global (ICAO) levels creates (together with the first specific objective) the result of International (ICAO) plans being consistent with EU plans. This result ultimately enables competitiveness of European industry, based on international agreements and EU/global standards. This might start in the medium term, but is most likely a long-term impact, involving all the ATM stakeholders.

4.3.3 Likely societal impacts

The scientific and economic/technological impacts discussed above will also support the attainment of societal impacts as shown in Figure 12.

Lack of performance of ATM system creates two real problems for society:

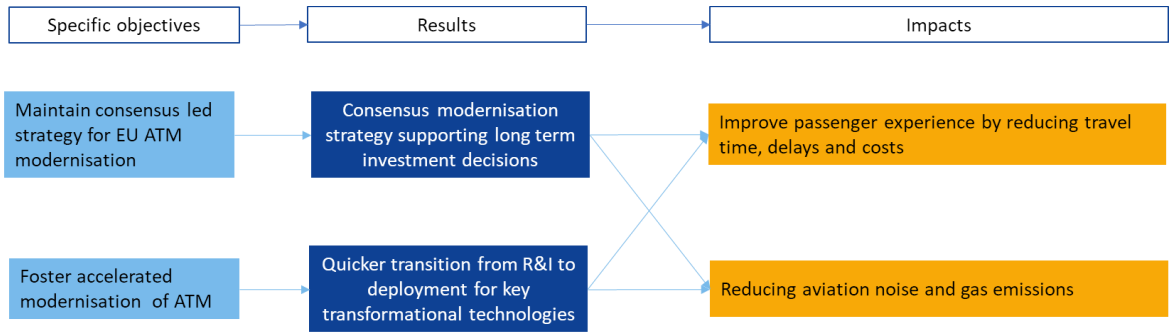
- Additional greenhouse gasses, and
- extra delays and consequent costs.

The solution of this problem is to accelerate deployment of novel ATM solutions through:

- Maintaining the consensus on the end solution and R&I needed to get there, in the form of a strategy for EU ATM modernisation;
- Fostering accelerated modernisation of ATM by facilitating a link between the R&I and the deployment programmes.

[95] EUROCONTROL (2018) European Aviation In 2040 Challenges Of Growth.

Figure 12: Impact pathway leading to societal impacts



Source: Think Research Ltd.

Likely environmental impacts

The environmental goal of reducing aviation noise and gas emissions (5-10% less CO_2 emissions per flight by 2035) is a long term impact, being a result of: consensus on modernisation strategy supporting long term investment decisions (and with that environmental and performance goals set in the strategy), and the quicker transition from R&I to deployment.

Table 4: Likely Environmental Impacts

Likely impacts	Quantification Method	Value
Reducing aviation noise and gas emissions	Reduction of 240 kg to 450 kg of CO_2 on average per flight due to improved flight efficiency Cumulative Benefit in terms of fuel savings from 2019 to 2050	€12b

Source: A proposal for the future architecture of the European Airspace, SESAR, 2019.

Majority of stakeholders, across all stakeholder groups, expressed the view that the initiative should make significant contribution to the EU efforts to achieve climate-related goals – 54% chose very relevant, and 29% relevant. The two identified campaigns stated that it was very relevant (59%), or relevant (40%).

Likely social impacts

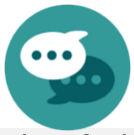
The social impact improves customer experience and business opportunities by reducing travel time, delays and costs whilst maintaining high levels of safety.

Consensus on the future of ATM, and quicker transition to deployment, jointly defines not only the direction of R&I but also the performance objectives that the future ATM system should enable in terms of capacity, delay, predictability, etc. Modern ATM will provide a service that improves customer experience through lower delays and better predictability. This impacts the society as a whole, and in specific ways different ATM stakeholders. This is a long-term impact.

Table 5: Likely Social Impacts

Likely impacts	Quantification Method	Value
Improve passenger experience by reducing travel time, delays and costs	Indirect benefits for passengers and EU citizens. Cumulative Benefit from 2019 to 2050	€760b

Source: Master Plan Companion Document on the Performance Ambitions and Business View. 1.0, SESAR, 2019.



Stakeholders stated that in their view the initiative for integrated ATM is very relevant (70% of respondents) or relevant (13%) to improved passenger experience by reducing travel time, delays and costs. The pattern of responses is the same across all the stakeholder groups. The respondents from two identified campaigns finds this impact very relevant (86%), or relevant (14%).

4.3.4 Likely impacts on simplification and/or administrative burden

The initiative is unlikely to create impacts in terms of simplification or administrative burden of the R&I activities supported under Horizon Europe.

4.3.5 Likely impacts on fundamental rights

The initiative is unlikely to create impacts on fundamental rights.

4.4 Functionalities of the initiative

This section outlines the functionalities that need to be considered when assessing the policy options in Section 6, reflecting the selection criteria for European Partnerships defined in the Commission proposal for the Horizon Europe Regulation.[96] In the following paragraphs, we discuss the implications of the criteria relating to the type and composition of the actors involved, the range of activities to be undertaken and the directionality required if the initiative is to deliver the objectives discussed above. We also consider the complementarities and synergies with other, related initiatives under Horizon Europe and beyond.

4.4.1 Internal factors

Type and composition of the actors involved

This functionality relates to the criterion "Involvement of partners and stakeholders from across the entire value chain, from different sectors, backgrounds and disciplines, including international ones when relevant and not interfering with European competitiveness". It concerns the need to involve the full range of stakeholders that can usefully contribute to delivering the future R&I agenda.

The core objective of the proposed initiative is to support an ambitious modernisation of European ATM enabling collaborative service provision based on high levels of automation. It is important the ATM solutions proposed and matured by the R&I are supported by the full range of ATM stakeholders. The future R&I for integrated ATM should therefore be open to:

- Suppliers of "ATM solutions" - ATM system manufacturers and data service providers.
- New entrants particularly active on emerging autonomy and connectivity solutions (such as but not limited to urban air mobility, U-space, mobile network operators).
- Operators and users of the ATM system namely air navigation service providers, airport operators and airspace users – including both civil and military organisations.
- The meteorological community such as MET service providers.
- EASA and national ATM regulators to ensure that the proposed solution can be operationally approved.

[96] European Commission (2018), Proposal for a Regulation of the European Parliament and of the Council establishing Horizon Europe – the Framework Programme for Research and Innovation.

- EUROCAE and other standardisation bodies to deliver the next generation standards EUROCONTROL as a key player in European ATM with a large R&I capability and specific operational roles in terms of managing the ATM network.
- The ATM R&I community of universities, research institutes and specialist SMEs that currently support exploratory research.
- The wider R&I community that could support the adaptation of new technologies (e.g. digitalisation, earth observation, satellite navigation, climate science, et.) to the ATM context.

This range of beneficiaries is largely present in the current partnership (see Appendix D) but additional scope in terms of new entrants is required.

Type and range of activities

This functionality relates to the criterion "Approaches to ensure flexibility of implementation and to adjust to changing policy, societal and/or market needs, or scientific advances". It concerns the types of activity that the initiative is intended to encourage, such that it is able to respond effectively to the challenges and problems described in Section 2.

The main envisaged activities are:

- **Research changing ATM requirements and emerging technologies covering all forms of air vehicle.** This involves the identification of emerging technologies and their screening for applicability in the ATM context. This includes identifying big data, artificial intelligence techniques, climate science and other novel concepts from other R&I initiatives that could support ATM automation.
- **Update Master Plan for modernisation of ATM in Europe:** An open and transparent process that involves all ATM stakeholders, whether directly involved with the R&I or not. An agile process is also required to support the transition of ATM solutions across TRL levels and forms of R&I depending on the success or otherwise of projects.
- **Develop an architecture to support a distributed ATM system:** A key focus of the required R&I is to ensure that a distributed architecture is developed that can be deployed across Europe to support ATM harmonisation. This new architecture will provide the basis for the interoperability of the ATM solutions. Once in place, innovation will be much easier to achieve in ATM.
- **Develop advanced ATM solutions to support digitalisation and automation:** This is the core activity, developing and maturing candidate ATM solutions in terms of operational performance including the assessment of impact on environment, safety, capacity, security and human factors.
- **Validate key ATM solutions through large scale demonstration:** Validation of ATM solutions in operational environments to develop evidence required to support operational approval and standardisation through large scale demonstrations in the operational environment with a particular focus on human roles and responsibilities.
- **Coordination with international organisations and standards development bodies:** In order to create a global market for EU products and services it is important that the solutions developed have international support - best achieved through

recognition at ICAO level and inclusion of ATM solutions in the Global Air Navigation Plan.[97]

Key issue with ATM R&I is management of interdependencies between projects. For example, number of innovative solutions may exist to increase runway throughput and a separate set of innovative solutions to increase arrival rate. However, not all of the runway throughput solutions will be compatible with arrival rate solutions.

The R&I management process needs to understand the interdependencies, and select the most promising solutions depending on the overall performance achievable by the best combination of solutions. This decision cannot be made by the individual projects but rather requires a coordination process across all the solutions being investigated. As digitalisation proceeds, the level of interaction between solutions increases, along with the need for a performance-based approach to management interdependencies between projects.

Directionality and additionality required

This functionality relates to the criteria "Common strategic vision of the purpose of the European Partnership" and "Creation of qualitative and significant quantitative leverage effects". The former highlights the importance of ensuring that all participating stakeholders have a common understanding of the purpose of the policy intervention and the direction of the R&I activity it is intended to encourage. The leverage effects relate to the creation of spill over effects of the knowledge gained in the broader community as well as the crowding-in effects on private investments in R&I – both among participating stakeholders and in the broader community, and/or the pooling of resources from EU Member States.

Modernisation of ATM in Europe requires a common vision to replace the current fragmented national systems with a new collaborative platform at EU level. The future R&I programme will require an EU level strategic research and innovation agenda that has consensus of the ATM industry and Member States.

Whilst the 2020 edition of the European ATM Master Plan provides an appropriate agenda, openness and transparency of the update process is important to ensure consensus is maintained while maintaining coherence with EU policy.

4.4.2 External factors

The proposed Regulation for Horizon Europe also identifies the need to consider "Coordination and complementarity with Union, local, regional, national and, where relevant, international initiatives or other partnerships and missions" when assessing the case for a partnership. It concerns the potential for linkages with other relevant R&I initiatives proposed or planned for the forthcoming Framework Programme, at the EU level in the context of the MFF 2021-27, and beyond.

Future ATM R&I therefore needs to be coherent with the wider R&I on:

- Air Transport. In particular the ATM system needs to be aware of the characteristics of air vehicles in order to optimise control strategies to reduce environmental impact.
- Multi-modal transport. In particular the ATM system needs to be aware of performance requirements to support multi-modal transport. For example, to ensure inter modal connections can be made by passengers.
- Digital technologies and Climate Science. In particular ATM needs to be aware of and adapt to the ATM context technologies for data manipulation and distribution, cyber

[97] ICAO (2019), 2016–2030 Global Air Navigation Plan (GANP).

security, advanced decision making including big data, artificial intelligence and findings and recommendations on climate change.

5 What are the available policy options?

In this chapter, we provide an overview of the key characteristics of the policy options for this initiative. The Horizon Europe regulations put forward three forms of European Partnerships that constitute the policy options for this initiative; standard Horizon Europe calls are a fourth option while acting also as a baseline against which the three partnership options will be compared.

To ensure a correct assessment of the different options and their effectiveness, it is crucial to take into consideration both the objectives and the functional requirements outlined in Section 4.4. The descriptions of the options in the sections below therefore focus on the implications of the options' characteristics related to these functionalities. They are based on the options' characteristics specifically related to the functionalities listed in Appendix G. A full description of the options is provided in the report on the overarching context to the impact assessment studies.

5.1 Option 0: Horizon Europe calls (baseline)

The baseline option refers to the use of open calls under the framework programme, without the creation of a specific partnership. The work programme would be based on the latest version of European ATM Master Plan as the strategic agenda for ATM R&I.

Table 6: Key characteristics of Option 0

	Implications of option
Enabling appropriate profile of participation (*actors involved*)	• The Commission would need to consult extensively with a wide range of stakeholders to translate the existing strategic R&I agenda for ATM into an annual work programme. • A well-defined process would be needed to ensure that the programme committees were properly informed about ATM R&I priorities, including the need for key demonstration programmes. • The specification of calls over the period of the Framework Programme could reflect the need for an evolving profile of participation, with different consortia forming at different stages to take different types of activity forward.
Supporting implementation of R&I agenda (*activities)*	• Implementation would rely on standard infrastructure underpinning the open calls procedure, drawing on resources of relevant executive agencies and Commission IT systems. • Administrative costs for the European Commission would be significantly reduced. • Calls for proposals would be published in the work programmes of Horizon Europe. • Transparency and open publication of results would ensure their availability to interested parties. • Given more limited funding than in the past, critical R&I priorities would need to be identified at the outset.

	Implications of option
	• Dissemination of knowledge among participants would only possibly take place within the consortia answering the calls. • The individual consortia may have limited incentive to initiate and maintain the coordination activities with standardisation bodies.
Ensuring alignment with R&I agenda (***directionality***)	• Annual Work programmes would need to reflect the requirement for R&I activity across TRLs, with input from representatives of all relevant stakeholders. • Specification of calls for activity at higher TRLs, particularly demonstration programmes, would need substantial input from industry. • Selection of high TRL projects would require provision of external (and independent) expert advice to the Commission. • Commission input into specification of calls would help to ensure alignment with overarching policy objectives. • A mechanism, possibly a CSA, would need to be defined to update the Strategic Research Agenda based on the results obtained during the Framework Programme. Without a strong process to agree the Strategic Research Agenda the likelihood of concrete national ATM-related implementation plans is reduced.
Securing leveraging effects (***additionality***)	• Progress of R&I effort would depend largely on EU funding, with no expectation of significant leveraging of industry support. • Demonstration programmes would require significant in-kind support and collaboration from industry, but it is not clear if critical mass could be reached.

5.2 Option 1: Co-programmed European Partnership

This option refers to the creation of an industry-led Co-programmed Partnership. The European ATM Master Plan could form the basis of a memorandum of understanding (MoU) between the Commission and the partnership. While the partnership would allow for flexibility in the stakeholder participation, progress in the delivery of the R&I programme would depend on the willingness of stakeholders to support individual projects rather than on legally binding commitments.

Table 7: Key characteristics of Option 1

	Implications of option
Enabling appropriate profile of participation (*actors involved*)	• The partnership would enable participation by all key stakeholders potentially contributing to the specification and delivery of the strategic R&I agenda.

	Implications of option
	• It would need to consult with a wide range of stakeholders to ensure that the R&I agenda, and ultimately the work programme, is aligned with industry and market needs. • Flexibility in stakeholder participation over time, with new partners joining to support new areas of activity in response to emerging results and changing priorities.
Supporting implementation of R&I agenda (*activities)*	• Implementation would rely on standard administrative infrastructure underpinning the open calls procedure, drawing on resources of relevant executive agencies and Commission IT systems. • Calls for proposals would be published in the work programmes of Horizon Europe. • Work programmes would need to reflect the requirement for R&I activity across TRLs, with input from the various partners to achieve an appropriate balance of activities. • The setup would involve a secretariat for the partnership, with staff most likely seconded from the members themselves. • Transparency and open publication of results would ensure their availability to interested parties.
Ensuring alignment with R&I agenda **(*directionality*)**	• The partnership would be responsible for ensuring that priorities for calls were specified in line with R&I priorities across all TRL levels. • R&I activity would be likely to focus on the medium-term needs of the industry. • The priorities for the calls, proposed by the partnership members for integration in the Framework Programme Work Programmes, are subject to further input from Member States (comitology) and Commission services. • Commission co-steering role could ensure alignment with overarching policy objectives and coordination with related programmes.
Securing leveraging effects **(*additionality*)**	• Aspirations for partner contributions would be clearly defined in the MoU. • Industry commitments would not be legally binding. • Expected in-kind contributions from the private sector would be identified in the work programme. • Given more limited funding than in the past, critical R&I priorities would need to be identified at the outset.

5.3 Option 2: Co-funded European Partnership

Under this option a Co-funded European Partnership based on the Grant Agreement would be created between the Commission and the consortium of public partners, resulting from

a call for a proposal for a programme co-fund action implementing the European Partnerships in the Horizon Europe.

Table 8: Key characteristics of Option 2

	Implications of option
Enabling appropriate profile of participation (*actors involved*)	• The partnership would be composed of consortium of public partners (MS, international funding bodies and public research institutions), resulting from a call for a proposal for a programme co-fund action implementing the European Partnerships in the Horizon Europe. • It would provide a forum for consulting stakeholders on R&I priorities.
Supporting implementation of R&I agenda (*activities)*	• The setup would involve a secretariat for the partnership, with staff most likely seconded from the members themselves. • Wide variety of activities available – Horizon Europe and the national initiatives.
Ensuring alignment with R&I agenda (*directionality*)	• The joint programme of activities is agreed by the partners and with the EU and typically focuses on societal grand challenges.
Securing leveraging effects (*additionality*)	• The intent is to create the greatest possible impact by pooling and/or coordinating national programmes and policies with EU policies and investments, helping to overcome fragmentation of the public research effort. • Member States that are partners in this partnership become the 'owners' of the priority and take sole responsibility for its funding

5.4 Option 3: Institutionalised European Partnership

5.4.1 Institutionalised Partnerships under Art 185 TFEU

Under this option an Institutionalised Partnership would be created between the Commission, EUROCONTROL and Member States wishing to contribute to the integrated ATM R&I.

Table 9: Key characteristics of Option 3: Institutionalised Partnership Art 185

	Implications of option
Enabling appropriate profile of participation (*actors involved*)	• Limits the scope of partners to Member States and Associated Third countries.
Supporting implementation of R&I agenda (*activities)*	• Eligibility for participation and funding follows by default the rules of the Framework programme, unless a derogation is introduced in the basic act.

Ensuring alignment with R&I agenda (*directionality*)	• Aims at reaching the greatest possible impact through the integration of national and EU funding, aligning national strategies in order to optimise the use of public resources and overcome fragmentation of the public research effort.
Securing leveraging effects (*additionality*)	• Limited due to lack of public funding bodies for ATM.

5.4.2 Institutionalised Partnerships under Art. 187 TFEU

Under this option an Institutionalised Partnership would be created between the Commission, EUROCONTROL and additional members wishing to contribute to the integrated ATM R&I.

Table 10: Key characteristics of Option 3: Institutionalised Partnership Art 187

	Implications of option
Enabling appropriate profile of participation (*actors involved*)	• The partnership would enable participation by all key stakeholders potentially contributing to the specification and delivery of the strategic R&I agenda through a clearly defined membership structure. Smaller players, like SMEs and academia, are less likely to be full members but would continue to support any open calls. • It would provide a forum for consulting stakeholders on R&I priorities and the work programme, ensuring that they were aligned with ATM in particular and aviation in general. • Participation would be less flexible than under other options, but it might nevertheless be possible to change the profile of participation over time, with new partners joining to support new areas of activity in response emerging results and changing priorities.
Supporting implementation of R&I agenda (*activities)*	• A dedicated administrative structure would be established to coordinate the specification of R&I activity, manage implementation and report on the result (with administrative expenditure limited to 4% of the budget and subject to 50:50 allocation between the Commission and private partners). • As an EU body, this type of partnership can represent the EU at international bodies such as ICAO and with international governments - supporting global coherence.
Ensuring alignment with R&I agenda (*directionality*)	• The partnership would be responsible for specifying a work programme fully in line with the R&I priorities identified by the industry to fulfil the European policy needs, combining activities across low and high TRLs and in different areas. • The work programme would reflect the medium to long term needs of the industry, drawing on the perspectives of different stakeholders. • Commission participation in the partnership governance arrangements and approval of the work programme would help

	Implications of option
	to ensure alignment with overarching policy objectives and enable integration with other programmes.
Securing leveraging effects (***additionality***)	• Funding requirements would be clearly defined at the outset, with private sector partners (EUROCONTROL, industry) providing two thirds of partnership resources through in-kind and/or financial commitments.

5.5 Options discarded at an early stage

The Co-funded Partnership and an Institutionalised Partnership created under Article 185 of the TFEU are not considered relevant for integrated Air Traffic Management due to the limited national R&I programmes in the area of ATM and the lack of relevant public bodies.[98]

Member States are keen for involvement in integrated ATM R&I but through the national service providers (as such, funded by the airlines) rather than the public purse.

Furthermore, the ATM R&I programme requires strong consensus across all the stakeholders (industry and Member States) to ensure that the results are directly deployable within the emerging architecture and are acceptable to the professionals that operate the system. This is best achieved by air navigation service providers working closely with the suppliers with inputs from the end users (e.g. airspace users).

The options dedicated to public-public partnerships are therefore not considered viable and not considered further.

6 Comparative assessment of the policy options

6.1 Assessment of effectiveness

Based on the intervention logic, the initiative aims to deliver scientific, economic/technological and societal (including environmental) impacts through a set of pathways (Section 4.3), which require a set of critical factors in place to be achieved in the best possible way (Section 4.4).

This section assesses the extent to which each retained policy option has the potential to allow for the attainment of the likely impacts in the scientific, economic/technological and societal sphere, based upon its characteristics (Section 5). At the end of each section we summarise the outcomes of the assessment by assigning a non-numerical score to each option for each impact desired.

The assessments in this section set the basis for the comprehensive *comparative* assessment of all retained options against all dimensions in Section 6.4. Table 11 lists the desired impacts of the proposed initiative as identified in Section 4.3.

[98] The desktop research found that national R&I programmes exist only in Germany, Netherlands, Spain, UK and France, which was confirmed in the stakeholder interviews.

Table 11: Likely impacts of the initiative

Impact area	Likely impacts
Scientific impact	New scientific knowledge and reinforcement of EU scientific capabilities
	Enhanced capacity among the next generation aviation professionals
Economic/technological impact	Ability to handle additional flights enabling growth in air transport
	Enable new economic activity based on drones
	Boosted EU industry globally through international agreements and the setting of global standards
Societal impact	Improve passenger experience by reducing travel time, delays and costs
	Reducing aviation noise and gas emissions

6.1.1 Scientific impacts

New scientific knowledge and reinforcement of EU scientific capabilities

This impact would be enabled by the creation of an R&I ecosystem that is capable of developing and validating the transformational ATM technologies required to modernise ATM (see Table 2) including those required for U-space.

This includes adapting advanced and fast-moving technologies such as AI, big data and cybersecurity to the ATM context.

Option 0: Horizon Europe calls (baseline)

Open calls are flexible enough to adapt to changing needs and could be beneficial for the R&I of rapidly emerging technologies supporting new airspace users. This would accelerate the research of these technologies whilst fostering innovation. R&I on automation requires uptake of knowledge from areas and expertise outside ATM and this could be achieved through open calls when they are specifically required to achieve synergies in the short-term.

However, the choice of topics under open calls through Horizon Europe is subject to prioritisation across all research areas which can result in an incomplete or imbalanced set of topics mismatching the needs for coordinated harmonised ATM. Thus, it will enhance innovation potential, but lack the needed directionality. Open calls may lead to limited commitment of the big suppliers and service providers due to their reduced ability to steer the R&I programme. Hence, this options receives a score of ++.

Option 1: Co-Programmed

Membership of the Co-programmed Partnership is likely to be dominated by the large players across the core ATM value chain at the expense of more innovative SMEs and academia. It has strong potential to develop the initial set of breakthrough technologies with a focus on delivering mature results to deployment activities.

However, the lack of an independent process to validate results and manage interdependencies may limit the ability to ensure robustness of the overall architecture.

The potential lack of range of innovative beneficiaries lead to a possible risk that advanced R&I needed to increase the level of automation is not prioritised; hence this option scores ++.

Option 3: Institutionalised Art 187

An Institutionalised Partnership would ensure long-term coordination of the R&I programme to guarantee that the necessary scientific breakthroughs are prioritised to support long term evolution of ATM including adaptation of advanced digital solutions to enable automation. The core membership may prioritise short-term solutions that do not fully embrace the innovation agenda. The additional directionality of an Institutionalised Partnership will ensure a balance between developing advanced solutions and maturing deployment-ready solutions. This may require the use of open calls to ensure horizon scanning and low TRL concepts are evaluated.

As this option provides the greatest directionality, it scores +++.

Stakeholders across all the categories consider there is a need EU funding on ATM research since it provides directionality to ensure a common view on the future path and avoid singularities of nations or private companies.

Enhanced capacity among the next generation aviation professionals

The modernisation of ATM will have a fundamental effect on the professionals employed by the service providers. Whilst significant research is conducted on the evolving role of air traffic controllers – less emphasis is placed on how the engineering roles are changing. However, virtualisation and the proposed distributed architecture will have a significant effect on engineering roles.

Inclusion of universities within the R&I programme will help ensure a supply of professionals with an understanding of emerging technologies, including AI and cybersecurity, in the ATM context.

Option 0: Horizon Europe calls (baseline)

Open calls have a dissemination side that would allow sharing of knowledge and ideas on ATM in Europe, and beyond, mostly in academic settings (e.g. conferences). The disseminated research results are loosely linked with the industry, only through the ad-hoc consortia. As the coordination on the topics and needed body of research knowledge is based only on a wide ranging open calls, it is unlikely the research results would be suited for further development into high level education programmes. This in turn slows the possibility for upskilling of both researchers and aviation professionals. This option scores ++.

Option 1: Co-programmed

A Co-programmed Partnership would support promotion of shared knowledge and ideas as well as feeding professional development in diversity and inclusion. However, it may not be sufficiently motivated to establish a strong relationships with academia and innovative SMEs or with other ATM R&I programmes beyond Europe and so it would be difficult to generate opportunities to exchange experiences.

As the potentially limited scope of membership would limit the opportunities for promoting knowledge exchange with the universities this option scores ++.

Option 3: Institutionalised Art 187

An Institutionalised Partnership would support dissemination events to ensure strong sharing and knowledge transfer. Genuine involvement of universities training the next generation of professional may be limited to open calls but still creates the basis for knowledge transfer.

As an Institutionalised Partnership would create stable programme that allows building a strong sharing and knowledge transfer between the stakeholders, ensuring enhanced capacity of the future aviation generation this option scores ++.

Stakeholders stated that in their view the initiative for integrated ATM is very relevant (44% of respondents) or relevant (24%) to deliver the impact on the education of the next generation of aviation professionals and encouragement of diversity and inclusion. Only in the business association stakeholder group the majority of responses fell into neutral category. The two identified campaigns state that this is relevant (64% of respondents), or hold neutral views in this respect (32%).

Summary

Table 12, below, lists the scores we assigned for each of the policy options, based upon the assessments above.

Table 12: Overview of the options' potential for reaching the scientific impacts

	Option 0: Horizon Europe calls	Option 1: Co-programmed	Option 3: Institutionalised Art. 187
New scientific knowledge and reinforcement of EU scientific capabilities	++	++	+++
Enhanced capacity among the next generation aviation professionals	++	++	++

Notes: Score +++ : Option presenting a *high* potential; Score ++: Option presenting a *good* potential; Score +: Option presenting a *low* potential

6.1.2 Economic/technological impacts

Ability to handle additional flights enabling growth in air transport

As the current system is becoming saturated there is only limited ability to accommodate additional traffic. Simulations of advanced harmonised concepts indicate that modernisation of ATM would allow forecasted traffic to be accommodated in safe and environmentally friendly manner.[99]

The SESAR Joint Undertaking have estimated the potential benefit as €510b over the period 2019 to 2050 (see Table 3).

Achieving this level of benefit requires an acceleration in the R&I programme. The SESAR Joint Undertaking also analysed a scenario where R&I was not accelerated leading to a 10 year delay in achieving modernisation. In this scenario the value of the benefit is reduced by €20b.[100]

[99] See A proposal for the future architecture of the European airspace, SJU, 2019.

[100] See Table 44 in Appendix F.

Option 0: Horizon Europe calls (baseline)

Although open calls would support the creation of various innovative concepts to address environmental concerns with a higher priority (through the prioritisation of this type of research topics), the follow up and delivery of this research to deployment would lack industry long-term consensus. This option would risk the entire benefit of handling additional traffic; hence, this option receives a score of +.

Option 1: Co-programmed

This option would support the necessary R&I, but with lower level of long term commitment from beneficiaries. The lack of an independent process to validate results and manage interdependencies may limit the ability to ensure robustness of the overall architecture and maintain high level of consensus. This option could support ATM modernisation, but would lack the dedicated and independent processes to support acceleration of R&I leading to a lower level of benefits; hence, this options receives a score of ++.

Option 3: Institutionalised Art 187

The Institutionalised Partnership would naturally focus on maturing solutions for deployment through activities like Very Large Scale Demonstrations and therefore support an acceleration of delivery of innovative solutions into operations. The independent support function would also be able to support resolution of diverging members' interests and decrease the risk of not achieving the necessary advanced for breakthrough technologies. Only this option would support ATM modernisation with the necessary acceleration of R&I leading to achieve the high level of benefits; hence, this options receives a score of +++.

To ensure that the proposed European Partnership would meet its objectives, the majority of stakeholders stated that the following activities are very relevant: piloting activities (52%), input to regulatory aspects (69%), co-creation of solutions with end-users (80%). For the co-creation of solutions with end-users, only in the academic/research institution stakeholder group two thirds of the responses fall under the relevant and neutral categories, while one third considers it very relevant.

Most of the airspace users stated that they do not have resources to participate directly in the research activities, but would like stronger involvement in the partnership similar to the current one. In the current one, they have a voice in the governance, but would like to expand that to the opportunity for higher involvement in the work.

Enable new economic activity based on drones

The use of drones is expected to create significant value to the EU economy. The SESAR Joint Undertaking has estimated that between 2019 and 2050 this would be greater than €350b (see Table 4). These markets are currently suppressed due to the lack of a traffic management concept and infrastructure that will allow the safe introduction of services and functionalities to support these operations in both new (e.g. urban) and current airspace. The current rules for professional drone use are restrictive and vary between EU Member States. The need to support integration of drones is becoming urgent and requires a significant acceleration of R&I which must also be closely coordinated with ATM research. It is estimated that a delay of 10 years, would reduce the potential benefit by €100b.[101]

[101] European ATM Master Plan, Edition 2020, SJU. See Table 44 in Appendix F for details of the calculation.

0: Horizon Europe calls (baseline)

Open calls would support the innovation required for accommodation of drones, enabling new entrants to be involved without the overhead of fully committing to a partnership.

However, accommodating drones into European airspace requires a set of solutions that are interoperable with the emerging ATM system and architecture. The directionality required to evaluate results and steer R&I would not exist with just open calls. Open calls are unlikely to create the necessary acceleration of R&I to achieve the higher level of benefits. Hence, this option receives a score of +.

Option 1: Co-programmed

The industry is committed to the development of UTM solutions,[102] and a Co-programmed Partnership is likely to create the right environment to create integrated ATM/UTM solutions.

This option may limit access to innovative drone operators, with the risk that innovative forms of UTM particularly for very low airspace are not fully exploited. It may also impede access to the UTM market for new entrants.

A Co-programmed Partnership would focus on delivering the "first generation" of UTM solutions but may not be sufficiently innovative to ensure that advanced solutions are properly researched and evaluated; hence this option receives a score of ++.

Option 3: Institutionalised Art 187

An Institutionalised Partnership would be able to develop and demonstrate the necessary solutions for enabling drone activity. Given the strong steering capacity of such a partnership, this could be achieved in a manner that is compatible with emerging ATM solutions – and could support the necessary acceleration and synergies enabling U-space solutions improve ATM.

Only this option would support the development of U-space with the necessary acceleration of R&I leading to achievement of high level of benefits; hence, this options receives a score of+++.

Across all categories except airspace user community, suppliers, SMEs and staff, stakeholders stated that the partnership should be extended to the U-space community. There should be flexibility in the partnership to involve different stakeholders especially in topics where they can add significant value, as is the case in the drone sector. In order to reach the highest magnitude of impacts, the acceleration of R&I deployment is needed; all the stakeholders except for a couple of stakeholders in the categories of airports and U-space community stated that the most coherent way to ensure this is through an institutionalised partnership.

Boosted EU industry globally through international agreements and the setting of global standards

For EU ATM products to be competitive in the global market it is important that they are standardised and recognised by ICAO – typically through inclusion in the Global Air Navigation Plan and if necessary, the Annexes to the Chicago Convention.[103,104]

[102] See for example: UAS Traffic Management Architecture, GUTMA, 2017.

[103] See the list of the Annexes to Chicago convention - https://www.icao.int/Documents/annexes_booklet.pdf

[104] See the further explanation in Appendix C, subsection "Achievements of the SESAR Joint Undertaking" and Appendix E, subsection "Importance of standards"

This requires a significant effort to coordinate and present European positions with key members of ICAO and then at the ICAO decision making bodies. For the last decade this role has been delegated by the Commission to the SESAR Joint Undertaking. This role is seen as one of the key successes of the current partnership.[105]

ANSPs and ATM Institutions in particular stated that European ATM has currently a strong position worldwide built up over the years by a coordinated programme that allowed them to have fruitful discussions at ICAO level.

Option 0: Horizon Europe calls (baseline)

Although open calls can include provision to support standardisation, this option would lead to the lack of strong voice to promote European standards internationally; hence this option scores +.

Option 1: Co-programmed

A Co-programmed Partnership (CP) would be focussed on ensuring deployment of solutions and hence providing evidence to standardisation both within Europe and globally. The supply industry is motivated to ensure solutions have a global market. However, as an industry body (as opposed to an EU body) the CP would not have access to the decision-making bodies at ICAO and would have less influence with overseas organisations responsible for ATM which tend to have governmental status.

This option would lead to the lack of a strong voice to promote European ATM standards internationally; hence this option scores +.

Option 3: Institutionalised Art 187

An Institutionalised Partnership would be able to support standardisation of emerging solutions to enable early deployment including management of diverging industrial interests. As this option would also allow the EU to continue to have a strong voice at ICAO and other international meeting this option receives a score of +++.

The operational stakeholders noted that the cross-border nature of ATM requires harmonisation and synchronisation at EU level with appropriate standards and regulations. Having agreed standards for ATM solutions is a way of ensuring wide geographical distribution of advanced technologies instead of having them only in the most advanced countries. A closer coordination with standardisation organisations and EASA would facilitate the SESAR innovation life-cycle.

Summary

Table 13, below, lists the scores assigned for each of the policy options, based upon the assessments above, taking into account the support expressed by the different stakeholders.

[105] Interim evaluation of the SESAR Joint Undertaking (2014-2016) operating under Horizon 2020, Experts Group Report.

Table 13: Overview of the options' potential for reaching the likely economic/technological impacts

	Option 0: Horizon Europe calls	Option 1: Co-programmed	Option 3: Institutionalised Art. 187
Ability to handle additional flights enabling growth in air transport	+	++	+++
Enable new economic activity based on drones	+	++	+++
Boosted EU industry globally through international agreements and the setting of global standards	+	+	+++

Notes: Score +++ : Option presenting a *high* potential; Score ++: Option presenting a *good* potential; Score +: Option presenting a *low* potential

6.1.3 Societal impacts

Reducing aviation noise and gas emissions

As discussed in Section 4.3.3, inefficiencies of the current ATM system lead to approximately 6% excess greenhouse gasses in ATM. If air traffic grows without modernisation these inefficiencies will grow. The SESAR Joint Undertaking have estimated that a potential reduction of 240 to 450 kg of CO2 on average per flight is possible due to improved flight efficiency (see Table 4). However, this benefit would be accrued due to the proposed transformation of ATM106 rather than small gains through the trajectory as targeted by current R&I.

Option 0: Horizon Europe calls (baseline)

Due to the environment being one of the main priorities in Horizon Europe (the European Green Deal) many open calls could be aimed at addressing these issues leading to substantial low TRL innovation on this topic. However, to reduce environmental impact, there is a need for highly coordinated R&I to ensure that solutions that are compatible with each other and, taken as a whole support an end-to-end optimisation of the flight paths are further matured. In addition, issues such as compatibility with the overall architecture and evolving automation required to modernise the whole of ATM need to be managed. Open calls, due to the low ability of prioritisation and directed development across TRL levels, risk diverging interest from the industry leading to insufficient focus of their efforts (in terms of resources and financing) into this topic; hence this option scores 1 +.

Option 1: Co-programmed

The Co-programmed Partnership would be focussed on ensuring deployment of solutions including prioritisation of the current Commission priorities (and in particular the European Green Deal). However, limited innovation potential of partnership led by industry may reduce the ability to deliver environmental goals and without an independent support function, environmental solutions will not be prioritised when solutions are down selected. Hence this option scores ++.

[106] A proposal for the future architecture of the European airspace, SJU, 2019.

Option 3: Institutionalised Art 187

An Institutionalised Partnership would support a common approach by all stakeholders in ATM, and would be focussed on the necessary ATM modernisation to enable environmental goals. The independent secretariat would ensure that the environmental priority is maintained as the R&I results require performance trade-offs (i.e. environment versus cost-efficiency - a trajectory with low environmental footprint is enabled by sufficient ATM capacity, which increases the ATM provision costs).

Only this option would support ATM modernisation with the necessary coordination and acceleration leading to the timely environmental optimisation of ATM, bringing; hence this option score +++.

The majority of stakeholders expressed an opinion that the establishment of specific legal structure is very relevant (53%) or relevant (35%) for more effective implementation of the partnership; it is also very relevant (55%) and relevant (24%) for faster implementation of R&I results. The distribution of responses is similar across all stakeholder groups.

Improve customer experience and business opportunities by reducing travel time, improving predictability

At busy times, airline passengers face significant delays in Europe. In the summer of 2018, over 25% of the passengers were delayed by more than 45 minutes[107]. Modernisation of ATM will have a profound impact in terms of ATM performance, reducing travelling time and improving the overall passenger experience. The SESAR Joint Undertaking have estimated that the value of potential indirect benefits for passengers and EU citizens between 2019 and 2050 is €760b if the necessary R&I can be accelerated to achieve the full transformation by 2040. If the transformation is delayed by 10 years, the SESAR Joint Undertaking estimated that the benefits will be €30b lower (see Table 5).

Option 0: Horizon Europe calls (baseline)

Open calls would support greater involvement of innovative SMEs leading to a wider selection of potential solutions. However, as with the environmental challenge, the lack of a mechanism to manage interdependencies between the emerging solutions risks the overall coherence of the R&I programme and may not lead to solutions consistent with the emerging architecture.[108]

The lack of directionality outweighs the potential benefits of enhanced innovation; hence, this option scores +.

Option 1: Co-programmed

A Co-programmed Partnership would be focussed on ensuring deployment of solutions to improve passenger experience. However, limited innovation may reduce the ability to deliver performance goals. Without an independent support function, this option may not be fully successful in providing a performance based management of interdependencies, ensuring that the most promising solutions are taken forward regardless of diverging views between members.

[107] EUROCONTROL (2019), Performance Review Report 2018.

[108] Appendix D provides information on results from the open calls under previous framework. The main conclusion is that a partnership approach was required to support exploitation of the results.

Whilst a Co-programmed Partnership would deliver the necessary solutions, it is unlikely that the necessary acceleration would be achieved, which is needed for the higher levels of benefits; hence this option scores ++.

Option 3: Institutionalised Art 187

An Institutionalised Partnership would support a common approach from all stakeholders in ATM, would be focussed on the necessary ATM modernisation to enable performance goals. The independent support function would ensure that best solutions are retained as the R&I progresses by enabling a performance based management of interdependencies.

Only this option would support ATM modernisation with the necessary acceleration of R&I leading to achieve the high level of benefits; hence, this option receives a score of 3 (+++).

As already mentioned in Section 4.3.3, across all stakeholder groups responding to the consultation, the initiative for integrated ATM is considered to be very relevant (70% of respondents) or relevant (13%) to improving passenger experience by reducing travel time, delays and costs.

Summary

Table 14, below, lists the scores we assigned for each of the policy options, based upon the assessments above, as well as taking into account the support expressed by the different stakeholders.

Table 14: Overview of the options' potential for reaching the likely societal impacts

	Option 0: Horizon Europe calls	Option 1: Co-programmed	Option 3: Institutionalised Art. 187
Reducing aviation noise and gas emissions	+	++	+++
Improve customer experience and business opportunities by reducing travel time, improving predictability	+	++	+++

Notes: Score +++ : Option presenting a *high* potential; Score ++: Option presenting a *good* potential; Score +: Option presenting a *low* potential

6.2 Assessment of coherence

6.2.1 Internal coherence

In this section we assess the extent to which the policy options show the potential of ensuring and maximising coherence with other programmes and initiatives under Horizon Europe, in particular European Partnerships.

