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IMPACT ASSESSMENT REPORT

Accompanying the document

**Proposal for a COUNCIL REGULATION establishing the Joint Undertakings under
Horizon Europe**

European Partnership for Integrated Air Traffic Management

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TABLE OF CONTENTS

PART 1 - COMMON FOR ALL CANDIDATE INSTITUTIONALISED EUROPEAN PARTNERSHIPS.....	4
1. BACKGROUND AND CONTEXT TO EUROPEAN PARTNERSHIPS IN HORIZON EUROPE AND FOCUS OF THE IMPACT ASSESSMENT– WHAT IS DECIDED	4
1.1. Focus and objectives of the impact assessment.....	4
1.2. The political and legal context	5
1.3. Why should the EU act.....	8
2. THE CANDIDATE EUROPEAN PARTNERSHIPS – WHAT NEEDS TO BE DECIDED	9
2.1. Portfolio of candidates for Institutionalised European Partnerships	9
2.2. Assessing the necessity of a European Partnership and possible options for implementation.....	10
2.3. Overview of the methodology adopted for the impact assessment	14
2.4. Horizontal perspective on candidate Institutionalised European Partnerships	18
PART 2 - THE CANDIDATE EUROPEAN PARTNERSHIP FOR INTEGRATED AIR TRAFFIC MANAGEMENT	23
1. INTRODUCTION: POLITICAL AND LEGAL CONTEXT.....	23
1.1. Emerging challenges in the field	25
1.2. EU relative positioning in the field	26
1.3. EU policy context beyond 2021	29
2. PROBLEM DEFINITION	31
2.1. What are the problems?	31
2.2. What are the problem drivers?	36
2.3. How will the problem(s) evolve?	39
3. WHY SHOULD THE EU ACT?	41
3.1. Subsidiarity: Necessity of EU action.....	41
3.1. Subsidiarity: Added value of EU action.....	41
4. OBJECTIVES: WHAT IS TO BE ACHIEVED?	42
4.1. General objectives of the initiative.....	42
4.2. Specific objectives of the initiative	43
4.3. Intervention logic.....	44
4.4. What is needed to achieve the objectives – Key functionalities needed	49

5.	WHAT ARE THE AVAILABLE POLICY OPTIONS?	53
5.1.	What is the baseline from which options are assessed?	53
5.2.	Description of the policy options	54
5.3.	Options discarded at an early stage	56
6.	HOW DO THE DIFFERENT POLICY OPTIONS COMPARE?	56
6.1.	Effectiveness.....	57
6.2.	Efficiency	63
6.3.	Coherence	65
6.4.	Tabular comparison of options and identification of preferred option.....	68
7.	THE PREFERRED OPTION - HOW WILL ACTUAL IMPACTS BE MONITORED AND EVALUATED?	69
7.1.	The preferred option	69
7.2.	Objectives and corresponding monitoring indicators.....	70

Glossary

<i>Term or acronym</i>	<i>Meaning or definition</i>
EIT	European Institute of Innovation & Technology
R&I	Research and Innovation
SDGs	United Nations Sustainable Development Goals
SMEs	Small and Medium-sized Enterprises
TFEU	Treaty on the Functioning of the European Union
ANSP	Air Traffic Management
ATM	Air Traffic Management
FAA	Federal Aviation Authority
ICAO	International Civil Aviation Organisation
SES	Single European Sky
SESAR	Single European Sky ATM Research
TRL	Technology Readiness Level
UTM	Unmanned Air System Traffic Management

PART 1 - COMMON FOR ALL CANDIDATE INSTITUTIONALISED EUROPEAN PARTNERSHIPS

1. BACKGROUND AND CONTEXT TO EUROPEAN PARTNERSHIPS IN HORIZON EUROPE AND FOCUS OF THE IMPACT ASSESSMENT– WHAT IS DECIDED

1.1. Focus and objectives of the impact assessment

This impact assessment accompanies the Commission proposal for Institutionalised European Partnerships to be funded under Horizon Europe, the 2021-2027 Framework Programme for EU Research and Innovation (R&I).¹ It sets out to **help decide in a coordinated manner the right form of implementation for specific candidate initiatives** based on a common approach and methodology to individual assessments². It also provides an **horizontal perspective on the portfolio of candidate European Partnerships** to identify further efficiency and coherence gains for more impact.

European Partnerships are initiatives where the Union, together with private and/or public partners (such as industry, public bodies or foundations) commit to support jointly the development and implementation of an integrated programme of R&I activities. The rationale for establishing such initiatives is to achieve the objectives of Horizon Europe more effectively than what can be attained by other activities of the programme.³

Based on the Horizon Europe Regulation, European Partnerships may be set up using **three different forms**: “Co-funded”, “Co-programmed” and “Institutionalised”. The setting-up of **Institutionalised Partnerships** involves new EU legislation and the establishment of dedicated implementing structures based on Article 185 or 187 of the Treaty on the Functioning of the EU (TFEU). This requires an impact assessment to be performed.

The Horizon Europe Regulation defines **eight priority areas**, scoping the domains in which Institutionalised Partnerships could be proposed⁴. Across these priority areas, **13 initiatives** have been identified **as suitable candidate initiatives** for Institutionalised Partnerships because of their objectives and scope. This impact assessment aims to identify whether 12 of these initiatives⁵ need to be implemented through this form of implementation and would not deliver equally well with traditional calls of Horizon Europe or other lighter forms of European Partnerships under Horizon Europe. This means assessing whether each of these initiatives meets the necessity test set in the **selection criteria** for European Partnerships in the Horizon Europe Regulation, Annex III.

This assessment is done **without any budgetary consideration**, as the overall budget of the Multiannual Financial Framework of the EU – and hence of Horizon Europe – for the next financing period is not known at this stage.⁶

¹ Horizon Europe Regulation (common understanding), <https://data.consilium.europa.eu/doc/document/ST-7942-2019-INIT/en/pdf>

² Based on the European Commission Better Regulation framework (SWD (2017) 350) and supported by an external study coordinated by Technopolis Group (to be published in 2020).

³ For further details on these points, see below Section 1.2.2.

⁴ Set out in the Annex Va of the Horizon Europe Regulation (common understanding). <https://data.consilium.europa.eu/doc/document/ST-7942-2019-INIT/en/pdf>

⁵ Only 12 are subject to this impact assessment, as one initiative on High Performance Computing has already been subject to an impact assessment in 2017 (SEC(2018) 47).

⁶ EU budget commitments to the European Partnership candidates can only be discussed and decided following the political agreement on the overall Multiannual Financial Framework and Horizon Europe budgetary envelopes. The level of EU contribution for individual partnerships should be determined once there are agreed objectives, and clear commitments from

1.2. The political and legal context

1.2.1. Shift in EU priorities and Horizon Europe framework

European priorities have evolved in the last decades, and reflect the social, economic, and environmental challenges for the EU in the face of global developments. In her Political Guidelines for the new European Commission 2019 – 2024⁷, the new Commission President put forward six overarching priorities, which reach well beyond 2024 in scope⁸. Together with the Sustainable Development Goals (SDGs), these priorities will shape future EU policy responses to the challenges Europe faces, and thus also give direction to EU research and innovation.