As discussed in Section 4.4.2, successfully achieving the ATM objectives will require a high level of coordination with other elements of Horizon Europe, including links to R&I on the future of Clean Aviation and access to R&I results in advanced areas such as AI, big data, etc.

Option 0: Horizon Europe calls (baseline)

Under this option, open calls under Horizon Europe would allow synergies and complementarities between R&I initiatives within Horizon Europe. The use of joint calls between ATM and advanced digital technologies would support innovation. However, this option would lack the ability to build longer terms key strategic collaborations necessary to deliver the consensus required for deployment in ATM. Hence, this option receives a score of ++.

Option 1: Co-programmed

This option would allow synergies with other European Partnerships to be established by the support function. Since calls are approved by the Commission, they can have a wider sense of synergies in a Horizon Europe scope. However, this option would only allow limited incentives to steer R&I performed due to advances in other areas. Therefore, exploitation of synergies will be ad hoc and not fully managed; hence, this option scores ++.

Option 3: Institutionalised Art 187

This option would enable synergies to be systematically identified and exploited leading to key strategic collaborations due to the independent support function and long-term relationship with other European Partnerships and activities within the programme. Thus, this option is awarded the highest score, +++.

All stakeholders interviewed notes that closer interaction with Clean Sky is required in order to avoid duplication, a greater coordination and synergies on the topics of automation and environment in aviation. However, no stakeholder interviewed saw benefit in merging the two initiatives.

6.2.2 External coherence

In this section we assess the extent to which the policy options show the potential of ensuring and maximising coherence with EU-level programmes and initiatives beyond the Framework Programme and/or national and international programmes and initiatives.

To achieve the ATM objectives, the proposed partnership needs to create close links with the SESAR deployment mechanism and international initiatives, particularly within ICAO and the other ATM modernisation programmes in USA, Japan and China.

Option 0: Horizon Europe calls (baseline)

Under this option, key strategic collaborations with other EU programmes and at an ICAO level would be very limited as they would not be supported by an independent knowledgeable coordination function. Hence, this option scores low, +.

Throughout all the categories, stakeholders made the strong point that there is a need to build up a partnership which has a body that can steer the R&I coordinating key stakeholders from the whole value chain continuously, to achieve the common EU-wide long-term ATM vision. Thus, they do not consider baseline to be a feasible option.

Option 1: Co-programmed

This option would focus on delivering deployable solutions and building synergies with other EU programmes under MFF (such as CEF funded deployment activities). However, as an industry body (as opposed to an EU body) it would not have access to the decision making bodies at global ICAO level and would have less influence amongst other overseas organisations responsible for ATM which tend to have government status. Hence, the score given to this option is ++.

Option 3: Institutionalised Art 187

Under this option, there would be a strong coordinating body that enables long term relationship to be established between programmes under MFF - and in particular the deployment arrangements for SESAR. This is the key transition (e.g. from R&I to deployment) that requires a very high level of industry consensus.

This option also provides the R&I initiative with the best mechanisms to work with international efforts, such as the FAA's NextGen in the USA to ensure that solutions are globally interoperable and to support these solution within ICAO. Hence, this option achieves the highest score, +++.

A stakeholder from the ANSP category said to note the necessity of an institutionalised partnership: as the FAA has to interact only with the associations. ICAO has a MoU with EU". ANSPs, ATM Institutions and SESAR Joint Undertaking agree that European R&I ATM has currently a strong position worldwide due to the coordinated programme that has allowed them to have discussions at ICAO level and be seen as a good example globally.

Summary

Table 15, below, lists the scores we assigned for each of the policy options, based upon the assessments above, taking into account the support expressed by different stakeholders.

Table 15: Overview of the options' potential for ensuring and maximising coherence

	Option 0: Horizon Europe calls	Option 1: Co-programmed	Option 3: Institutionalised Art. 187
Internal coherence	++	++	+++
External coherence	+	++	+++

Notes: Score +++ : Option presenting a *high* potential; Score ++: Option presenting a *good* potential; Score +: Option presenting a *low* potential.

6.3 Comparative assessment of efficiency

In order to compare the policy options under common standards, we developed a standard cost model for all 13 candidate Institutionalised Partnership studies. The model and the underlying assumptions and analyses are set out in the report on the overarching context to the impact assessment studies.

Table 16, below, shows the intensity of additional costs against specific cost items for the various options as compared to the baseline, i.e. *Option 0 (Horizon Europe calls)*. In this table we have taken into account that for *Option 3 (Institutionalised Partnership)* there would be a moderate additional costs for the set-up of a dedicated implementation structure seeing that such a structure is already existing. For *Option 1 (Co-programmed)*, we considered an additional cost for the call and project implementation as MS would not be providing contributions.

Table 16: Intensity of additional costs compared with Option 0

Cost items	Option 0: Horizon Europe calls	Option 1: Co-programmed	Option 3: Institutionalised Art. 187
Preparation and set-up costs			
Preparation of a partnership proposal (partners and EC)	0	++	++
Set-up of a dedicated implementation structure	0	0	++
Preparation of the SRIA / roadmap	0	++	
Ex-ante Impact Assessment for partnership	0	0	+++
Preparation of EC proposal and negotiation	0	0	+++
Running costs (Annual cycle of implementation)			
Annual Work Programme (AWP) preparation	0	+	+
Call and project implementation	0	0	+
Cost to applicants	0	0	0
Partners costs not covered by the above	0	+	+
Additional EC costs (e.g. supervision)	0	+	++
Winding down costs			
EC	0	0	+++
Partners	0	+	+

Notes: 0: no additional costs, as compared with the baseline; +: minor additional costs, as compared with the baseline; ++: high additional costs, as compared with the baseline; +++: very high additional costs, as compared with the baseline.

The scores related to the costs set out above enable a "value for money" analysis (cost-effectiveness) in the final scorecard analysis in Section 6.4. For this purpose, in Table 17 where we provide the scores for the scorecard analysis, based on our insights and findings and based on the scores above, we assign a score 1 to the option with the highest costs and a score 3 to the lowest.

Table 17: Matrix on 'overall costs' and 'cost-efficiency'

	Option 0: Horizon Europe calls	Option 1: Co-programmed	Option 3: Institutionalised
Overall cost	3	2	1
Cost-efficiency	3	3	2

Notes: Score 1 = Substantial additional costs, as compared with the baseline; score 2 = Medium additional costs, as compared with the baseline; score 3 = No or minor additional costs, as compared with the baseline.

We considered that while there is a clear gradation in the **overall** costs of the policy options, the cost differentials are less marked when we take into account financial leverage (co-financing rates) and the total budget available for each of the policy options, assuming

a common Union contribution. From this perspective, there are only one or two percentage points that split the most cost-efficient policy options – the baseline *Option 0* and the *Co-programmed* policy options – and the least cost-efficient – the Institutionalised Partnership options. We have therefore assigned a score of 3 to the *Option 0* and the *Co-programmed* policy options for **cost-efficiency** and a score of 2 for the Institutionalised Partnership policy options.

It should be noted that the potential for the creation of crowding-in effects for industry has been taken into account when assessing the effectiveness of the policy options, above.

The analysis above does not take account of the additional leverage created by the full involvement of EUROCONTROL in the ATM partnership, which significantly reduces the costs to the EU for this partnership and increases the gross leveraging ratio to 1:3 for Option 3.

6.4 Comprehensive comparison of the options and identification of the preferred option

Building upon the outcomes of the previous sections, this section presents a comparison of the options' 'performance' against the three dimensions of effectiveness, efficiency and coherence.

In Section 6.4.1, we first compare the policy options against each other for each criterion in the effectiveness and coherence dimensions, resulting in a scorecard with scores from 1 to 3 where 3 stands for a substantially higher performance. Combined with the results from the comparative assessment for efficiency in Section 6.3, above, the final scorecard will allow for the identification of the preferred option in Section 6.4.2, taking all dimensions and criteria into account.

6.4.1 Effectiveness

To be effective, the initiative must develop an R&I ecosystem representing the entire ATM and U-space value chains that is capable of accelerating R&I in a manner that supports rapid deployment of the results in a coherent and harmonised manner across the EU.

Whilst *Option 0: Horizon Europe calls* would enable innovation in the field, it would not nurture a sufficiently collaborative approach across the industry, nor would it ensure needed follow-through to deployment[109] and therefore would put the potential benefits at risk.

Option 1: Co-programmed Partnership would nurture an industry partnership but would lack the independent support required to steer the R&I and ensure that interdependencies between projects are successfully managed. It is considered unlikely that this option could accelerate R&I in ATM.

Only *Option 3: Institutionalised Art 187 partnership* would have the full set of functionalities required to accelerate a collaborative R&I programme to deliver the required transformative technologies and is therefore best placed to deliver the full €1,800b of benefits.

6.4.2 Coherence

Coherence is critical for success:

[109] As it is highly unlikely that a solution can be developed from TRL0 to TRL8 within one project, be it under Open calls or under other options.

- Internal coherence to ensure that useful results from other R&I programmes are successfully integrated within the ATM R&I – this is particularly important in areas such as AI and cybersecurity where ATM needs to re-use solutions from other R&I initiatives.
- External coherence to ensure that successful results are presented and accepted at ICAO and therefore become part of the global plan to modernise ATM.

Due to lack of directionality, *Option 0* risks delivering the required coherence. *Option 1* would provide greater coherence but as it would essentially be an industry body, it would not be able to provide the EU with a voice at ICAO (where a governmental body can be accepted). Only *Option 3* with its independent support function is able to promote both internal and external coherence to achieve the environmental and economic benefits.

6.4.3 Efficiency

Although *Option 0* has an overall lower cost, the lack of directionality and partnership would place the potential economic and environmental benefits at significant risk. Of the two forms of partnerships, *Option 1*, has lower costs but lacks the ability to independently manage dependencies and represent the EU at international meetings – hence placing the required acceleration at risk. So, although *Option 3* is marginally more expensive, in our view, the additional effectiveness and coherence fully justifies the higher costs.

Table 18: Scorecard of the policy options

	Criteria	Option 0: Horizon Europe calls	Option 1: Co-programmed	Option 3: Institutionalised Art. 187
Effectiveness	**Scientific impacts**			
	New scientific knowledge and reinforcement of EU scientific capabilities	2	2	3
	Enhanced capacity among the next generation aviation professionals	2	2	2
	Economic/technological impacts			
	Ability to handle additional flights enabling growth in air transport	1	2	3
	Enable new economic activity based on drones	1	2	3
	Boosted EU industry globally through international agreements and the setting of global standards	1	1	3
	Societal impacts			
	Reducing aviation noise and gas emissions	1	2	3
	Improve customer experience and business opportunities by reducing travel time, improving predictability	1	2	3

	Criteria	Option 0: Horizon Europe calls	Option 1: Co-programmed	Option 3: Institutionalised Art. 187
Coherence	**Internal coherence**	2	2	3
	External coherence	1	2	3
Efficiency	**Overall cost**	3	2	1
	Cost-efficiency	3	3	2

Notes: Scores for effectiveness and coherence: 3 = *substantially higher performance*; 2 = *higher performance*; 1 = *lower performance*. Scores for efficiency: 1 = *substantial additional costs*, as compared with the baseline; 2 = *medium additional costs*, as compared with the baseline; 3 = *No or minor additional costs*, as compared with the baseline.

6.4.4 Identification of the preferred option

The scorecard in Table 18 shows that *Option 0* performs less well against almost all dimensions and criteria compared to the *Option 1* and *Option 3*. Even though it reached a higher score against the overall costs criterion, we considered that this does not weigh up against its lower performance against the other dimensions.

The scorecard also shows that **benefits are clearly maximised under the *Option 3***. In particular, compared with the other options, *Option 3* would:

- Provide greater effectiveness by maximising leverage effects of the R&I by enabling an acceleration of the R&I by harnessing the momentum and knowledge of the current partnership. As EUROCONTROL and industry would each provide matching funding for the EU budget, this leads to a gross leveraging ratio of up to 1:3.
- Improved coherence through an independent support function able to ensure that external R&I results are taken into account and by providing a global voice for Europe.
- Overall the marginally increased costs are considered acceptable for the greater likelihood of achieving the significant environmental and economic benefits of timely ATM modernisation.

The conclusion of our assessment is that Option 3 is the preferred option, showing a higher level of cost-effectiveness than the other options.

7 The preferred option

7.1 Description of the preferred option

In Table 19, below, we indicate the alignment of the preferred option with the selection criteria for European Partnerships defined in Annex III of the Horizon Europe Regulation. Seeing that the design process of the candidate Institutionalised Partnerships is not yet

concluded and several of the related topics are still under discussion at the time of writing, the criteria of additionality/directionality and long-term commitment are covered in terms of *expectations* rather than ex-ante demonstration.

Table 19: Alignment with the selection criteria for European Partnerships

Criterion	Alignment of the preferred option
Higher level of effectiveness	The Institutionalised Partnership is specifically designed to support pan-EU harmonisation of ATM leading to significant environmental, economic and social benefits. The stronger link to the SES policy is critical to reduce risk with transferring solutions from R&I to deployment and hence increase industry commitment.
Coherence and synergies	The Institutionalised Partnership will support synergies with related R&I in advanced digital solutions reducing the likelihood of the industry developing ATM specific solutions where these are not needed. The Institutionalised Partnership is able to build direct links with the deployment programme, supporting an accelerated handover of results leading to a faster accrual of benefits. The Institutionalised Partnership is also advantageous in its ability to represent the EU at ICAO and other international meetings ensuring that European solutions are embedded in future global plans and standards.
Transparency and openness	Through a drive to promote standards for developed solutions the Institutionalised Partnership will support transparency of results leading to increased exploitation both within the EU and globally. The membership process and types of activity including open calls need to ensure a wider participation than the core membership (particularly of academia and SMEs).
Additionality and directionality	The EU role in the governance of the Institutionalised Partnership is advantageous in ensuring that the modernisation of ATM is driven by policy needs and not slowed down by sometimes diverging national and industrial interests.
Long term commitment	The financial contribution of industry is anticipated to be 66% (33% from EUROCONTROL and 33% from the industry) of the aggregated European Partnership budgetary commitments. These commitments are in line with previous commitments to the existing programme over the last decade.

Feedback on the inception impact assessments:[110] Majority of stakeholders gave an opinion on the option for the partnership. Whenever it was expressed, the preferred option was Institutionalized partnership under Art 187.

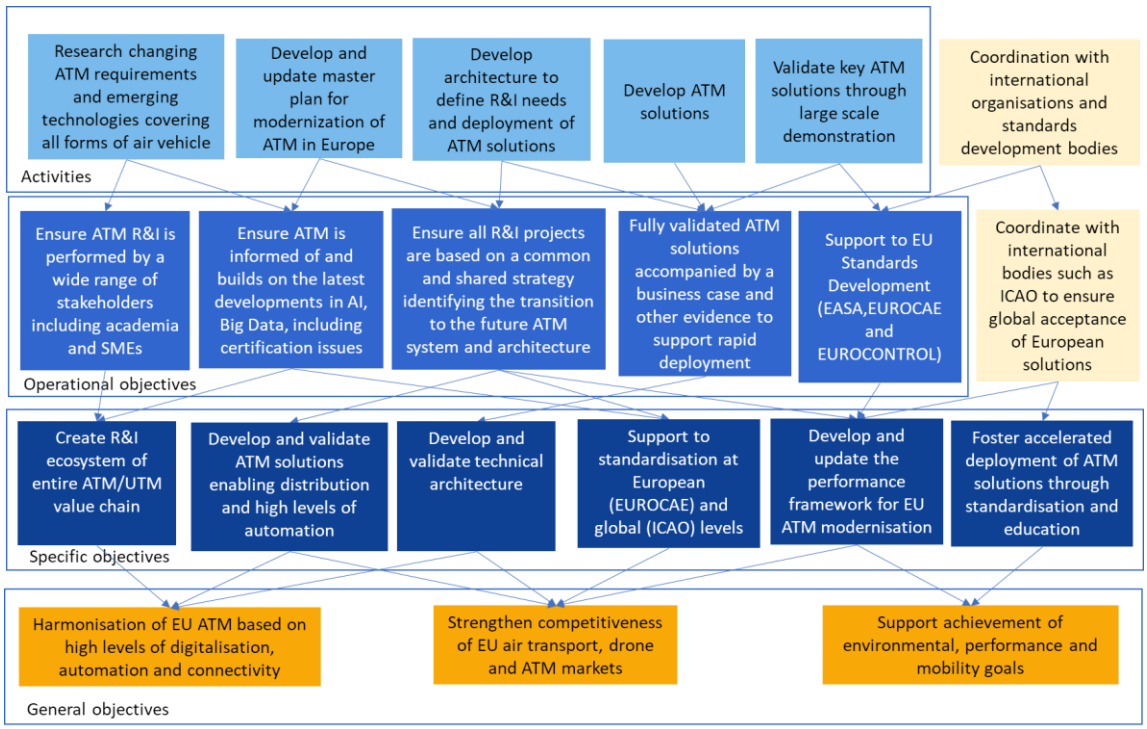
[110] The European Commission received 28 responses to the inception impact assessment for integrated ATM. The responses are aligned with the stakeholder responses to the open public consultation and the interviews performed for this report. Therefore, we did not refer to this feedback in the report.

7.2 Objectives and corresponding monitoring indicators

7.2.1 Operational objectives

Figure 13, below, lists a range of actions and activities, going also beyond the R&I activities that can be implemented under Horizon Europe (highlighted in yellow). This reflects the definition of European Partnerships in the Horizon Europe regulation as initiatives where the Union and its partners "commit to jointly support the development and implementation of a programme of research and innovation activities, including those related to market, regulatory or policy uptake."

Figure 13: Operational objectives of the initiative



Source: Think Research Ltd.

7.2.2 Monitoring indicators

Table 20 identifies key monitoring indicators for tracking progress of the initiative towards its targeted impacts.

The societal impact of ATM is currently measured by the Performance Review Body of the European Commission. It is recommended that this body is utilised to monitor the success of the R&I programme in terms of actual operational performance. It is also noted that the current metrics are limited, and that additional monitoring could be usefully performed:

- For environmental impact, the current metric could be extended to include the full trajectory (the current metric only measures horizontal efficiency in the cruise phase)[111].
- The current performance metrics cover safety, capacity (through measurement of delay) and cost-efficiency. This could be extended to include passenger centric measures that better reflect the value of improvements to EU citizens[112].

[111] See for example: https://www.nats.aero/environment/3di/

[112] Passenger-Oriented Enhanced Metrics, A. Cook, G. Tanner, S. Cristóbal and M. Zanin, SESAR Innovation Days 2012.

Table 20: Monitoring indicators in addition to the Horizon Europe key impact pathway indicators

	Short-term (typically as of year 1+)	Medium-term (typically as of year 3+)	Long-term (typically as of year 5+)
Scientific impact			
New scientific knowledge and reinforcement of EU scientific capabilities	Number of ATM solutions reaching TRL2	Number of ATM solutions reaching TRL4	Number of ATM solutions reaching TRL6
Enhanced capacity among the next generation aviation professionals fostering diversity and inclusion	Number of researchers involved in upskilling (training, mentoring/coaching, mobility and access to R&I infrastructures)	Number and share of upskilled FP researchers with increased individual impact in ATM	Number and share of upskilled FP researchers with improved working conditions, including researchers' salaries
Technological / economic impact			
Accelerated delivery of innovative solutions into operations	Number of innovative ATM solutions developed	Number of innovative ATM solutions deployed	Creation, growth & market shares of companies having developed FP innovations
Enable new economic activity based on drones	Number of innovative U-spaces solutions developed	Number of innovative U-space solutions deployed	Creation, growth & market shares of companies having developed FP innovations
Enable European industry competitiveness based on international agreements and EU/global standards	Number of standards identified as being required	Number of standards initiated	Number of standards completed
Societal impact			
Reducing aviation noise and gas emissions	Planned capability of ATM solutions to reduce CO_2 emissions per flight	Validated capability of delivered solutions to reduce CO_2 emissions per flight	Measured reduction in CO_2 emissions per flight during operations
Improve customer experience and business opportunities by reducing travel time, improving predictability	Planned capability of ATM solutions to improve ATM performance	Validated capability of delivered solutions to improve ATM performance	Measured performance improvement

Source: Think Research Ltd.

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Appendix B Synopsis report on the stakeholder consultation – Focus on the candidate European Partnership on Integrated Air Traffic Management

Disclaimer: the views expressed in the contributions received are those of the respondents and cannot under any circumstances be regarded as the official position of the Commission or its services.

B.1 Introduction

Following the European Commission's proposal for Horizon Europe in June 2018,[113] 13 candidates for institutionalised partnerships within 8 partnership areas have been proposed, based on the political agreement with the European Parliament and Council on Horizon Europe reached in April 2019.[114] Whether these proposed institutionalised partnerships will go ahead in this form under the next research and innovation programme is subject to an impact assessment.

In line with the Better Regulation Guidelines,[115] the stakeholders were widely consulted as part of the impact assessment process, including national authorities, the EU research community, industry, EU institutions and bodies, and others. These inputs were collected through different channels:

- A feedback phase on the inception impact assessments of the candidate initiatives in August 2019,[116] gathering 350 replies for all 13 initiatives.
- A structured consultation of Member States performed by the EC services over 2019.
- An online public stakeholder consultation administered by the EC, based on a structured questionnaire, open between September and November 2019, gathering 1635, replies for all 12 initiatives.
- A total of 608 Interviews performed as part of the thematic studies by the different study teams between August 2019 and January 2020.

This document is the synopsis report for the initiative "Integrated Air Traffic Management". It provides an overview of the responses to the different consultation activities. A full analysis of the results is provided in the study Data Report.

[113] https://ec.europa.eu/commission/presscorner/detail/en/IP_18_4041

[114] https://ec.europa.eu/commission/presscorner/detail/en/STATEMENT_19_2163

[115] https://ec.europa.eu/info/files/better-regulation-guidelines-stakeholder-consultation_en

[116] The full list of inception impact assessments is available here. They were open for public feedback until 27 August 2019.

B.2 Feedback to the inception impact assessment on candidate initiatives for institutionalised partnerships

Following the publication of the inception impact assessment, a feedback phase of three weeks allowed any citizen to provide feedback on the proposed initiatives on the "Have your say" web portal. In total 350 feedbacks were collected for all initiatives.

For the initiative "Integrated Air Traffic Management" 28 individual feedbacks were collected. The form of respondent is identified in Table 21.[117]

Table 21: Responses to the Inception Impact Assessment

Stakeholder groups	Number of respondents
Academic/research institutions	6
Business associations	4
Companies/business organisations	4
Environmental organisations	1
EU citizens	5
Non-governmental organisation	1
Other	1
Public authorities	3
Trade union	2

Among the elements mentioned were:

- Institutional partnership under Article 187 of the TFEU is the one that best suits ATM.
- Baseline scenario of open calls is not an alternative to increase efficiency and speed up development or implementation of the Single European Sky of which EU economy and travelling public are the beneficiaries.
- An institutional partnership for ATM is required due to the fragmented and conservative industry that without coordination will lead to stand alone research projects and lack of research continuity that will not help address the challenging tasks of R&I and deployment.
- ATM has specific challenges that require research coordination, expertise and resources from the whole value chain including key actors. Solutions that are still under development and future challenges are best address by a dedicated institutional ATM partnership
- The momentum, context and success of the SESAR Joint Undertaking should be followed up. The participation stability, resilience and experience acquired in the last 10 years by SESAR's systematic approach are required in order to follow the learning curve that will allow to address the future challenges.
- ATM due to its nature requires to ensure participation from cross-industry stakeholders, effective coordination and efficient execution across the network in order to bring economies of scale amongst a unified vision such as the current European ATM Master

[117] Feedback on inception impact assessment to be found on https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2019-4978577/feedback_en?p_id=5722693

Plan, Flightpath 2050 goals or Single European Sky framework. In order to ensure this, political consensus in required.

- A free market will not lead to investments due to them being prohibitively high at an early stage. A European partnership is needed to ensure that R&I investments add value for the public and support job opportunities, sustainable, safety and innovative initiatives. This will allow to have a functioning international air traffic management that is beneficial for a transport network and a guarantor for the economic development in Europe.
- The partnership should create a systematic approach to successfully address the challenges of digitalisation (including augmented and virtual reality), Artificial Intelligence, big data, block chain, cyber security, automation, optimisation, sustainability, maximum environmental efficiency, accommodation of new airspace users, accommodation of traffic in complex airspace and single-pilot operations.
- Take a holistic approach that includes an adapted regulatory framework, operational aspects and development and maturation of the critical enabling technologies. Standardisation, and implementation are crucial to develop an interoperable, scalable and harmonised EU ATM system that safe, efficient, sustainable, connected, airspace and air transport.
- ATM Modernisation is a global issue and the partnership should keep a global mindset pushing towards harmonisation without leaving behind the R&I European focus. It should encourage networking and cooperation to promote EU standards at a global level in order to implement solutions that can be leveraged in terms of global industry. Solutions should be in line with ICAO recommendations and EASA regulations, especially for drones.
- To ensure better transition through the R&I pipeline and acceleration of development processes. Exploratory research is essential to feed the innovation pipeline and must be reinforced whilst accepting uncertainty to allow innovation. Reduction in bureaucracy, administrative overhead, funding flexibility and making results fully available could allow a smoother transition from R&I to development.
- Better regulation is key to close the gap between validation and industrialisation. It will enable to have a synchronized, coordinated and harmonized deployment of technologies based on positive Cost Benefit Analysis. Launch pilot and demonstration projects will also promote this.
- All types (and size) of stakeholders should contribute to the partnership, ensuring leader roles and responsibilities as well as a robust institutional governance. It is crucial to include the industrial or suppliers, social partners representing “human in the loop”, service providers or operational stakeholders such as airspace users (this should be reinforced) and regulators like EASA. To enable this it should facilitate openness to enable newcomers to join and covering the whole European network including non-EU associate members that play a significant role.
- Diverging interests from the industry and service providers should not influence the research and development priorities but it should be kept customer and result driven. The focus should be on operational performance benefits for the whole network and society (including passengers).
- An ATM partnership should learn from other industries and domains whilst keeping a strong communication with affected communities. An example is to cooperate closely with Clean Sky. It should also apply lessons learned from previous ATM partnerships such as the SESAR Joint Undertaking.

- Coordination and clarity in the policy, vision, strategy/planning objectives and roles is necessary. The partnership should be in line with the European ATM Master Plan and ensure its maintenance, including recommendations of Airspace Architecture Study, Wise Person Group and European Court of Auditors report on the Single European Sky.

B.3 Structured consultation of the member states on European partnerships

A structured consultation of Member States through the Shadow Strategic Configuration of the Programme Committee Horizon Europe in May/ June 2019 provided early input into the preparatory work for the candidate initiatives (in line with the Article 4a of the Specific Programme of Horizon Europe). This resulted in 44 possible candidates for European Partnerships identified as part of the first draft Orientations Document towards the Strategic Plan for Horizon Europe (2021-2024), considering the areas for possible institutionalised partnerships defined in the Regulation.

The feedback provided by 30 countries (all Member States, Iceland and Norway) has been analysed and summarised in a report, with critical issues being discussed at the Shadow Strategic Programme Committee meetings.

B.3.1 Key messages overall for all candidate Institutionalised Partnerships are the following:

Overall positive feedback on the proposed portfolio, but thematic coverage could be improved

The results indicate a high level of satisfaction with the overall portfolio, the level of rationalisation achieved, and policy relevance. While delegations are in general satisfied with the thematic coverage, the feedback suggests the coverage could be improved in cluster 2 "Culture, creativity and inclusive society" and cluster 3 "Civil Security for Society".

Large number (25) of additional priorities proposed for partnerships by delegations

Despite high satisfaction with the portfolio and candidates put forward by the Commission, countries put forward a high number of additional priorities to be considered as European Partnerships. A closer examination suggests that these additional proposals are motivated by very different reasons. Whilst some proposals are indeed trying to address gaps in the portfolio and reach a critical mass, then, others are driven by the wish to maintain existing networks, currently not reflected in the Commission proposal (e.g. those based on JPIs, ERA-NETs). In addition, some proposals reflect worries over some topics not being sufficiently covered in the existing proposals, but could be possibly well covered within the scope of existing partnerships, or by traditional calls under the Framework Programme.

Critical view on the high number and openness of Joint Undertakings

Country feedback suggests dissatisfaction with the high number of proposed Article 187 TFEU partnerships. Notably smaller as well as EU-13 countries raise concerns with regards to the potential insufficient transparency and openness of the partnership model. In the feedback, countries either directly support or ask to carefully analyse whether the objectives of this proposal could be reached with the co-programmed model.

For those partnerships that will be set up on the basis of Article 187, the country feedback stresses the need to ensure a clear shift towards openness in the governance, membership policy and allocation of funding of these partnerships. Notably, it is emphasised that the JU rules should not have any limitations or entry barriers to the participation of SMEs and other partners, including from academia.

Although the feedback suggests a general criticism, there are few concrete and broadly supported proposals, including to reduce the number of institutionalised partnerships mergers or by alternative implementation modes.

Lack of cross-modal perspective and systematic approach to mobility

The current proposal foresees 5 partnerships in the area of transport (for rail, air traffic management, aviation, connected and automated driving, zero-emission road transport), and 2 that in closely related technologies for radically reducing carbon emissions (hydrogen, batteries). Several delegations would wish to see a systemic approach to developing mobility and addressing related challenges (optimisation of overall traffic, sustainable mobility solutions for urbanisation), and do not support a mode-dependent view only. This suggests the need to discuss how to ensure greater cooperation between transport modes and cross-modal approaches in establishing partnerships in the area of mobility.

Partnership composition: the role of Member States in industry partnerships

The composition and types of partners is an important element for the success of a partnership, e.g. to ensure the right expertise and take-up of results. Ensuring broad involvement without overly complicating the governance of the partnership remains an important an important challenge in the design of future partnerships.

In the feedback, several Member States express their interest to join as a partner in partnerships that have traditionally been industry-led. However, individual comments suggest there are different views on what their involvement means in practice, with some countries expressing readiness to commit funding, while others support limiting their involvement to alignment of policies and exploiting synergies. This suggests the need to discuss further what the involvement of Member States means in practice (notably in terms of contributions, in the governance), and what would be possible scenarios/options in Horizon Europe. There is special interest in testing and deployment activities, in synergies with Cohesion Funds and CEF priorities and investments.

Although it is too early to determine the interest of industry/ businesses in the topics proposed for partnerships where the main partners are public authorities, their involvement in in public centric partnerships will also be an important question in the design and preparation of future proposals.

Some proposals are more mature than others

The analysis of feedback per partnership candidates suggests that some proposals are more mature, while others would need more time to determine the scope, objectives, partner composition and contribution and appropriate mode of implementation. This relates to in particular to partnerships with no predecessors and those where the main partners are public. It suggests that the proposals would need to be developed at different paces in order to achieve good quality, and thus, not all partnership proposals may be ready for implementation at the start of Horizon Europe.

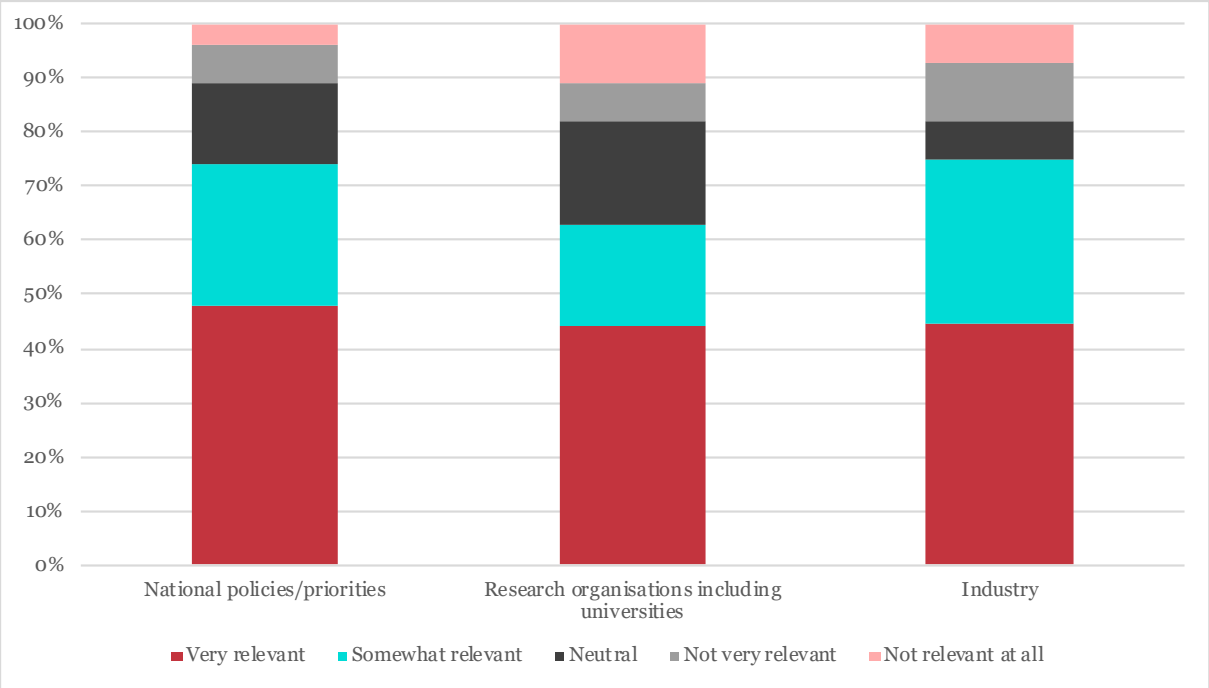
For the initiative "Integrated Air Traffic Management" the following overall feedback was received from Member States. There is good agreement with the overall objectives, with some delegations proposing additional elements to strengthen the proposal – notably the research and innovation aspects. For smaller / EU-13 countries, better integration of aspects related to digitalisation, drones and small aircrafts into the EU ATM system would significantly increase the relevance of the partnership. Several countries highlight the need to elaborate on the involvement of Member States, the national services responsible for regulating and controlling air traffic. Comments also suggest broadening the partner composition with new categories of stakeholders.

B.3.2 Overall feedback for the initiative "Integrated Air Traffic Management"

Relevance and positioning in a national context

Overall the feedback from countries confirm the relevance of the proposed European Partnership for Integrated Air Traffic Management, with 74% considering it very or somewhat relevant for their national policies and priorities, and for their industry, and slightly less (63%) considering it relevant for their research organisations, including universities.

Figure 14: Relevance of the European Partnership for Integrated Air Traffic Management in the national context



On the question of existing national/regional R&I strategies, plans and/ or programmes in support of the proposed Partnership, 17 countries report to have relevant elements in place. National R&I strategies or plans (52 %, AT, DE, ES, FR, HR, IE, IT, LV, NL, RO, SE, SI, NO) and national economic, sectoral strategy and/or plan with a strong emphasis on research and/or innovation (52 %, AT, ES, FI, FR, HR, HU, IE, IT, LV, NL, RO, SE, SI, NO) were identified most frequently. Countries reported to a lesser extent to having regional R&I and/or smart specialisation strategies (37 %, DE, ES, FR, HR, IE, IT, SE, SI, UK, NO), dedicated R&I funding programmes or instruments (30 %, DE, ES, FR, HR, IE, IT, RO, ES). 22% of countries (CZ, ES, HR, IE, SE, NO) reported other policies/ programmes, such as upcoming sectoral agenda, a national research innovation agenda, or R&I programmes focusing more broadly on disruptive technologies.

Delegations identified a number of aspects that could be reinforced in the proposal for this partnership that would increase its relevance for national priorities.[118] Some delegations emphasised the need to more use of the results of the Airspace Architecture Study[119] and the report of the Wise Persons Group on the Future of the Single European Sky[120] that indicate a number of concrete recommendations aimed at optimising Europe's airspace

[118] Comments on scope and content have to be assessed in the context of the overall priority setting to ensure coherence.

[119] A proposal for the future architecture of the European airspace, SJU, 2019.

[120] Report of Wise Persons Group on the future of the Single European Sky, 2019.

organisation in such a way that can facilitate the uptake of new technologies, including research on the benefits, risks and effects of these proposals . Other individual comments make suggestions to further strengthen the following areas: reduction of departure/arrival delays, taxing and more efficient local traffic management, Human Performance, Safety Performance and Cybersecurity, short term challenges like airspace capacity, integrating drones, and ATM efficiency and aviation safety. In the additional comments some countries reiterated the relevance of the Partnership and overall agreement with the proposed objectives, whilst others express the need for a more integrated/ systemic approach (including by merging the proposed partnership with the one on Clean Aviation), a stronger focus on research activities and better involvement of Member States in the agenda setting.

Most countries (63%) are at this stage undecided concerning their interest to participate, as a partner. At this stage 8 country (CZ, DE, ES, FR, CR, IE, IT, MT) express interest to join as a partner, and 4 (CY, EE, HU, IS) countries express no interest to participate.

A small share of countries report as potential partners or contributors regional R&I and /or smart specialisation strategies (33%), governmental research organisations (33%), research infrastructures (30%), and existing or planned national R&I programmes (30% and 26% respectively). Additional comments highlight countries wish to further clarify national involvement and contributions in the proposed partnerships. While some respondents express readiness for aligning national funding initiatives and contributing to the Partnership, others prefer to limit national involvement to aligning policies and exploiting synergies (notably with Cohesion Funds), but without any further commitment of funding.

While most are undecided concerning their participation, almost all countries (93%) expressed interest in having access to results produced in the context of the partnership.

Feedback on objectives and impacts

Overall there is a good agreement (74%) on the use of a partnership approach in addressing challenges related to air traffic management. There is strong agreement (70%) that the partnership is more effective in achieving the objectives and delivering clear impacts for the EU and its citizens, but to lesser degree that (56%) it would contribute to improving the coherence and synergies within the EU R&I landscape.

Member States indicate strong agreement with the proposed objectives at short, medium and long term (82%) and the expected scientific, economic and societal impacts at European level (82%), with the remaining ones remaining neutral. 71% of countries consider the impacts very or somewhat relevant in the national context. 70% of countries found the envisaged duration of the proposed partnership adequate, while 19% of countries need more information to assess this. Individual additional comments in relation to objectives highlight the following:

- The need to address more research and innovation agendas;
- The need to encourage deployment and implementation of new solutions;
- Support stronger links with other related partnership candidates, notably to promote connectivity across transport modes;
- More focus on accelerating digitalisation, integrating drones and small aircrafts into the EU ATM system, and security aspects (in addition to safety).

Views on partners, contributions and implementation

Majority of countries (62%) agree with the proposed type and composition of partners, and 26 % of respondents need more information for informed decision. In additional comments, several countries emphasised the need to move away from the current set up

of the SESAR JU towards a model that facilitates the participation of smaller players and SMEs (e.g. in relation to the use of drones). Several countries highlight the need to elaborate on the involvement of Member States, in particular the national services responsible for regulating and controlling air traffic. Comments also suggest to broaden the partner composition with new categories of stakeholders, such as communication and data service providers or regions with smaller airports represented by private partners and research organizations. Individual feedback also suggests increasing the level of cooperation with the military air traffic and European Union Aviation Safety Agency (EASA) to speed up the process of technology, and to engage citizens and civil society (as changes to the ATM will have impacts on when people will travel).

At this stage, most countries (74%) would need more information on contributions and level of commitments expected from partners.

The proposed use of Article 187 implementation mode is supported by 41% of countries, while 48% would require additional information. Whilst several countries express the added value of having an institutionalised partnerships, many also stress the need to ensure high level of openness and transparency of the JU model (notably by ensuring open competitive calls, and removing entry barriers for the participation of smaller organisation). At the same time, there are also some delegations expressing support to implementing this priority with a co-programmed partnership, and some who suggest a merger with the Partnership on Clean Aviation.

B.4 Targeted consultation of stakeholders related to the initiative "Integrated Air Traffic Management"

In addition to the consultation exercises coordinated by EC services, the external study thematic teams performed targeted consultations with businesses, research organisations and other partners on different aspects of potential European Partnerships.

B.4.1 Approach to the targeted consultation

The interviews were conducted in three phases, each having a different focus and objectives:

- Phase 1: Refining our understanding of the context, intervention, problems and drivers.
- Phase 2: Assessing the options for the future partnership for Integrated Air Traffic Management, in particular:
    - Option 0: no partnership;
    - Option 1: co-programmed partnership;
    - Option 2: co-funded partnership;
    - Option 3: potential institutional partnership.
- Phase 3: Concrete differentiation between the options.

A questionnaire was designed with the intention of guiding the stakeholder interviews; it was not used as a script, but rather as a guideline for the interviews. The questionnaire was structured along the following key topics:

Table 22: Interview topics

Topics	Selection criteria
A. Objectives	Effectiveness
B. Costs and benefits	
C. Contribution to EU policies	
D. Coherence	Coherence and synergies
E. Governance	
F. Membership and openness	Openness and transparency
G. Key Performance Indicators (KPI)	Additionality and directionality
H. Need for an integrated ATM partnership	
I. Research needs	
J. Benefits of EU action	
K. Leverage effect	Partners' commitment and membership

All interviews start with:

- a short presentation of the scope of work including the 4 options being considered, and
- a quick introduction by the interviewee on his/her role and, if relevant, interactions with SESAR.

The focus of the interview is achieved by prioritising questions according to the phase.

Table 23: Option characteristics presented to stakeholders

Partnership type/Characteristics	Co-programmed	IP A187	Co-funded	IP A185
Type of partnership	Public-private Industry-led		Public-public National bodies-led	
Partners	Member States, Foundations and international partners (industry)	Members States, foundations and international partners (industry)	Public authorities	Member States
Suitability	Broader communities, medium term priorities, need for flexibility	Long term challenges and priorities	Pooling national programmes and policies	Long term challenges and priorities
Establishment	Memorandum of understanding	Decision by Council and	Grant Agreement between EC and	Decision by Council and

Partnership type/Characteristics	Co-programmed	IP A187	Co-funded	IP A185
	between EC and partners	European Parliament	consortium of partners	European Parliament
Flexibility	High in its implementation	Limited changes, legislation needed	High in its implementation	Limited changes, legislation needed
Funding arrangements	- Non-legally binding - Membership fees - Project calls through Horizon Europe	- Legally binding - Membership fees for Joint Undertaking administration (4%) - Project calls implemented and managed by the partnership, Horizon Europe rules - Expected significant in-kind and financial contribution (1:1 minimum) to be defined in the basic act	- Ensured through Grant Agreement - Consortium of partners - Funding rate 30%, up to 70%	- Legally binding - DIS designated by the participating States - Project calls implemented and managed by the partnership, Horizon Europe rules - Expected significant in-kind and financial contribution (1:1 minimum) to be defined in the basic act
EC influence	High during implementation phase		Limited to setting-up negotiations	
EC involvement	Approves priorities (calls)	Approves annual work programme	Approves annual work programme	Approves annual work programme
Set-up and implementation effort	Low effort	High effort	Moderate effort	High effort

The targeted interviews were conducted during October and November, with a two-day session in Brussels to cover main institutional stakeholders and the remainder conducted by conference calls. All the interviewees have been invited through email and reminded after 2 weeks if no response. The chosen interviewees were given a chance to propose other members in their organisation for the interview. In order to reach the expected number of interviewees, 60 potential interviewees were contacted, and a list of extra candidates was kept in case of need. Finally, 48 interviewees where contacted but 50 interviews were conducted. This is because the two interviewees responded to the questions at different levels, first at a high level on needs, objectives and problems of ATM and the second one in more detail about the different types of partnership and other topics from Table 22.

B.4.2 Overview of respondents to the targeted consultation

The interviews were designed to cover the entire ATM R&I value chain. The identified groups are listed in Table 24. The individual interviewees have been selected to ensure coverage both geographically and through stakeholder types; in many instances we have selected representative organisations with knowledge of the predecessor partnership in current plans, complemented by sample of organisations not currently involved, from each stakeholder group.

Table 24: Stakeholder groups and interviewing rationale

Group	Description	Additional rationale
Academia	Universities researching ATM and related digital enablers	Independent and objective way of looking at the challenges and how to solve them
Airports	Both current members and non-members	To get their insight on the options, objectives and need for future R&I challenges
Airspace user community	Airlines	To get their insight on the options, objectives and need for future R&I challenges
ANSPs	Both current members and non-members	To get their insight on the options, objectives and need for future R&I challenges
ATM institutions	Institutions and organisations involved in ATM	Insight view of the objectives and processes required and how to meet them (specifically in the military dimension and for standardisation)
Member States	Members of the Single Sky Committee	Perceived need and objective; indication of how MS should be involved
R&D organisations	Both current members and non-members	To get their insight on the options, objectives and need for future R&I challenges and in particular how to involve advanced digital solutions
SESAR JU executives	Members of the current SESAR JU management team	To reflect their experience of handling an ATM partnership
SMEs	SMEs researching ATM and related digital enablers	To get their insight on the options, objectives and need for future R&I challenges and in particular how to involve SMEs
Staff	Associations that represent employees with a role in ATM	To get their insight on the options, objectives and need for future R&I challenges from a social point of view
Suppliers	Both current members and non-members	To get their insight on the options, objectives and need for future R&I challenges
The unmanned airspace vehicle (UAV) community	Unmanned airspace system (UAS) operators, UAS traffic management (UTM) manufacturers and institutions	To get their insight on the options, objectives and need for future R&I challenges and in particular how to involve the UTM community

Table 25 contains the breakdown of interviewees by stakeholder group.

Table 25: Number of interviews per stakeholder category

Stakeholder category	Number	Share (%)
Academia	2	4%
Airports	3	6%
Airspace user community	5	10%
Air navigation service providers (ANSPs)	7	14%
ATM institutions	7	14%
Member States/ Single European Sky (SES) Committee	3	6%
R&D organisations	2	4%
SESAR Joint Undertaking executive	8	16%
SMEs	2	4%
Staff	1	2%
Suppliers	6	12%
The UAV community	4	8%
TOTAL	**50**	

With an average of 4 interviews per category, the highest number of interviews belongs to the stakeholder groups of SESAR Joint Undertaking executives, ANSPs, ATM institutions and suppliers, with eight, seven, seven and six interviews respectively and representing just over 50% of the interviews (56%). It must be noted that the interviewees that were interviewed twice belong to the categories of SESAR Joint Undertaking executive and ATM institutions. Followed by these categories, is the Airspace user community with five interviews and the UAV community with four interviewees. With three and two interviewees are airports, Member States or their SES representatives, R&D organisations and SMEs (some R&D organisations and UAV companies are also SMEs). Finally, we only managed to interview one staff association, mainly due to the small amount of such organisations at EU level that are involved in ATM R&I.

It is important to mention that the success rate of asking and interviewing Member States or their SES representative was very low. Many Member States directed the interviews to their national ANSPs or declined due to being busy or not having enough experts on the matter.

B.4.3 Key results/messages from the targeted consultation

It is worth noting that despite the variety of stakeholders' types, the responses to the stakeholder consultation show there is a strong consensus on their views of ATM R&I, with only slight differences, mainly in the details.

Political and legal context

Emerging Challenges in the field

The need to modernise the existing system though the application of emerging technologies such as digitalisation, automation and big data was a recurrent theme amongst the interviewed and throughout all the categories. Generally, and more specifically airspace users, see as the main challenge addressing environmental

sustainability. In addition, various stakeholders from the airspace user community, ANSPs, ATM institutions and Member States categories, brought up the fact that these challenges are very well reflected in the Airspace Architecture Study.[121]

In addition, airspace user community believe there should be further research in relation to manned and unmanned vehicle interaction.

EU positioning

Many stakeholders in the categories of ANSPs, ATM institutions and SESAR Joint Undertaking agree that European R&I ATM has currently a strong position worldwide, due to having built over the years a coordinated programme that has allowed them to have discussions at ICAO level and be an example for other parts of the world. Furthermore, some stakeholders, specially ATM institutions and the UAV community, stated the EU is losing its upfront position in some of the emerging markets since they develop quicker than the ATM solutions. In this area, the lack of coordinated R&I included in the ATM programme, would leave Europe behind other regions as China and USA which are investing heavily in the drones and UTM research and development.

Previous programmes

A typical comment, especially in the categories of ANSPs, Member States, staff and the SESAR Joint Undertaking executive, regarding the current R&I ATM partnership, SESAR Joint Undertaking (SJU), is that the past ten years allowed the programme to reach a mature situation creating a momentum in the industry, and the advantages of the partnership that has a common vision and will to implement it, can now be exhaustively exploited. SJU experience and results are the fruit of a continuous learning curve, which should be built upon, and lessons learned should be used for future improvements. Stakeholders across all the categories, stated that the SJU has achieved a balanced partnership, except for the need to involve EASA, standardisation bodies, and some new key players such as the UAV community.

There were comments from stakeholders that have been long time in the industry such as in ANSPs, ATM Institutions, suppliers and Member States that agree framework programmes previous to the SJU had a fragmented nature and were a proof that, in ATM, European network benefit is only achieved if there is coordination, and direction accomplished through the consensus across the whole industry. Furthermore, they agree we should not go back into those days given the challenges in front of the industry and national authorities.

Potential synergies between partnerships

A closer interaction with Clean Sky is required in order to avoid duplication, a greater coordination and synergies on the topics of automation and environment in aviation. However, almost every stakeholder interviewed in every category sees no benefit in merging. Merging the partnerships would not make sense due to their different *objectives, scope, timeline to deployment and KPIs*. In case of merger, we would have two subprogrammes under one partnership with funds distribution disputes and an increase in managerial complexity. This was further emphasised by the stakeholders that are involved in both partnerships.

With Shift to Rail the scope and the technologies to be researched are just too different. It would be a good idea to interact on the multimodality matters.

[121] SESAR Joint Undertaking (2019). A proposal for the future architecture of the European airspace. Available at https://www.sesarju.eu/node/3253.

Why should the EU act?

Directionality

Stakeholders across all the categories consider there is a need for EU funding on ATM research. They believe it provides directionality and coherence to an industry that cannot be developed nationally due to the cross-border nature of aviation operations which requires interoperability of national ATM systems. EU funding acts as a mechanism or framework to develop a common view on the future path and avoid singularities of nations or private companies.

Coordination

Action from EU, as stated by most stakeholders across all the categories, provides steering, avoids fragmentation and harmonises the whole value chain of ATM stakeholders. It ensures the benefits are accrued at European network level, thus providing latest technology to all stakeholders, in all geographical areas, not only for the most developed countries.

EU funding of R&I is required to attract investment and commitment from the industry. This is due to the need to outweigh the heavy administration, use of resources, and effort needed to participate in the EU funded R&I. Suppliers, R&D organisations and SMEs emphasised that they believe it is best to invest and commit to a future common path that benefits the whole European network. They need to see an eventual benefit that is worth the investment in order to overcome their individual interests of developing their own R&I and products in isolation, in the favour of a common architecture and goal. Industrial stakeholders such as suppliers and ANSPs stated this would happen if there was no EU funding.

Needs, problems and objectives

European ATM Master Plan and Airspace Architecture Study as ATM R&I guidelines

Mentioned as a need by stakeholders in all the categories is the fact that a significant amount of future R&I is needed to complete the current research agenda and deliver the solutions under the latest edition of European ATM Master Plan.[122]

One of the objectives the potential partnership should have, to which all the stakeholders agree is the maintenance and update the European ATM Master Plan. The European ATM Master Plan sufficiently describes R&I needs in the long term, however the Airspace Architecture Study is a more detailed plan that prioritises the research needs in the shorter term. These need to be better linked with other strategic planning documents like EASA's European Plan for Aviation Safety,[123] Deployment Programme,[124] Network Strategic Plan.[125] The European ATM Master Plan should also be more performance driven than it is today.

However, some stakeholders in various categories where critical regarding the heaviness of the document which requires changes so that is more understandable to members of public. There is some criticism of the Master Plan's lack of a far-seeing and innovative vision which the AAS does take into account. Thus, as said by stakeholders from airports,

[122] SESAR Joint Undertaking (2019). European ATM Master Plan: Digitalising Europe's Aviation Infrastructure, Executive View, 2020 edition

[123] EASA (2019). European Plan for Aviation Safety 2019-2023

[124] SESAR Deployment Manager (2018). Deployment Programme edition 2018

[125]EUROCONTROL (2015). Network Strategic Plan 2015-2019

airspace user community, ANSPs, ATM institution, SESAR Joint Undertaking executive and suppliers, the Master Plan should include the AAS findings.

Furthermore, the European ATM Master Plan updates need to involve in consultation all the stakeholders as it is done currently.

R&I fragmentation

Many stakeholders across all categories directly or indirectly referred that the main problems of ATM are fragmentation of R&I and, consequently, operations. In the event of having no partnership, or a partnership without a neutral and strong coordinating body, fragmentation would be caused by two main reasons: diverging industry interests and sovereignty. This would worsen the current lack of interoperability. Most stakeholders, especially in the industrial and institutional side of the value chain: airspace user community, ANSPs, ATM institutions, Member States, SESAR Joint Undertaking executives, staff, suppliers and the UAV community, agree the interoperability is a key for a cross boundary industry such as aviation. Furthermore, they believe lack of interoperability is one of the key topics that needs further research in ATM since it leads to many issues. Thus, lack of coordination and direction in the ATM R&I would lead to R&I fragmentation, which has been highlighted as a problem that is a source of many other problems.

ATM system modernisation

Some stakeholders in the categories of service providers and suppliers mentioned that one of the needs is to develop a network centric system that is scalable, resilient and flexible to quickly adapt to external changes or new technologies. A system with these characteristics would solve the problem of airspace capacity which is strongly linked with other ATM inefficiencies.

As commented in the section on emerging challenges, stakeholders in all the categories make the point that R&I should focus on developing new technologies and concepts (e.g. automation or artificial intelligence) that aim at the overall system modernisation and digitalisation (ANSPs, suppliers and the UAV community emphasised the importance of digitalisation and automation).

R&I pace and its link with deployment

The pace of R&I is about right today. Acceleration, if needed, should not constrain quality nor safety. However, deployment does need to be accelerated through paying more attention to the implementation challenges (e.g. very large demonstrations and early demonstrators) and change management needed for deployment. This will allow to implement breakthrough technologies faster. Fundamental (exploratory), industrial and validation research activities are all needed, giving more importance to the validation exercises since it collects evidence for standards and regulations which facilitate deployment. There is a need to get closer to deployment and close gaps between the research and industrialisation phases. Eight of twelve stakeholder groups noted that closer cooperation and involvement of EASA and EUROCAE would support narrowing of the gap between the R&I and industrialisation phases. This issue was not commented on by academia, airports, R&D organisations and SMEs. Some stakeholders believe R&I should get a bit closer but to keep it separate from deployment while others believe it would be good to get very close or even into deployment using CEF funds. Airspace users agree that the end users such as ANSPs, airspace users and airports should be the ones driving R&I since they are more aware of the needs and it would avoid emergence of diverging interests among suppliers.

In addition, some stakeholders mentioned the need of prioritising R&I as it moves towards higher TRLs on its way to deployment.

Openness and transparency

Openness and transparency are important to be considered but there is a wide view that the current partnership, SESAR Joint Undertaking, addresses these values correctly. Fragmented data sharing needs to be tackled in order to enable the use of big data techniques. Communication of the research and solutions developed has to be kept as it is in the current partnership with expectations to keep improving it.

Comparative assessment of the policy options

Baseline

Throughout all the categories, stakeholders made the strong point that there is a need to build a partnership as a body that can steer the R&I coordinating key stakeholders continuously, to achieve the common EU-wide long-term ATM vision. Thus, the baseline is not considered by them as a feasible option.

Co-programmed

A couple of stakeholders inside the categories of airports and the UAV community suggested that a co-programmed partnership could be a good idea in order to promote more competition between ideas and bring innovation whilst giving more opportunities and enhance the competitiveness of SMEs. However, a stakeholder from the SME category mentioned co-programmed could pick either the best or worst direction, and would likely be controlled by the big players. It was also seen as the preferred option by a stakeholder from the airspace user community since they believe it limits national influence. However, most of the stakeholders see it as a partnership type that lacks the cohesive strength required to move the R&I in the direction that has EU-wide benefits as a goal. Even if the European Commission may act as coordinating figure, it is not likely that the general Horizon Europe services would necessarily have core industry expertise to be able to coordinate R&I taking into account the long-term goals of deployment of results (as the services focus on R&I, not the uptake). The fact that it is non-legally binding creates a big risk in commitment from the key stakeholders leading to diverging interests.

Furthermore, many stakeholders, especially those at institutional level, agree that a co-programmed partnership would not have a necessary neutrality of coordination (given diverging interests). As co-programmed partnership would not have a status of a state institution, it would lose the ability to represent the EU ATM interests on international stage.

Institutional partnership under article 187

To progress the R&I in ATM and produce benefits for the entire society and network, there is a need to have legally binding commitments, strong leadership and steering because high efforts are required. In addition, the nature of ATM requires to have private members which have the industry experts but also public authorities such as EUROCONTROL and the European Commission in the centre to be the guiding light. Therefore, most of the stakeholders share the conviction that an institutionalised partnership (IP) under Article 187 with a similar set up to SESAR Joint Undertaking is the best option.

Furthermore, the current partnership achieved a unique vision for the future and the consensus between the stakeholders on the roadmap. The IP under Art 187 would push further the previous effort and make sure the last 10 years were not in vain.

Discarded options: co-founded and institutional partnership under article 185

Every interviewed stakeholder in all the categories, including stakeholders in the Member States category, made clear the point that in the ATM industry the relevant stakeholders are both in the public and in the private sector. The knowledgeable expertise can mainly

be found in the private sector and the public sector is mainly composed by the Member States which do not get involved in R&I as such. This was highlighted when the Member States forwarded our interview invitation to their Single Sky Committee representatives (or advised to talk to their ANSP representative) as their role is in steering the R&I at a higher level, through providing opinion and approving the European ATM Master Plan.

Therefore, due to the low participation of public authorities in the R&I and the need to include the private industry, all the stakeholders (including those from Member States/SES) agreed that co-founded and institutional partnership under article 185 should be discarded.

The preferred option

Stakeholder involvement

One of the key added value of the current partnership is that it brings together the key stakeholders of the value chain to agree on the key European issues whilst keeping it manageable. This should be kept in the preferred option. However, some stakeholders across all the categories commented on the possibility of extending the partnership to the UAV community, business aviation, regulators, communication service providers and satellite communication service providers, and to have a stronger involvement of EASA (as a regulator) and standardisation bodies (e.g. EUROCAE). Airspace users, SMEs, staff and supplier stakeholder groups did not directly cite the inclusion of drones, but did endorse the European ATM Master Plan as a good strategic agenda (which includes these emerging challenges). There is a need to further involve airspace users and make R&I more market-driven for which EASA needs to be strongly involved. It would be interesting, if they exist, to involve experts in change management. Some stakeholders made the point of bringing innovative companies with cutting-edge solutions in the partnership, with the caveat to ensure they are stable.

Most of the airspace users stated that they do not have resources to participate directly in the research activities, but would like stronger involvement in the partnership similar to the current one. In the current one, they have a voice in the governance, but would like to expand that to the opportunity for higher involvement in the work.

Increase flexibility

There should be flexibility to enrol different stakeholders. Airspace users, the drone community, academia, SMEs and innovative companies should be enrolled in the partnership specially in topics where they can add significant value, but taking care to keep the governance manageable. In order to do so, some interviewees, especially in the ANSP and supplier category, suggested these could be involved as third party beneficiaries, through open calls or having different membership options with different membership fee and resource contribution. In having different membership options, it was mention that even if the contribution is different having members with different levels of say around the table adds complexity, so they should have the same say but not the same project engaging options.

Level of funding

The funding level of SESAR 2020 is the minimum needed. It must be borne in mind that if adding into the scope of the partnership, either by including new wide topics such as drones and digitalisation or by implementing Very Large Demonstration/ early adopters to get solutions closer to deployment, the funding should double. There is a threshold in the funding under which there is no leverage of the investment.

Winding down

Some suggestions from stakeholders, interviewed in the categories of ATM institutions and SESAR Joint Undertaking executive, on when to close down the institutional partnership include: once the European ATM Master Plan is achieved and the system only needs to be maintained in order make sure it does not degrade, once the process of digitalisation is sufficiently mature or once the industry is able to coordinate themselves following a strategic research and innovation agenda and overcoming individual interests.

This would slowly take place by reducing activity and switching from a strong coordinating body to a monitoring body.

B.5 Open public consultation on the Candidate institutionalised European Partnerships

B.5.1 Approach to the open public consultation

The consultation was open to everyone via the EU Survey online system.[126] The survey contained two main parts and an introductory identification section. The two main parts collected responses on general issues related to European partnerships (in Part 1) and specific responses related to 1 or more of the 12 candidate initiatives (as selected by a participant).

The survey contained open and closed questions. Closed questions were either multiple choice questions or matrix questions that offered a single choice per line, on a Likert-scale. Open questions were asked to clarify individual choices.

The survey was open from 11 September till 12 November 2019. The consultation was available in English, German and French. It was advertised widely through the European Commission's online channels as well as via various stakeholder organisations.

The analysis of the responses was conducted by applying descriptive statistic methods to the answers of the closed questions and text analysis techniques to the analysis of the answers of the open questions. The keyword diagrams in this report have been created by applying the following methodology: First, the open answer questions were translated into English. This was followed by cleaning of answers that did not contain relevant information, such as "NA", "None", "no comment", "not applicable", "nothing specific", "cannot think of any", etc. In a third step, common misspellings were corrected, such as "excellence" instead of "excellence", or "partnership" instead of "partnership". Then, then raw open answers were tokenised (i.e. split into words), tagged into parts of speech (i.e. categorised as a noun, adjective, preposition, etc) and lemmatised (i.e. extraction of the root of each word) with a pre-trained annotation model in the English language. At this point, the second phase of manual data cleaning and correction of the automatic categorisation of words into parts of speech was performed. Finally, the frequency of appearance and co-occurrences of words and phrases were computed across the dataset and the different sub-sets (e.g. partnerships, stakeholder groups). Data visualisations were created based on that output.

The keyword graphs in the following sections have been built based on the relationships between words in the open responses of the survey participants. It features words that appear in the same answer either one after the other or with a maximum distance of two words between them. Each keyword is represented as a node and each co-occurrence of a pair of words is represented as a link. The size of the nodes and the thickness of the links vary according to the number of times that keywords are mentioned and their co-occurrence, respectively. In order to facilitate the visualisation of the network, the keyword graphs have been filtered to show the 50 most common co-occurrences. Although the

[126] https://ec.europa.eu/eusurvey/runner/ConsultationPartnershipsHorizonEurope

keywords do not aim to substitute a qualitative analysis, they assist the identification of the most important topics covered in the answers and their most important connections with other topics, for later inspection in the set of raw qualitative answers.

B.5.2 Overview of respondents to the open public consultation

Profile of respondents

In total, 1635 respondents filled in the questionnaire of the open public consultation. Among them, 272 respondents (16.64%) were identified to have responded to the consultation as part of a campaign (coordinated responses). Based on the Better Regulation Guidelines, the groups of respondents where at least 10 respondents provided coordinated answers were labelled as *'campaigns',* segregated and analysed separately and from other responses. In total 11 campaigns were identified. In addition, 162 respondents in the consultation also display similarities in responses but in groups smaller than 10 respondents. Hence, these respondents were not labelled as campaigns and therefore were not analysed separately from the general analysis.

Among the 1635 respondents, 1178 (72.05%) completed the online consultation in English, 141 (8.62%) in German, 89 (5.44%) in French, 58 (3.55%) in Italian and 47 (2.87%) in Spanish, see Figure 15. Respondents that belong to the 11 campaigns follow the same pattern of language distribution, with English being the dominant language of respondents in that group. Table 26 shows that over 50% of respondents come from 4 Western and Southern European countries – Germany, Italy, France and Spain. Overall, the number of respondents from Eastern and Northern Europe is lower, while among non-EU countries the greater number of respondents come from Switzerland, Norway and Turkey, which are countries associated to the Framework Programme. In the group of respondents labelled as campaigns, most respondents are from Germany (48 respondents or 17.65%), France (39 respondents or 14.34%), Italy (37 respondents or 13.6%), Belgium (23 respondents or 8.46%), the Netherlands (21 respondents or 7.72%) and Spain (17 respondents or 6.25%). Hence, a similar pattern of country of origin is observed in the entire sample of respondents and for the campaigns.

Across all respondents 40.80% indicated to answer to the open public consultation in a public way (non-anonymous) and 20.67% of all respondents indicated their Transparency Register number.

Figure 15: Language of the consultation that selected respondents (N=1635) (non-campaign replies) Aggregation of responses of all candidate initiatives

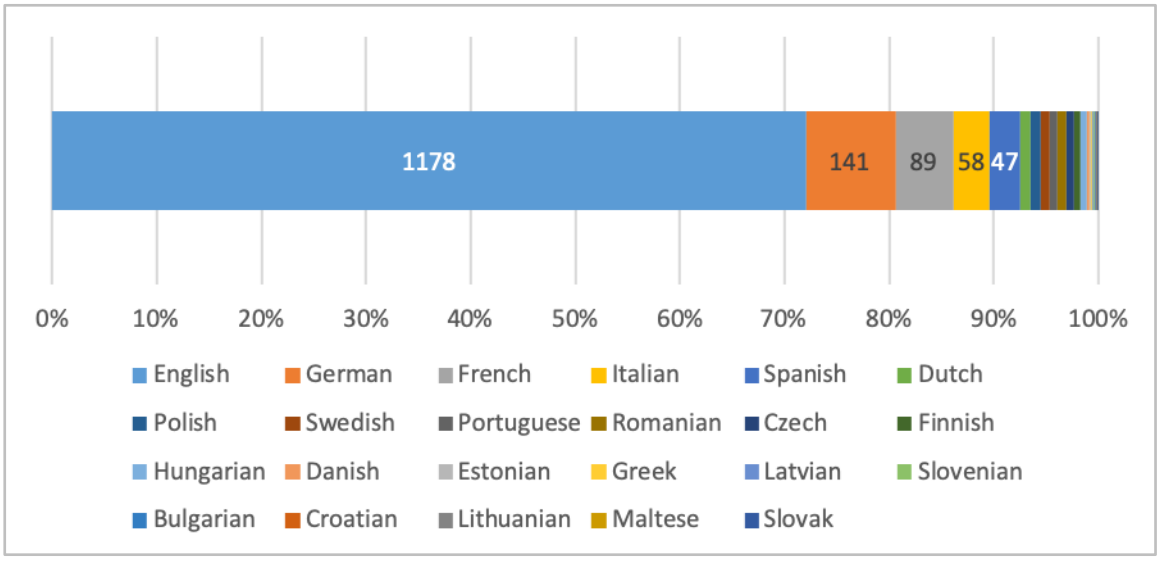


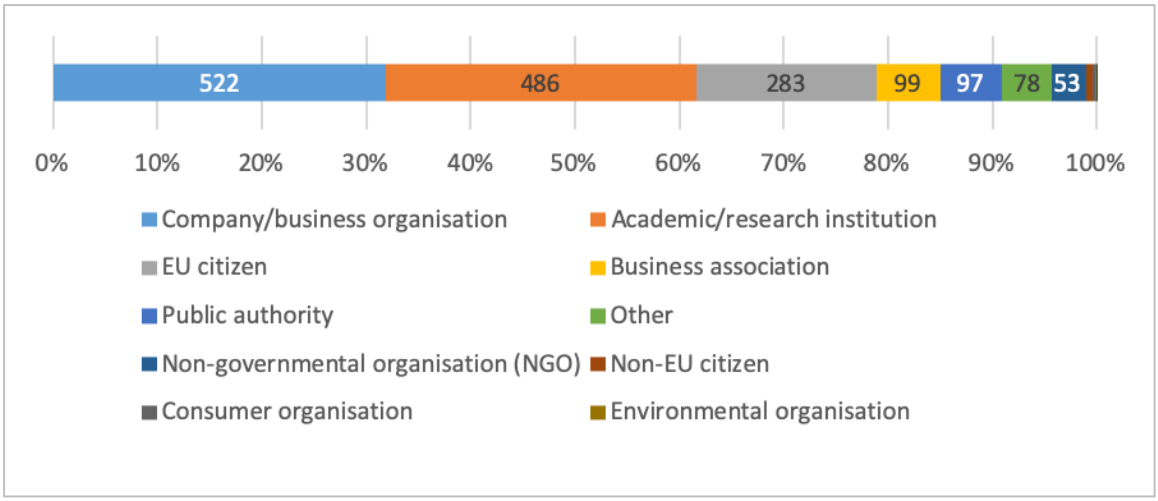
Table 26: Country of origin of respondents (N=1635)

Country	Number of respondents	Percentage of respondents
Germany	254	15.54%
Italy	221	13.52%
France	175	10.70%
Spain	173	10.58%
Belgium	140	8.56%
The Netherlands	86	5.26%
Austria; United Kingdom	61	3.73%
Finland	49	3.00%
Sweden	48	2.94%
Poland	45	2.75%
Portugal	32	1.96%
Switzerland	28	1.71%
Czechia	24	1.47%
Greece	23	1.41%
Norway; Romania	22	1.35%
Denmark	20	1.22%
Turkey	19	1.16%
Hungary	14	0.86%
Ireland	12	0.73%
United States	11	0.67%
Estonia; Slovakia; Slovenia	10	0.61%
Bulgaria; Latvia	9	0.55%
Bosnia and Herzegovina	7	0.43%
Lithuania	4	0.24%
Canada; Croatia; Israel	3	0.18%
China; Ghana; Iceland; Japan; Luxembourg; Morocco	2	0.12%
Bhutan; Botswana; Cyprus; Iran; Malta; Mexico; Moldova; Mongolia; Palestine; Russia; Serbia; South Africa; Tunisia; Ukraine; Uruguay	1	0.06%

According to Figure 16, the three biggest groups of respondents are companies and business organisations (522 respondents or 31.93%), academic and research institutions (486 respondents or 29.72%) and EU citizens (283 respondents or 17.31%). Business associations, representing multiple businesses, were the fourth largest responding group (99 respondents or 6.05%), no other types of associations were presented amongst the selectable options for respondents. Among the group of respondents that are part of

campaigns, most respondents are provided by the same groups of stakeholders, namely companies and business organisations (121 respondents or 44.49%), academic and research institutions (54 respondents or 19.85%) and EU citizens (42 respondents or 15.44%).

Figure 16: Type of respondents (N=1635) (non-campaign replies) Aggregation of responses of all candidate initiatives



Respondents were asked to indicate the organisational size of the companies, organisations and institutions they work for. Based on Table 27, a greater number of respondents work in large companies and business organisations (295 respondents out of 522 or 56.51%) and large academic and research institutions (348 respondents out of 486 or 71.60%). A greater number of respondents that are employed by business associations and NGOs indicated an organisation size of 1 to 9 employees. Among the group of respondents that are marked as campaigns, a greater number of respondents work in large companies and business organisations (82 respondents out of 121 or 67.77%) and academic and research institutions (39 out of 54 respondents or 72.22%).

Table 27: Size of organisations that represent consultation respondents (N=1635)

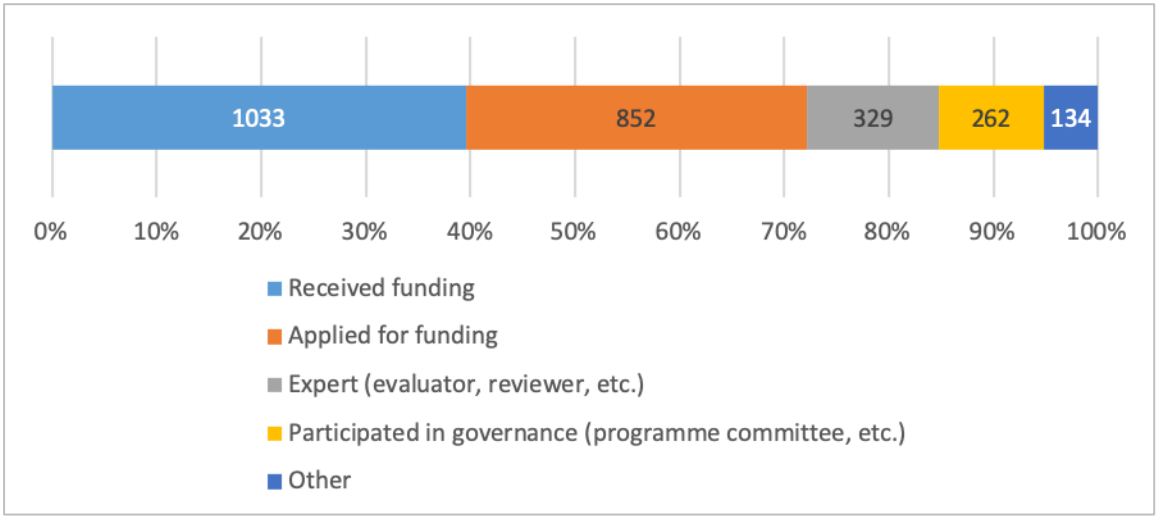
	Organisation size			
Type of respondents' organisations	**Large (250 employees or more)**	**Medium (50 to 249 employees)**	**Small (10 to 49 employees)**	**Micro (1 to 9 employees)**
Company/business organisation	295	66	90	71
Academic/research institution	348	95	31	12
Business association	15	6	34	44
Public authority	58	33	6	0
Non-governmental organisation (NGO)	7	9	11	26
Consumer organisation	1	0	2	1
Environmental organisation	0	0	1	0
Trade union	0	0	1	0

	Organisation size			
Type of respondents' organisations	Large (250 employees or more)	Medium (50 to 249 employees)	Small (10 to 49 employees)	Micro (1 to 9 employees)
Other	24	16	19	19

Among all consultation respondents, 1303 (79.69%) have been involved in the on-going research and innovation framework programme Horizon 2020 or the preceding Framework Programme 7, while 332 respondents (20.31%) were not. In the group of campaign respondents, the share of those who were involved in these programmes is higher (245 respondents out of 272 or 90.07%) than in the group of non-campaign respondents (1058 out of 1363 or 77.62%). When respondents that participated in the Horizon2020 or in the preceding Framework Programme 7 were asked to indicate in which capacity they were involved in these programmes, the majority stated that they were a beneficiary (1033 respondents or 39.58%) or applicant (852 respondents or 32.64%).

The main stakeholder categories, e.g. companies/business organisation, academic/research institutions, etc., show a similar distribution across the capacities in which they 'have been involved in Horizon 2020 or in the Framework Programme 7' as the overall population of consultation respondents (see distribution in Figure 17). However, a few stakeholder categories have mainly been involved in the capacity of "Received funding" and/or "Applied for funding", this applies to business associations, NGOs and public authorities.

Figure 17: Capacity in which respondents were involved in Horizon 2020 or in the Framework Programme 7 (N=1303)(non-campaign replies) Aggregation of responses of all candidate initiatives, multiple options allowed



Among those who have been involved in the on-going research and innovation framework programme Horizon 2020 or the preceding Framework Programme 7, 1035 respondents (79.43%) are/were involved in a partnership. The share of respondents from campaigns that are/were involved in a partnership is higher than for non-campaign respondents, 89.80% versus 77.03% respectively. The list of partnerships under Horizon 2020 or its predecessor Framework Programme 7 together with the numbers, percentages of participants is presented in Table 28, the table also shows the key stakeholder categories for each partnership.

Most consultation respondents participated in the following partnerships: Fuel Cells and Hydrogen 2 (FCH2) Joint Undertaking, Clean Sky 2 Joint Undertaking, European Metrology Programme for Innovation and Research (EMPIR) and in Bio-Based Industries Joint

Undertaking. The comparison between the non-campaign and campaign groups of respondents shows that the overall distribution is quite similar. However, there are some differences. For the campaign group almost a half of respondents is/was involved in the Fuel Cells and Hydrogen 2 (FCH2) Joint Undertaking, a higher share of campaign respondents is/was participating in Clean Sky 2 Joint Undertaking and in Single European Sky Air Traffic Management Research (SESAR) Joint Undertaking.

Table 28: Partnerships in which consultation respondents participated (N=1035)

Name of the partnership	Number and % of respondents from both groups (n=1035)	Number and % of respondents from a non-campaign group (n=815)	Academic/research institutions	Business associations	Company/business organisations (<250)	Company/business organisations (250+)	EU citizens	NGOs	Public authority
Fuel Cells and Hydrogen 2 (FCH2) Joint Undertaking	354 (33.33%)	247 (30.31%)	97	9	37	43	41	8	5
Clean Sky 2 Joint Undertaking	195 (18.84%)	145 (17.79%)	57	2	10	27	37	1	7
European Metrology Programme for Innovation and Research (EMPIR)	150 (14.49%)	124 (15.21%)	64	0	13	9	14	2	19
Bio-Based Industries Joint Undertaking	142 (13.72%)	122 (14.97%)	39	8	20	27	14	1	6
Shift2Rail Joint Undertaking	124 (11.98%)	101 (12.40%)	31	7	5	31	14	3	7
Electronic Components and Systems for European Leadership (ECSEL) Joint Undertaking	111 (10.72%)	88 (10.80%)	42	2	7	20	12	0	5
Single European Sky Air Traffic Management Research (SESAR) Joint Undertaking	66 (6.38%)	46 (5.64%)	10	3	3	20	3	2	3
5G (5G PPP)	53 (5.12%)	47 (5.77%)	20	1	6	14	5	0	1

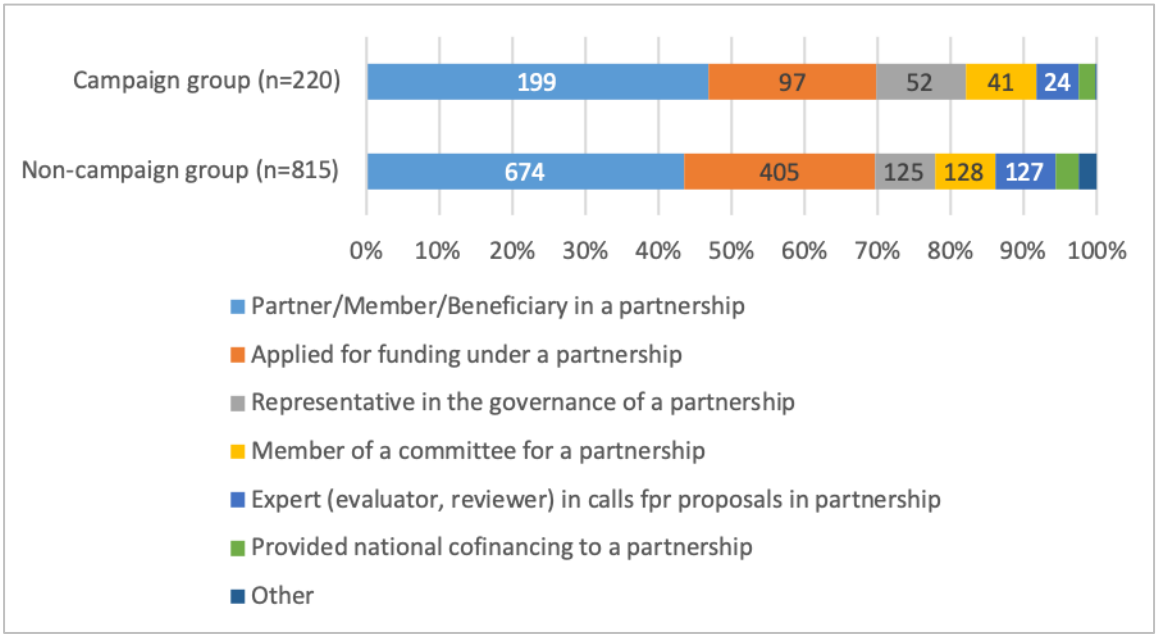
Name of the partnership	Number and % of respondents from both groups (n=1035)	Number and % of respondents from a non-campaign group (n=815)	Academic/research institutions	Business associations	Company/business organisations (<250)	Company/business organisations (250+)	EU citizens	NGOs	Public authority
Eurostrars-2 (supporting research-performing small and medium-sized enterprises)	44 (4.25%)	40 (4.91%)	17	0	6	1	7	0	6
Innovative Medicines Initiative 2 (IMI2) Joint Undertaking	37 (3.57%)	35 (4.29%)	18	2	3	3	2	4	3
Partnership for Research and Innovation in the Mediterranean Area (PRIMA)	28 (2.71%)	26 (3.19%)	15	0	3	1	2	0	2
European and Developing Countries Clinical Trials Partnership	25 (2.42%)	24 (2.94%)	12	0	1	2	3	3	2
Ambient Assisted Living (AAL 2)	22 (2.13%)	21 (2.58%)	11	2	1	1	3	0	3
European High-Performance Computing Joint Undertaking (EuroHPC)	22 (2.13%)	18 (2.21%)	6	0	2	3	5	0	2

When respondents were asked in which role(s) they participate(d) in a partnership(s), over 40% indicated that they act(ed) as partner/member/beneficiary in a partnership (see Figure 18). The second largest group of respondents stated that they applied for funding under a partnership. The roles selected by non-campaign and campaign respondents are similar.