As part of the Multi-annual Financial Framework (MFF) 2021-27 the new EU Framework Programme for Research and Innovation **Horizon Europe will play a pivotal role for Europe to lead the social, economic, and environmental transitions needed to achieve these European policy priorities**. It will be more impact driven with a strong focus on delivering European added value, but also be more effective and efficient in its implementation.⁹ Horizon Europe finds its rationale in the daunting challenges that the EU 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.*” While Horizon Europe continues the efforts of strengthening the scientific and technological bases of the Union and foster competitiveness, a more strategic and impact-based approach to EU R&I investment is taken. Consequently, the **objectives of Horizon Europe** highlight the need *to deliver on the Union strategic priorities and contribute to the realisation of EU objectives and policies, contribute to tackling global challenges, including the Sustainable Development Goals by following the principles of the Agenda 2030 and the Paris Agreement.*¹⁰

In this context, **at least 35 % of the expenditure from actions under the Horizon Europe Programme will have to contribute to climate action**. Furthermore, a **Strategic Plan** is co-designed with stakeholders to identify **key strategic orientations for R&I support** for 2021-2024 in line with the EU priorities. In the Orientations towards the first Strategic Plan for Horizon Europe, the need to strategically 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, that actions under Pillar II of Horizon Europe “Global Challenges and European Industrial Competitiveness” will target only selected themes of especially high impact that significantly contribute to delivering on the political priorities of the Union. Most of the candidate European Partnerships fall under this Pillar.

1.2.2. Key evolutions in the approach to partnerships in Horizon Europe

Since their start in 1984 the successive set of Framework Programmes uses a variety of instruments and approaches to support R&I activities, address global challenges and industrial

partners. Importantly, there is a ceiling to the partnership budgets in Pillar II of Horizon Europe (the legal proposal specifies that *the majority of the budget in pillar II shall be allocated to actions outside of European Partnerships*).

⁷ https://ec.europa.eu/info/strategy/priorities-2019-2024_en

⁸ 1.A European Green Deal; An economy that works for people; A Europe fit for the Digital Age; Promoting our European way of life; A Stronger Europe in the World; and 6.A New push for European Democracy

⁹ 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

¹⁰ Article 3, Common understanding regarding the proposal for Horizon Europe Framework Programme.

competitiveness. Collaborative, competition-based and excellence-driven R&I projects funded through Work Programmes are the most traditional and long-standing approach for implementation. Since 2002, available tools also include **partnerships**, whereby the Union together with private and/or public partners commit to jointly support the development and implementation of a R&I programme. These were introduced as part of creating the European Research Area (ERA) to align national strategies and overcome fragmentation of research effort towards an increased scientific, managerial and financial integration of European research and innovation. Interoperable and integrated national research systems would allow for better flows of knowledge, technology and people. Since then, the core activities of the partnerships consist of building critical mass mainly through collaborative projects, jointly developing visions, and setting strategic agendas.

As analysed in the **interim evaluation of Horizon 2020**¹¹, a considerable repertoire of partnership initiatives have been introduced over time, with 8 forms of implementation¹² and close to 120 partnership initiatives running under Horizon 2020 - without clear exit strategies and concerns about their degree of coherence, openness and transparency. Even if it is recognised that these initiatives allow setting long-term agendas, structuring R&I cooperation between otherwise dispersed actors, and leveraging additional investments, the evaluation points to the complexity generated by the proliferation of instruments and initiatives, and their insufficient contribution to policies at EU and national level.

Box 1 Key lessons from the interim evaluation of Horizon 2020 and R&I partnerships

- The **Horizon 2020 Interim Evaluation** concludes that the overall partnership landscape has become overly complex and fragmented. It identifies the need for rationalisation, improve their openness and transparency, and link them with future EU R&I missions and strategic priorities.
- The **Article 185 evaluation** finds that these public-public partnerships have scientific quality, global visibility and networking/structuring effects, but should in the future focus more on the achievement of policy impacts. From a systemic point of view, it found that the EU public-to-public cooperation (P2P) landscape has become crowded, with insufficient coherence.
- The **Article 187 evaluation** points out that Public-Private Partnership (PPP) activities need to be brought more in line with EU, national and regional policies, and calls for a revision of the Key Performance Indicators. As regards the **contractual PPPs (cPPPs)** their reviews identified challenges of coherence among cPPPs and the need to develop collaborations and synergies with other relevant initiatives and programmes at EU, national and regional level.

Over 80% of respondents to the Open Public Consultation (OPC) indicated that a significant contribution by future European Partnerships is 'fully needed' to achieve climate-related goals, to develop and effectively deploy technology, and for EU global competitiveness in specific sectors/domains. Views converged across all categories of respondents, including citizens, industry and academia.

¹¹ Interim evaluation of Horizon 2020, Commission Staff Working Document, SWD(2017)221 and 222
Interim evaluation of the Joint Undertakings operating under Horizon 2020 (Commission Staff Working Document, SWD(2017) 339); Evaluation of the Participation of the EU in research and development programmes undertaken by several Member States based on Article 185 of the TFEU, Commission Staff Working Document, SWD (2017)340)

¹² E.g. initiatives based on Article 187 (Joint Technology Initiatives), Article 185 TFEU, Contractual Public-Private Partnerships (cPPPs), Knowledge & Innovation Communities of the European Institute of Innovation & Technology (EIT-KICs), ERA-NETs, European Joint Programmes, Joint Programming Initiatives.

The impact assessment of Horizon Europe identifies therefore the need to **rationalise the EU R&I funding landscape**, in particular with respect to partnerships, as well as to **re-orient partnerships towards more impact** and delivery on EU priorities. To address these concerns and to realise the higher ambition for European investments, Horizon Europe puts forward **a major simplification and reform for the Commission's policy on R&I partnerships**¹³. Reflecting its pronounced systemic nature aimed at contributing to EU-wide 'transformations' towards the sustainability objectives, Horizon Europe indeed intends to make a more effective use of these partnerships with a **more strategic, coherent and impact-driven approach**. Key related changes that apply to all forms of European Partnerships encapsulated in Horizon Regulation are summarised in the Box below.

Box 2 Key features of the revised policy approach to R&I partnerships under Horizon Europe based on its impact assessment

- ✓ **Simpler architecture & toolbox** by streamlining 8 partnership instruments into 3 implementation forms (Co-Funded, Co-Programmed, Institutionalised), under the umbrella 'European Partnerships'
- ✓ **More systematic and transparent approach** to selecting, implementing, monitoring, evaluating and phasing out all forms of partnerships (**criteria** for European Partnerships):
 - The selection of Partnerships is embedded in the strategic planning of Horizon Europe, thereby ensuring coherence with the EU priorities. The selection criteria require that partnerships are established with stronger ex-ante commitment and higher ambition.
 - The implementation criteria stipulate that initiatives adopt a systemic approach in achieving impacts, including broad engagement of stakeholders in agenda-setting and synergies with other relevant initiatives to promote the take-up of R&I results.
 - A harmonised monitoring & evaluation system will be implemented, and ensures that progress is analysed in the wider context of achieving Horizon Europe objectives and EU priorities.
 - All partnerships need to develop an exit strategy from Framework Programme funding. This new approach is underpinned by principles of openness, coherence and EU added value.
- ✓ **Reinforced impact orientation:**
 - Partnerships are established only if there is evidence they support achieving EU policy objectives more effectively than other Horizon Europe actions, by demonstrating a clear vision and targets (**directionality**) and corresponding long-term commitments from partners (**additionality**).
 - European Partnerships are expected to provide mechanisms – based on a concrete roadmap - to join up R&I efforts between a broad range of actors towards the development and uptake of innovative solutions in line with EU priorities, serving the economy and society, as well as scientific progress.
 - They are expected to develop close synergies with national and regional initiatives, acting as dynamic change agents, strengthening linkages within their respective ecosystems and along the value chains, as well as pooling resources and efforts towards the common EU objectives.

Under Horizon Europe, a 'European Partnership'¹⁴ is defined 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.”*

The Regulation further specifies that European Partnerships shall 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.”*

¹³ Impact assessment of Horizon Europe, Commission Staff Working Document, SWD(2018)307.

¹⁴ Article 8 and Annex III of the Horizon Europe Regulation (common understanding)

1.3. Why should the EU act

1.3.1. Legal basis

Proposals for Institutionalised European Partnerships are based on:

- 1) Article 185 TFEU which allows the Union to make provision, in agreement with the Member States concerned, for participation in research and development programmes undertaken by several Member States, including participation in the structures created for the execution of those programmes; or
- 2) Article 187 TFEU according to which the Union may set up joint undertakings or any other structure necessary for the efficient execution of Union research, technological development and demonstration programmes.¹⁵

1.3.2. Subsidiarity

The EU should act only in areas where there is demonstrable advantage that the action at EU level is more effective than action taken at national, regional or local level. Research is a shared competence between the EU and its Member States according to the TFEU. Article 4 (3) specifies that in the areas of research, technological development and space, the EU can carry out specific activities, including defining and implementing programmes, without prejudice to the Member States' freedom to act in the same areas. The candidate initiatives focus on areas where there is a demonstrable value added in acting at the EU level due to the scale, speed and scope of the efforts needed for the EU to meet its long-term Treaty objectives and deliver on its strategic policy priorities and commitments. In addition, the proposed initiatives should be seen as complementary and reinforcing national and sub-national activities in the same area. Overall European Partnerships find their **rationale in addressing a set of systemic failures**¹⁶:

- 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 agendas and/or R&I funding programmes. They aim to address **transformational failures** to better align agendas and policies of public and private funders, pool available resources, create critical mass, avoid unnecessary duplication of efforts, and leverage sufficiently large investments where needed but hardly achievable by single countries.
- The concentration of efforts and pooling of knowledge on common priorities to solve multi-faceted societal and economic challenges is at the core of these initiatives. Specifically, enhanced cross-disciplinary and cross-sectoral collaboration and an improved integration of value chains and ecosystems are among the key objectives of these instruments. In the light of Horizon Europe, the aim is to **drive system transitions and transformations towards EU priorities**.
- Especially in fast-growing technologies and sectors such as ICT, there is a need to **react to 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.
- They also aim to address **market failures** predominantly to enhancing industry investments thanks to the sharing of risks.

¹⁵ Both Articles are under Title XIX of the TFEU - Research and Technological Development and Space.

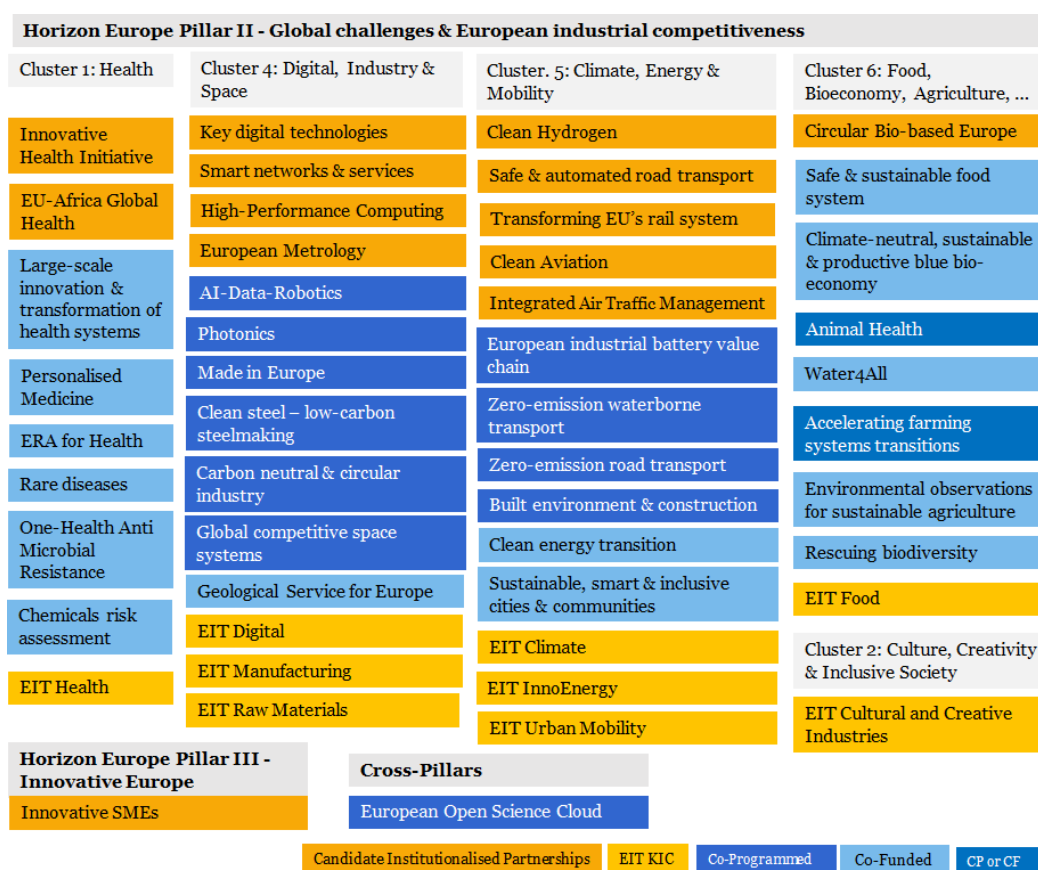
¹⁶ The Interim Evaluation of Horizon 2020 and the impact assessment of Horizon Europe provide qualitative and quantitative evidence on these points. Sections 1 and 2 of each impact assessment on candidate European Partnerships include more detail on the necessity to act at EU level in specific thematic areas.