The few respondents that selected "Other" as their role were provided with the opportunity to outline their role. A total of 25 people did provided description. The answers provided were very varied and could not be clustered in sub-groups, a few examples are: former communication and stakeholder relationship officer, chair of steering board, system

engineer, grant manager, Joint Programming Initiative (JPI), or a role in advocacy of the partnership.

Figure 18: Role of respondents in a partnership (N=1035) (non-campaign replies) Aggregation of responses of all candidate initiatives



In the open public consultation respondents could provide their views on each of the candidate Institutionalised European Partnerships, and each respondent could select multiple partnerships to provide their views on. The table below presents the number and percentage of respondents for each partnership. It is visible that the majority of respondents (31.37%) provided their views on the Clean Hydrogen candidate partnership. More than 45% of respondents from the campaigns selected this partnership. Around 15% of all respondents provided their views for the candidate partnerships European Metrology, Clean Aviation and Circular bio-based Europe. The share of respondents in the campaign group that chose to provide views on the Clean Aviation candidate partnership is of 20%. The smallest number of respondents provided opinions on the candidate initiative 'EU-Africa research partnership on health security to tackle infectious diseases – Global Health'.

Table 29: Future partnerships for which consultation respondents provide responses (N=1613)

Name of the candidate Institutionalised European partnership	Number and % of respondents from both groups (n=1613)	Number and % of respondents from a non-campaign group (n=1341)	Academic/research institutions	Business associations	Company/business organisations (<250)	Company/business organisations (250+)	EU citizens	NGOs	Public authority
Clean Hydrogen	506 (31.37%)	382 (28.49%)	123	21		55	74	8	13

Name of the candidate Institutionalised European partnership	Number and % of respondents from both groups (n=1613)	Number and % of respondents from a non-campaign group (n=1341)	Academic/research institutions	Business associations	Company/business organisations (<250)	Company/business organisations (250+)	EU citizens	NGOs	Public authority
European Metrology	265 (16.43%)	225 (16.78%)	112	3	21	11	34	3	28
Clean Aviation	246 (15.25%)	191 (14.24%)	57	5	21	34	54	3	8
Circular bio-based Europe: sustainable Innovation for new local value from waste and biomass	242 (15%)	215 (16.03%)	63	19	36	35	31	7	13
Transforming Europe's rail system	184 (11.41%)	151 (11.26%)	29	14	23	39	31	2	7
Key Digital Technologies	182 (11.28%)	162 (12.08%)	55	13	20	22	35	5	7
Innovative SMEs	111 (6.88%)	110 (8.20%)	19	12	39	4	14	4	10
Innovative Health Initiative	110 (6.82%)	108 (8.05%)	35	6	9	12	16	16	5
Smart Networks and Services	109 (6.76%)	107 (7.98%)	34	9	12	17	21	2	6
Safe and Automated Road Transport	108 (6.70%)	102 (7.61%)	25	12	11	19	10	3	9
Integrated Air Traffic Management	93 (5.77%)	66 (4.92%)	8	7	4	24	9	2	7
EU-Africa research partnership on health security to tackle infectious diseases – Global Health	49 (3.04%)	47 (3.50%)	15	2	4	3	12	6	4

Campaigns per candidate Institutionalised European Partnership

As was mentioned above, 11 campaigns were identified, the largest of them includes 57 respondents. The table below presents the campaigns that replied for each candidate partnership. As presented, the candidate Institutionalised Partnership Clean Hydrogen has the highest number of campaigns, namely 5. A few partnerships, such as Innovative SMEs, Smart Networks and Systems, were not targeted by campaigns. Some campaign respondents decided to provide opinions about several partnerships, therefore, campaign #2 and #6 feature in several partnerships.

Table 30: Overview of campaigns across partnerships

Name of the candidate Institutionalised European partnership	Number of a campaign group (total number of respondents in a campaign)	Number of respondents that provided views about a partnership
Clean Hydrogen	Campaign #1 (57 respondents)	57 respondents
	Campaign #2 (41 respondents)	25 respondents
	Campaign #7 (18 respondents)	18 respondents
	Campaign #9 (14 respondents)	13 respondents
	Campaign #11 (10 respondents)	9 respondents
Clean Aviation	Campaign #2 (41 respondents)	17 respondents
	Campaign #6 (19 respondents)	19 respondents
	Campaign #8 (14 respondents)	13 respondents
Integrated Air Traffic Management	Campaign #2 (41 respondents)	10 respondents
	Campaign #6 (19 respondents)	12 respondents
European Metrology	Campaign #3 (36 respondents)	35 respondents
Circular bio-based Europe: sustainable Innovation for new local value from waste and biomass	Campaign #5 (20 respondents)	20 respondents
Transforming Europe's rail system	Campaign #4 (31 respondents)	29 respondents
Key Digital Technologies	Campaign #10 (12 respondents)	12 respondents
Innovative SMEs	-	-
Innovative Health Initiative	-	-
Smart Networks and Services	-	-
Safe and Automated Road Transport	-	-
EU-Africa research partnership on health security to tackle infectious diseases – Global Health	-	-

B.5.3 Responses to the open public consultation at programme level

The following section of the report presents the analysis of responses at programme level, meaning all respondents (excluding campaigns) were included, independent of which candidate European Partnerships respondents selected to provide their views on. The results for responses as part of campaigns are presented separately.

Characteristics of future candidate European Partnerships

Respondents were asked to assess what areas, objectives, aspects need to be in the focus of the future European Partnerships under Horizon Europe and to what extent. According to Figure 19, a great number of respondents consider that a significant contribution by the future European Partnerships is 'fully needed' to achieve climate-related goals, to the development and effective deployment of technology and to EU global competitiveness in specific sectors/domains. Overall, respondents' views reflect that many aspects require attention of the Partnerships. The least attention should be paid to responding towards priorities of national, regional R&D strategies, including smart specialisation strategies, according to respondents.

Overall, only minor differences can be found between the main stakeholder categories. Academic/research institutions value the responsiveness towards EU policy objectives and focus on development and effective deployment of technology a little less than other respondents. Business associations, however, find that the future European Partnerships under Horizon Europe should focus a little bit more on the development and effective deployment of technology than other respondents. Furthermore, business associations, large companies as well as SMEs (companies with less than 250 employees) value role of the future European Partnerships for significant contributions to EU global competitiveness in specific sectors domains a little higher than other respondents. Finally, both NGOs and Public authorities put a little more emphasis on the role of the future European Partnerships for significant contributions to achieving the UN SDGs.

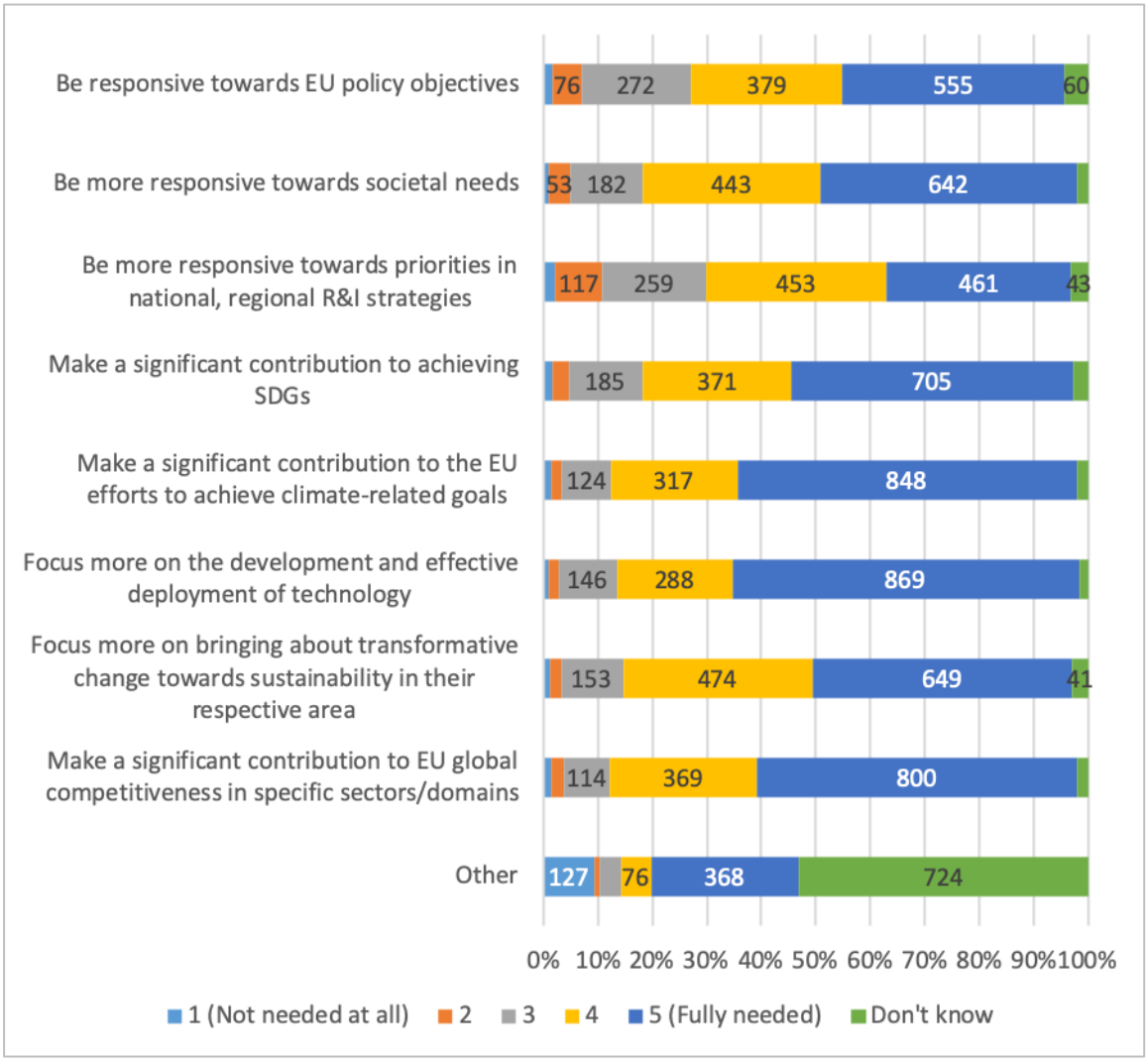
The views of citizens (249, or 18.27%), both EU and non-EU citizens, that participated in the open public consultation do not reflect significant differences with other types of respondents. However, respondents that are/were directly involved in a partnership under Horizon 2020 or its predecessor Framework Programme 7 assign a higher importance of the future European Partnerships to be more responsive towards EU policy objectives and to make a significant contribution to achieving the UN's Sustainable Development Goals.

Among 272 respondents that are classified as **campaigns,** the majority (86.76%) indicated that the future European Partnerships should focus more on the development and effective deployment of technology. Other categories of presented needs that received a high score among many campaign respondents are the need to make a significant contribution to the EU efforts to achieve climate-related goals, Sustainable Development Goals and to EU global competitiveness in specific sectors/domains. The least number of campaign respondents valued the need to be more responsive towards priorities in national, regional R&I strategies (54 respondents gave a score "5 Fully needed", or 19.85%) and to be more responsive towards societal needs (71 respondents gave a score "5 Fully needed", or 26.10%).

Similarly as for non-campaign respondents, we find only minor differences between the main stakeholder categories amongst campaign respondents. Academic/research institutions indicated that the future European Partnerships need to focus a little less on development and effective deployment of technology than other respondents. On the contrary, large companies find the focus on the development and effective deployment of technology a little more needed than other respondents, as do public authorities. Furthermore, large companies feel responsiveness towards priorities in national, regional R&I strategies is a little less needed than other respondents. Public authorities, however,

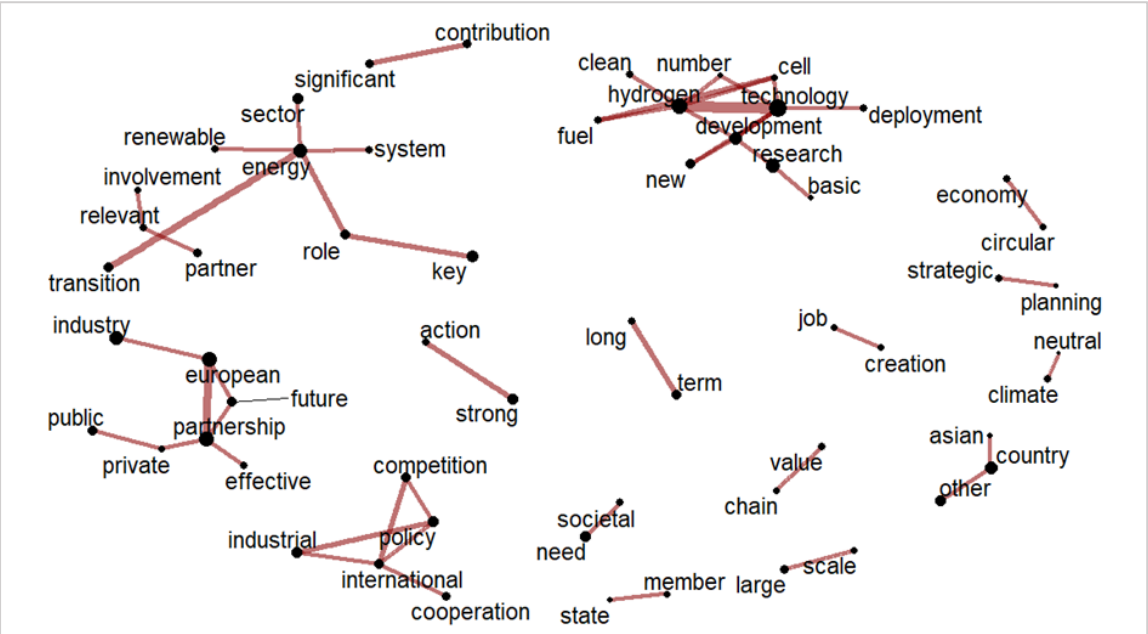
value the responsiveness towards societal needs and priorities in national, regional R&I strategies more than others.

Figure 19: To what extent do you think that the future European Partnerships under Horizon Europe need to (N=1363) (non-campaign replies) Aggregation of responses of all candidate initiatives



The analysis of the open answers provided to explain the "Other" field show that many respondents included the set-up of public-private European partnerships and the link between industrial policy and international competition and cooperation (see Figure 20). This is confirmed through qualitative analysis of answers, many of which mention the importance of collaboration and integration of relevant stakeholders to tackle main societal challenges and to contribute to policy goals. Against this backdrop, fragmentation of funding and research efforts across Europe should be avoided. Additionally, several respondents suggested that faster development and testing of technologies, acceleration of industrial innovation projects, science transfer and market uptake are deemed as priorities. Next to that, many respondents provided answers related to the fields of hydrogen and the energy transition, which corresponds to the high number of respondents that provided answers to the candidate European Partnership specific questions related to these topics.

Figure 20: Assessment of needs, open answers to "Other" field, 50 most common co-occurring keywords (N=734) (non-campaign replies) Aggregation of responses of all candidate initiatives



Many of the respondents that are classified as campaigns took the opportunity of the "Other" field to underline their key messages. The main aspects mentioned were:

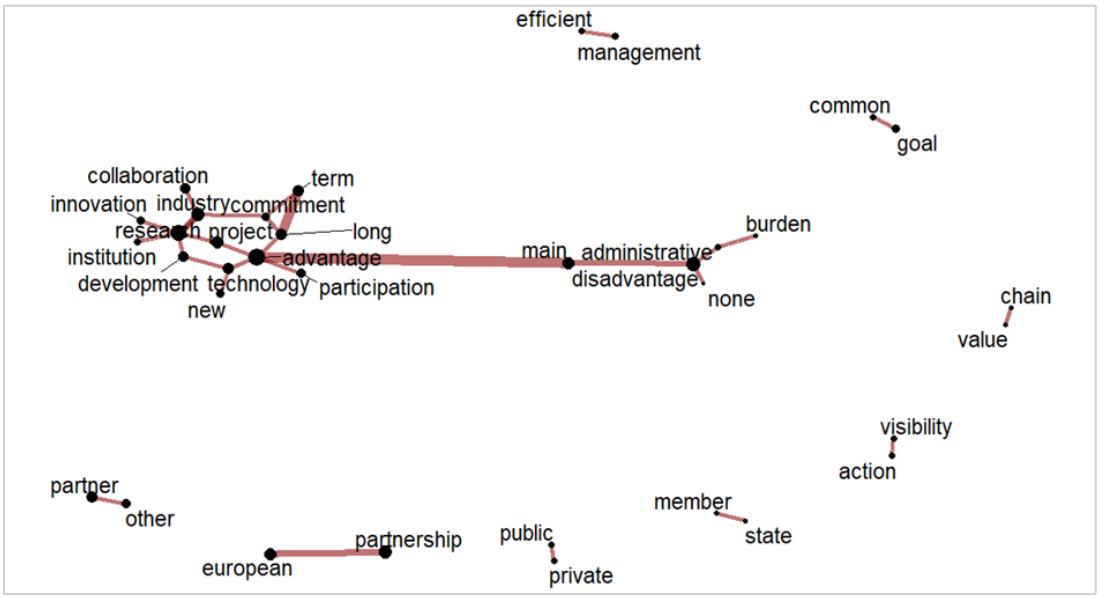
- The global positioning of Europe: outlining the role of global competition (including the role of technology), the importance of autonomy for Europe and the ability of Europe to act as a key player at the global level.
- The balance between policy objectives and private sector interests: Partnerships are regarded as an instrument to secure industry commitments due to the stability required for investments that serve policy goals.
- The importance of the transition between research and innovation (implementing research results in the market).
- The importance of multidisciplinary, and specifically cross-sectoral/cross-partnership collaboration.
- The importance of the long term commitment of a wide range of relevant stakeholders.

Next to that many respondents as part of campaigns stressed the importance of the energy transition, hydrogen and the environment, which corresponds to the high number of respondents that provided answers to the candidate European Partnership specific questions related to these topics.

Main advantages and disadvantages of Institutionalised European Partnerships

In the next question, respondents were asked to outline the main advantages and disadvantages of participation in an Institutionalised European Partnership (as a partner) under Horizon Europe. This was an open question for which a keyword analysis was used (see the main results in Figure 21). As can be observed, the advantages mentioned focus on the development of technology, overall collaboration between industry and research institutions, and the long-term commitment. Disadvantages mentioned are mainly administrative burdens.

Figure 21: What would you see as main advantages and disadvantages of participation in an Institutionalised European Partnership (as a partner) under Horizon Europe? (non-campaign replies) Aggregation of responses of all candidate initiatives, 30 most common co-occurring keywords (N=1551)



When asked about the main advantages and disadvantages of participation in an Institutionalised European Partnership (as a partner) under Horizon Europe, the following points were mentioned by respondents that are classified as campaigns:

Advantages:

- Long term commitment, stability, and visibility in financial, legal, and strategic terms
- Participation of wide range of relevant stakeholders in an ecosystem (large/small business, academics, researchers, experts, etc.)
- Complementarity with other (policy) initiatives at all levels EU, national, regional
- Efficient and effective coordination and management
- High leverage of (public) funds
- Some innovative field require high levels of international coordination/standardisation (at EU/global level)
- Ability to scale up technology (in terms of TRL) through collaboration
- Networking between members
- Direct communication with EU and national authorities

Disadvantages:

- Slow processes
- System complexity
- Continuous openness to new players should be better supported as new participants often bring in new ideas/technologies that are important for innovation
- Lower funding percentage compared to regular Horizon Europe projects
- Cash contributions
- Administrative burdens

- Potential for IPR constraints

Relevance of EU level efforts to address problems in selected areas of Partnerships

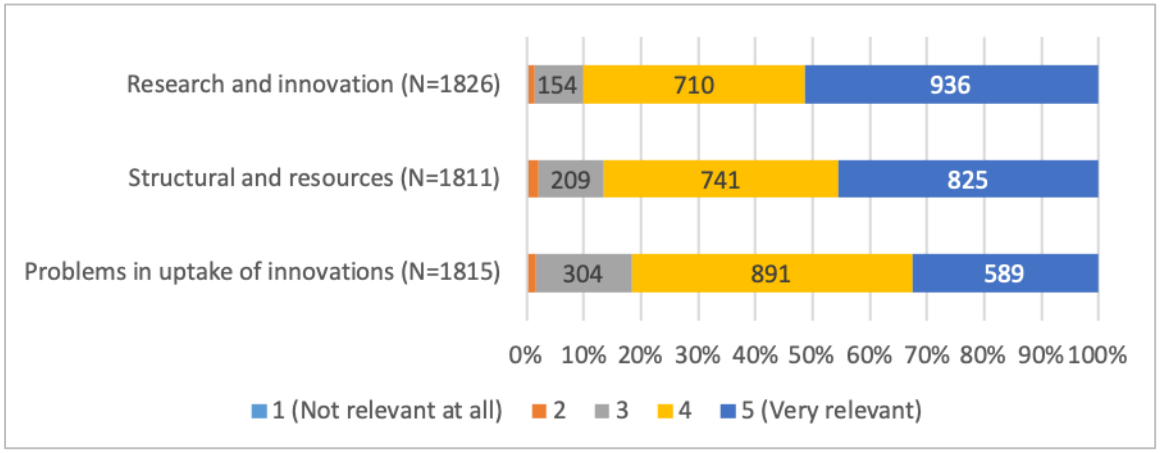
Per candidate European Partnership respondents were asked to rate the relevance of partnership specific problems in three main areas: Research and innovation problems, Structural and resource problems and Problems in the uptake of innovations. To aggregate results the average of the responses on partnership specific problems were calculated.

As presented in Figure 22, research and innovation related problems were rated as most relevant by the respondents across all candidate initiatives, followed by structural and resources problems and problems in the uptake of innovations. Overall, all three areas were deemed (very) relevant across the partnerships, as more than 80% of respondents found these challenges (very) relevant.

Only minor differences were found between the main stakeholder categories of respondents. Research and innovation problems were found slightly more relevant by academic/research institutions, yet slight less relevant by large companies and SMEs. Structural and resource problems were indicated as slightly more relevant by NGOs, but slightly less by academic/research institutions. While both NGOs and public authorities find it slightly more relevant to address problems in uptake of innovation than other respondents.

The views of citizens, both EU and non-EU citizens, are the same as other respondents (no significant differences). Respondents that are/were directly involved in a current/preceding partnership (Horizon 2020 or Framework Programme 7) find, however, the uptake of innovation problems slightly more relevant than other respondents.

Figure 22: To what extent do you think this is relevant for research and innovation efforts at EU level to address the following problems in relation to the candidate partnership in question? (non-campaign replies) Aggregation of responses of all candidate initiatives

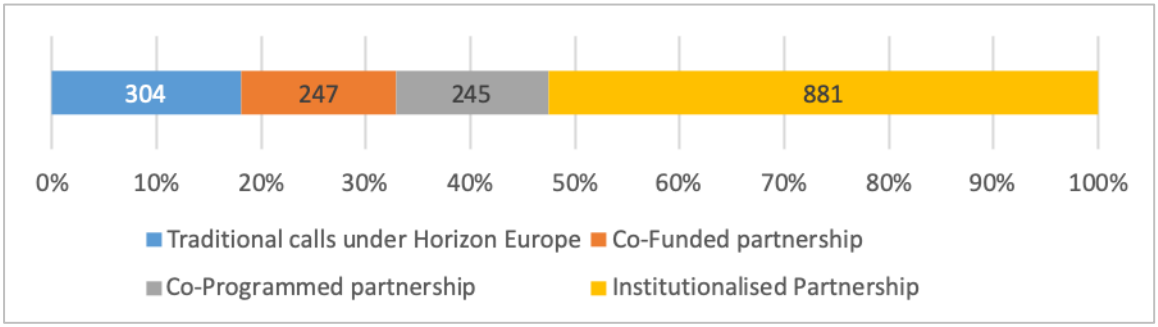


Horizon Europe mode of intervention to address problems

After providing their views on the relevance of problems, respondents were asked to indicate how these challenges could be addressed through Horizon Europe intervention. As shown in Figure 23, just over 50% of all respondents indicated that institutionalised partnerships were the best fitting intervention, however, relatively strong differences between stakeholder categories were found. The intervention of institutionalised partnerships was indicated more by business associations and large companies, but less by academic/research institutions and SMEs. While academic/research institutions valued traditional calls more often, this was not the case for business associations, large companies and public authorities. Public authorities indicated a co-programmed intervention more often than other respondents. Citizens, compared to other respondents,

indicated slightly less often that institutionalised partnerships were the best fitting intervention. Respondents that are/were directly involved in a current/preceding partnership, however, selected the institutionalised partnership intervention in far higher numbers (nearly 70%).

Figure 23: In your view, how should the specific challenges described above be addressed through Horizon Europe intervention? (non-campaign replies) Aggregation of responses of all candidate initiatives



When asked to reflect on their answers, respondents that pointed to the need for using the "institutionalised partnership" intervention mentioned the long-term commitment of collaboration, a common and ambitious R&I strategy as well as the overall collaboration between industry and research institutions. Respondents that referred to possible approaches, sometimes gave examples of good experiences in with other interventions:

1. Traditional calls because of their flexibility and integration of a wide range of actors, as long as the evaluation panels do not deviate from the policy premier. This was mentioned by 94 participants, evenly distributed across companies (25 of them), academics (26) and EU citizens (25).
2. Co-funded partnership, as a mechanism to ensure that all participants take the effort seriously, while allowing business partnerships to develop. This approach was deemed suitable based on previous experiences with ERANETs. This was raised by 84 participants, 36 of them academic respondents, 18 companies and 16 EU citizens.
3. Co-programmed partnerships to tackle the need to promote and engage more intensively with the private sector. This was mentioned by 97 participants, most of them companies (34), followed by academics (22), business associations (15) and EU citizens (11).

Relevance of a set of elements and activities to ensure that the proposed European Partnership would meet its objectives

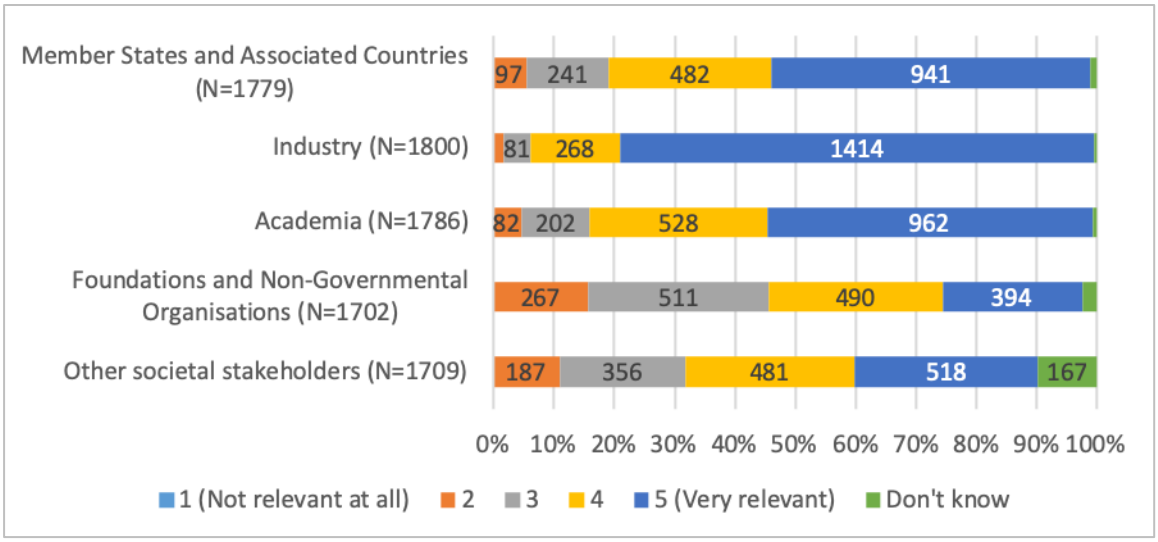
Setting joint long-term agendas

Respondents were asked how relevant it is for the proposed European Partnerships to meet their objectives to have a strong involvement of specific stakeholder groups in setting joint long-term agenda. As presented in Figure 24, collectively all respondents see stakeholders from industry as the most relevant, followed by academia and governments (Member States and Associated Countries). The involvement of foundations and NGOs as well as other societal stakeholders were, however, still found to be (very) relevant by more than 50% of the respondents.

When looking at the differences between the answers of the main stakeholder categories only minor differences could be found. Overall, it could be observed that most respondents indicated the stakeholder group they belong to themselves or that represent them as relevant to involve. Academic/research institutions find it more relevant to involve academia and less relevant to involve industry when compared to other respondents. The other way around large companies, SMEs and business associations find it more relevant

to involve industry and less relevant to involve academia, Member States and Associated Countries and NGOs. The involvement of Member States and Associated Countries was found more relevant by academic/research institutions and public authorities. NGOs also values their own involvement and those of other societal stakeholders more than other respondents. views of citizens also show a slightly higher relevance for foundations and NGOs. This is less so the case for respondents that are/were directly involved in a current/preceding partnership (most predominantly companies and academia).

Figure 24: In your view, how relevant are the following elements and activities to ensure that the proposed European Partnership would meet its objectives - Setting joint long-term agenda with strong involvement of: (non-campaign replies) Aggregation of responses of all candidate initiatives

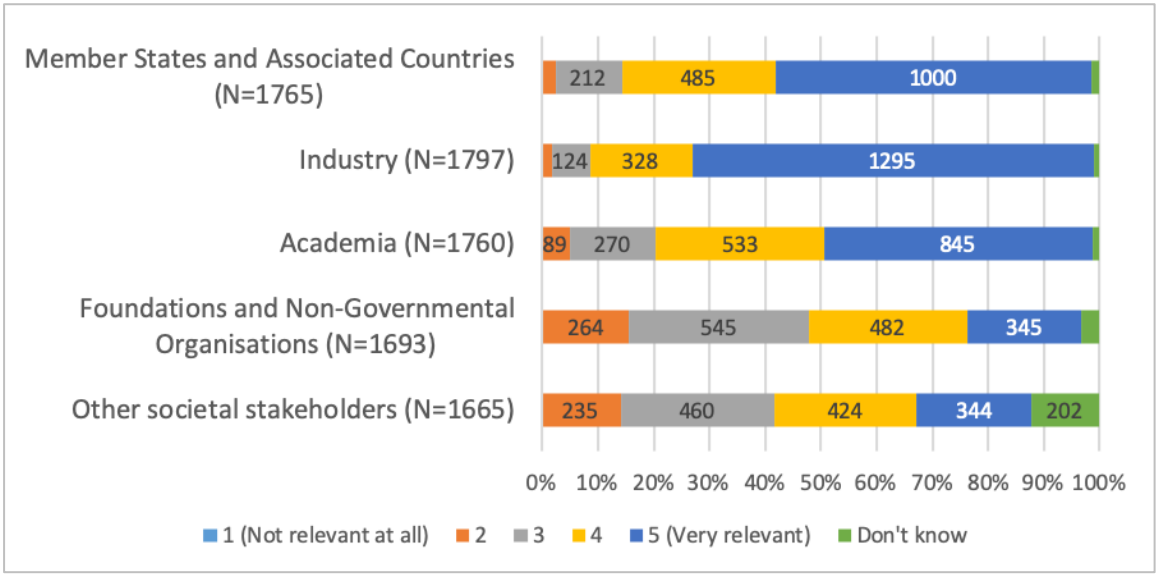


Pooling and leveraging resources through coordination, alignment and integration with stakeholders

Respondents were also asked how relevant it is for the proposed European Partnership to meet its objectives to pool and leverage resources (financial, infrastructure, in-kind expertise, etc.) through coordination, alignment and integration with specific groups of stakeholders. As shown in Figure 25 - similarly as for the previous questions-, respondents also see stakeholders from industry as the most relevant, followed by academia and governments (Member States and Associated Countries). The involvement of foundations and NGOs as well as other societal stakeholders are also still found to be (very) relevant for more than 50% of the respondents.

Similarly as described for the question on setting joint long-term agendas, most stakeholder categories valued their own involvement higher than other respondents – although also here differences between stakeholder categories were minor. As such, academic/research institutions see the relevance of academia higher, while large companies, SMEs and business association indicated a lower relevance of academia than other respondents. Similarly, these private sector stakeholders valued the relevance of industry higher than others while valuing the relevance of NGOs and other societal stakeholders less. NGOs value themselves and other societal stakeholders however higher than other respondents, and also public authorities indicated a higher relevance for Member States and Associated Countries then other respondents. Citizens mainly put more emphasis on the role of NGOs and other societal stakeholders then other respondents.

Figure 25: In your view, how relevant are the following elements and activities to ensure that the proposed European Partnership would meet its objectives – Pooling and leveraging resources (financial, infrastructure, in-kind expertise, etc.) through coordination, alignment and integration with: (non-campaign replies) Aggregation of responses of all candidate initiatives

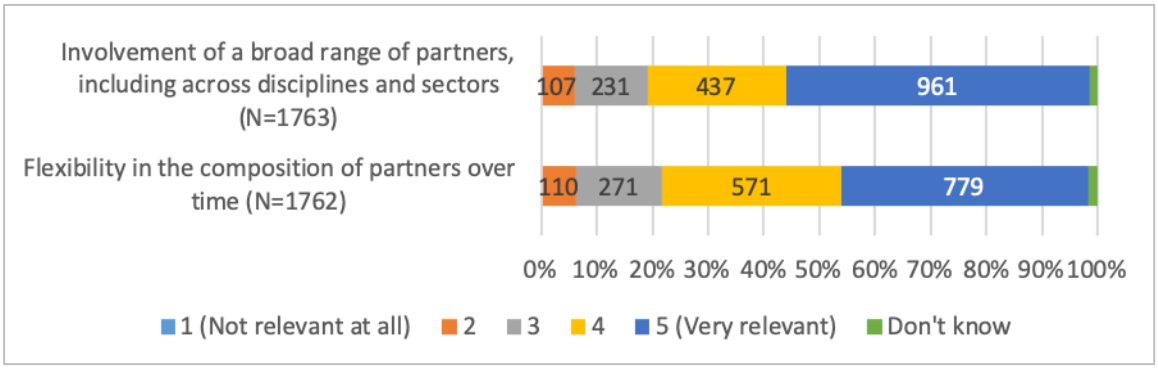


Composition of the partnerships

Regarding the composition of the partnership most respondents indicated that for the proposed European Partnership to meet its objectives the composition of partners needs to be flexible over time and that a broad range of partners, including across disciplines and sectors, should be involved (see Figure 26).

When comparing stakeholder groups only minor differences were found. Academic/research institutions and public authorities found the involvement of a broad range of partners and flexibility in the composition of partners over time slightly more relevant than other respondents, while large companies found both less relevant. SMEs mainly found the flexibility in the composition of partners over time less relevant than other respondents, while no significant differences were found regarding the involvement of a broad range of partners. Citizens provided a similar response to non-citizens. Respondents that are/were directly involved in a current/preceding partnership, when compared to respondents not involved in a current/preceding partnership, indicated a slightly lower relevance of the involvement of a broad range of partners and flexibility in the composition of partners over time.

Figure 26: In your view, how relevant are the following elements and activities to ensure that the proposed European Partnership would meet its objectives – Partnership composition (non-campaign replies) Aggregation of responses of all candidate initiatives

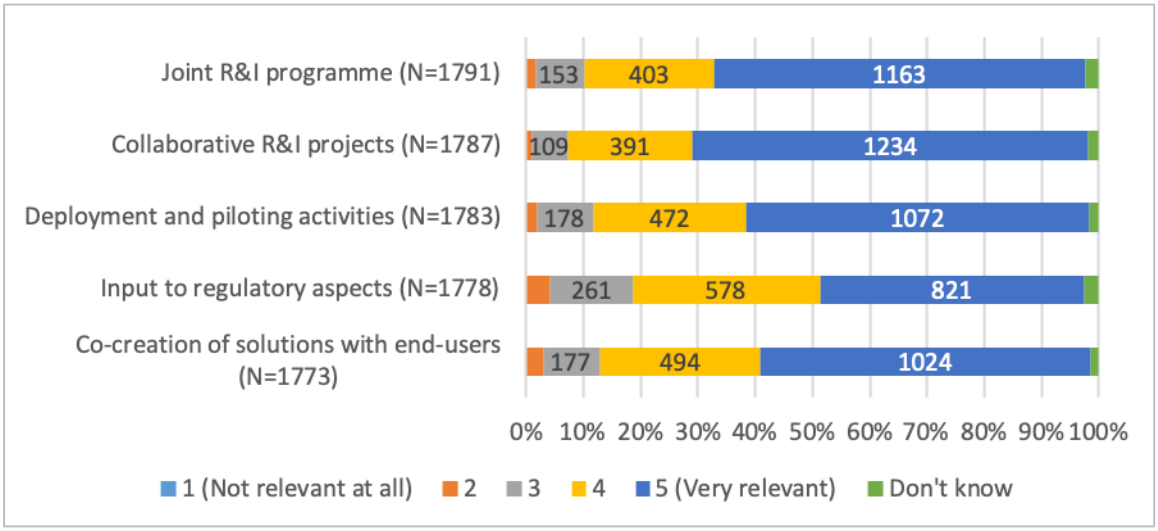


Implementation of activities

Most respondents indicated that implementing activities like a joint R&I programme, collaborative R&I projects, deployment and piloting activities, providing input to regulatory aspects and the co-creation of solutions with end-users are all (very) relevant for the partnerships to be able to meet its objectives (see Figure 27).

Minor differences were found between the main stakeholder categories, the differences found were in line with their profile. As such, academic/research institutions found joint R&I programme & collaborative R&I projects slightly more relevant and deployment and piloting activities, input to regulatory aspects and co-creation with end-users slightly less relevant than other respondents. For SMEs an opposite pattern is shown. Large companies, however, also found collaborative R&I projects slightly more relevant than other respondents, as well as input to regulatory aspects. The views of citizens are similar to non-citizens. Respondents that are/were directly involved in a current/preceding partnership, when compared to respondents not involved in a current/preceding partnership, show a slightly higher relevance across all activities shown in Figure 27.