2. THE CANDIDATE EUROPEAN PARTNERSHIPS – WHAT NEEDS TO BE DECIDED

2.1. Portfolio of candidates for Institutionalised European Partnerships

The new approach for more objective-driven and impactful European Partnerships is reflected in the way candidate Partnerships have been identified. It involved a co-design exercise aiming to better align these initiatives with societal needs and policy priorities, while broadening the range of actors involved. Taking into account the 8 areas for Institutionalised European Partnerships set out in the Horizon Europe Regulation¹⁷, a co-design exercise as part of the Strategic Planning process of Horizon Europe lead to the identification of **49 candidates for Co-funded, Co-programmed or Institutionalised European Partnerships**¹⁸. Out of these, **13 were identified as suitable candidate Institutionalised Partnerships because of their objectives and scope**¹⁹. Whilst the Co-Funded and Co-Programmed Partnerships are linked to the comitology procedure (including the adoption of the Strategic Plan and the Horizon Europe Work Programmes), Institutionalised Partnerships require the adoption of legislation and are subject to an impact assessment. The Figure below gives an overview of all candidate European Partnerships according to their primary relevance to Commission priorities for 2019-2024.

Figure 1 - Overview of the candidates for Co-Funded, Co-Programmed and Institutionalised European Partnerships according to Horizon Europe structure



Source: Technopolis group (2020)

¹⁷ Horizon Europe Regulation (common understanding), Annex Va.

¹⁸ Shadow configuration of Strategic Programme Committee for Horizon Europe. The list of candidate European Partnerships is described in "Orientations towards the Strategic Plan of Horizon Europe" - Annex 7

¹⁹ Only 12 are subject to this impact assessment, as one initiative on High Performance Computing has already been subject to an impact assessment in 2017 (SEC(2018) 47)

There are only three partnerships for which implementation as an Institutionalised Partnership under Article 185 is an option, i.e. European Metrology, the EU-Africa Global Health partnership, and Innovative SMEs. Ten partnerships are candidates for Institutionalised Partnerships under Article 187. Overall the initiatives can be categorised into ‘horizontal’ partnerships and ‘vertical’ partnerships.

The ‘horizontal’ partnerships have a central position in the overall portfolio, as they are expected to develop methodologies and technologies for application in the other priority areas, ultimately supporting European strategic autonomy in these areas as well as technological sovereignty. These ‘horizontal’ partnerships are typically proposed as Institutionalised or Co-programmed Partnerships, in addition to a number of EIT KICs, they cover mainly the digital field in addition to space, creative industries and manufacturing, but also the initiative related to Innovative SMEs. ‘Vertical’ partnerships are focused on the needs and development of specific application areas, and are primarily expected to support enhanced environmental sustainability thereby addressing Green Deal related objectives. They also deliver on policies for more people centred economy, through improved wellbeing of EU citizen and the economy, like health related candidate European Partnerships.

2.2. Assessing the necessity of a European Partnership and possible options for implementation

Horizon Europe Regulation Article 8 stipulates that Institutionalised European Partnerships based on Article 185 and 187 TFEU *shall be implemented only where 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, and if justified by a long-term perspective and high degree of integration.* At the core of this impact assessment is therefore the need to demonstrate that the impacts generated through a Partnership approach go beyond what could be achieved with traditional calls under the Framework Programme – the Baseline Option. Secondly, it needs to assess if using the Institutionalised form of a Partnership is justified for addressing the priority.

For all candidate Institutionalised European Partnerships the options considered in this impact assessment are the same, i.e.:

- Option 0 – Baseline option – Traditional calls under the Framework Programme
- Option 1 – Co-programmed European Partnership
- Option 2 – Co-funded European Partnership
- Option 3 – Institutionalised Partnership
 - Sub-option 3a Institutionalised Partnerships based on Art 185 TFEU
 - Sub-option 3b Institutionalised Partnerships based on Art 187 TFEU

2.2.1. Option 0 - Baseline option – Traditional calls

Under this option, strategic programming for R&I in the priority area will be done through the mainstream channels of Horizon Europe. The related priorities will be implemented through **traditional calls** of Horizon Europe covering a range of actions, mainly R&I and/or innovation actions but also coordination and support actions, prizes or procurement. Most actions involve consortia of public and/or private actors in ad hoc combinations, while some actions are single actor (mono-beneficiary). There will be no dedicated implementation structure and no support other than what is foreseen in the related Horizon Europe Work Programme. This means that discontinuation costs/benefits of predecessor initiatives should be factored in for capturing the baseline situation when relevant.

Under this option, strategic planning mechanisms in the Framework Programme will allow for a high level of flexibility in the ability of traditional calls to respond to particular needs over time, building upon additional input in co-creation from stakeholders and programme committees involving Member States. The Union contribution to addressing the priority covers the full duration of the initiative, during the lifetime of Horizon Europe. Without a formal EU partnership mechanism, it is less likely that the stakeholders will develop a joint Strategic Research Agenda and commit to its implementation or agree on mutual commitments and contributions outside their participation in funded projects.

2.2.2. European Partnerships

Under this set of options, three different forms of implementation are assessed: Co-funded, Co-Programmed, Institutionalised European Partnerships. These have **commonalities that cannot serve as a distinguishing factor in the impact assessment process**. They are all based on agreed objectives and expected impacts and underpinned by Strategic Research and Innovation Agendas / roadmaps that are shared and committed to by all partners in the partnership. They all have to follow the same set of criteria along their lifecycle, as defined in the Horizon Europe Regulation (Annex III), including ex ante commitment from partners to mobilise and contribute resources and investments. The Union contribution is defined for the full duration of the initiative for all European Partnerships. The Horizon Europe legal act introduces few additional requirements for Institutionalised Partnerships, e.g. the need for long-term perspective, strong integration of R&I agendas, and financial contributions.

Figure 2 - Key differences in preparation and implementation of European Partnerships

Type	Legal form	Implementation
Co-Programmed	Contractual arrangement / MoU	Division of labour , whereby Union contribution is implemented through Framework programme and partners' contributions under their responsibility.
Co-Funded	Grant Agreement	Union provides co-funding for an integrated programme with distributed implementation by entities managing and/or funding national research and innovation programmes
Institutionalised based on Article 185/187 TFEU	Basic act (Council regulation, Decision by European Parliament and Council)	Integrated programme with centralised implementation

The main differences between the different forms of European Partnerships are in their preparation and in the way they function, as well as in the overall impact they can trigger. The Co-Programmed form is assessed as the simplest, and the Institutionalised the most complex to prepare and implement. The functionalities of the different form of Partnerships – compared to the baseline option – are presented in Figure 3. They relate to the types of actors Partnerships can involve and their degree of openness, the types of activities they can perform and their degree of flexibility, the degree of commitment of partners and the priority setting system, and their ability to work with their external environment (coherence), etc. These key distinguishing factors will be at the basis of the comparison of each option to determine their overall capacity to deliver what is needed at a minimised cost.

Figure 3 Overview of the functionalities provided by each form of European Partnerships, compared to the traditional calls of Horizon Europe (baseline)

Baseline: Horizon Europe calls	Option 1: Co-Programmed	Option 2: Co-Funded	Option 3a: Institutionalised Art 185	Option 3b: Institutionalised Art 187
Type and composition of actors (including openness and roles)				
<u>Partners:</u> N.A., no common set of actors that engage in planning and implementation <u>Priority setting:</u> open to all, part of Horizon Europe Strategic planning <u>Participation in R&I activities:</u> fully open in line with Horizon Europe rules	<u>Partners:</u> Suitable for all types: private and/or public partners, foundations <u>Priority setting:</u> Driven by partners, open stakeholder consultation, MS in comitology <u>Participation in R&I activities:</u> fully open in line with Horizon Europe rules	<u>Partners:</u> core of national funding bodies or government research organisations <u>Priority setting:</u> Driven by partners, open stakeholder consultation <u>Participation in R&I activities:</u> limited, according to national rules of partner countries	<u>Partners:</u> National funding bodies or governmental research organisation <u>Priority setting:</u> Driven by partners, open stakeholder consultation <u>Participation in R&I activities:</u> fully open in line with Horizon Europe rules, but possible derogations	<u>Partners:</u> Suitable for all types: private and/or public partners, foundations <u>Priority setting:</u> Driven by partners, open stakeholder consultation <u>Participation in R&I activities:</u> fully open in line with Horizon Europe rules, but possible derogations
Type and range of activities (including additionality and level of integration)				
<u>Activities:</u> Horizon Europe standards that allow broad range of individual actions <u>Additionality:</u> no additional activities and investments outside the funded projects <u>Limitations:</u> No systemic approach beyond individual actions	<u>Activities:</u> Horizon Europe standard actions that allow broad range of individual actions, support to market, regulatory or policy/ societal uptake <u>Additionality:</u> Activities/investments of partners, National funding <u>Limitations:</u> Limited systemic approach beyond individual actions	<u>Activities:</u> Broad, according to rules/programmes of participating States, State-aid rules, support to regulatory or policy/ societal uptake <u>Additionality:</u> National funding <u>Limitations:</u> Scale & scope depend on participating programmes, often smaller in scale	<u>Activities:</u> Horizon Europe standards that allow broad range of individual actions, support to regulatory or policy/societal uptake, possibility to systemic approach <u>Additionality:</u> National funding	<u>Activities:</u> Horizon Europe standards that allow broad range of individual actions, support to regulatory or policy/societal uptake, possibility to systemic approach (portfolios of projects, scaling up of results, synergies with other funds). <u>Additionality:</u> Activities/investments of partners/ national funding
Priority-setting process and directionality				
<u>Priority setting:</u> Strategic Plan and annual work programmes, covering max. 4 years. <u>Limitations:</u> Fully taking into account existing or to be developed SRIA/ roadmap	<u>Priority setting:</u> Strategic R&I agenda/ roadmap agreed between partners & EC, covering usually 7 years, incl. allocation of Union contribution Input to FP annual work programme drafted by partners, finalised by EC (comitology) Objectives & commitments set in contractual arrangement	<u>Priority setting:</u> Strategic R&I agenda/ roadmap agreed between partners & EC, covering usually 7 years, incl. allocation of Union contribution Annual work programme drafted by partners, approved by EC Objectives & commitments set in Grant Agreement	<u>Priority setting:</u> Strategic R&I agenda/ roadmap agreed between partners & EC, covering usually 7 years, incl. allocation of Union contribution Annual work programme drafted by partners, approved by EC Objectives & commitments set in legal act	<u>Priority setting:</u> Strategic R&I agenda/ roadmap agreed between partners & EC, covering usually 7 years, incl. allocation of Union contribution Annual work programme drafted by partners, approved by EC (veto-right in governance) Objectives & commitments set in legal act
Coherence: internal (Horizon Europe) & external (other Union programmes, national programmes, industrial strategies)				
<u>Internal:</u> Coherence between different parts of the FP Annual Work programme can be ensured by EC <u>External:</u> Limited for other Union programmes, no synergies with national/regional programmes & activities	<u>Internal:</u> Coherence among partnerships & with parts of the FP Annual Work programme can be ensured by partners & EC <u>External:</u> Limited synergies with other Union programmes & industrial strategies. If MS participate, with national/ regional programmes & activities	<u>Internal:</u> Coherence among partnerships & with parts of the FP Annual Work programme can be ensured by partners & EC <u>External:</u> Synergies with national/ regional programmes & activities	<u>Internal:</u> Coherence among partnerships & with parts of the FP Annual Work programme can be ensured by partners & EC <u>External:</u> Synergies with national/ regional programmes & activities	<u>Internal:</u> Coherence among partnerships & with parts of the FP Annual Work programme can be ensured by partners & EC <u>External:</u> Synergies with other Union programmes and industrial strategies If MS participate, with national/ regional programmes & activities

2.2.2.1. 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 Commission and the private and/or public partners. Private partners are represented by industry associations, which also support the daily management of the partnership. This type of partnership would allow for a large degree of flexibility for the activities, partners and priorities to continuously evolve. The commitments of partners are political efforts described in the contractual arrangement and the contributions from partners are provided in kind more than financially. The priorities for the calls, proposed by the Partnership's members for integration in the Horizon Europe's Work Programmes, are subject to further input from Member States (comitology) and Commission services. The Union contribution is implemented within the executive agency managing Horizon Europe calls for research and innovation projects proposals. The full array of Horizon Europe instruments can be used, ranging from research and innovation (RIA) types of actions to coordination and support actions (CSA) and including grants, prizes, and procurement.

2.2.2.2. Option 2 – Co-funded European Partnership

The Co-funded European Partnership is **based on a Grant Agreement** between the Commission and a consortium of partners, resulting from a specific call in the Horizon Europe Work Programme. This form of implementation only allows to address public partners at its core. Typically these provide co-funding to a common programme of activities established and/or implemented by entities managing and/or funding national R&I programmes. The recipients of the EU co-funding implement the initiative under their responsibility, with national funding/resources pooled to implement the programme with co-funding from the Union. The expectation is that these entities would cover most if not all EU Member States. Calls and evaluations would be organised centrally, beneficiaries in selected projects would be funded at national level, following national funding rules.