Figure 27: In your view, how relevant are the following elements and activities to ensure that the proposed European Partnership would meet its objectives – Implementing the following activities (non-campaign replies) Aggregation of responses of all candidate initiatives



Relevance of setting up a legal structure (funding body) for the candidate European Partnerships to achieve improvements

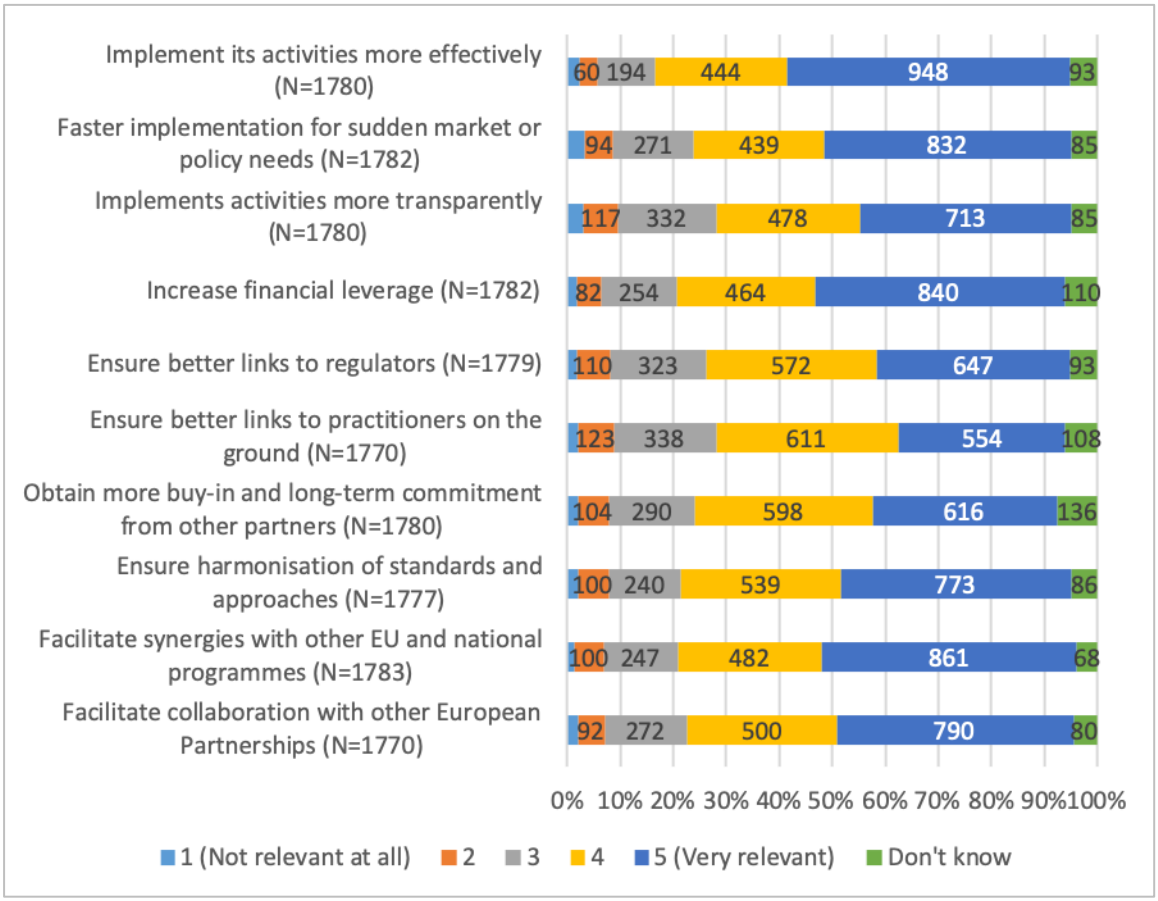
Respondents were then asked to reflect on the relevance of setting up a legal structure (funding body) for achieving a set of improvements, as presented in Figure 28. In general, 70%-80% of respondents find a legal structure (very) relevant for these activities. The legal structure was found most relevant for implementing activities in a more effective way and least relevant for ensuring a better link to practitioners on the ground, however differences are small.

When comparing the main stakeholder categories we found minor differences. Academic/research institutions indicated a slightly lower relevance for transparency, better links to regulators as well as obtaining the buy-in and long-term commitment of other partners. SMEs also indicated a lower relevance regarding obtaining the buy-in and long-term commitment of other partners. Large companies showed a slightly higher relevance for implementing activities effectively, ensure better links to regulators, obtaining the buy-in and long-term commitment of other partners, synergies with other EU/MS programmes and collaboration with other EU partnerships than other open consultation respondents. NGOs find it slightly more relevant to implement activities faster for sudden market or

policy needs. Public authorities, however, find it slightly less relevant to facilitate collaboration with other European Partnerships than other respondents.

The views of citizens show a slightly lower relevance for a legal structure in relation to implementing activities in an effective way. Quite different results are shown for respondents that are/were directly involved in a current/preceding partnership when compared to respondents not involved in a current/preceding partnership, they indicated a higher relevance across all elements presented in Figure 28.

Figure 28: In your view, how relevant is to set up a specific legal structure (funding body) for the candidate European Partnership to achieve the following? (non-campaign replies) Aggregation of responses of all candidate initiatives



Scope and coverage of the candidate European Partnerships based on their inception impact assessments

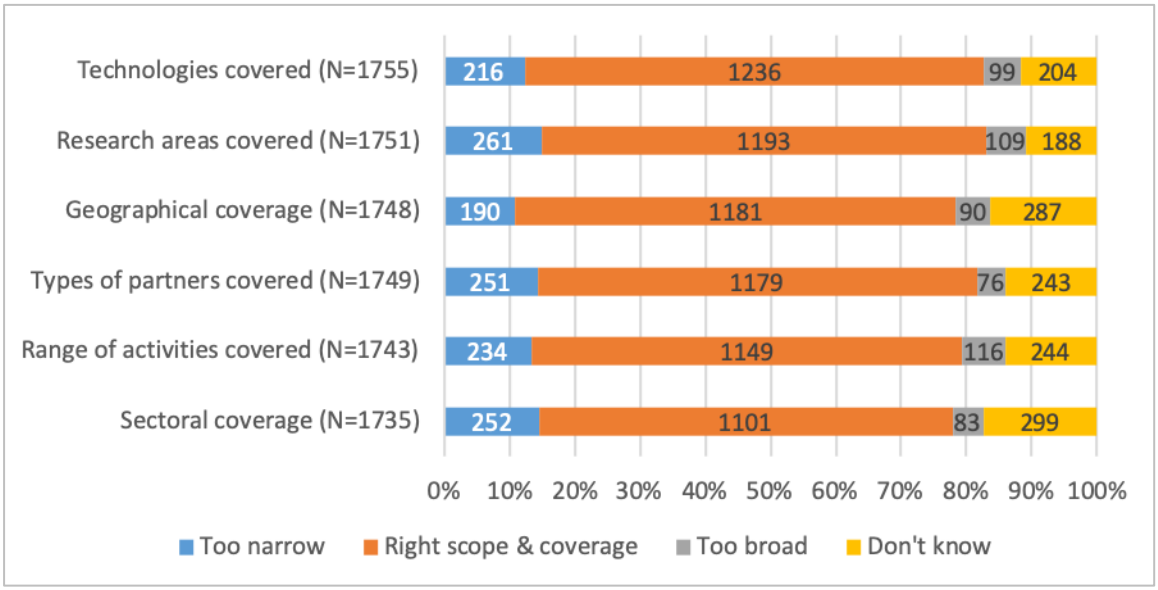
The response regarding the scope and coverage for the partnerships, based on inception impact assessments, shows that the large majority feels like the scope and coverage initially proposed in the inception impact assessments is correct. Figure 29 shows the results. However, about 11% to 15% of the respondents indicated the scope and coverage to be too narrow. About 11%-17% of respondents answered "Don't know". In the open answers respondents mostly reflected on specific aspects of the geographical and sectoral scope and coverage of the specific candidate European Partnerships, no overall lessons could be extracted.

Overall, differences between the main stakeholder categories were found to be minor. Academic/research institutions indicated slightly more often that the research area was "too narrow" then other respondents. SMEs on the other hand indicated slightly more often that the research area and the geographical coverage were "too broad". NGOs and public authorities, however, found the geographical coverage slightly more often "too narrow" when compared to other respondents. Large companies found the range of activities

slightly more often "too broad" and the sectoral focus slightly more often "too narrow" when compared to other respondents.

The views of citizens are the same as for other respondents. Most notably, respondents that are/were directly involved in a current/preceding partnership, when compared to respondents not involved in a current/preceding partnership, more often indicated that the candidate institutionalised European Partnership have the "right scope & coverage".

Figure 29: What is your view on the scope and coverage proposed for this candidate institutionalised European Partnership, based on its inception impact assessment? (non-campaign replies) Aggregation of responses of all candidate initiatives



Scope for rationalisation and alignment of candidate European Partnerships with other initiatives

When asked whether it would be possible to rationalise a specific candidate European Institutionalised Partnership and its activities, and/or to better link with other comparable initiatives, nearly two thirds of respondents answered "Yes" (1000, or 62.15%), while over one third answered "No" (609, or 37.85%). Nearly no differences were found between the main stakeholder categories, only large companies and SMEs indicated slightly more often "Yes" in comparison to other respondents.

The views of citizens are the same as for other respondents. Respondents that are/were directly involved in a current/preceding partnership, indicated "No" more often, the balance is about 50/50 between "Yes" and "No" for this group.

In the open responses respondents often referred to specific similar/comparable and complementary initiatives discussing the link with a specific candidate European Partnership, no overall lessons could be extracted, but more detailed results can be found in the partnership specific result sections.

Relevance of European Partnerships to deliver targeted scientific, economic/technological and societal impacts

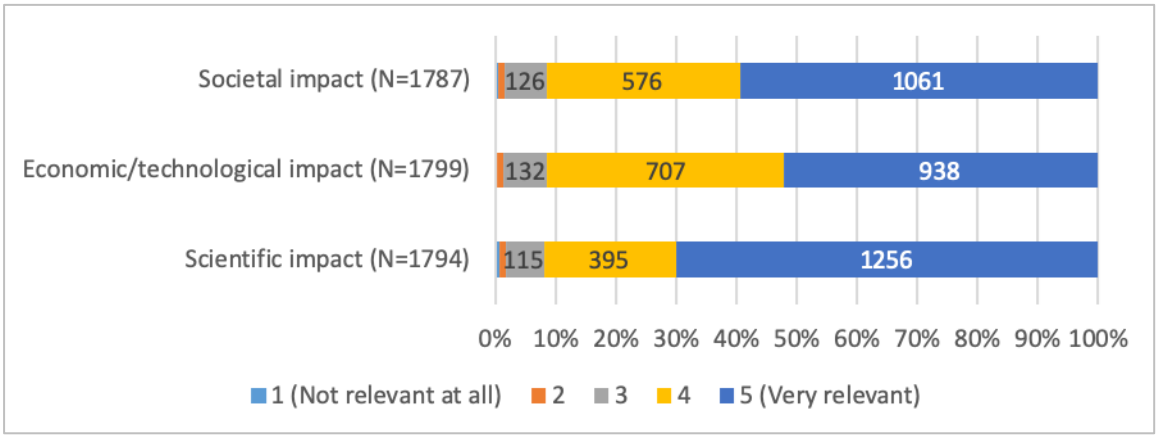
Finally, respondents were asked to rate the relevance of partnership specific impacts in three main areas: Societal impacts, Economic/technological impacts and Scientific impacts. To aggregate results the average of the responses on partnership specific impacts were calculated.

As presented in Figure 30, overall, all three areas were deemed (very) relevant across the candidate partnerships. Scientific impact was indicated as the most relevant impact, more than 90% of respondents indicated that these impacts were (very) relevant.

Only minor difference between stakeholder groups were found. Academic/research institutions found scientific impacts slightly more relevant, while large companies found economic and technological impacts slightly more relevant than other respondents. NGOs found societal impact slightly more relevant, while SMEs found this slightly less important.

Citizens, both EU and non-EU citizens, did not a significantly different view when compared to other respondents. Respondents that are/were directly involved in a current/preceding partnership find all impacts slightly more relevant than other respondents.

Figure 30: In your view, how relevant is it for the candidate European Institutionalised Partnership to deliver on the following impacts? (non-campaign replies) Aggregation of responses of all candidate initiatives



B.6 Responses to the open public consultation for the candidate partnership "Integrated Air Traffic Management"

B.6.1 Introduction

This section outlines the results of the Open Public Consultation for the candidate European Partnership on Integrated Air Traffic Management. The section outlines the following:

- Results on general questions, segregated for this candidate European Partnership:
  - Views on the needs of the future European Partnerships under Horizon Europe
  - Views on the advantages and disadvantages of participation in an Institutionalised European Partnership
- Results on specific questions for this candidate European Partnership:
  - Relevance of research and innovation efforts at the EU level to address problems
  - Views on Horizon Europe interventions to address these problems
  - Views on the relevance of elements and activities in: setting a joint long-term agenda; pooling and leveraging resources; partnership composition; implementation of activities.
  - Views on setting up a specific legal structure (funding body)
  - Views on the proposed scope and coverage of this candidate European Partnership
  - Views on the alignment of the European Partnership with other initiatives
  - Relevance of this candidate European Partnership to deliver impacts

B.6.2 Characteristics of respondents

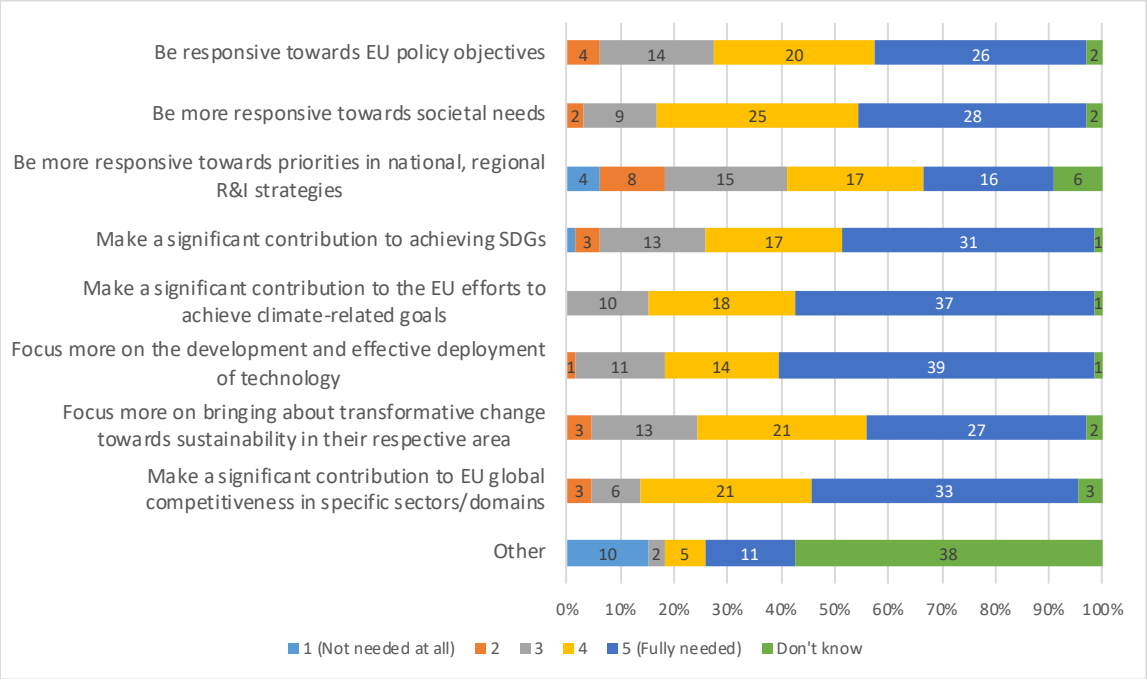
There are 66 respondents who have answered (part of) the consultation for the Integrated Air Traffic Management Partnership. Of these respondents, 10 (15.15%) were citizens. The largest group of respondents were businesses with 28 (42.42%) respondents. There were 8 respondents from academic and research institutions (12.12%) and 7 from both public authorities and business associations (10.61%). The remaining respondents were from NGO's (2, 3.03%), environmental organisations (1, 1.52%) and other (3, 4.55%). both with 123 respondents (32.20%). Over 3/4s of respondents, namely 51 (77.27%), have been involved in the on-going research and innovation framework programme, of which 38 respondents (74.51%) were directly involved in a partnership under Horizon 2020 or its predecessor Framework Programme 7.

B.6.3 Characteristics of future candidate European Partnerships – as viewed by respondents to the Integrated Air Traffic Management initiative

At the beginning of the consultation, the respondents were asked on their views of the needs of the future European Partnerships under Horizon Europe. All 66 respondents answered this question. Overall, respondents indicated that many of these needs were very relevant. The needs where most respondents indicated this, was focusing more on the development and effective deployment of technology (39, 59.09%) and making a significant contribution to EU efforts to achieve climate related goals (37, 56.06%). Aside from 'other', the options where the least amount of respondents indicated that they were very relevant, being more responsive towards priorities in national and/or regional R&I strategies (16, 24.24%). In the case of this option, the responses differ. This is also the only option (aside from other), where multiple respondents have indicated that it is not needed at all.

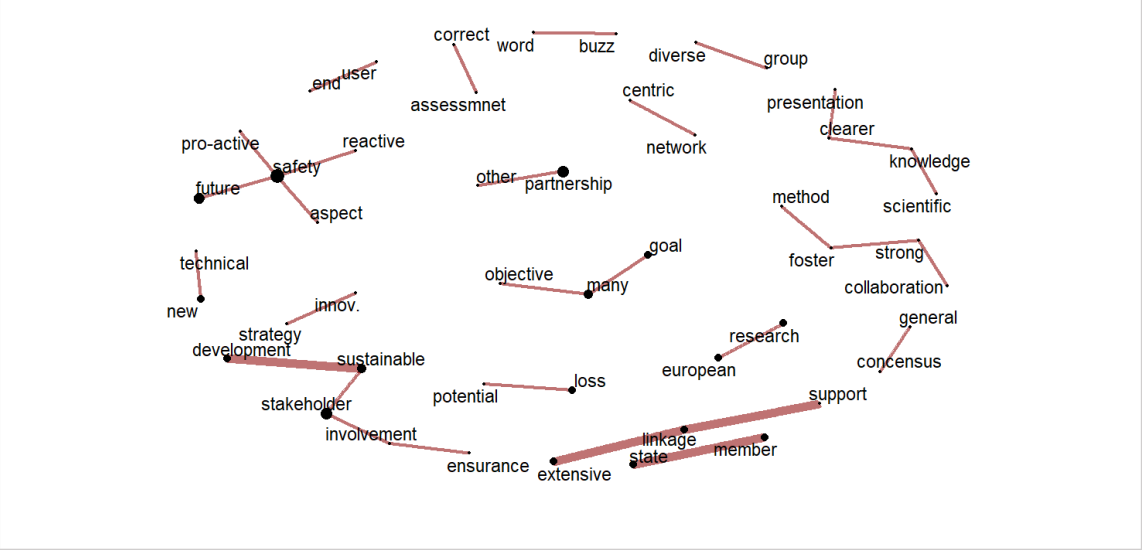
No statistical differences were found between the views of citizens and other respondents.

Figure 31: Views of the respondents in regard to the needs of future European Partnerships under Horizon Europe (N=66)



The respondents also had the option to indicate other needs. The results of the analysis resulted in the chart shown in Figure 32 showing the co-occurrences of keywords. The results show that respondents have indicated needs around extensive support linkage, sustainable stakeholder development and safety.

Figure 32: Assessment of open answers of other needs, 30 most common co-occurring keywords (N=18)

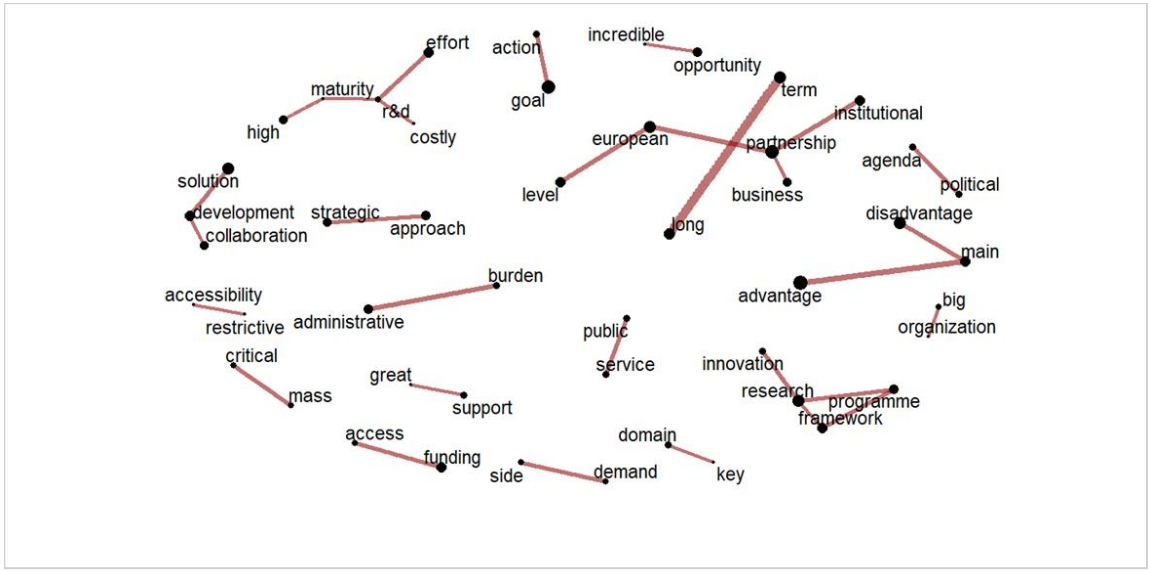


The respondents also had the option to indicate other needs. Some indicated that ensuring the safety levels are taken into account is important. A few called for implementation of strategic research agenda and the long-term vision. Another topic was the importance of bridging the gap between the research and actual deployment of researched innovation. To finish with the call for paying attention to regulation from early research stages.

B.6.4 Main advantages and disadvantages of Institutionalised European Partnerships

The respondents were asked what they perceived to be the main advantages and disadvantages of participation in an Institutionalised European Partnership (as a partner) under Horizon Europe. The keyword analysis used for open questions resulted in the graph shown in Figure 33. This analysis showed the respondents mentioned administrative burden, research and innovation programme framework and political agendas.

Figure 33: Assessment of open answers with advantages and disadvantages of participation in an Institutionalised European Partnership, 30 most common co-occurring keywords (N=44)



The main advantage stated by different stakeholder categories is the pooling of research and funding resources for ATM R&I which are not available to single players (be it an industry, a Member State, or academia). Another cited advantage relates to having agreed, common goals and strategic road map at EU level. Partnership helps building trust between

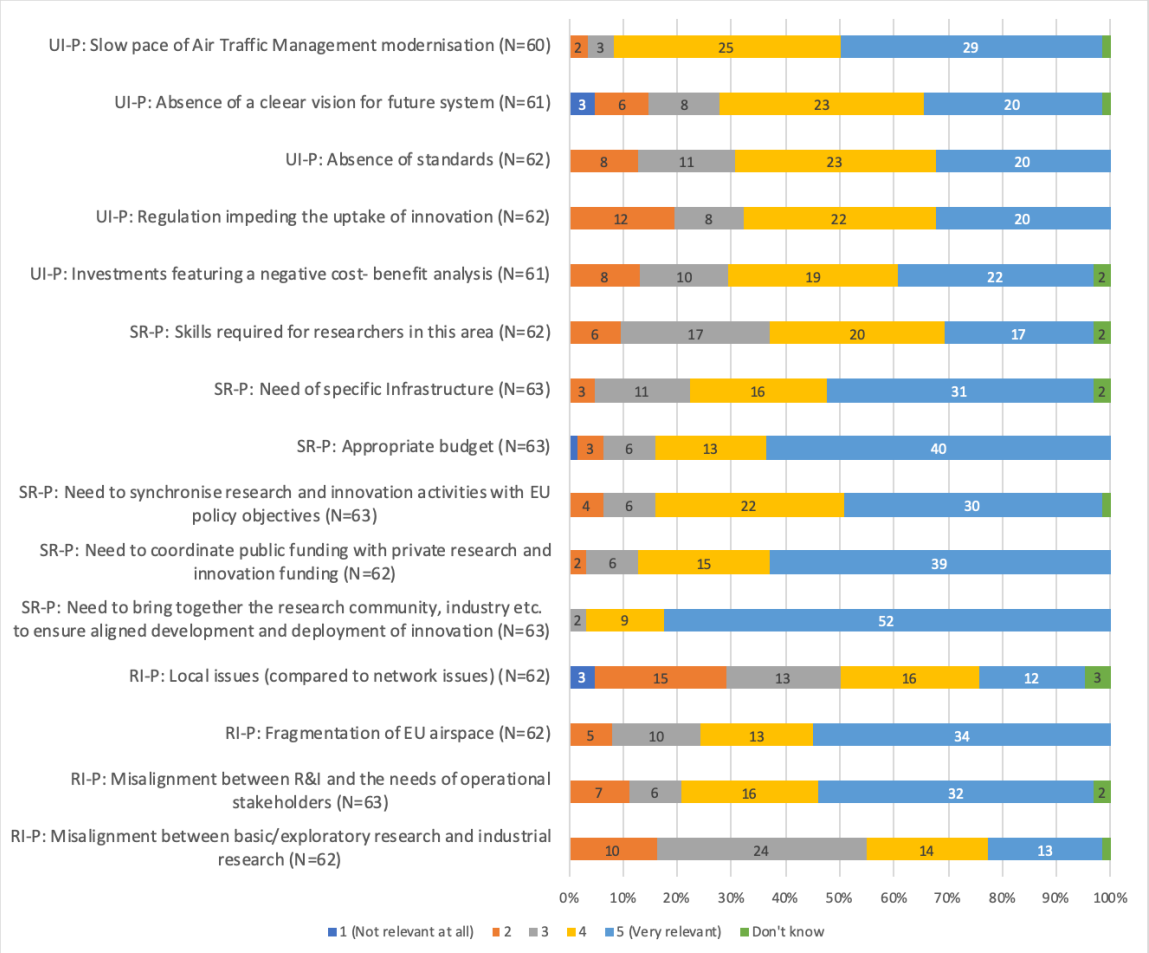
different members and thus creating long-term research and industrial relations. Further, a current partnership has a good collaboration with the military, where it relates to the ATM issues, which should be formalised in case of the continuation of the partnership.

The disadvantages cited are: administrative burden of participation in H2020 (note, this is based on the current experience), lack of flexibility to address changing goals and objectives, slow decision-making processes, which are sometimes due to differing political agendas of participants. One respondent (non-EU citizen category) stated that it is not easy to get involved if an industry of a Member State is not mature enough.

B.6.5 Relevance of EU level efforts to address problems in relation to the Integrated Air Traffic Management initiative

In the consultation, respondents were asked to provide their view on the relevancy of research and innovation efforts at EU level to address the following problems in relation to air traffic management, specifically on three types of problems: problems in uptake of air traffic management innovations (UI-P), structural and resource problems (SR-P) and research and innovations problems (RI-P). In Figure 34, the responses to these answers are presented.

Figure 34: Views of respondents on relevance of research and innovation efforts at the EU level to address problems in relation to air traffic management



With regard to the uptake in innovation problems, 29 respondents have indicated that the research and innovation efforts at the EU level to address the issue of slow pace of Air Traffic Management modernisation is very relevant (48.33%), and further 25 stated it is relevant – 90% of all respondents, across all categories, find this as a relevant problem. Regarding other uptake of innovation problems, like *absence of clear vision for future systems, regulation impeding the uptake of innovation and investments featuring negative*

cost-benefit analysis, about 60% of respondents stated that these are either very relevant or relevant. Furthermore, majority of individual stakeholders consider the *absence of standards* as one of the problems in uptake of air traffic management innovations (30% stated very relevant and 37% relevant problem). Majority of academic and half of business association stakeholders do not consider this problem as relevant.

There are large differences in the responses that the respondents have given with regard to structural and resource problems. 52 respondents have indicated that the need to bring together the Air Traffic Management research community is very relevant (82.54%). This problem has the most 'very relevant' answers of any of the problems that the respondents were asked to reflect on. About 85% of respondents stated that the questions of appropriate budget and the need to coordinate public funding with private research and innovation funding received are either very relevant or relevant. Another important finding is that 52 respondents (82%) stated that the need to synchronise research and innovation activities with EU policy objectives is very relevant or relevant in the ATM. While another of the structural problems outlined: skills required for researchers in this area, only received 17 very relevant answers (27.42%). No specific differences in responses have been noted across different stakeholder categories.

Two of the research and innovation problems have received over 30 responses indicating that they are very relevant problems, namely the fragmentation of EU airspace and the misalignment between R&I and the needs of operational stakeholders. Almost 80% of stakeholders declared that fragmentation of EU airspace is relevant (13, or 21%) or very relevant (24, or 58%) problem to be addressed by research and innovation efforts at EU level. The two other problems only received a little over 10 of very relevant responses (12, 19.35% and 13, 20.97% respectively).

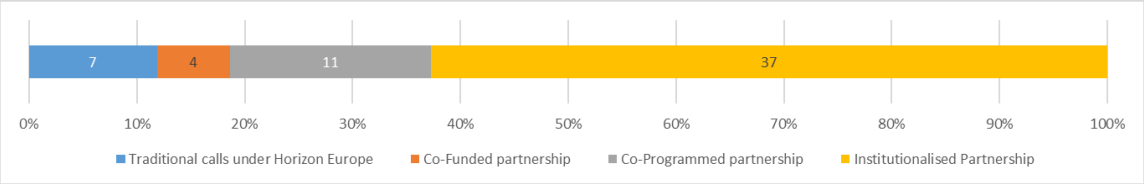
Slight statistical differences were found between the views of citizens and other respondents. Citizens found the "research and innovation problems related to more relevant and the structural and resource problems" less relevant. Respondents involved in a current or preceding partnership (Horizon 2020 or Framework Programme 7), found the uptake in innovation problems regarding regulation and the absence of a clear vision for future system less relevant.

B.6.6 Horizon Europe mode of intervention to address problems

After providing their views on the relevance of problems, respondents were asked to indicate how these challenges could be addressed through Horizon Europe intervention. As shown in Figure 35, over 60% of respondents indicated that institutionalised partnerships were the best fitting intervention.

Citizens, compared to other respondents, indicated less often that institutionalised partnerships were the best fitting intervention.

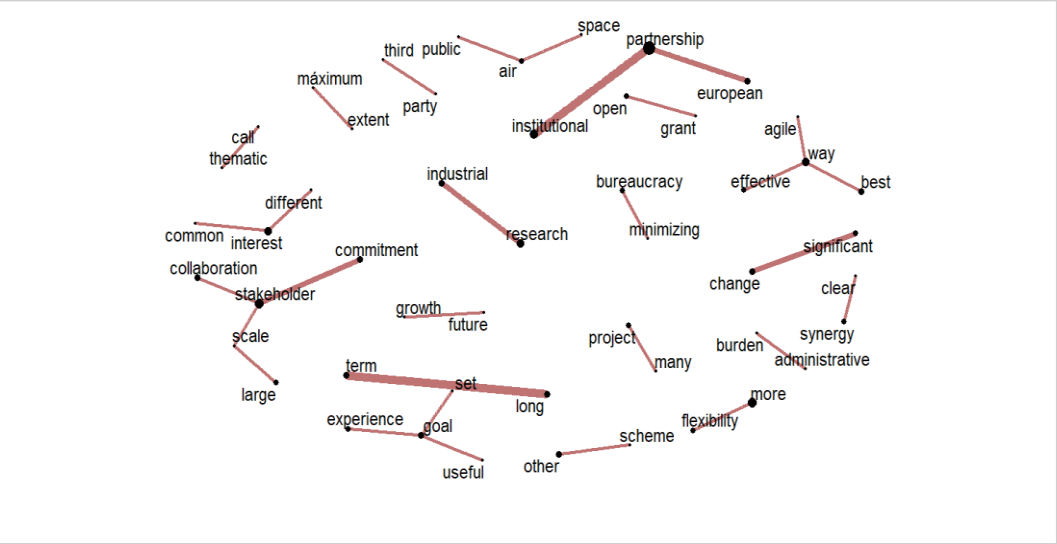
Figure 35: Assessment of Horizon Europe intervention



The respondents were asked to briefly explain their answers to the question above. People who stated that an institutionalised partnerships was the best fitting answer, mentioned that the current partnership mechanism worked well, and that in order to achieve common EU-level goals, this should be continued. The changes to the current settings mentioned by respondents relate to the need of more flexibility to be able to address changing goals in an agile manner. Further reasons included the statements that the entire ATM value

chain is needed, where the respondents feel that the involvement of the value chain around the common strategic agenda in ATM is possible only through the Institutionalised Partnership. Further, the military cooperation on ATM issues should be formalised in the case of partnership continuation. Most of the respondents choosing this option mention the need to reduce as much as possible the administrative burden. Respondents choosing the Co-programmed partnership (N=11) mentioned this being the middle ground between the offered options when complexity of the agenda, flexibility of partnership and costs are taken into account. The respondents choosing the Traditional calls mentioned that those are very well established (i.e. evaluation, management), and more open to competition, reducing the number of funding instruments. Most of the respondents choosing the Traditional calls are from citizen category.

Figure 36: Assessment of open answers to explain their choice institutionalised partnership in the assessment of the Horizon Europe intervention, 30 most common co-occurring keywords (N=63)



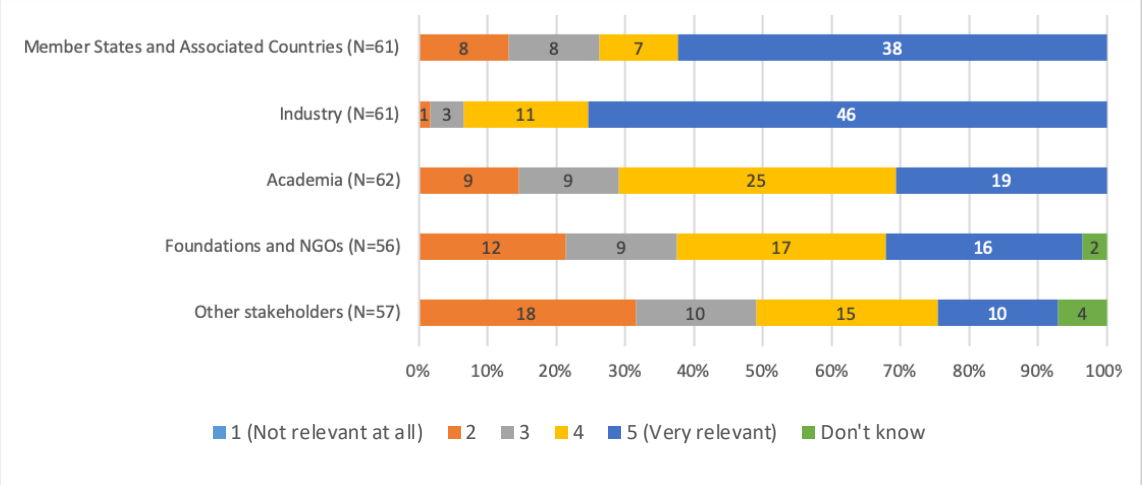
B.6.7 Relevance of a set of elements and activities to ensure that the proposed European Partnership would meet its objectives

Setting joint long-term agendas

Respondents were asked how relevant the involvement of actors is in setting a joint long-term agenda to ensure that the proposed European Partnership would meet its objectives (Figure 37). The highest amount of respondents indicated that the involvement of Industry is very relevant (46 respondents or 69.70%). A large part of respondents also indicated that the involvement of Member States and Associated Countries (38, 57.58%) is very relevant. Less respondents indicated that the involvement of academia, foundations and NGO's and other stakeholders was very relevant. However over half of the respondents have indicated given academia and foundations either a score of 4 or 5 (very relevant) on the relevance scale. For other stakeholders this percentage is 37.87%.

No statistical differences were found between the views of citizens and other respondents.

Figure 37: Views of respondents on relevance of actors in setting a joint long-term

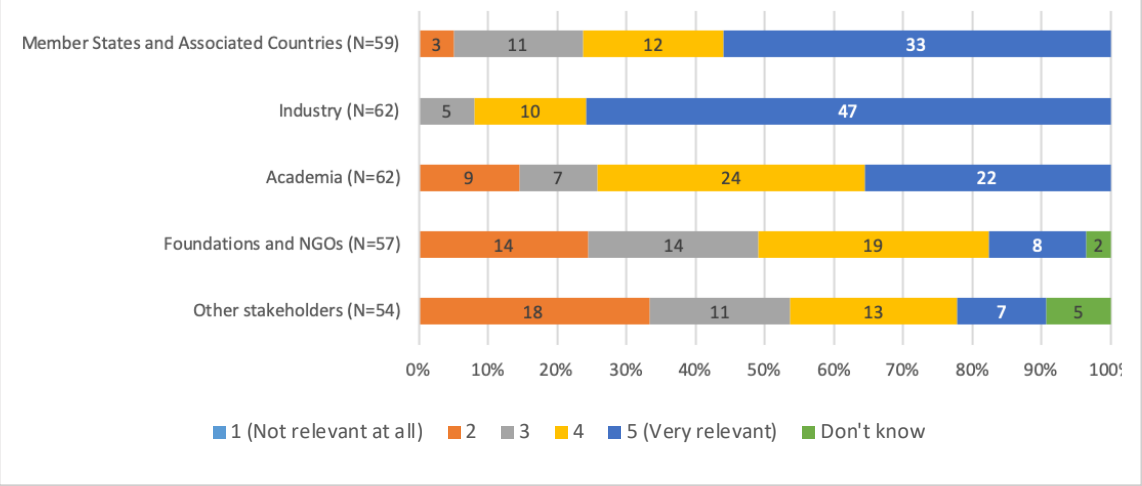


Relevance of elements and activities in pooling and leveraging resources

With respect to the relevance of actors in pooling and leveraging resources, such as financial, infrastructure, in-kind expertise etc.), to meet Partnership objectives, the patterns are very similar. Most of the respondents (47, 75.81%) indicated that industry was very relevant. A large part of respondents also indicated that the involvement of Member States and Associated Countries (33, 55.93%) and Academia (22, 35.48%) is very relevant. Also, similar to the previous question, the Foundations and NGO's and other stakeholders were seen as less relevant and the opinions of the respondents seem divided on these types of stakeholders. No respondents indicated that any of the categories was Not relevant at all.

No statistical differences were found between the views of citizens and other respondents.

Figure 38: Views of respondents on relevance of actors for pooling and leveraging resources



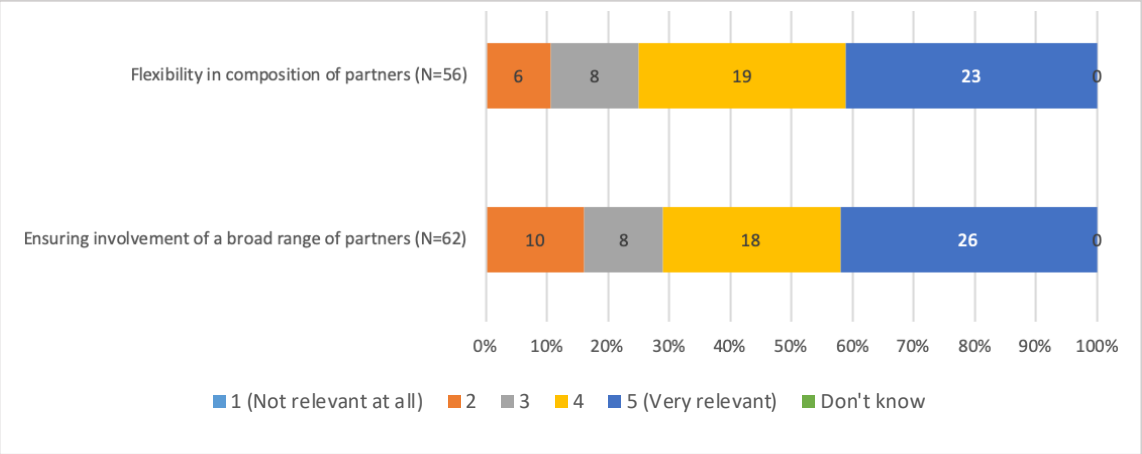
Relevance of elements and activities for the partnership composition

Respondents were asked about the relevance of Partnership composition, such as flexibility in the composition of partners over time and involvement of a broad range of partners (including across disciplines and sectors), to reach Partnership objectives. As it is visible in Figure 39, these questions were answered similarly. Ensuring involvement of a broad range of partners has slightly more 'very relevant' answers (26, 41.94%) than the flexibility in the composition of partners (23, 41.07%). Overall 75% of respondents have given

flexibility either a score of 4 or 5 (very relevant) which is higher than the 70.97% who have given the broad range of partners a score of 4 or 5 (very relevant).

No statistical differences were found between the views of citizens and other respondents.

Figure 39: Views of respondents on relevance of partnership composition elements

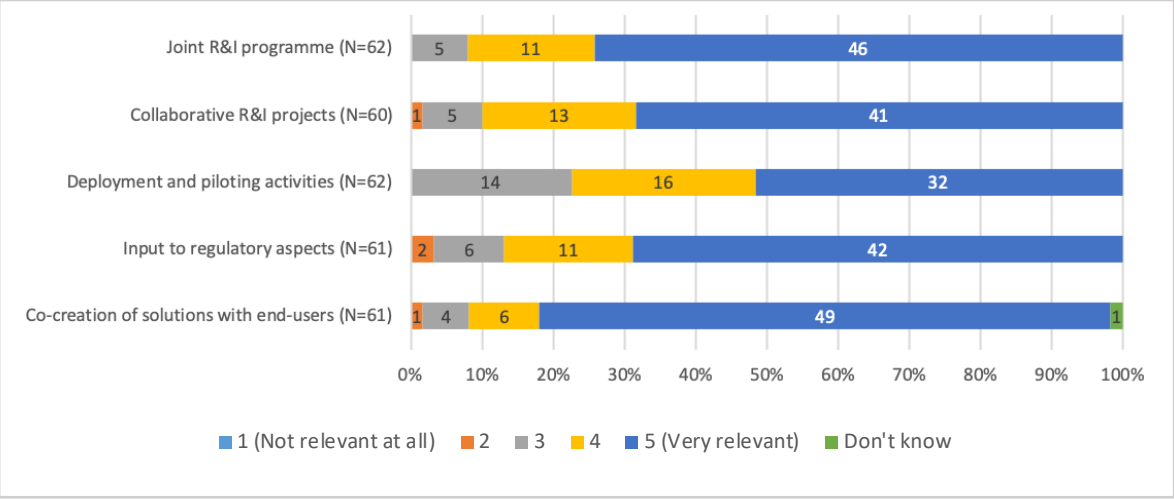


Relevance of implementation of activities

Respondents were asked to provide opinions on relevance of implementation of several activities for meeting objectives of the Integrated Air Traffic Management Partnership. Among activities were listed – a joint R&D programme, collaborative R&D projects, deployment and piloting activities, input to regulatory aspects and co-creation of solutions with end-users. Out of 61 respondents, 49 (80.33%) indicated that co-creation of solutions with end users were very relevant to ensure that the Partnership would meet its objectives. For all the other options, the majority (over 50%) of all respondents have indicated that these are very relevant. Respondents have answered 5 (fully relevant) the least in regard to deployment and piloting activities, although still 51,62% of respondents have given this answer. See Figure 40.

No statistical differences were found between the views of citizens and other respondents.

Figure 40: Views of respondents on relevance of implementation of the following activities

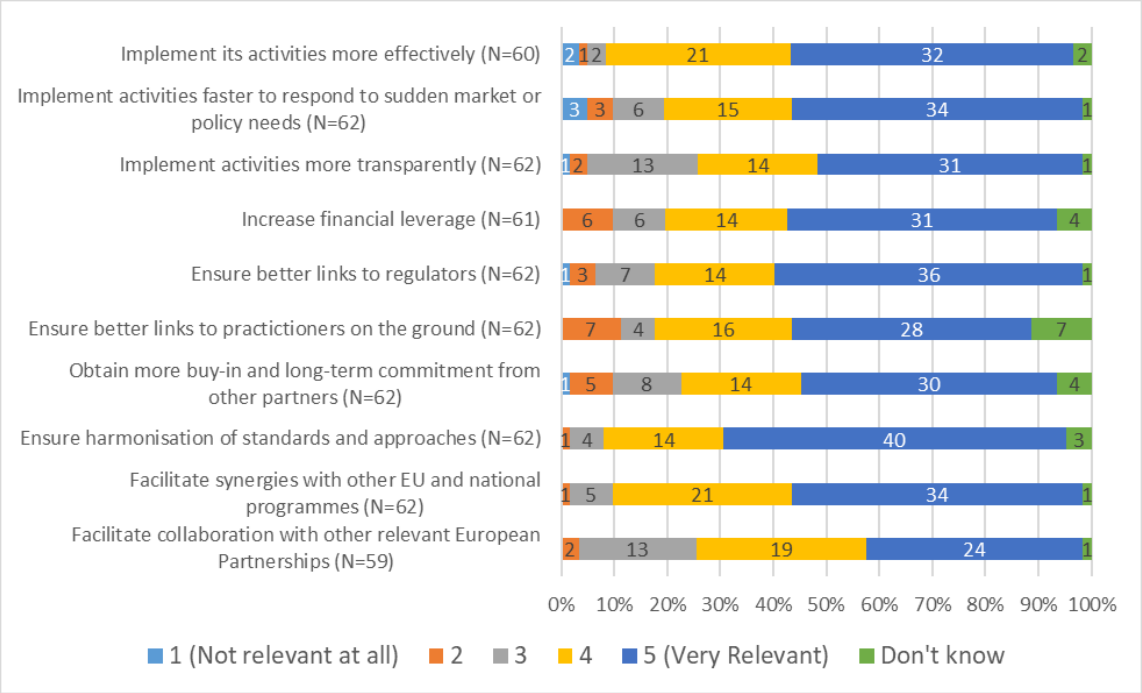


B.6.8 Relevance of setting up a legal structure (funding body) for the candidate European Partnerships to achieve improvements

Respondents were also asked to assess the relevance of a specific legal structure (funding body) for the candidate European Partnership to achieve several activities. According to Figure 41, respondents indicated that it was very relevant to set up a specific legal structure for the partnership to ensure harmonisation of standards and approaches (40, 64.52%), followed by the need to ensure better links with regulators (36, 58%).The implementation of activities more effectively is deemed relevant (21 respondents) or very relevant (32 respondents).The relevance of a specific legal structure to facilitate collaboration with other Partnerships is deemed the least relevant, as this question has received the most answers in category 3 of the 5 point relevance scale (20,97%) and the least 5 (very relevant) answers (24, 38.71%) of all the questions.

No statistical differences were found between the views of citizens and other respondents.

Figure 41: Views of respondents on relevance of a specific legal structure

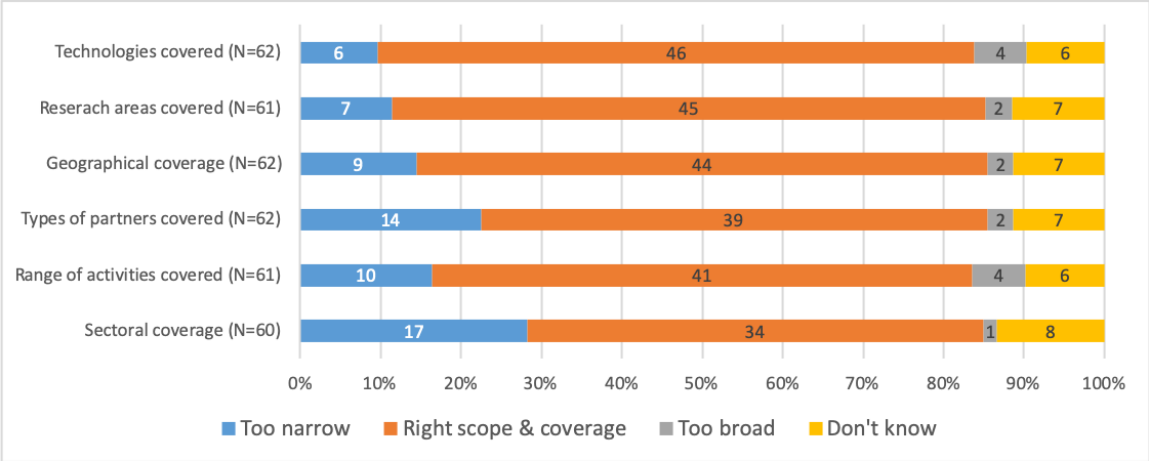


B.6.9 Scope and coverage of the candidate European Partnerships based on their inception impact assessments

Respondents were asked to assess the scope and coverage of the Integrated Air Traffic Management, based on its inception impact assessment. The clear majority of the respondents have indicated that the partnership has the right scope and coverage across all areas. The respondents have been the most positive with regard to technologies covered, where 46 respondents (75.41%) have indicated the partnership has the right scope and coverage. Respondents found that the sectoral scope and coverage was right, the least often, while still over 56% of the respondents has indicated that it was the right scope. On average, the respondents who have indicated that the scope and coverage are too narrow, have done so as they feel that airspace users should be more involved in the new partnership than is the case today.

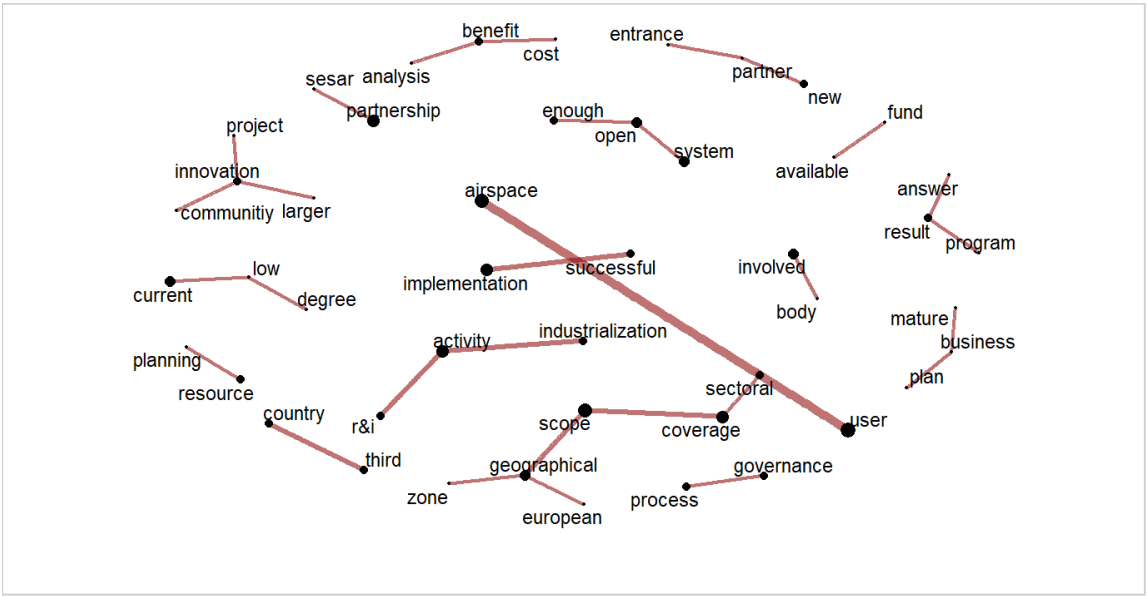
No statistical differences were found between the views of citizens and other respondents.

Figure 42: Views of respondents on the scope and coverage proposed for the Integrated Air Traffic Management Partnership



Aside from this multiple choice question, the respondents were also asked to provide any comment that they may have on the proposed scope and coverage for this candidate Institutionalised Partnership. The keyword analysis used for open questions resulted in the graph shown in Figure 43. Several responses (about 10 out of 34) mention the need for higher involvement of end-users, i.e. airspace users in the programme, taking into account their diversity (e.g. schedule, cargo, business airlines, general aviation). Several respondents just clarified that the assessment of scope and coverage was based on the current partnership, as they have not seen the proposal for the future partnership. Some stakeholders stated that the membership of the current partnership was not open to new entrants. The current partnership was mentioned as a good starting point for the future partnership. Furthermore, the need to reach sustainability goals was mentioned.

Figure 43: Assessment of open answers with regard to the proposed scope and coverage for this candidate Institutionalised Partnership, 30 most common co-occurring keywords (N=20)



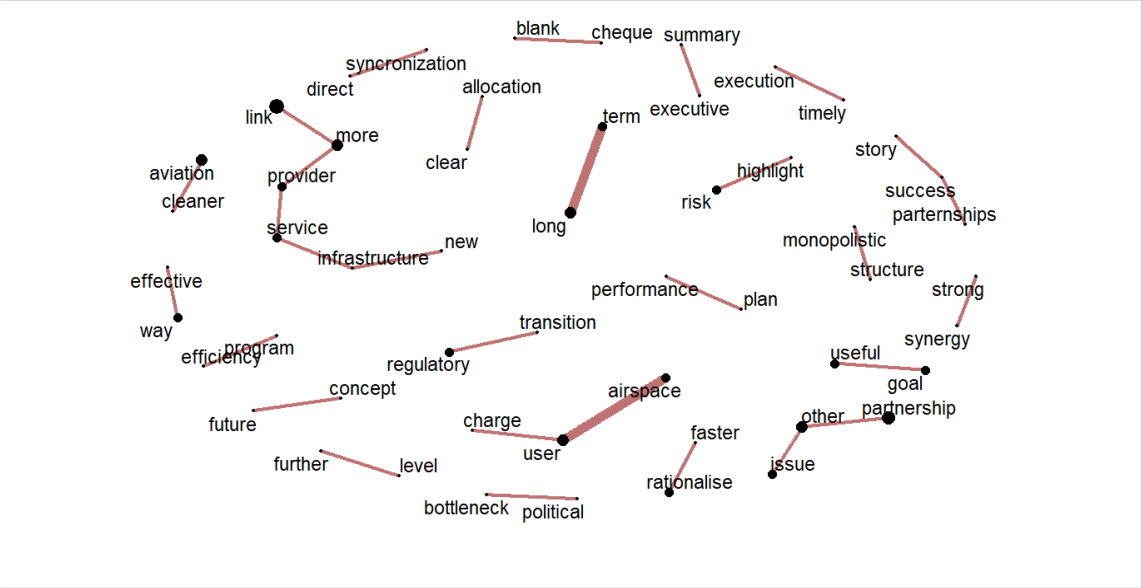
B.6.10 Scope for rationalisation and alignment of candidate European Partnerships with other initiatives

The respondents were also asked if they thought it would be possible to rationalise the candidate European Institutionalised Partnership and its activities, and/or to better link it with other comparable initiatives – 37 respondents (66.07%) have indicated that they think this is the case, 19 respondents (29%) have stated no (10 interviewees offered no responses).

No statistical differences were found between the views of citizens and other respondents.

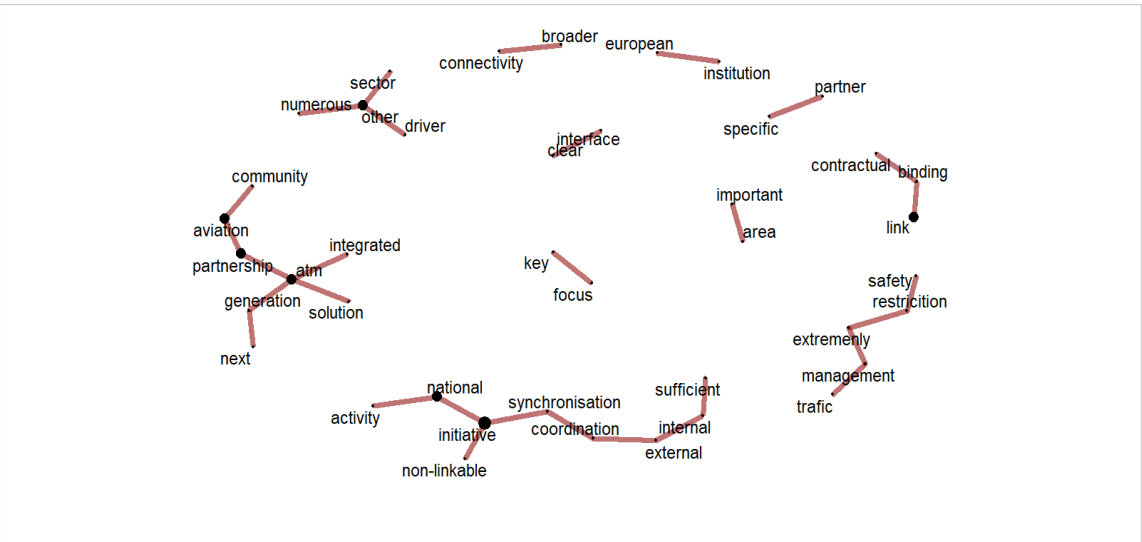
The respondents who answered affirmative, where asked which other comparable initiatives it could be linked with. The results of the analysis resulted in the chart shown in Figure 44 showing the co-occurrences of keywords. Thirteen respondents indicated that the Partnership should be linked to Clean Sky partnership. Several responses further stated that there should be no rationalisation, or that it was not clear what was meant by rationalisation. Key Digital Technologies and Smart Networks and Services initiatives were also mentioned as candidates for synchronisation and strong synergies.

Figure 44: Assessment of open answers on the question on which other comparable initiatives it could be linked with, 30 most common co-occurring keywords (N=31)



For the respondents who answered negatively on the previous question, the results of the analysis resulted in the chart shown in Figure 45 showing the co-occurrences of keywords. Respondents feel that there is almost no overlap on content of this initiative with other initiatives, but clear interfaces exist. According to them ATM R&I need very specific partners and expertise, and while it is already extremely complex, it must stay manageable.

Figure 45: Assessment of open answers on the question why other comparable initiatives are not suitable to be linked, 30 most common co-occurring keywords (N=9)

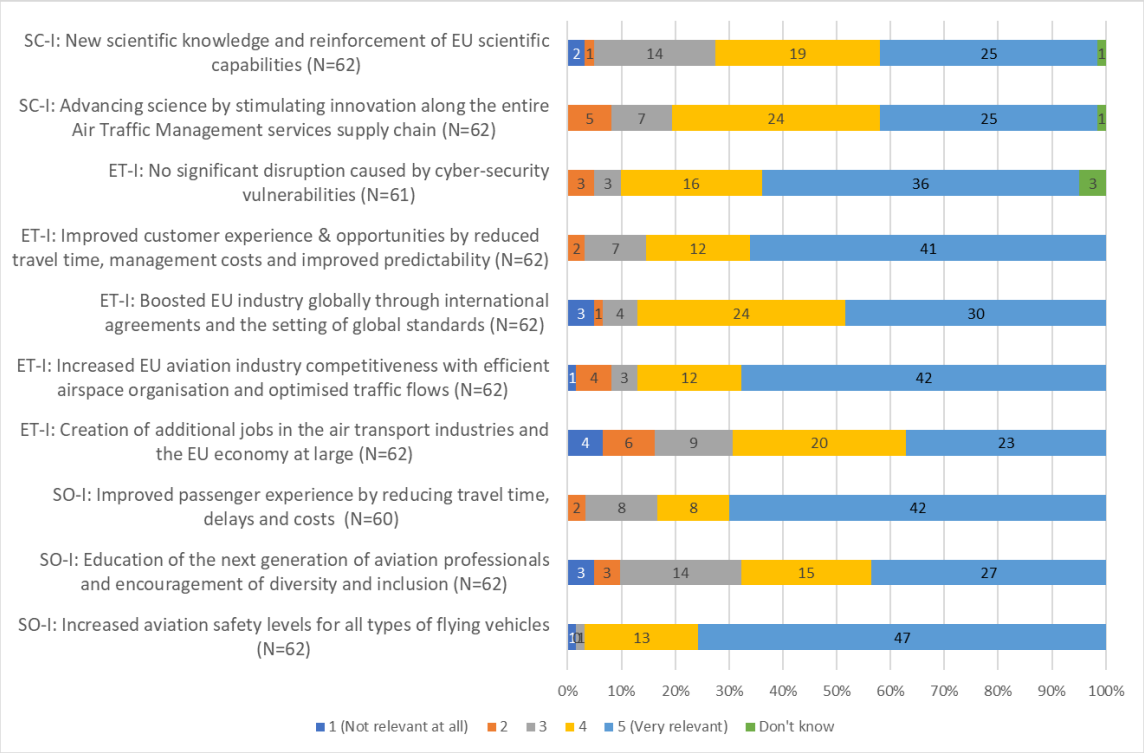


B.6.11 Relevance of European Partnerships to deliver targeted scientific, economic/technological and societal impacts

Respondents were asked to assess the relevance of the candidate European Institutionalised Partnership to deliver on listed impacts. According to Figure 46, the candidate Partnership is expected to be 'very relevant' for increasing aviation safety levels for all types of flying vehicles and for improving passenger experience by reducing travel time, delays and costs. In contrast, the impact on education of the next generation of aviation professionals and encouragement of diversity and inclusion is expected to be lower, as only 27 out of 62 respondents (43.55%) consider that the Partnership would be 'very relevant' for this, but further 39% of respondents find it relevant. Among listed economic/technological impacts, over 60% of respondents indicated that the candidate Partnership is relevant to achieve an impact on EU aviation industry competitiveness, on customer experience & opportunities by reduced travel time, management costs and improved predictability, and on the number of disruptions caused by cyber-security vulnerabilities. The pattern of responses about the scientific impacts are similar, however, a smaller number of respondents (about 40%) consider that the Partnership would have a very relevant effect on generation of new scientific knowledge and reinforcement of EU scientific capabilities, while further 30% of respondents find it relevant.

No statistical differences were found between the views of citizens and other respondents, except for the economic/technological impact related to the creation of additional jobs in the air transport industries and the EU economy at large which citizens found less relevant.

Figure 46: Views of respondents on the relevance of the candidate European Institutionalised Partnership to various impacts



B.6.12 Summary of campaigns results for this specific initiative

Four campaigns have been identified among the respondents to this initiative. Two campaigns cover 22 respondents and their responses are summarised below. The other two campaigns cover 5 respondents for this initiative and are not reported here. In total 29% of respondents were considered to be part of campaigns.

The first campaign[127] includes 41 respondents (campaign #2), however, only 10 of them decided to provide opinions for this Partnership.

The ten respondents in this campaign group cover different stakeholder groups[128] as depicted in Figure 47. As can be seen, this campaign groups covers a variety of stakeholders that expressed very similar opinions.

Figure 47: Campaign #2 stakeholders divided in open public consultation categories and ATM value chain categories.

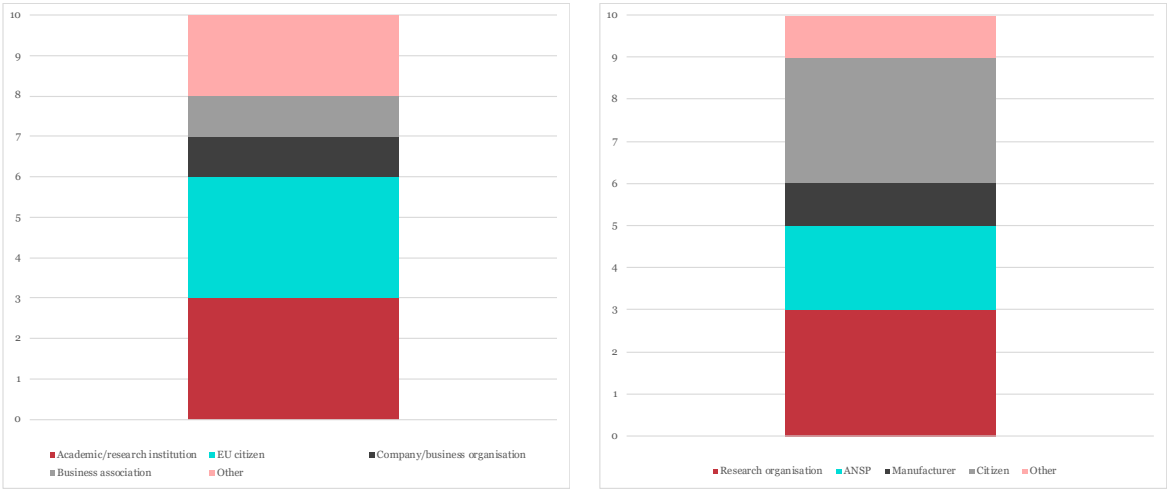


Table 31: Overview of responses of the first campaign (campaign #2) (N=10)

Question category	Summary of responses
Research and innovation problems	With exception of one respondent, the category "fragmentation of EU airspace" received the score 5 'very relevant'. Views of respondents about other answer categories are mixed, but, on average, they have a score between 3 and 4.
Structural and resource problems	Most categories are considered 'very relevant' by respondents. The lowest score received the category "skills required for researchers in this area".
Problems in uptake of digital innovations	Most respondents consider 'very relevant' the following answer categories: "regulation impeding the uptake of innovation" and "slow pace of Air Traffic Management modernisation". Other categories received a lower score, on average, and display mixed views.
Preferred Horizon Europe intervention	Institutionalised Partnership was selected by all respondents. When respondents were asked to explain their choice, several of them used the following quote: *"Institutionalised Partnership allows to bring together and align all private and public actors towards common challenging targets and roadmap to address the long cycles of R&I of the sector. It offers the critical mass and the flexibility of resources allocation upon achieved technical maturation and evolution of needs as well as a strong centralized management and the technical and strategic coordination necessary in a pan-European effort like ATM is by definition".*
Relevance of actors for setting join long-term agenda	Most answer categories received a high score (namely, 5) with exception of "foundations and NGOs" and "other stakeholders".

[127] Campaigns are determined across all responses for all the initiatives.

[128] Stakeholder groups as determined in the Open public consultation.

Question category	Summary of responses
	Involvement of industry is considered most relevant by all respondents.
Relevance of actors for pooling and leveraging resources	Most answer categories received a high score (namely, 5) with exception of "foundations and NGOs" and "other stakeholders". Involvement of industry is considered most relevant by all respondents.
Partnership composition	Respondents gave an average score (between 3 and 4) to listed elements of partnership composition.
Implementation of activities	With exception of one respondent, the categories "joint R& programme" and "input to regulatory aspects" were rated 'very relevant'. In contrast, "deployment and piloting activities" received the lowest score (namely – 3.7), on average.
Relevance of the legal structure	Across all categories, respondents indicated that the legal structure would be 'very relevant'. The lowest number of respondents that gave the highest score is in the category "implement activities more transparently".
Scope and coverage of the candidate Partnership	Most respondents consider that listed components of the candidate Partnership have right scope and coverage. However, 4 out of 10 respondents indicated that the geographic scope and coverage of the future Partnership is too narrow. Respondents were offered an opportunity to provide comments on the proposed scope and coverage of the Institutionalised Partnership. Several of them included the following quote: *"A more balanced distribution in TRL-levels is needed. The membership is very rigid. A more flexible structure is needed, which welcomes new comers such as new airspace users".*
Rationalisation of the candidate Partnership and linking to other initiatives	Out of 10 respondents, 6 consider that it would not be possible to rationalise the candidate Partnership and its activities, and/or to better link it with other comparable initiatives. Respondents were asked to explain their answer. Most of those who considered that it is possible to rationalise, and/or better link the candidate Partnership with other comparable initiatives inserted a following quote: *"While distinct partnerships are needed (as stakeholders and processes are different), there should be mechanisms for synergies and cross-fertilization in place as they share objectives - notably lowering emissions - and solutions need to be developed in a consistent way"*. In contrast, those who stated that it is not possible to rationalise the candidate Partnership and its activities, used the following quote: *"Unclear expectation for rationalisation, need to remain focused on ATM modernisations topics through a dedicated partnership".*
Societal impact	All respondents consider that the candidate Partnership would be 'very relevant' to "increase aviation safety levels for all types of flying vehicles" and to "improve passenger experience by reducing travel time, delays and costs". In contrast, the category "education of the next generation of aviation professionals and encouragement of diversity and inclusion" received an average score (between 3 and 4).
Economic/technological impact	Most respondents consider that the candidate Partnership would be 'very relevant' for all suggested impacts, with exception of "creation of additional jobs in the air transport industries and the EU economy at large", "no significant disruption caused by

Question category	Summary of responses
	cyber-security vulnerabilities". In those categories, the average score is slightly lower.
Scientific impact	With exception of two respondents, both answer categories are considered 'very relevant' by respondents.

The second campaign consists of 19 respondents (campaign #6) and 12 completed questions for this Partnership – all 12 are either manufacturers or manufacturer representative organisations.

Table 32: Overview of responses of the second campaign (campaign #6) (N=12)

Question category	Summary of responses
Research and innovation problems	Only one answer category received a high score (5 'very relevant') from almost all respondents, namely – "fragmentation of EU airspace". Other categories received a score of 2 ("not relevant").
Structural and resource problems	Most categories are considered 'very relevant' by respondents. The categories with the lowest average score are "skills required for researchers in this area" (on average, score 2.08) and "need of specific infrastructure" (on average, score 3.91).
Problems in uptake of digital innovations	All respondents consider that the candidate Partnership would be 'very relevant' to address problems in uptake of air traffic management innovations due to "slow pace of Air Traffic Management modernisation". All respondents gave a score 4 ('relevant') to the answer category "investments featuring the uptake of innovation". Other answer categories received a score of 2 or 3 by all respondents.
Preferred Horizon Europe intervention	Institutionalised Partnership was selected by all respondents. When respondents were asked to explain their choice, all of them used the following quote: *"Huge challenges ahead (traffic growth, increased complexity, GHG targets). EU partnership is most effective approach:* *-long-term framework for innovation driven by EU policy priorities & oversight* *-develop strategic value chains* *-pool&align resources, validation platforms&investment,economies of scale* *-bring stakeholders around an integrated joint roadmap* *-EU action more economically efficient than fragmented local initiatives, which may not be possible in many cases"*.
Relevance of actors for setting join long-term agenda	All respondents consider that involvement of Member States and Associated Countries, Industry is 'very relevant'. Other answer categories were received a score of 2 by almost all respondents.
Relevance of actors for pooling and leveraging resources	All respondents consider that involvement of Member States and Associated Countries, Industry is 'very relevant'. The category "Academia" received a score 4 by all respondents, while other answer categories were received a score of 2 by all respondents.
Partnership composition	Both elements of partnership composition received a low score by all respondents (either 2 or 3).
Implementation of activities	With exception of the answer category "collaborative R&I projects" that received a low score (between 2 and 3), other categories were considered 'very relevant' by all respondents.

Question category	Summary of responses
Relevance of the legal structure	Across all categories, all respondents indicated that the legal structure would be 'very relevant'.
Scope and coverage of the candidate Partnership	Across all categories, all respondents indicated that the scope and coverage of the candidate Partnership is right. Respondents were offered an opportunity to provide comments on the proposed scope and coverage of the Institutionalised Partnership. Several of them included the following quote: *"Complement to question 2: Institutionalised partnership is the relevant instrument:* *- brings economies of scale* *-brings together stakeholders around a single&integrated joint roadmap* *-EU action is more economically efficient than fragmented local initiatives, which may not be possible in many cases".*
Rationalisation of the candidate Partnership and linking to other initiatives	All respondents consider that it would be possible to rationalise the candidate Partnership and its activities, and/or to better link it with other comparable initiatives. Respondents were asked to explain their answer, all of them inserted a following quote: *"Links with Clean Aviation: while distinct partnerships are needed (as stakeholders and processes are different), there should be mechanisms for synergies and cross-fertilization in place as they share objectives - notably lowering emissions - and solutions need to be developed in a consistent way".*
Societal impact	Almost all respondents consider that the candidate Partnership is 'very relevant' for increasing aviation safety levels for all types of flying vehicles and for improving passenger experience by reducing travel time, delays and costs. In contrast, most respondents consider that the Partnership would be 'relevant' (score 4) for educating the next generation of aviation professionals and encourage diversity and inclusion.
Economic/technological impact	With exception of the answer category "no significant disruption caused by cyber-security vulnerabilities", other categories are considered 'very relevant' by most respondents.
Scientific impact	Both answer categories are considered 'very relevant' by all respondents.

Appendix C Methodological Annex

The Impact Assessment studies for all 13 candidate institutionalised European Partnerships mobilised a mix of qualitative and quantitative data collection and analysis methods. These methods range from desk research and interviews to the analysis of the responses to the Open Consultation, stakeholder analysis and composition/portfolio analysis, bibliometrics/patent analysis and social network analysis, and a cost-effectiveness analysis.

The first step in the impact assessment studies consisted in the definition of the context and the problems that the candidate partnerships are expected to solve in the medium term or long run. The main data source in this respect was desk research. The Impact Assessment Study Teams went through grey and academic literature to identify the main challenges in the scientific and technologic fields and in the economic sectors relevant for their candidate partnerships. The review of official documentations, especially from the European Commission, additionally helped understand the main EU policy proprieties that the initiatives under assessment could contribute to achieve.

Almost no candidate institutionalised European Partnership is intended to emerge ex nihilo. Partnerships already existed under Horizon 2020 and will precede those proposed by the European Commission. In the assessment of the problems to address, the Impact Assessment Study Teams therefore considered the achievements of these ongoing partnerships, their challenges and the lessons that should be drawn for the future ones. For that purpose, they reviewed carefully the documents in relation to the preceding partnerships, especially their (midterm) evaluations conducted. The bibliography in Appendix A gives a comprehensive overview of the documents and literature reviewed for the present impact assessment study.

Finally, the description of the context of the candidate institutionalised European Partnerships required a good understanding of the corresponding research and innovation systems and their outputs already measured. The European Commission services and, where needed the ongoing Joint Undertakings or implementation bodies of the partnerships under Article 185 of the TFEU, provided data on the projects that they funded and their participants. These data served as basis for descriptive statistic of the numbers of projects and their respective levels of funding, the type of organisations participating (e.g. universities, RTOs, large enterprises, SMEs, public administrations, NGOs, etc.) and how the funding was distributed across them. Special attention was given to the countries (and groups of countries, such as EU, Associated Countries, EU13 or EU15) and to the industrial sectors, where relevant. The sectoral analysis required enriching the eCORDA data received from the European Commission services with sector information extracted from ORBIS. We used the NACE codification up to level 2. These data enabled identified the main and, where possible, emerging actors in the relevant systems, i.e. the organisations, countries and sectors that will need to be involved (further) in the future partnerships.

The horizontal teams also conducted a Social Network Analysis using the same data. It consisted in mapping the collaboration between the participants in the projects funded under the ongoing European partnerships. This analysis revealed which actors – broken down per type of stakeholders or per industrial sector – collaborate the most often together, and those that are therefore the most central to the relevant research and innovation systems.

The data provided by the European Commission finally served a bibliometric analysis aimed at measuring the outputs (patents and scientific publications) of the currently EU-funded research and innovation projects. A complementary analysis of the Scopus data enabled to determine the position and excellence of the European Union on the international scene, and identify who its main competitors are, and whether the European research and innovation is leading, following or lagging behind.

All together, these statistical analyses will complement the desk research for a comprehensive definition of the context in which the candidate institutionalised European Partnerships are intended to be implemented. The conclusions drawn on their basis will be confronted to the views of experts and stakeholders collected via three means:

- The comments to the inception impact assessments of the individual candidate institutionalised European partnerships received in August 2019
- The open public consultation organised by the European Commission from September to November 2019
- The interviews (up to 50) conducted by each impact assessment study team conducted between August 2019 and January 2020.

For instance, in all three exercises, the respondents were asked to reflect on the main challenges that the candidate institutionalised European Partnerships should address. In the open public consultations, they mainly reacted to proposals from the European Commission like when they were given to opportunity to give feedback to the inception impact assessment.

The views of stakeholders (and experts) were particularly important for determining the basic functionalities that the future partnerships need to demonstrate to achieve their objectives as well as their most anticipated scientific, economic and technological, and societal impacts. The interviews allowed more flexibility to ask the respondents to reflect about the different types of European Partnerships. Furthermore, as a method for targeted consultation, it was used to get insights from the actors that both the Study Teams and the European Commission were deemed the most relevant. For the comparative assessment of impacts, the Study Teams confronted the outcomes of the different stakeholder consultation exercises to each other with a view of increasing the validity of their conclusions, in line with the principles of triangulation. Appendix B includes also the main outcomes of these three stakeholder consultation exercises.

The comparison of different options for European partnerships additionally relied on a cost-effectiveness analysis. When it comes to research and innovation programmes, the identification of costs and benefits should primarily be aimed at identifying the "value for money" of devoting resources from the EU (and Member States) budget to specific initiatives. Based on desk research and consultation with the European Commission services, the horizontal study team produced financial estimates for different types of costs (preparation and setup costs, running costs and winding down costs) and per partnership option. The costs were common to all candidate European Partnerships. The results of the cost model were displayed in a table, where each cost was translated on a scale using "+" in order to ease the comparison between the partnership options.

A scorecard analysis, which allocated each option a score between 1 and 3 against selected variables, was used to highlight those options that stand out as not being dominated by any of the other options in the group: such options are then retained as the preferential ones in the remainder of our analysis. It also allowed for easy visualisation of the pros and cons of alternative options.

Appendix D Additional information on the policy context

D.1 Introduction

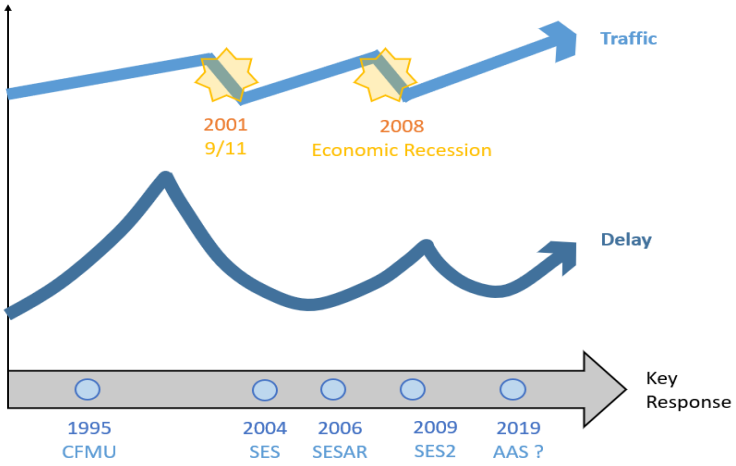
This appendix provides additional material on policy context, including:

- The need for SESAR,
- The SESAR programme,
- The SESAR Joint Undertaking,
- Aviation's contribution to SDGs.

D.2 The need for SESAR

Figure 48 illustrates the historical evolution of air traffic delay in Europe, also referred to as en-route Air Traffic Flow Management delay. This is the delay accumulated due to the lack of capacity of portions of airspace dedicated to cruise phase of the flights (also referred to as en-route). When capacity is reached, all aircraft planned to enter that portion of airspace subsequently are delayed.

Figure 48: Evolution of en-route Air Traffic Flow Management delay in Europe.



Source: Authors analysis of PRR2018.

The three peaks in delay are worthy of note. In late 1990s significant delays led to two forms of intervention:

- The creation by EUROCONTROL of the Central Flow Management Unit (CFMU)[129] and successful implementation of key capacity enablers including RVSM[130] and B-RNAV.[131]
- The development of the Single European Sky initiative, leading to the first package of legislation in 2004.

In the early 2000's delays were growing, and a similar delay crisis was predicted - but with limited confidence that technical solutions existed. This led to the creation of the SESAR

[129] The Central Flow Management Unit (CFMU) provides Air Traffic Flow Management across Europe and is now a central part of the Network Manager, and changed the name to Network Manager Operations Centre (NMOC).

[130] Reduced Vertical Separation Minima (RVSM) allowed the vertical separation minima to be reduced from 2000 to 1000 ft in en-route airspace and provided a large capacity increase.

[131] Basic Area Navigation (B-RNAV) is a forerunner of Required Navigation Performance (RNP5) for en-route airspace and enabled a flight efficient and capacity benefit.

programme. The crisis did not materialise due to fall in air traffic following the 2008 financial crisis.

In 2018 significant delays returned. Potential solutions from the current SESAR programme have been identified in the Airspace Architecture Study[132] to resolve the problem. The proposed integrated ATM partnership would have the objective of accelerating the development and deployment of the necessary solutions.

D.3 SESAR in the SES Context

The EU competence in Air Traffic Management, exercised through the Single European Sky, is designed to drive performance improvement at EU level through a range of measures including economic regulation[133] and network functions.[134]. As the recent Court of Auditors report makes clear,[135] the SES initiative is justified but not yet fully effective.

The Single European Sky (SES) was the Commission's response to the significant air transport delays that plagued the 1990s. The SES legislation promotes the development, modernisation, and harmonisation of Air Traffic Management (ATM) across Europe. Over the years, SES has developed into a performance-oriented system in which the service providers (or ANSPs) are incentivised to adopt new concepts and technologies (as well as new ways of managing the business) to achieve the SES High Level goals.

In 2006, the European Commission launched the SESAR programme, "technological pillar" of the Single European Sky: "*It aims to improve Air Traffic Management (ATM) performance by modernising and harmonising ATM systems through the definition, development, validation and deployment of innovative technological and operational ATM solutions"* .[136]

Thus, the SESAR programme consists of definition of the strategic research and innovation agenda, R&I activities and deployment activities, all linked through the SESAR innovation lifecycle. The SESAR innovation lifecycle is central to the SES policy. SESAR is designed to mature and validate operational concepts and systems necessary for the modernisation of ATM. European airspace is amongst the busiest and most complex in the world. Traditionally Air Navigation Services have been provided by a patchwork of different national systems operated by national providers known as Air Navigation Service Providers (ANSPs).

The SESAR programme is defined as a continuous lifecycle that steers the R&I programme to effectively close performance gaps in the deployed system as illustrated in Figure 49.

[132] A proposal for the future architecture of the European airspace, SJU, 2019.