2.2.2.3. Option 3 – Institutionalised European Partnership

This type of Partnership is the most complex and high-effort arrangement, and requires meeting additional requirements. Institutionalised European Partnership are **based on a Council Regulation (Article 187 TFEU or a Decision by the European Parliament and Council (Article 185 TFEU))** and are implemented by dedicated structures created for that purpose. These regulatory needs limit the flexibility for a change in the 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 agendas in the private and/or public sectors in the EU in order to address a strategic challenge. It is therefore necessary to demonstrate that other forms of implementation would not achieve the objectives or would not generate the necessary expected impacts, and that a long-term perspective and high degree of integration is needed. For both Article 187 and 185 initiatives, contributions from partners can be in the form of financial and in-kind contributions. Eligibility for participation and funding follows by default the rules of Horizon Europe, unless a derogation is introduced in the basic act.

Option 3a - Institutionalised Partnerships based on Article 185 TFEU

Article 185 of the TFEU allows the Union to participate in programmes jointly undertaken by Member States and limits therefore the scope to **public partners** which are 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 legal entity (Dedicated Implementation Structure) of their choice for the implementation. By default, participation of non-associated Third Countries is not foreseen. Such participation is possible only if it is foreseen in the basic act and subject to conclusion of an international agreement.

Option 3b - Institutionalised Partnerships based on Article 187 TFEU

Article 187 of the TFEU allows the Union to set up joint undertakings or any other structure necessary for the efficient execution of EU research, technological development and demonstration programmes. This type of Institutionalised Partnership brings together a stable set of **public and private 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 (JU)) 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.

Participation of non-associated Third Countries is only possible if foreseen in the basic act and subject to conclusion of an international agreement.

2.3. Overview of the methodology adopted for the impact assessment

The methodology for each impact assessment is based on the Commission Better Regulation Guidelines²⁰ to evaluate and compare options with regards to their **efficiency, effectiveness and coherence**. This also integrates **key selection criteria for European Partnerships**.

Box 2 Summary of European Partnerships selection criteria²¹

- **Effectiveness** in achieving the related objectives and impacts of the Programme;
- **Coherence** and synergies of the European Partnership within the EU R&I landscape;
- **Transparency & openness** as regards the identification of priorities and objectives and the involvement of partners & stakeholders from the entire value chain, backgrounds & disciplines;
- Ex-ante demonstration of **additionality** and **directionality**;
- Ex-ante demonstration of the partners' **long term commitment**.

2.3.1. Overview of the methodologies employed

In terms of **methods and evidence used**, the impact assessments draw on an external study covering all candidate Institutionalised European Partnerships in parallel to ensure a high level of coherence and comparability of analysis, in addition to an horizontal analysis.²² For all initiatives, the understanding of the overall context of the candidate institutionalised

²⁰ European Commission (2017), Better Regulation Guidelines (SWD (2017) 350)

²¹ For a comprehensive overview of the selection criteria for European Partnerships, see Annex 6.

²² Technopolis Group (2020), Impact Assessment Study for Institutionalised European Partnerships under Horizon Europe, Final Report, Study for the European Commission, DG Research & Innovation

European Partnerships relied on desk research, including among others the lessons learned from previous partnerships. This was complemented by the analysis of a range of quantitative and qualitative evidence, including evaluations of past and ongoing initiatives; foresight studies; statistical analyses of Framework Programmes application and participation data, and Community Innovation Survey data; analyses of science, technology and innovation indicators; reviews of academic literature; sectoral competitiveness studies and expert hearings. 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, as described below. Public consultations (both open and targeted) supported the comparative assessment of the policy options. For each initiative, up to 50 relevant stakeholders were interviewed by the external contractor (policymakers, business including SMEs and business associations, research institutes and universities, and civil organisations, among others). In addition, the analysis was informed by the results of the Open Public Consultation run between September and November 2019, the consultation of Member States through the Strategic Programme Committee and the online feedback received on the Inception Impact Assessments of the set of initiatives.

A more detailed description of the methodology and evidence base that were mobilised, completed by thematic specific methodologies, is provided in Annexes 4 and 6.

2.3.2. *Method for identifying the preferred option*

The first step of the assessments consisted in scoping the problems that the initiatives are expected to solve given the overall economic, technological, scientific and social context, including the lessons to be learned from past and ongoing partnerships on what worked well and less well. This supported the identification of the objectives of the initiative in the medium and long term with the underlying intervention logic – showing how to get there.

Given the focus of the impact assessment on comparing different forms of implementation, the Better Regulation framework has then been adapted to introduce “**key functionalities needed**” - making the transition between the definition of the objectives and what would be crucial to achieve them *in terms of implementation*. The identification of “key functionalities needed” for each initiative as an additional step in the impact assessment is based on the distinguishing factors between the different options (see Section 2.2.1). In practical terms, each option is assessed on the basis of the degree to which it would allow for the key needed functionalities to be covered, as regards e.g. the type and composition of actors that can be involved (‘openness’), the range of activities that can be performed (including additionality and level of integration), the level of directionality and integration of R&I strategies; the possibilities offered for coherence and synergies with other components of Horizon Europe, including other Partnerships (internal coherence), and the coherence with the wider policy environments, including with the relevant regulatory and standardisation framework (external coherence). This approach guides the identification of discarded options while allowing at the same time a structured comparison of the options not only as regards their effectiveness, efficiency and coherence, but also against a set of other key selection criteria for European Partnerships (openness, transparency, directionality)²³.

In line with the Better Regulation Framework, the assessment of the effectiveness, efficiency and coherence of each option is made compared to the baseline. Therefore, for each of these

²³ The criterion on the ex-ante demonstration of partners' long term commitment depends on a series of factors that are unknown at this stage, and thus fall outside the scope of the analysis.

aspects the performance of using traditional calls under Horizon Europe is first estimated and scored 0 to serve as a reference point. This includes the discontinuation costs/benefits of existing implementation structures when relevant. The policy options are then scored compared to the baseline with a + and – system with a two-point scale, to show a slightly or highly additional/lower performance compared to the baseline. A scoring of 0 of a policy option means that it would deliver as much as the baseline option.

On the basis of the evidence collected, the intervention logic of each initiative and the key functionalities needed, the impact assessments first evaluate the **effectiveness** of the various policy options to deliver on their objectives. To be in line with the Horizon Europe impact framework, the fulfilment of the specific objectives of the initiative is translated into ‘expected impacts’ - how success would look like -, differentiating between scientific, economic/ technological, and societal (including environmental) impacts. Each impact assessment considers to which extent the different policy options provides the ‘key functionalities needed’ to achieve the intended objectives. The effectiveness assessment does not use a compound score but shows how the options would deliver on the different types of expected impacts. This is done to increase transparency and accuracy in the assessment of options²⁴.

A similar approach is followed to evaluate the coherence of options with the overarching objectives of the EU’s R&I policy, and distinguishes between **internal** and **external coherence**. Specifically, internal coherence covers the consistency of the activities that could be implemented with the rest of Horizon Europe, including European Partnerships (any type). External coherence refers to the potential for synergies and/or complementarities (including risks of overlaps/gaps) of the initiative with its external environment, including with other programmes under the MFF 2021-27, but also the framework conditions at European, national or regional level (incl. regulatory aspects, standardisation).