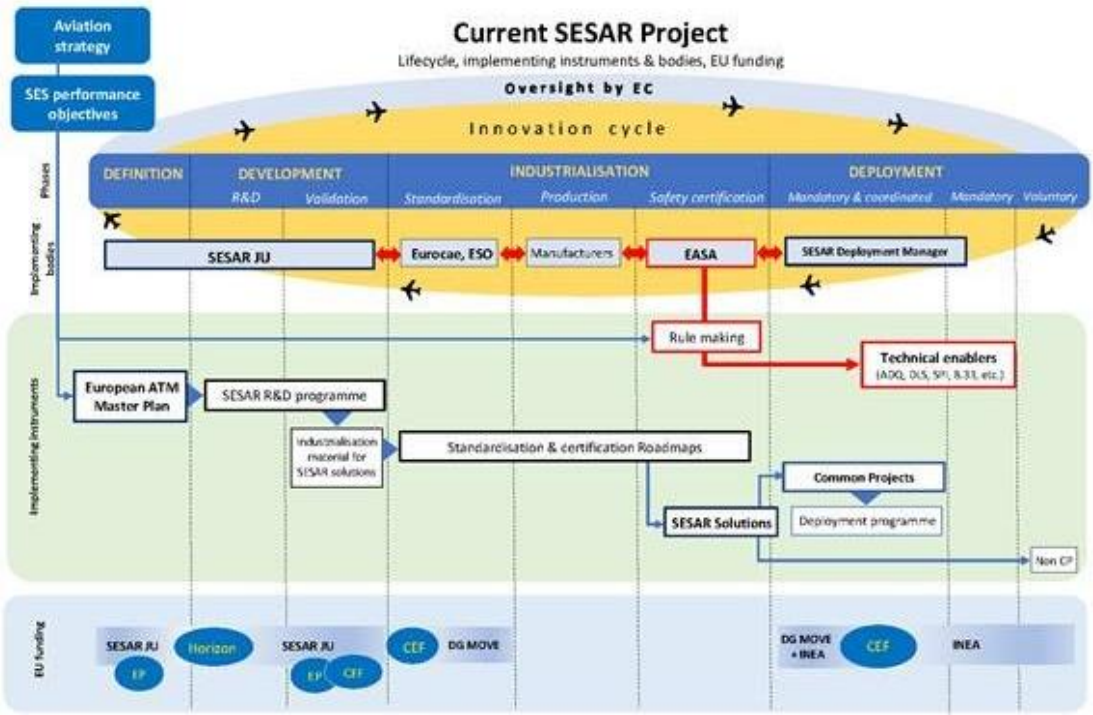
[133] Commission Implementing Regulation (EU) 2019/317 of 11 February 2019 laying down a performance and charging scheme in the single European sky and repealing Implementing Regulations (EU) No 390/2013 and (EU) No 391/2013.

[134] Commission Implementing Regulation (EU) 2019/123 of 24 January 2019 laying down detailed rules for the implementation of air traffic management (ATM) network functions and repealing Commission Regulation (EU) No 677/2011.

[135] Single European Sky: a changed culture but not a single sky, Special Report 18/2017, European Court of Auditor.

[136] Source: https://ec.europa.eu/transport/modes/air/sesar_en

Figure 49: SESAR Innovation Lifecyle[137]



Source: DG-MOVE.

Key issues for accelerating deployment in ATM are:

- Reducing the implementation risks for both equipment supplier and ANSPs by ensuring that regulators and standardisation bodies have the current evidence to support operational approval and standards development. This is referred to as closing the industrialisation gap[138] and should be an objective of the future integrated ATM partnership.
- Ensuring a common and agreed evolution of systems hence reducing the commercial risk in developing products – in Europe this is achieved through the ATM Master Plan.
- Enabling synchronised deployment to reduce the time between system deployment and accruing benefits by ensuring that national ANSPs invest in a coherent manner – this is an objective of the SESAR deployment phase and common project legislation.[139]

D.4 R&I Prior to SESAR

Prior to SESAR, significant R&D was being undertaken in Air Traffic Management:

- EUROCONTROL spent about €150-200m a year on R&D;
- The Commission funding for ATM under the Fifth Framework Programme amounted to €20.8m between 1998 and 2002, and by around €100m over the 2002-2006 period;

[137] Source: DG-MOVE, European Commission

[138] Interim evaluation of the SESAR Joint Undertaking (2014-2016) operating under Horizon 2020, Experts Group Report.

[139] Commission Implementing Regulation (EU) No 716/2014 of 27 June 2014 on the establishment of the Pilot Common Project supporting the implementation of the European ATM Master Plan Text with EEA relevance.

- The European Investment Bank also contributed €390m to support ATM in Europe between 1999 and 2003.[140]

A 2006 review of existing R&D identified 58 initiatives; including:[141]

- FP6 funded 44 ATM[142] related research projects. The topics covered wide range, and some, became central to the SESAR Development Phase work programme, for example:
  - EPISODE 3 set foundation for the SESAR operational concept and performance framework.
  - SWIM-SUIT project came up with the precursors of the current SWIM solutions.
  - The ART project laid groundwork for SESAR remote tower solutions.
  - The EMMA projects pioneered A-SMGCS solutions.
- EUROCONTROL research included the PHARE programme which included research on 4D trajectory management and formed the basis of the concept developed within the SESAR Definition Phase. PHARE included strong input from the national programmes including Netherlands (NLR), Germany (DLR), France (DSNA) and the UK (NATS, DERA).
- National Programmes which fed into the procurement plans of ANSPs. In particular, LFV in Sweden had a strong national programme.

Despite the reasonable level of research, the programmes overlapped with each other and the results were fragmented leading to low value for money. The combined research effort was leading to competing rather than a common view of the future of ATM.

A key objective of SESAR was to coordinate all European ATM research towards a common goal, which was mandated by the SESAR Joint Undertaking regulation.143

D.5 The SESAR Joint Undertaking[144]

D.5.1 Scope and objectives

The SESAR Joint Undertaking was initially established in 2007 with the objectives and tasks defined in Table 33.

Table 33: Objectives and tasks of the SESAR Joint Undertaking

Objectives and tasks of the SESAR Joint Undertaking
The aim of the Joint Undertaking shall be to ensure the modernisation of the European air traffic management system by coordinating and concentrating all relevant research and development efforts in the Community. It shall be responsible for the execution of the European ATM Master Plan and in particular for carrying out the following tasks: • organising and coordinating the activities of the development phase of the SESAR project, in accordance with the European ATM Master Plan, resulting from the definition phase of the project managed by EUOCONTROL, by combining and managing under a single structure public and private sector funding,

[140] SEAME CBA and Governance Study, Steer Davies Gleave, 2005.

[141] SESAR Consortium DLT-0507-221-00-02, 2006.

[142] The R&I tended to be conducted by research organisations and ANSPs, with limited involvement from airspace users and airport operators. Total ATM related research received €167m in funding (with the total budget of €289m).

[143] Council Regulation (EC) No 219/2007 of 27 February 2007 on the establishment of a Joint Undertaking to develop the new generation European air traffic management system (SESAR)

[144] Interim Evaluation of the SESAR Joint Undertaking (2014-2016) operating under Horizon 2020, Experts Group Report.

Objectives and tasks of the SESAR Joint Undertaking
• ensuring the necessary funding for the activities of the development phase of the SESAR project in accordance with the European ATM Master Plan, • ensuring the involvement of the stakeholders of the air traffic management sector in Europe, in particular: air navigation service providers, airspace users, professional staff associations, airports, and manufacturing industry; as well as the relevant scientific institutions or the relevant scientific community, • organising the technical work of research and development, validation and study, to be carried out under its authority while avoiding fragmentation of such activities, • ensuring the supervision of activities related to the development of common products duly identified in the European ATM Master Plan and if necessary, to organise specific invitations to tender.

Source: Council Regulation (EC) No 219/2007 of 27 February 2007 on the establishment of a Joint Undertaking to develop the new generation European air traffic management system (SESAR).

At the core of the activities of the SESAR Joint Undertaking is the European ATM Master Plan which acts as the strategic research and innovation agenda for the partnership.

The first version of the European ATM Master Plan was developed prior to the establishment of the SESAR Joint Undertaking and endorsed by the European Council in 2009. Since then, the European ATM Master Plan has been regularly updated by the SESAR Joint Undertaking following widespread stakeholder consultation. Each version requires approval of Member States through a positive opinion of the Single Sky Committee.[145]

Table 34 defines the main changes in each subsequent version of the European ATM Master Plan.

Table 34: Versions of the European ATM Master Plan

Edition	Additional Changes	MS State Endorsement
2009	Initial version created by the SESAR Definition Phase	Council Decision[146]
2012[147]	Increase the ATM community's awareness and focusing efforts on a manageable set of essential operational changes. Prepare for SESAR deployment phase, developing clear stakeholder roadmaps which provide a temporal view of the ATM. Promote and ensure interoperability at global level, in particular with the US ATM Modernisation programme, NextGen and ICAO. Promote synchronisation of ATM R&I and Deployment Programmes to ensure global interoperability.	SSC Opinion
2015[148]	Introduced a vision for the future European ATM system, including Common Support Services and cybersecurity. Explicitly introduces drones and rotorcraft as airspace users.	SSC Opinion

[145] The Single Sky Committee is the comitology committee for the Single European Sky.

[146] Council resolution on the endorsement of the European Air Traffic Management Master Plan 2935th TRASPORT, TELECOMMUICATIONS and EERGY Council meeting, Brussels, 30 March 2009. Available at: https://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/trans/106966.pdf

[147] European ATM Master Plan, Edition 2012, SJU. Available at: https://ec.europa.eu/transport/sites/transport/files/modes/air/sesar/doc/2012_10_23_atm_master_plan_ed2oct2012.pdf)

[148] European ATM Master Plan, Edition 2015, SJU. Available at: https://ec.europa.eu/transport/sites/transport/files/modes/air/sesar/doc/eu-atm-master-plan-2015.pdf

Edition	Additional Changes	MS State Endorsement
	Incorporates the results of more comprehensive military involvement through the European Defence Agency (EDA).	
2020	Addresses new challenges: tackling the unprecedented increase in traffic demand from both manned, and unmanned aviation, enabling the emergence of new business models, while supporting the sustainability of aviation. Enables digital transformation of the aviation infrastructure to accommodate aerial vehicles, which are set to become more autonomous, more connected and more intelligent.	SSC Opinion

Source: authors analysis of each edition of the European ATM Master Plan.

In 2014, the Council agreed that continuation of SESAR was the most effective way to achieve ATM modernisation[149,150] in Europe and extended the duration of the SESAR Joint Undertaking from 2016 to 2024,[151] leading to two distinct phases of the SESAR R&I programme, see Table 35.

Table 35: Phases of the SESAR Joint Undertaking

Phase	Dates	EC Contribution	Total Available Budget
SESAR1	2008 – 2016	TEN-T: €350 M FP7: €350	€2.1 b
SESAR2020	2015 – 2024	H2020: €585	€1.8 b

Source: Interim Evaluation of the SESAR Joint Undertaking (2014-2016) operating under Horizon 2020, Experts Group Report.

SESAR is the only source for funding of air traffic management R&I funding under Horizon 2020.

D.5.2 SESAR Joint Undertaking Work Programme

The main elements of the SESAR Joint Undertaking R&I programme are[152] presented in Table 36.

[149] SJU Extension – Impact Assessment Study, Ernst and Young, 31 July 2012.

[150] COMMISSION STAFF WORKING DOCUMENT Revision of Council Regulation (EC) N°219/2007 of 27 February 2007 on the establishment of a Joint Undertaking to develop the new generation European air traffic management system (SESAR).

[151] Council Regulation (EU) No 721/2014 of 16 June 2014 amending Regulation (EC) No 219/2007 on the establishment of a Joint Undertaking to develop the new generation European air traffic management system (SESAR) as regards the extension of the Joint Undertaking until 2024.

[152] SESAR Joint Undertaking Single Planning Document, SJU, 2019.

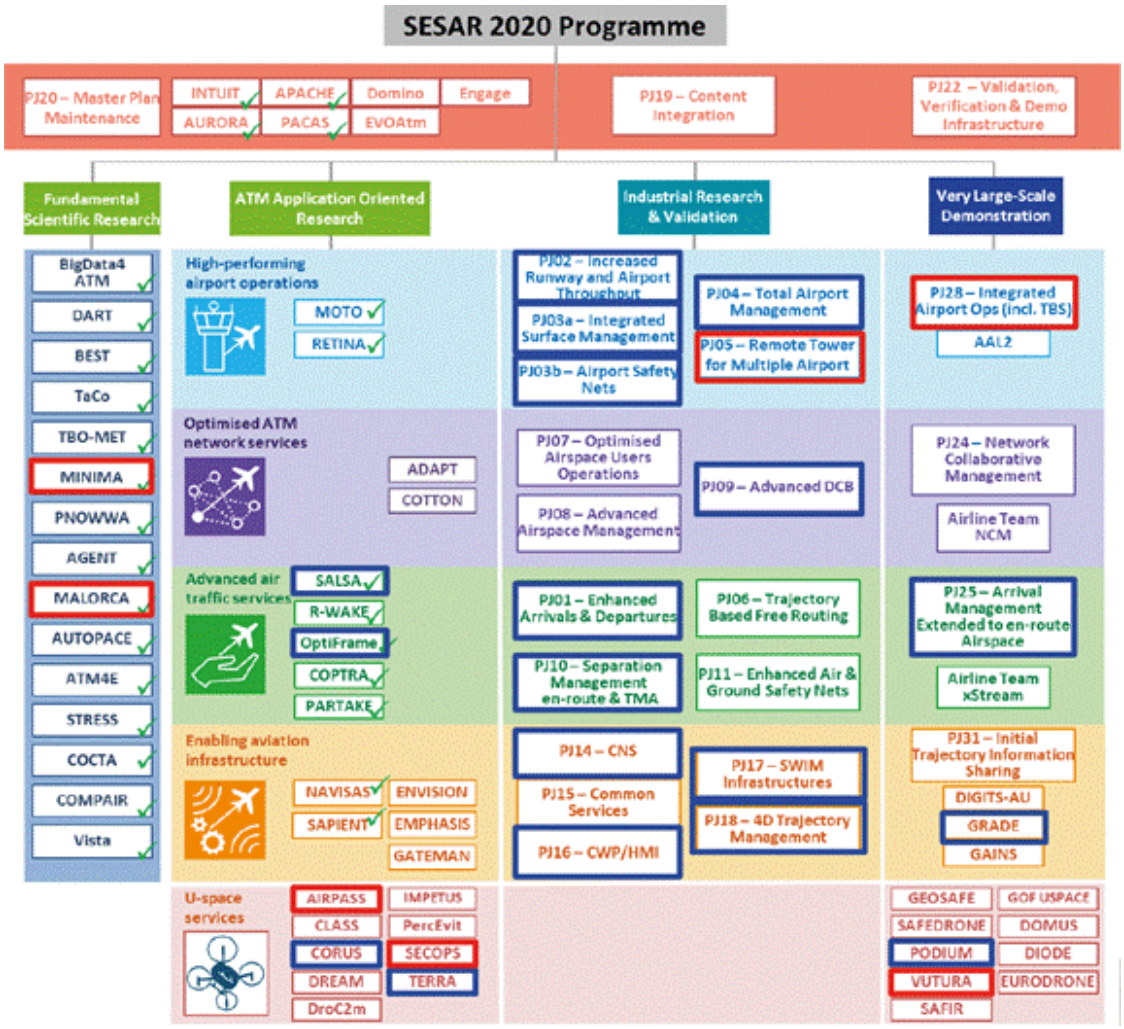
Table 36: Main elements of SESAR Joint Undertaking R&I Programme

Programme	Forms of R&I	Budget	Type of call
Core Programme	• Industrial Research and Validation • Very Large Scale Demonstrations • Transversal Activities (including ATM Master Plan maintenance)	80%	Restricted to SJU members
Exploratory Research Programme	• Fundamental Scientific Research • ATM Application Oriented Research	20%	Open Calls

Source: SESAR Single Programming Document, SJU, 2019.

The structure of the SESAR work programme is illustrated in Figure 50.

Figure 50: Structure of the SESAR2020 Programme



Source: SESAR Joint Undertaking Single Planning Document, 2019 to 2022, April 2019.

D.5.3 SESAR Joint Undertaking Membership

SESAR Joint Undertaking membership includes the main stakeholders of the European ATM industry including air navigation service providers, airports, equipment manufacturers and R&I laboratories. There are currently 19 SESAR Joint Undertaking members composed of 37 individual companies (see Table 37). In addition, EUROCONTROL is a founding Member.

Table 37: Members of the SESAR Joint Undertaking

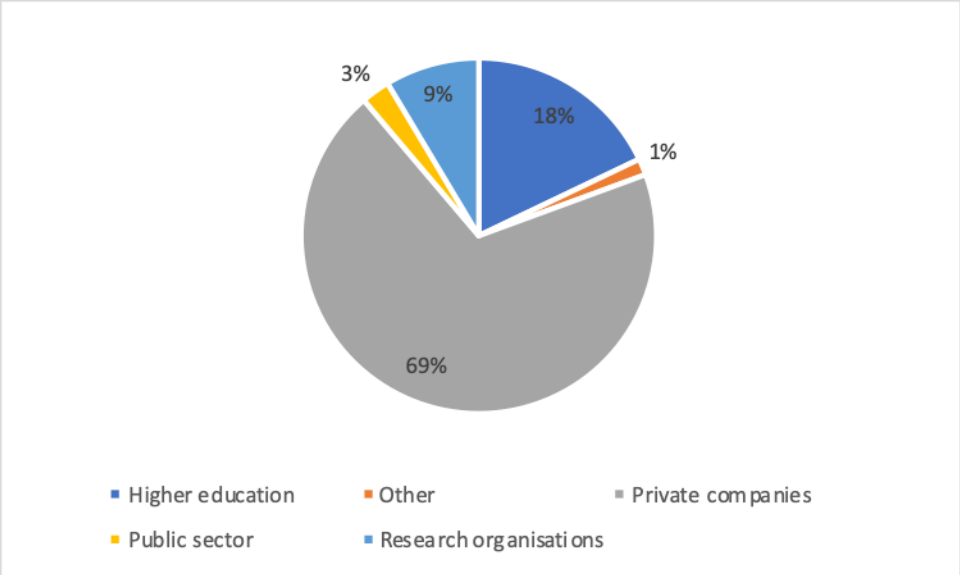
Member	Beneficiary	Sector	Country
AT-ONE	DLR	Research Org	Germany
	NLR	Research Org	Netherlands
B4	PANSA	Service Provider	Poland
	ANS CR	Service Provider	Czech Republic
	ORO Navigacija	Service Provider	Lithuania
	LPS SR	Service Provider	Slovak Republic
COOPANS	Naviair	Service Provider	Denmark
	Croatia Control Ltd	Service Provider	Croatia
	LFV	Service Provider	Sweden
	AustroControl	Service Provider	Austria
	IAA	Service Provider	Ireland
FSP	Frequentis AG	Ground Industry	Austria
	Atos Belgium SA/NV	Ground Industry	Belgium
	HungaroControl	Service Provider	Hungary
NATMIG	Sintef	Ground Industry	Norway
	AirTel ATN Ltd	Ground Industry	Ireland
	SaaB AB	Ground Industry	Sweden
SEAC2020	Heathrow Airport Ltd	Airport	UK
	Munich Airport	Airport	Germany
	Aeroports de Paris	Airport	France
	Zurich Airport	Airport	Switzerland
	Schiphol Airport	Airport	Netherlands
	Avinor AS	Airport	Norway
	Swedavia AB	Airport	Sweden
Airbus SAS	Airbus SAS	Airborne Industry	France
Dassault Aviation	Dassault Aviation	Airborne Industry	France
Honeywell Aerospace SAS	Honeywell Aerospace SAS	Airborne Industry	France
Thales Avionics SAS	Thales Avionics SAS	Airborne Industry	France
Finmeccanica – Leonardo	Finmeccanica – Leonardo	Ground Industry	Italy
Indra Sistemas SA	Indra Sistemas SA	Ground Industry	Spain
Thales Air Systems SAS	Thales Air Systems SAS	Ground Industry	France
DFS	DFS	Service Provider	Germany
DSNA	DSNA	Service Provider	France
ENAIRE	ENAIRE	Service Provider	Spain
ENAV SpA	ENAV SpA	Service Provider	Italy
NATS EnRoute Plc	NATS EnRoute Plc	Service Provider	UK
Skyguide	SkyGuide	Service Provider	Switzerland

Source: Interim Evaluation of the SESAR Joint Undertaking (2014-2016), Experts Group Report.

Approximately 80% of SESAR R&I is performed by the members following "closed calls". The members' supply chains support their contributions as third link parties or as subcontractors to the members.

SESAR Joint Undertaking membership does not directly include Universities and SMEs. However, the remaining 20% of R&I activities is performed by a range of academia and SMEs following open calls – mostly of Exploratory Research. In total, there have been 268 individual participants in the SESAR2020 programme (both open and closed calls). The private sector dominates with almost 70%, with the 18% of participation from Higher education sector, and 9% coming from Research organisations, as depicted in Figure 51.

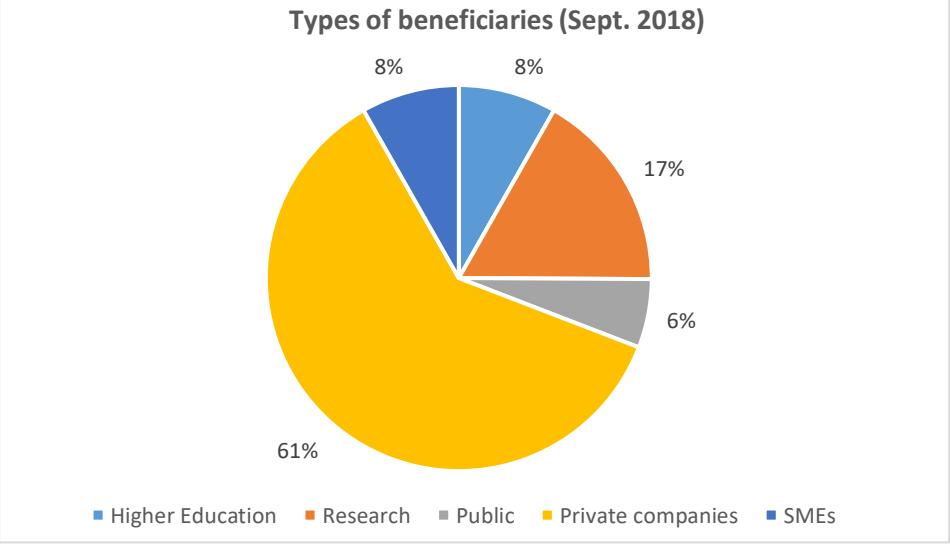
Figure 51: Type of participants in the SESAR Joint Undertaking.



Source: DG RTD data, calculation: Technopolis Group.

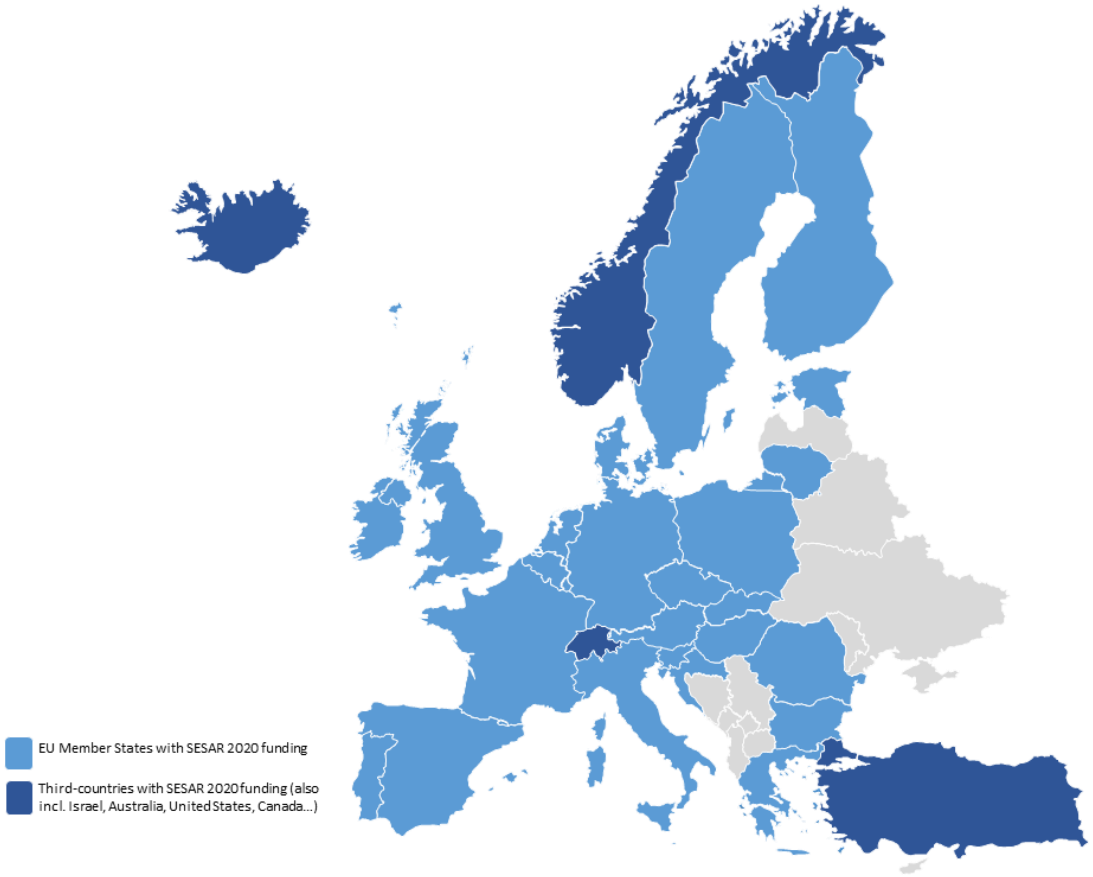
Figure 52 and Figure 53 illustrate the forms and geographical spread of SESAR Joint Undertaking beneficiaries.

Figure 52: Types of SESAR Joint Undertaking beneficiaries



Source: DG RTD data, calculation: Technopolis Group.

Figure 53: Location of SESAR Joint Undertaking beneficiaries



Source: DG RTD data, calculation: Technopolis Group.

D.5.4 Achievements of the SESAR Joint Undertaking

The focus of the current R&I programme is to develop and validate advanced solutions and concepts for the future air traffic management system in line with the European ATM Master Plan. Each solution represents a change in the way air traffic management is performed, and is supported by:

- A business case,
- A safety case,
- A performance case,
- A human performance case,
- A specification or similar material to support standardisation.

The SESAR Solutions Catalogue[153] defines 63 such solutions that have reached a sufficient maturity for deployment. EUROCAE and EUROCONTROL have developed over 50 standards to support deployment of SESAR solutions.[154]

For **scientific and technological analysis** of the current partnership, it is important to bear in mind the type of partners involved and the field of partnership, which is ATM.

[153] SESAR Solutions Catalogue 2019 Third edition, SJU, 2019.

[154] Source: https://ec.europa.eu/transport/sites/transport/files/ec-716-2014_article4b_standardisatregulatroadmap.pdf_

Scientific publications can be expected predominantly from the academic partners and from research organisations, but much less so from industry partners.

Based on the data available through DG RTD, 24 of the SESAR projects produced 32 publications in the field of 'Smart, green and integrated transport' (see Table 38).

Table 38: Number and share of publications by year.

Smart, green and integrated transport	2016	2017	2018	2019	Total
Total	5	22	4	1	32
Share	16%	69%	13%	3%	100%

Source: DG RTD, calculation: Technopolis Group

Table 39: Main journals from SESAR Joint Undertaking publications.

Journal Title	Total	Journal Title	Total
IEEE Transactions on Intelligent Transportation Systems	3	IEEE Access	1
IEEE Transactions on Visualization and Computer Graphics	3	IEEE Transactions on Biomedical Engineering	1
ANADOLU UNIVERSITY JOURNAL OF SCIENCE AND TECHNOLOGY A - Applied Sciences and Engineering	2	IEEE Wireless Communications Letters	1
Computer Graphics Forum	2	IFAC-PapersOnLine	1
Frontiers in Neuroscience	2	Informatics	1
Journal of Applied Meteorology and Climatology	2	Journal of Aircraft	1
Aerospace	1	Journal of Geophysical Research: Atmospheres	1
Atmospheric Measurement Techniques	1	Journal of Guidance, Control, and Dynamics	1
Augmented Reality, Virtual Reality, and Computer Graphics - Lecture Notes in Computer Science	1	Journal of The Royal Society Interface	1
Augmented Reality, Virtual Reality, and Computer Graphics - Lecture Notes in Computer Science, 9768	1	MATEC Web of Conferences	1
Brain Sciences	1	Transportation Research Part A: Policy and Practice	1
Frontiers in Human Neuroscience	1	Transportation Research Procedia	1

Source: DG RTD, calculation: Technopolis Group

The search of SCOPUS database produced 93 scientific papers in the period 2012-2019 (87 in the period 2014-2019) that listed as the source of funding SESAR Joint Undertaking. A number of these papers have been presented at the conferences (which are indexed in SCOPUS), as in some of the disciplines that are participating in the ATM, conferences are of more importance than the publications in journals.

The three main, peer-reviewed conferences in the ATM are:

1. The ATM Seminar, organised biannually, jointly by the Federal Aviation Administration and EUROCONTROL, aimed at established researchers (www.atmseminarus.org);
2. International Conference on Research in Air Transportation (ICRAT), organised biannually, jointly by the Federal Aviation Administration and EUROCONTROL, aimed at young researchers (www.icrat.org);
3. SESAR Innovation Days, organised by the SESAR Joint Undertaking, every year (https://www.sesarju.eu/sesarinnovationdays).

Conference proceedings are publicly available on the conference websites, and are indexed in the SCOPUS database.[155] The last three editions of ATM Seminar (2013-2017, as listed in SCOPUS) include 217 peer-reviewed papers. The ATM Seminar confers awards for best papers in each session and best conference paper. In the last two editions of the ATM Seminar, about half of the awards were won by European researchers, a significant number working on SESAR Joint Undertaking funded projects.[156]

The SESAR Innovation Days conference is open to any research in the field of ATM, and is aimed at reviewing and showcasing the research performed in the SESAR Joint Undertaking. There have been eight editions of the conference so far, and the number of accepted papers has been growing.

In summary, the research produced under the current partnership is of high scientific value, when assessed across the indicators that are important in the field – participation and awards received at the main conferences.

The **technological achievements** of the partnership are presented in terms of patent analysis and the technological solutions developed and implemented.

Patents can be expected from industry partners since they have a genuine interest in protecting their innovation. However, due to competition, business practices and the pre-competitive nature of collaborative R&I projects at EU-level, etc. most industrial partners in the field of ATM are not likely to apply for IPR. Therefore, the numbers of IPs recorded in the DG RTD database are of little use to describe properly the technological achievements of the partnership. IPRs can be found as outputs from three projects: two applied for a patent and one for a trademark.

The more important technological achievement of the partnership can be found in the catalogue of mature[157] ATM solutions produced by the partnership: SESAR Solutions Catalogue 2019,[158] containing 63 mature solutions and 79 solutions being developed. These solutions have been tested in over 200 validation exercises, at over 50 test beds across Europe.

Figure 54 displays a sample of locations deploying the SESAR solutions. The blue markers denote the airports deploying SESAR Solutions that are mandated through the EU's Pilot

[155] It takes a while for the proceedings to be indexed in SCOPUS, which is why the last ATM Seminar from June of 2019 and several SESAR Innovation Days proceedings are not yet available.

[156] Source: www.atmseminarus.org

[157] Mature from the R&I point of view, which is to say passing TRL 6.

[158] SESAR Solutions Catalogue, SJU, 2019.

Common Project[159], while the green markers point to the sample of locations where local SESAR deployments[160] are taking place.

Figure 54: Locations where SESAR Joint Undertaking solutions are being deployed

Source: SESAR Solutions Catalogue 2019.

The current deployment programme encompasses 349 projects with total costs of €2.9 billion with €1.2 billion co-funding the Connecting Europe Facility.

In summary, the current partnership (and as such the ATM R&I in Europe) produces high-quality scientific knowledge and a number of technological achievements are available and are being deployed, not only in Europe.

D.5.5 Outcomes and (expected) impacts

Since its inception in 2008, the SESAR Joint Undertaking has successfully coordinated European ATM R&I. The success of SESAR is best illustrated by the European ATM Master Plan, culminating in the 2015 edition,[161] and SESAR Solutions Catalogue.[162] To date 63 ATM solutions have been developed.

[159] Commission Implementing Regulation (EU) No 716/2014 of 27 June 2014 on the establishment of the Pilot Common Project supporting the implementation of the European Air Traffic Management Master Plan Text with EEA relevance.

[160] The detailed implementation data is available at: https://www.atmmasterplan.eu/deployment

[161] European ATM Master Plan, Edition 2020, SJU.

[162] SESAR Solutions Catalogue 2019 Third edition, SJU, 2019.

In addition, SESAR is strong brand demonstrating EU leadership in ATM in a competitive global landscape.[163] Indeed, the SESAR Joint Undertaking played a strong role in the development of global plans at ICAO level and in maintaining international interoperability of ATM systems through coordination with the FAA (Federal Aviation Authority) and other similar initiatives.[164]

The SESAR Joint Undertaking has also supported the European Commission's development of aviation and ATM policy through key studies performed at the request of DG-MOVE, including datalink communications,[165] U-space[166] and the recent Airspace Architecture Study.[167]

The SESAR Joint Undertaking results have therefore contributed to improvement of ATM both in the EU and globally. The key strengths of the SESAR Joint Undertaking are:

- Strong global brand supporting EU leadership,
- SESAR solutions demonstrably improving ATM performance,
- Integrated R&I platform including users, providers, suppliers, staff and regulators.

D.5.6 Identified needs for action

Previous assessments stress the importance of *SESAR and the* SESAR Joint Undertaking *as key enablers for the implementation of the wider SES policy"*[168]*.* However, two key weaknesses were found:

- Limited exploitation of advanced external R&I and internal exploratory research in the core ("closed call") programme. This illustrates a potential issue in the limited membership of the SESAR Joint Undertaking not enabling the beneficiaries of Exploratory Research to continue on the topic in the core programme.
- Limited progress on key enablers where there is limited industry consensus (for example, next generation datalinks and flight data processing) potentially highlighting the need for greater emphasis on transformational technologies.

In 2018, the SESAR Joint Undertaking performed a study on behalf of the European Parliament and European Commission to develop a proposal for a Future Airspace Architecture. Whilst the proposal is largely based on the current European ATM Masterplan, it also represents a step change in requiring both more transformational technologies and faster pull through from scientific research of digital enablers to support enhanced automation.

[163] Interim Evaluation of the SESAR Joint Undertaking (2014-2016) operating under Horizon 2020, Experts Group Report.

[164] Section 2.5 of SESAR Joint Undertaking Single Programming Document 2019-2021, SJU, 2019.

[165] Source: https://www.sesarju.eu/newsroom/brochures-publications/vdlm2-%E2%80%93-measurements-analysis-and-simulation-campaign-elsa-study

[166] Source: https://www.sesarju.eu/U-space

[167] Source: https://www.sesarju.eu/news/airspace-architecture-study-presented-european-parliament

[168] Interim Evaluation of the SESAR Joint Undertaking (2014-2016) operating under Horizon 2020, Experts Group Report.

The European Court of Auditors has considered both SES[169] and SESAR Deployment,[170] other parts of the SESAR innovation lifecycle. The former provided three recommendations relevant to the SESAR Joint Undertaking and to the future ATM research and development activities:

- Review the EU's support structure to ATM R&I in light of its objectives – including the need to justify continued support and whether a temporary structure is appropriate.
- Reinforce the accountability of the SESAR Joint Undertaking – by defining clear milestones and regular reports on progress with the implementation of the European ATM Master Plan.
- Prioritise EU support to R&I solutions that promote defragmentation and a competitive environment.

Delivering the Single European Sky and ensuring ATMs role in a sustainable aviation sector requires a much greater transformation than has hitherto been achieved. The level of transformation is discussed in Appendix F.

D.6 Aviation contribution to Sustainable Development Goals

"The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership."[171]

Aviation as a provider of transport and mobility is able to support a number of SGDs. ATM as an enabler of efficient transport contribute to multiple Sustainable Development Goals:

- SDG 9 (Industry, Innovation and Infrastructure)
- SDG 11 (Sustainable Cities and Communities)
- SDG 13 (Climate Action)

Indirect positive impact is expected for example in:

- SDG 3 (Good health and well-being)
- SDG 8 (Decent work and economic growth)
- SDG 12 (Responsible production and consumption)[172]

The following table has been developed from a report developed by Air Transport Action Group (ATAG) to illustrate how aviation can contribute to 11 SDGs.[173]

[169] Single European Sky: a changed culture but not a single sky, Special Report 18/2017, European Court of Auditors.

[170] The EU's regulation for the modernisation of air traffic management has added value – but the funding was largely unnecessary, Special Report 11/2019, European Court of Auditors.

[171] Sustainable development goals knowledge platform. Available at: https://sustainabledevelopment.un.org/sdgs

[172] European Commission (2019) Orientations towards the first Strategic Plan implementing the research and innovation framework programme Horizon Europe. Co-Design via web open consultation.

[173] Aviation Benefits Beyond Borders, ATAG, October 2018.

Table 40: How aviation can contribute to 11 Sustainable Development Goals

SDG	How Aviation can support		
	Direct	Indirect	Induced
1. No poverty	Creating jobs in air transport connected places	Continuity of remittances is supported by the maintenance of family and cultural ties is aided by air transport links.	
2. Zero hunger		The World Food Programme (WFP), in partnership with the UN Humanitarian Air Service, is tasked with getting food to those in the midst of war, civil conflict and natural disasters. Because many of these zones are inaccessible by road, air transport is the only option.	
3. Good health and well-being		The industry, too, has a vital role to play in responding to disaster. In 2010, Airlink was established to help coordinate responses to emergencies by the air transport industry.	Aviation also has a crucial role to play in pandemic response. When a viral outbreak occurs, it is vital that the air transport sector acts quickly to work with governments and international institutions to ensure that the virus does not travel further.
4. Quality education		Ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for many means travelling to another country, sometimes in another region of the globe. For students from developing countries, the opportunity to travel to established universities for higher education is invaluable.	Air transport connectivity make these ambitions far more likely to be realised.

SDG	How Aviation can support		
	Direct	Indirect	Induced
7. Affordable and clean energy		Airport planning and design also takes into consideration environmental aspects to maximise efficiency with the minimal possible impact on the environment.	
8. Decent work and economic growth	Creating jobs that directly serve passengers at airlines, airports and air navigation service providers (ASNPs)	Employment and activities of suppliers to the air transport industry	Spending of those directly or indirectly employed in the air transport sector supports additional jobs in other industries
9. Industry, innovation and infrastructure	Since the dawn of air travel, aviation has been at the forefront of technological innovation, researching and developing disruptive, ground-breaking technology with each new generation of aircraft or each new control technique.		Connectivity contributes to improved productivity by encouraging investment and innovation, improving business operations and efficiency.
10. Reduced inequalities	The greatest increase in propensity to travel is in developing economies, reducing geographical inequalities.		In developed economies the connectivity to rural areas is increasing, making it more accessible to everyone.
11. Sustainable cities and communities	New technology will enable some remote and seasonal airports to remain open and viable improving sustainability.	Smaller airports within a network generate traffic that ensures the sustainability of larger airports, resulting in improved load factors and optimal aircraft utilisation by airlines.	