To compare the expected costs and benefits of each option (**efficiency**), the thematic impact assessments broadly follow a cost-effectiveness approach²⁵ to establish to which extent the intended objectives can be achieved for a given cost. A preliminary step in this process is to obtain a measure of the expected costs of the policy options, to be used in the thematic assessments. As the options correspond to different implementation modes, relevant cost categories generally include the costs of setting-up and running an initiative. For instance, set-up costs includes items such as the preparation of a European Partnership proposal and the preparation of an implementation structure. The running costs include the annual work programme preparation costs. Where a Partnership already exists, discontinuation costs and cost-savings are also taken into account²⁶. The table below provides an overview of the cost categories used in the impact assessment and a qualitative scoring of their intensity when compared to the baseline option (traditional calls). Providing a monetised value for these average static costs would have been misleading, because of the different features and needs of each candidate initiative.²⁷ The table shows the overall administrative, operational and

²⁴ In the thematic impact assessments, scores are justified in a detailed manner to avoid arbitrariness and spurious accuracy. A qualitative or even quantitative explanation is provided of why certain scores were given to specific impacts, and why one option scores better or worse than others.

²⁵ For further details, see Better Regulation Toolbox # 57.

²⁶ Discontinuation costs will bear winding down and social discontinuation costs and vary depending on e.g. the number of full-time-equivalent (FTEs) staff concerned, the type of contract (staff category and duration) and applicable rules on termination (e.g. contracts under Belgian law or other). If buildings are being rented, the cost of rental termination also apply. As rental contracts are normally tied to the expected duration of the current initiatives, these termination costs are likely to be very limited. In parallel, there would also be financial cost-savings related to the closing of the structure, related to operations, staff and coordination costs in particular. This is developed further in the individual efficiency assessments.

²⁷ A complete presentation of the methodology developed to assess costs as well as the sources used is described in the external study supporting this impact assessment (Technopolis Group, 2020).

coordination costs of the various options. These costs are then put into context in the impact assessments to reflect the expected co-financing rates and the total budget available for each of the policy options, assuming a common Union contribution (cost-efficiency):

- The costs related to the baseline scenario (traditional calls under Horizon Europe) are pre-dominantly the costs of implementing the respective Union contribution via calls and project, managed by the executive agencies (around 4%, efficiency of 96% for the overall investment).
- For a Co-Programmed partnership the costs of preparation and implementation increase only marginally compared to the baseline (<1%), but lead to an additional R&I investment of at least the same amount than the Union contribution²⁸ (efficiency of 98% for the overall investment).
- For a Co-Funded partnership the additional R&I investment by Member States accounts for 2,3 times the Union contribution²⁹. The additional costs compared to the baseline of preparing and implementing the partnership, including the management of the Union contribution implemented by the national programmes, can be estimated at 6% of the Union contribution (efficiency of 98% related to the overall investment).
- For an Article 185 initiative the additional R&I investment by Member States is equal to the Union contribution³⁰. The additional costs compared to the baseline of preparing and implementing the partnership, including the management of the Union contribution implemented by the dedicated implementation structure, can be estimated at 7% of the Union contribution (efficiency of 96% related to the overall investment).
- For an Article 187 initiative the additional R&I investment by partners is equal to the Union contribution³¹. The additional costs compared to the baseline of preparing and implementing the partnership, including the management of the Union contribution implemented by the dedicated implementation structure, can be estimated at 9% of the Union contribution (efficiency of 94% related to the overall investment).

Figure 4 - Intensity of additional costs compared with Horizon Europe Calls (for Partners, stakeholders, public and EU)

Cost items	Baseline: traditional calls	Option 1: Co- programmed	Option 2 Co-funded	Option 3a - Art. 185	Option 3b -Art. 187
Preparation and set-up costs					
Preparation of a partnership proposal (partners and EC)	0	↑↑			
Set-up of a dedicated implementation structure	0			Existing: ↑ New: ↑↑	Existing: ↑↑ New: ↑↑↑
Preparation of the SRIA / roadmap	0	↑↑			
Ex-ante Impact Assessment for partnership	0			↑↑↑	
Preparation of EC proposal and negotiation	0			↑↑↑	
Running costs (Annual cycle of implementation)					
Annual Work Programme preparation	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				

²⁸ Minimum contributions from partners equal to the Union contribution

²⁹ Based on the default funding rate for programme co-fund actions of 30%, partners contribute with 70% of the total investment.

³⁰ Based on the minimum requirement in the legal basis that partners contribute at least 50% of the budget.

³¹ Based on the minimum requirement in the legal basis that partners contribute at least 50% of the budget.

Cost items	Baseline: traditional calls	Option 1: Co- programmed	Option 2 Co-funded	Option 3a - Art. 185	Option 3b -Art. 187
Partners costs not covered by the above	0	↑	0	↑	↑
Additional EC costs (e.g. supervision)	0	↑	↑	↑	↑↑
Winding down costs					
EC	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.

The cost categories estimated for the common model are then used to develop a scorecard analysis and further refine the assessment of options for each of the 12 candidate Institutionalised Partnerships. Specifically, the scores related to the set-up and implementation costs are used in the thematic impact assessments to consider the scale of the expected benefits and thereby allow a simple “value for money” analysis (**cost-effectiveness**)³². In carrying out the scoring of options, the results of fieldwork, desk research and stakeholder consultation undertaken and taken into account.

For the **identification of the preferred option**, the scorecard analysis builds a hierarchy of the options by individual criterion and overall in order to identify a single preferred policy option or in case of an inconclusive comparison of options, a number of ‘retained’ options or hybrid. This exercise supports the systematic appraisal of alternative options across multiple types of monetary, non-monetary and qualitative dimensions. It also allows for easy visualisation of the pros and cons of each option. Each option is attributed a score of the adjudged performance against each criterion with the three broad appraisal dimensions of effectiveness, efficiency and coherence.

As a last step, the alignment of the preferred option with key criteria for the selection of European Partnerships is described, reflecting the outcomes of the ‘**necessity test**’.³³ The monitoring and evaluation arrangements are concluding the assessment, with an identification of the key indicators to track progress towards the objectives over time.