SDG	How Aviation can support		
	Direct	Indirect	Induced
12. Responsible consumption and production	Once an aircraft reaches the end of its service life, it can be recycled to ensure safe disposal and to take advantage of the many high-quality components and materials of which it is made. The idea is to move this idea into the ATM industry too by recycling and not having an excess of radars. Virtual centres allow to have a responsible use of air traffic services.	It is the role of countries to ensure that improvements in ATM infrastructure are properly financed. As there are long lead times for procuring new equipment, such as air traffic control centres and the latest surveillance equipment, ATM investment needs long-term planning.	
13. Climate action	In 2008 industry leaders announced a climate action plan based on three global goals, which the entire sector has committed to: 1. Achieve a 1.5% average annual fuel efficiency improvement from 2009 to 2020 (already being surpassed, average 2.1% per year). 2. Stabilise net CO2 emissions at 2020 levels through carbon-neutral growth. 3. Reduce net emissions to 50% of what they were in 2005 by 2050.	While the aviation industry is prioritising fuel efficiency to try and reduce its climate change impact, there are a number of ways in which a changing climate could impact air transport operations.	
17. Partnerships for the goals	For the potential of new navigational technology to be realised, the industry needs the engagement and cooperation of governments and international institutions. Airspace is governed by sovereign states, meaning that any reform needs governmental buy-in. But aviation transcends national boundaries.	Encouraging progress has been made on the first three pillars of the industry's environmental strategy. However, to achieve the goal of carbon-neutral growth from 2020 other measures need to be taken.	

Source: Aviation Benefits Beyond Borders, ATAG, October 2018.

Appendix E Additional information related to the problem definition

E.1 Purpose

This appendix provides additional information related to the problem definition in terms of a description of the current ATM system and its limitations, and an analysis of stakeholders involved in ATM.

In addition, a taxonomy of failures is provided Table 41.

Table 41: Taxonomy of failures

Market failures	
Market power	Membership is dominated by the core players particularly in terms of suppliers. Representation of the unmanned aircraft systems(UAS) community is required to ensure new entrants are able to support definition of UTM solutions.
Externalities	Slow take up in new technologies has led to uncertain markets for some products leading to limited R&I investment – in particular for "big ticket items" like next generation datalink and flight data processing.
Information asymmetry	Limited interactions between Industrial and Exploratory research leading to limited uptake of new ideas in the core programme.
Systemic failures	
Capability	Current membership has limited capability in cybersecurity and UAS. In addition, the capability in distributed architectures needs to be tested.
Network	The current partnership overcame the weak network failure and established the foundations of collaboration and exchange. There is however still space for improvement by the inclusion of other types of stakeholders (e.g. professional organisations, academia) for whom the membership is economically unattainable.
Institutional	Here we have a mix of both hard and soft institutional failures; in particular membership overheads are considered high. New partnership needs to streamline processes and emphasise collaborative commitment to common goals, particularly on "big ticket items".
Infrastructural	There is a need for development and deployment of the next generation (digital) of ATM infrastructure, and there is a strong need to strengthen the knowledge infrastructures (e.g. education for required specialties as ATM is rather a niche in the academic world) needed to enable and stimulate these activities. A new demonstration platform specifically designed around virtual centres and ATM data services may be required.
Transformational failures	
Directionality	The current partnership laid the foundation for overcoming these particular failures and has specified the roadmap for the future developments. However, the improvements are possible in each of the categories. Strong communication of results will be required to convince Member States that the transition is necessary for the European economy and that the status quo protection of national infrastructures is no longer a valid solution.
Demand articulation	
Policy coordination	
Reflexivity	

Source: Think Research Limited

E.2 Limitations of the current ATM System

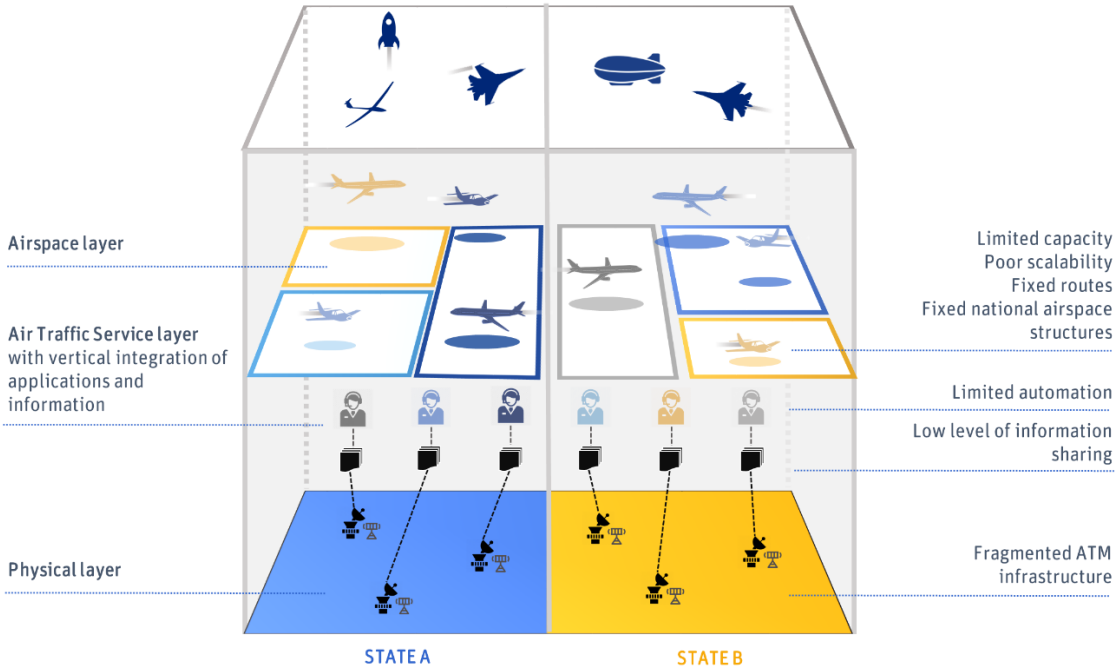
Traditionally, the ANSPs are organised to provide services to one or more flight information regions , each with a unique control centre with tightly integrated flight data processing system, weather, surveillance and aeronautical information, separation, conflict detection and safety nets. Each control centre has its own infrastructure in place, which includes communication, navigation and surveillance and meteorological sensors, and ground-ground communications with neighbouring control centre, Network Manager, and airports. The information sharing capabilities between these stakeholders is still limited. To sum up, the ANSPs manage both the infrastructure (i.e. radars, data, meteorology, etc.) and operational aspects of air traffic control over their State's airspace.

The current ATM system in Europe is often referred to as fragmented.[174] This is the result of years of bespoke developments by national ANSPs leading to the proliferation of control centres, and ATM systems under the responsibility of individual air navigation service providers (ANSP). Excess costs are also caused by fragmented planning, piecemeal procurement, and duplication of support activities.

The cost of fragmentation of European ATM carries a high cost – around €900m - €1,400m annually or 20-30% of annual costs of air navigation service provision.

The current ATM architecture is illustrated in Figure 55.

Figure 55: Schematic of the current ATM architecture



Source: A proposal for the future architecture of the European airspace, SJU, 2019.

The lack of interoperability and limited automation of the current ATM systems leads to a number of limitations that need to be overcome if the ATM system is to support sustainable growth in aviation in a cost-effective manner. The limitations are summarised in Table 42.

[174] The impact of fragmentation in European ATM/CNS, Prepared by Helios Economics and Policy Services, April 2006.

Table 42: Limitations of the current ATM system

Factors limiting overall capacity	
Non-optimal organisation of airspace	The current airspace organisation is not yet fully optimised to network flows and makes limited use of cross-border cooperation.
Limited use of data communications	The current voice-intensive process leads to high saturation of radio frequencies and can lead to voice communications constraining sector capacity. More sophisticated interactions between controllers and pilots require datalink communication that can support time and safety critical instructions.
Limited opportunity to create new sectors	Each sector creation requires a new frequency and there is already limited frequency availability in congested areas. Some sectors are already very small and cannot be further split unless creating operational issues.
Limited automation support for controllers	Current technology deployed in most centres does not provide an optimal level of automation that would support extra capacity. Limited automation support means significant human effort is still required to manage traffic. The resulting system lacks scalability to meet growing demand.
Factors limiting capacity scalability and resilience	
Limited predictability	High buffers across the planning and execution phases due to limited predictability reduce the actual usage of existing capacity. Lack of end-to-end trajectory optimisation during both planning and execution phases mean that the capacity potential cannot be achieved at network level.
Limited information sharing and interoperability	Current limits on interoperability and data sharing lead to sub-optimisation. Suboptimal view and usage of effective available airspace at network level.
Limited flexibility in the use of air traffic controllers across centres	Controllers' qualification is limited to a number of sectors or combinations of sectors typically within a specific centre. This limits their ability to support additional configurations that include sectors from another centre.
Geographical constraints on air traffic services provision	The location of all (technical) services that support the provision of air traffic control to an aircraft in today's architecture is tightly coupled to the location of where an aircraft is flying. This limits the possibility for an ANSP to provide air traffic services beyond its current area of responsibility. It also limits the possibility to share technical services between multiple ANSPs.

Source: A proposal for the future architecture of the European airspace, SJU, 2019.

E.3 Stakeholder Analysis

E.3.1 Introduction

ATM has a relatively simple value chain – involving a range of actors that collaborate to provide safe services to airspace users.[175] The following roles are considered:

- Provision of air navigation services;
- Deployment of new technologies and concepts.

Further, the current views of the future of air navigation services are based on the introduction of two new forms of service provider:

- ATM data services providers;
- U-Space service providers.

E.3.2 Service Provision

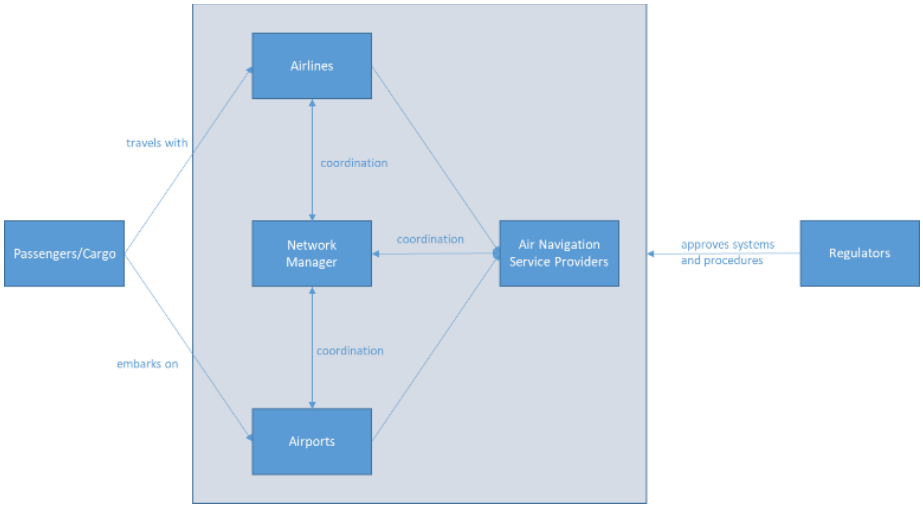
ATM is typically provided under monopoly conditions by national air navigation service providers (ANSPs), which is due to the historical setup and development of the air navigation services provision. An ANSP is a public or a private legal entity providing air navigation services. It manages air traffic on behalf of a company, region or country. Vertically integrated national ANSPs were traditionally part of the government, often with the same organisation providing regulatory functions (this is still the case in the USA, where the FAA[176] is both regulator and service provider).

Over the last 20 years, there has been a steady process of "corporatisation" of ANSPs. In most cases the ANSP is created as a standalone organisation fully funded by the collection of air navigation charges from airspace users. These organisations typically remain under public ownership but there are examples of semi-private firms which include MUAC (Maastricht Upper Airspace Control), the NATS in the United Kingdom and Skyguide in Switzerland. Figure 56 depicts the stakeholders in the ATM service provision. These services are provided to air traffic during all phases of operations (approach, aerodrome and en-route). Whilst en-route ATM is provided as a monopoly service, a number of States decided to open air traffic control (ATC) at aerodrome to competition. The most mature market is in the UK, but Spain, Germany and Norway (amongst others) allow for some competition for airport ATM services.

[175] Airspace users are all the end-users of the air navigation service provision: schedule airlines, charter airlines, business aviation , military, general aviation, emergency services, etc.

[176] Source: https://www.faa.gov/about/

Figure 56: ATM services provision stakeholder analysis



Source: Think Research Limited

The fact that each ANSP organises its resources and capacity (through the airspace organisation and controller availability), locally, results in a fragmentation of ATM at European level. This limits flexibility for routing, flexibility for allocation of controllers, and leads to the ATM system with poor scalability, and limits its capacity to provide air traffic services at the right time (including peak times), in the right place.

Charges are levied on aircraft in order to cover the air navigation services provided in three main phases of flight: movements at and around the aerodrome (aerodrome control), approach and departure of flights including initial climb and descent (approach control), and en-route. Whilst EUROCONTROL, through the Central Route Charges Office , provides a harmonised system of charging for en-route services, there is no equivalent system for aerodrome or approach control services,[177] which is done individually. Therefore, as the air traffic control is charged for through user fees,[178] the airlines (and subsequently passengers) pay the full price of the service including modernisation.

SES and SESAR have already led to a more network centric approach to ATM in Europe. In addition to SESAR, the Network Manager and Performance Scheme both support network centric modernisation both in technology and expertise. It is clear however that an acceleration is required, including a shift to a distributed architecture that enables network optimisation.

E.3.3 Deployment

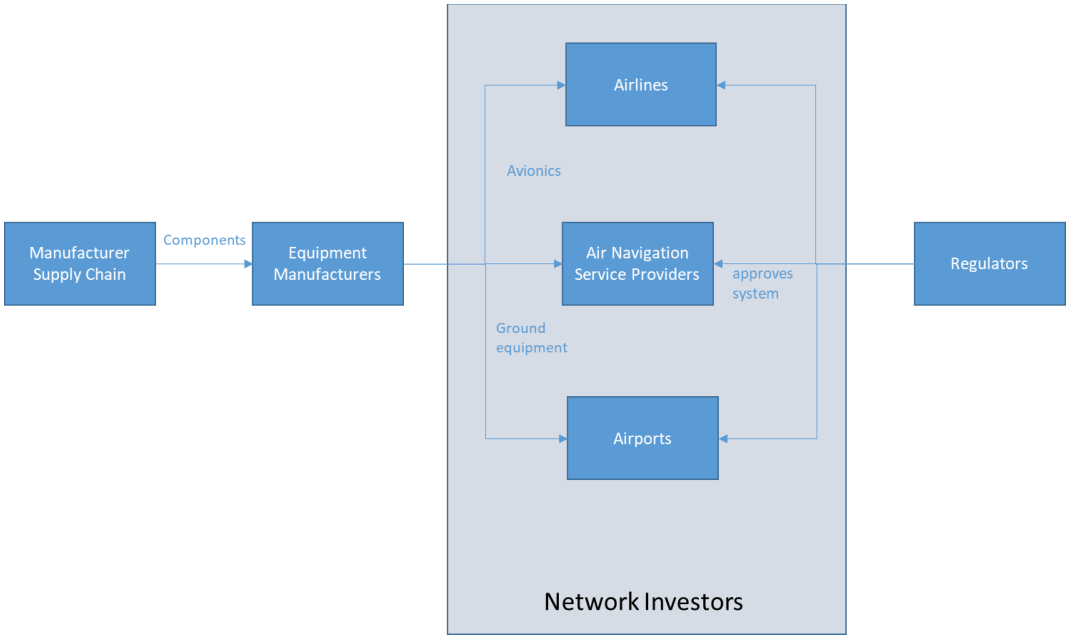
The current deployment of SESAR solutions relies on the three forms of network investors (airlines, ANSPs and airports) purchasing equipment from a range of equipment suppliers with diverse supply chains comprising of many SMEs.

The deployment of new technologies and concepts differs according to the nature of the stakeholders and their market, illustrated in Figure 57.

[177] Study of Terminal Charges for Air Traffic Control services, March 2019, European Commission.

[178] COMMISSION IMPLEMENTING REGULATION (EU) 2019/317 of 11 February 2019 laying down a performance and charging scheme in the single European sky and repealing Implementing Regulations (EU) No 390/2013 and (EU) No 391/2013.

Figure 57: ATM equipment supply stakeholder analysis



Source: Think Research Limited

In terms of ground ATM products produced within Europe distinct markets have emerged:

- The market for en-route systems such as flight data processors (FDP), radar data processes and controller work positions is dominated by a small number of large players (Thales, Indra and Leonardo). These systems tends to have a lifecycle of between 10 and 20 years. For en-route systems manufacturers tends to develop new generations under contract to an ANSP. Each new system would be specified by the ANSP and developed as a bespoke system, often with proprietary interfaces. This has led to limited development of products and challenges in the harmonisation of air traffic data transfer. Due to the restricted number of existing en-route centres and the need for interoperability, new products require large scale and synchronised deployment in order to achieve substantial operational and financial benefits.
- The market for aerodrome systems (Tower FDPs, airfield lighting systems, surface movement guidance and control systems) includes a wider range of suppliers (in addition to the main suppliers, smaller companies such as ADB Safegate, Saab, Honeywell and Frequentis have competitive products). As the market for airport air traffic systems is several hundred aerodromes across Europe rather than one en-route ANSP per State, there tends to be more innovation in airport systems. Airport air traffic control has become more liberalised under the influence of the SES and is subject to competition in some countries including Spain, Germany and Norway. Therefore, airports are able to invest in local enablers that are tailored to their needs to improve performance whereas, as explained above, en-route ATC often require widespread deployment to achieve benefits.

In comparison, airborne ATM products or avionics have a mature global market with significant European (e.g. THALES) as well as US companies (e.g. Honeywell, Rockwell Collins) dominating the commercial airline market with a wider group companies supporting the general and business aviation markets.

E.3.4 ATM Data Service Providers

Air navigation service providers currently process and combine the data required in order to operate their own air traffic services through a vertically integrated national structure.

As the European airspace becomes de-fragmented and the digital evolution takes place leading to remote provision of air traffic services, air traffic data will need to be commonly available by all air traffic service providers.

Common ATM data services mainly require computational resources, are less dependent on human actors, and therefore are easily scalable. The ATM data service providers will require technologies and expertise that will allow to deliver these services and it will charge air traffic data service providers for the data shared with them.

ATM data service providers still need to be defined, however there are two major entities that could take this role. There are existing Communication, navigation and surveillance service providers such as SITA[179] which could take over this role. However, the opening of this new market could allow new entities to emerge. The latter could be fulfilled by new entrants such as cutting-edge companies in the data science domain or public regulated bodies enrolling their own data expertise. The nature of the services, and in particular their safety criticality, is important in considering the regulatory and certification requirements to be placed on the service providers.

The ATM data service role could be undertaken by a traditional ATM service provider or by telecommunications providers like Nokia that runs similar services for other sectors.

E.3.5 U-pace service providers

U-space is the complement to ATM for drones. As different forms ATM are provided in different types of airspace, U-Space will also consist of a different services depending on the nature of airspace and the operational mission the drone is undertaking.

The three main issues are:

a) Accommodation of drones in controlled airspace. This is mostly an ATM issue - drones will be expected to operate in accordance with current rules and regulations but where the varying levels of performance of the air vehicle may cause control issues requiring additional controller support tools.

b) Accommodation of drones in uncontrolled airspace. This is a mixture of ATM and U-Space solutions. Technological solutions will be required to ensure drones are able to detect and avoid manned aircraft operating under visual rules.

c) Use of drones in urban airspace is a solely U-space issue. To date a number of specific problems have been identified not least the nuisance issue of drones being operated in an unsafe manner including encroaching on protected airspace around airports. The types of services are still being defined but will include elements such as:

- Identification – to enable authorities to identify the drone operator
- Geo-fencing – to prevent drones from entering protected airspace.
- Notification and approval – to provide information to airports and general aviation when and where drone activity is expected.
- Autonomous operations – use of advanced solutions to enable self-separation of drones sharing a defined airspace.

[179] See: https://www.sita.aero/

U-space services could be provided by the existing ATM service providers,[180] or by new entrants – including large companies like Amazon[181] that see enabling drone operations as part of their expanding business models, or SMEs like Altitude Angel[182] that are developing innovative solutions.

E.3.6 Summary of air traffic management stakeholders

The Table 43 below provides an overview of the current stakeholders.

Table 43: ATM stakeholder summary

Stakeholders	Action	Quantity
Passengers/Cargo	Passengers and cargo are making use of air transport services provided by airspace users. Passengers are normally represented in ATM discussions by the airlines.	N/A
Airspace users comprising		
Airlines with a range of business models including full service, low cost, regional, cargo and charter airlines	Provide mobility to passengers and cargo by operating aircraft in controlled airspace.	~200
Business and General Aviation	Provide aerial services in controlled and uncontrolled airspace	~400
Airports		
Airports Operators	Airport Operators are responsible for provision of passenger services	~600
Air Navigation Service Providers:		
National ANSPs	Provide Air Navigation service on behalf of a country	~50
Network Manager	Coordinates use of resources across the ATM network	1
Commercial tower ANS Providers	Provide Air Navigation services to commercial traffic in aerodromes	~250
MET Providers	Provide meteorological service for air navigation	~50
CNS Providers	Provide communication, navigation and surveillance service	~2
Regulators including:		
EASA	Approval of ANS equipment and procedures	~30
National regulators (NSA)	Approval of ANS equipment and procedures	28
Manufacturers, including:		
Equipment Manufacturers	Provide ANS equipment	~10
Manufacturer Supply Chain	Provide components of ANS equipment	~100

[180] The CANSO Europe 2035 Vision states "ANSPs are best placed to provide a number of core U-space services critical to the success of U-space, while ensuring safe integration with ATM".

[181] Source: https://blog.aboutamazon.com/transportation/another-new-frontier-for-prime-air

[182] Source: https://www.altitudeangel.com/

Stakeholders	Action	Quantity
Research Organisations:		
R&I and University Having ATM with a significant ATM R&I capability.	Research for the benefit of ATM	~10

Source: Think Research Limited

Appendix F Additional information related to the objectives definition

F.1 Purpose

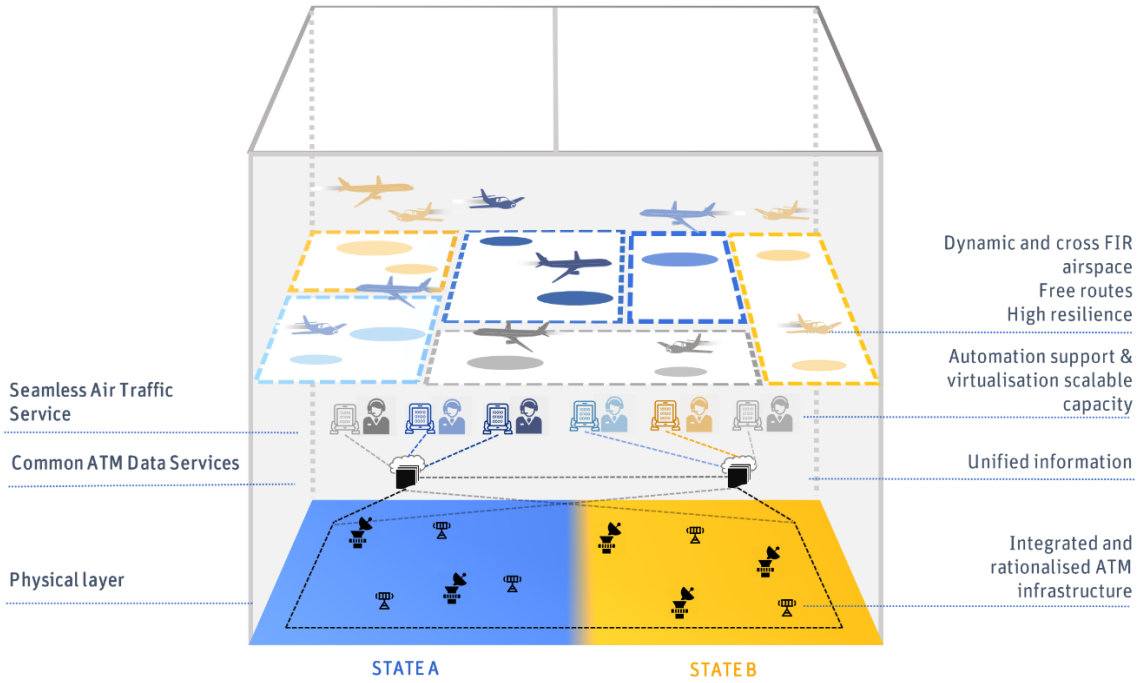
This appendix provides additional information related to the definition of objectives, In particular:

- The R&I needs to enable a modernisation of ATM to support sustainable growth of air transport,
- Economic impacts,

F.2 Future R&I Needs

In 2018 it become clear that the European ATM system would not be able to cope with predicted levels of demand. A proposal was developed to accelerate modernisation of ATM using an architectural approach that brings together the airspace, operations and infrastructure in a harmonised manner across the EU. The main principles of this architecture are shown in Figure 58.

Figure 58: Proposed Future Architecture



Source: A proposal for the future architecture of the European airspace, SJU, 2019.

The proposal is based on a number of key transformations that require R&I as defined in Table 2. The R&I needs are a step change to the current programme: rather than focussing on contained individual ATM solutions that support marginal performance improvement of specific functions the need is now to focus on a small number of breakthrough technologies that together create a step change in overall system performance.

In addition to scientific R&I, significant research is also required into regulatory issues:

- Ability of Member States to dynamically change responsibility for ATS in their airspace,
- Certification and approval of highly automated systems,
- Economic regulation of different elements of the value chain.

F.2.1 Importance of Architecture

The specific objectives place high importance of developing a service-oriented architecture to develop and maintain consensus.

Many of the limitations of the current system have been caused by a lack of a defined architecture. Rather, bespoke national systems have been connected together using a range of bespoke interface standards specific to ATM. This has led to limited interoperability, high maintenance costs and significant difficulty in achieving widespread deployment of new systems (due to the high level of local adaptation required).

The required transition needs to be highly coordinated and based on commonly agreed service and infrastructure principles. The proposed architecture is the framework to achieve those agreements.

Once established, the architecture will allow different parts of the system to develop at different speeds depending on local needs whilst maintaining an overall coherence at network level. The wider implication of this is the ATM R&I would then need to be less coordinated and innovations would be developed within the common framework.

F.2.2 Importance of standards

As a highly regulated industry, ATM has many standards, at global level as annexes to ICAO's Chicago Convention[183] and at regional level – in Europe ATM standards and specifications are developed by EUROCAE, EUROCONTROL and the European Standardisation Organisation.

However, it is still possible to implement a change to an ATM system without a standard. In this case the ANSP prepares a detailed safety case for the regulator demonstrating that the proposed change is safe and interoperable. This route has enabled piecewise modernisation of the current fragmented system – in which the level of local adaptation can outweigh the benefits of standardisation.

Adoption of a common architecture reduces the need for local adaptation and increases the needs for standards. Many of the existing standards may need to be updated to suit the new architecture. Proposals are being developed within the architecture to separate key concerns leading to new forms of standards, for example:

- Operational services – The ATM services (separation, sequencing),
- Information services - The information services required to provide ATM services,
- Infrastructure requirements – The technical performance of the underlying infrastructure to provide the information services,
- Hardware requirements – Specifications of specific physical equipment (radars, radios etc).

A key output of the R&I will be the evidence required by the standards development organisations to develop and validate the required standards.

[183] See: https://www.icao.int/publications/pages/doc7300.aspx

F.3 Economic impact

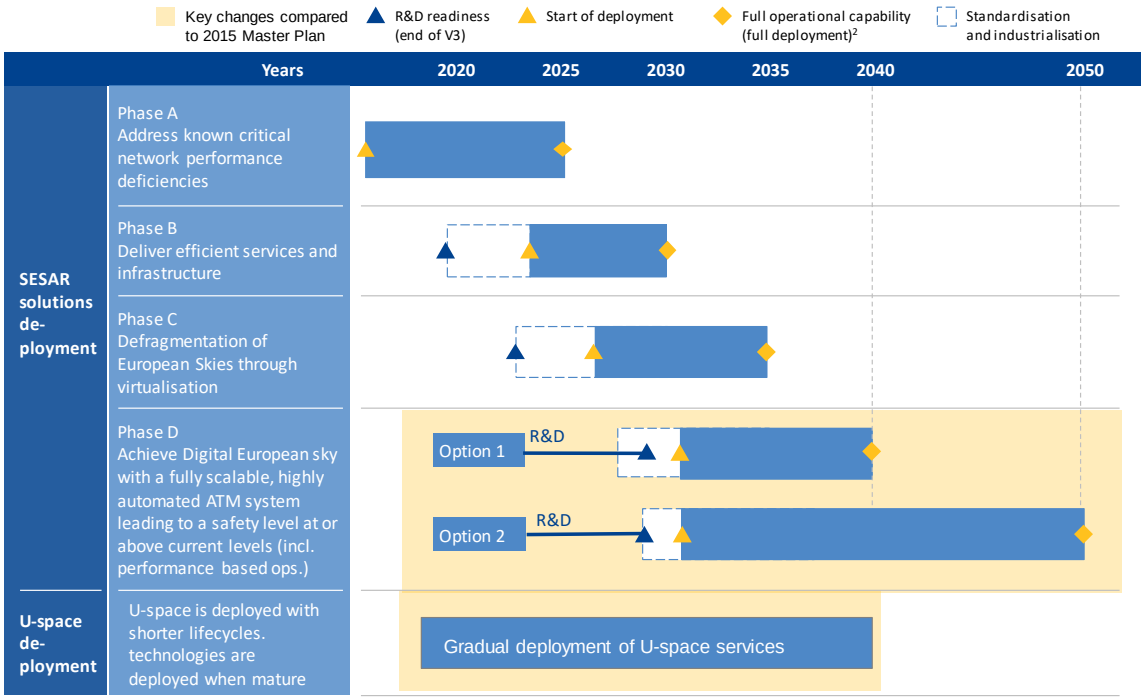
The European ATM Master Plan,[184] identified two rollout scenarios differentiated by the extent to which the ATM community joins forces and changes working methods to accelerate the R&I lifecycle:

- Option 1: Full implementation of the SESAR vision by 2040
- Option 2: Full implementation of the SESAR vision by 2050

Figure 59 illustrates the roll-out of the SESAR Vision, supported by the existing SESAR programme, including the implementation of an optimised European airspace architecture and the 'fast tracking' of the deployment of U-space services from 2019.

The two options for the rollout of technology enabling the completion of phase D of the Master Plan (which related to the R&I required during the Horizon Europe timeframe) are shown; option 1 requires an earlier start of implementation and thus industry and stakeholders' consensus and commitment.

Figure 59: SESAR Roll Out Plan



Source: European ATM Master Plan Edition 2020, SJU, 2019.

The economic benefits are summarised in Table 44, where:

- All monetary figures are expressed in € billion.
- The table shows the cumulative results for the period 2019 to 2050 (both years included).
- Although Option 1 is fully deployed by 2040, the benefits continue to be accrued until 2050.

[184] European ATM Master Plan, Edition 2020, SJU.

Table 44: Economic Value of SESAR Roll-out scenarios

	Option 1	Option 2	Delta
Level of investment	37	39	2
Direct benefits of the ATM value chain	510	490	20
Indirect benefits of additional GDP	170	160	10
Indirect benefits for passengers and EU citizens	760	730	30
Total for Manned Aviation	1440	1380	60
Benefits of deploying U-space	350 to 400	250 to 300	Over 100
Total (ATM and U-Space)	**1790 to 1840**	**1630 to 1680**	**Over 160**

Source: SJU analysis of Business Cases developed for the European ATM Master Plan Updated Programme.

Achieving option 1 would make it possible to reap crucial benefits about a decade earlier and at a lower cost, thanks to cutting on transition costs and going straight to the performing solutions and organisation. This requires new ways of working:

- More agility: creating solutions through prototypes and demonstrations developed in smaller teams with shorter time frames; developing solutions by addressing service-related challenges without prejudging upfront what the optimal technical solution is; creating innovation labs to fast-track R&D, perform quick prototyping and incubate new ideas.
- Openness, in the form of increased collaboration between 'traditional' engineering domains and new entrants that are now likely to attract more capital.
- Coordination to reduce innovation cycles from about 30 years to about 5-10 years, focusing on disruptive innovation. To achieve this, the development and deployment of the integration of drones into the airspace, and in particular the development and implementation of U-space services, may be used as a 'laboratory' that can support faster life cycles in the manned aviation environment; in addition, 'sandboxing' between organisations may allow faster times to market.

A regulatory framework that will also be required to support innovation — through market take-up, incentives for early movers and focus on delivery of services, with an emphasis on what services should be provided and how, rather than on what technologies should be implemented.

This innovative approach would allow better connections and synchronisation between ground-based developments and the airborne industry, whose plans and expectations for the future are already known.

Appendix G Additional information related to the policy options descriptions

G.1 Degree of coverage of the different functionalities by policy option

Table 45: Type and composition of actors (including openness and roles)

Option 0: Horizon Europe calls	Option 2: Co-funded	Option 3: Institutionalised Art 185	Option 1: Co-programmed	Option 3: Institutionalised Art 187
What is possible? *Any legal entity* in a consortiu**m** can apply to Horizon Europe calls in ad hoc combinations Calls are open to participation from across Europe and the world (not all entities from third countries are eligible for funding)	***What is possible?*** Partners can include *any national funding body or governmental research organisation*, Possible to include also *other type of actors*, including foundations.	***What is possible?*** Partners can include *MS and Associated Countries*.	***What is possible?*** Suitable for *all types of partners*: private and/or public partners, including MS, regions, foundations. By default open to AC/ 3rd countries, but subject to policy considerations. Can cover a *large and changing community.* HE rules apply by default to calls included in the FP Work Programme, so any legal entity can apply to these.	***What is possible?*** Suitable for *all types of partners*: private and/or public partners, including MS, foundations. By default open to legal entities from AC/ 3rd countries, but subject to policy considerations. In case of countries participating non-associated third countries can only be included as partners if foreseen in the basic act and subjected to conclusion of dedicated international agreements HE rules apply by default, so any legal entity can apply to partnership calls.
What is limited? Systematic/ structured engagement with public authorities, MS, regulators, standard making bodies, foundations and NGOs.	***What is limited?*** Requires substantial national R&I programmes (competitive or institutional) in the field. Usually only legal entities from countries that are part of the consortia can apply to calls launched by the	***What is limited?*** Non-associated third countries can only be included as partners if foreseen in the basic act and subjected to conclusion of dedicated international agreements. Needs good geographical coverage – participation of at least 40% of Member States is required	***What is limited?*** If MS launch calls under their responsibility, usually only legal entities from countries that are part of the consortia can apply to these, under national rules	***What is limited?*** Requires a *rather stable set of partners* (e.g. if a sector has small number of key companies). Basic act can foresee exceptions for participation in calls / eligibility for funding.

Option 0: Horizon Europe calls	Option 2: Co-funded	Option 3: Institutionalised Art 185	Option 1: Co-programmed	Option 3: Institutionalised Art 187
	partnership, under national rules.	Requires substantial national R&I programmes (competitive or institutional) in the field. While by default the FP rules apply for eligibility for funding/participation, in practice (subject to derogation) often only legal entities from countries that are Participating States can apply to calls launched by the partnership, under national rules.		
What is not possible? To have a joint programme of R&I activities between the EU and committed partners that is implemented based on a common vision.	***What is not possible?*** To have industry/ private sector as partners.	***What is not possible?*** To have industry/ private sector as partners.		

Table 46: Type and range of activities (including flexibility and level of integration)

Option 0: Horizon Europe calls	Option 2: Co-funded	Option 3: Institutionalised Art 185	Option 1: Co-programmed	Option 3: Institutionalised Art 187
What is possible? Horizon Europe standard actions that allow *broad range of individual activities* from R&I to TRL 7 or sometimes higher. Calls for proposals published in the Work Programmes of Horizon Europe (adopted via comitology).	***What is possible?*** Activities may range from R&I, pilot, deployment actions to training and mobility, dissemination and exploitation, but according to national programmes and rules. Decision and implementation by "beneficiaries" (partners in the co-fund grant agreement) e.g. through institutional funding programmes, or by "third parties" receiving financial support, following calls for proposals launched by the consortium.	***What is possible?*** Horizon Europe standard actions that allow a broad range of coordinated activities from R&I to uptake. In case of implementation based on national rules (subject to derogation) Activities according to national programmes and rules. Allows integrating national funding and Union funding into the joint funding of projects	***What is possible?*** *Horizon Europe standard actions* that allow a broad range of coordinated activities from R&I to uptake. The association representing private partners allows to continuously build further on the results of previous projects, including activities related to regulations and standardisation and developing synergies with other funds Union contribution is implemented via calls for proposals published in the Work Programmes of Horizon Europe based on the input from partners (adopted via comitology). Open and flexible form that is simple and easy to manage.	***What is possible?*** *HE standard actions* that allow to build a portfolio with broad range of activities from research to market uptake. The back-office allows dedicated staff to implement integrated portfolio of projects, allowing to build a "system" (e.g. *hydrogen*) via pipeline of support to accelerate and scale up the take-up of results of the partnership, including those related to regulations and standardisation and developing synergies with other funds. E.g. setting up biorefinery plants and promoting their replication by additional investments from MS/ private sector. Procuring/purchasing jointly used equipment (e.g. HPC) Allows integrating national funding and Union funding into the joint funding of projects
What is limited?	***What is limited?*** Scale and scope of the programme the resulting funded R&I actions and depend on the participating programmes, typically		***What is limited?*** Limited control over precise call definition, resulting projects and outcomes, as they are implemented by EC agencies.	***What is limited?*** Limited flexibility because objectives, range of activities and partners are defined in the Regulation, and negotiated in the Council (EP).

Option 0: Horizon Europe calls	Option 2: Co-funded	Option 3: Institutionalised Art 185	Option 1: Co-programmed	Option 3: Institutionalised Art 187
	smaller in scale than FP projects			
What is not possible? To design and implement in a systemic approach a portfolio of actions. To leverage additional activities and investments beyond the direct scope of the funded actions				

Table 47:Directionality

Option 0: Horizon Europe calls	Option 2: Co-funded	Option 3: Institutionalised Art 185	Option 1: Co-programmed	Option 3: Institutionalised Art 187
What is possible? Strategic Plan (as implementing act), annual work programmes (via comitology). Possible also to base call topics on existing or to be developed SRIA/roadmap	***What is possible?*** Strategic R&I agenda/roadmap agreed between partners and EC Annual work programme drafted by partners, approved by EC Objectives and commitments are set in the Grant Agreement.	***What is possible?*** Strategic R&I agenda/roadmap agreed between partners and EC Objectives and commitments are set in the legal base. Annual work programme drafted by partners, approved by EC Commitments include obligation for financial contributions (e.g. to administrative costs, from national R&I programmes).	***What is possible?*** Strategic R&I agenda/roadmap agreed between partners and EC Objectives and commitments are set in the contractual arrangement. Input to FP annual work programme drafted by partners, finalised by EC (comitology) Commitments are political/best effort, but usually fulfilled	***What is possible?*** Strategic R&I agenda/roadmap agreed between partners and EC Objectives and commitments are set in the legal base. Annual work programme drafted by partners, approved by EC (veto-right in governance) Commitments include obligation for financial contributions (e.g. to administrative costs, from national R&I programmes).
What is limited? No continuity in support of priorities beyond the coverage of the strategic plan (4 years) and budget (2 years Annual work programme).				
What is not possible? Coordinated implementation and funding linked to the concrete objectives/ roadmap, since part of overall project portfolio managed by agency				

Table 48: Coherence (internal and external)

Option 0: Horizon Europe calls	Option 2: Co-funded	Option 3: Institutionalised Art 185	Option 1: Co-programmed	Option 3: Institutionalised Art 187
What is possible? Coherence between different parts of the Annual Work programme of the FP ensured by EC	***What is possible?*** Coherence among partnerships and with different parts of the Annual Work programme of the FP can be ensured by partners and EC Synergies with national/regional programmes and activities	***What is possible?*** Coherence among partnerships and with different parts of the Annual Work programme of the FP can be ensured by partners and EC Synergies with national/regional programmes and activities Synergies with other programmes	***What is possible?*** Coherence among partnerships and with different parts of the Annual Work programme of the FP can be ensured by partners and EC If MS participate: Synergies with national/regional programmes and activities Synergies with industrial strategies	***What is possible?*** Coherence among partnerships and with different parts of the Annual Work programme of the FP can be ensured by partners and EC Synergies with other programmes or industrial strategies If MS participate: Synergies with national/regional programmes and activities
What is limited? Synergies with other programmes or industrial strategies	***What is limited?*** Synergies with other programmes or industrial strategies	***What is limited?*** Synergies with industrial strategies	***What is limited?*** Synergies with other programmes	
What is not possible? Synergies with national/regional programmes and activities				

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