2.4. Horizontal perspective on candidate Institutionalised European Partnerships

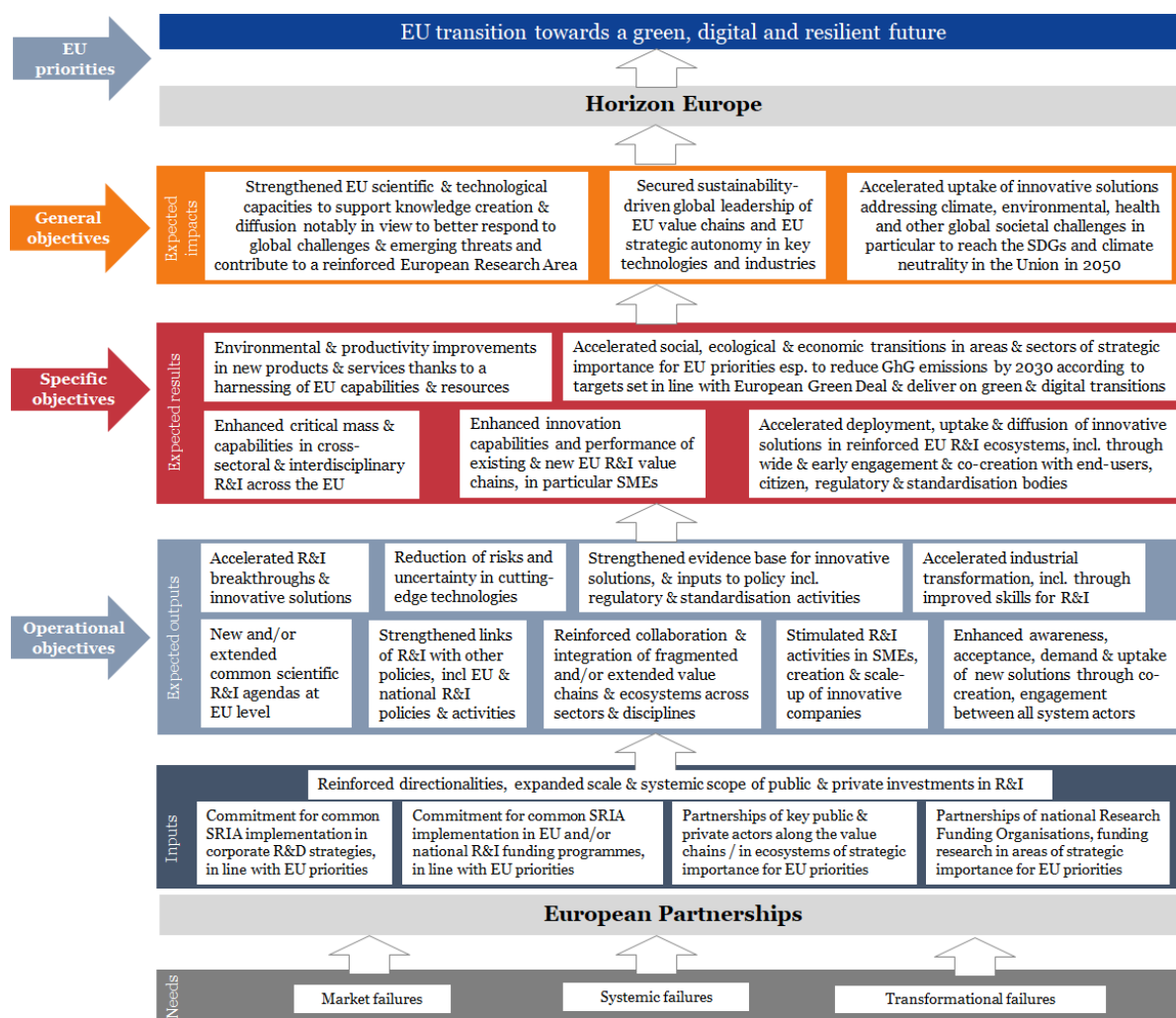
2.4.1. Overall impact orientation, coherence and efficiency needs

The consolidated **intervention logic** for the set of candidate Institutionalised European Partnerships in the Figure below builds upon the objectives as reported in the individual impact assessments.

³² More details on the methodology can be found in Annex 4.

³³ Certain aspects of the selection criteria will be further addressed/ developed at later stages, notably in the context of preparing basic acts (e.g. Openness and Transparency; Coherence and Synergies), in the Strategic Research and Innovation Agendas (e.g. Directionality and Additionality), and by collecting formal commitments (Ex-ante demonstration of partners’ long-term commitment).

Figure 5 – Overall intervention logic of the European Partnerships under Horizon Europe



Source: European Commission, DG Research & Innovation, Unit A2 Programme Analysis and Regulatory Reform, adapted from Technopolis Group (2020)

When analysed as a package the 12 candidate Institutionalised European Partnerships are expected to support the achievement of the European policy priorities targeted by Horizon Europe by pursuing the following joint general objectives:

- Strengthening and integrating EU scientific and technological capacities to support knowledge creation and diffusion notably in view to better respond to global challenges and emerging threats and contribute to a reinforced European Research Area;
- Securing sustainability-driven global leadership of EU value chains and EU strategic autonomy in key technologies and industries; and
- Accelerate the uptake of innovative solutions addressing climate, environmental, health and other global societal challenges contributing to Union strategic priorities, in particular to reach the Sustainable Development Goals and climate neutrality in the Union in 2050.

In terms of specific objectives, they jointly aim to:

- Enhance the critical mass and scientific capabilities in cross-sectoral and interdisciplinary research and innovation across the Union;
- Accelerate the social, ecological and economic transitions in areas and sectors of strategic importance for Union priorities, in particular to reduce greenhouse gas

emissions by 2030 according to the targets set in line with the European Green Deal, and deliver on the green and digital transition;

- c) Enhance the innovation capabilities and performance of existing and new European research and innovation value chains, in particular SMEs;
- d) Accelerate the deployment, uptake and diffusion of innovative solutions in reinforced European R&I ecosystems, including through wide and early engagement and co-creation with end-users, citizen and regulatory and standardisation bodies;
- e) Deliver environmental and productivity improvements in new products and services thanks to a harnessing of EU capabilities and resources.

In terms of their operations, taking an horizontal perspective on all initiatives allows for the identification of further possible collective efficiency and coherence gains for more impact:

- **Coherence for impact:** The extent and speed by which the expected results and impacts will be reached, will depend on the scale of the R&I efforts triggered, the profile of the partners involved, the strength of their commitments, and the scope of the R&I activities funded. To be fully effective it comes out clearly that future partnerships need to operate over their whole life cycle in full coherence with their environment, including potential end users, regulators and standardisation bodies. This relates also to the alignment with relevant EU, national or regional policies and synergies with R&I programmes. This needs to be factored in as of the design stage to ensure a wide take-up and/or deployment of the solutions developed, including their interoperability.
- **Collaboration for impact:** Effectiveness could also be improved collectively through enhanced cross-disciplinary and cross-sectoral collaboration and an improved integration of value chains and ecosystems. An adequate governance structure appears in particular necessary to ensure cross-fertilisation between all European Partnerships. This applies not only to initiatives where similar R&I topics are covered and/or the same stakeholders involved or targeted, but also to the interconnections needed between the ‘thematic’ and the ‘vertical’ Partnerships, as these are expected to develop methodologies and technologies for application in EU priority areas. Already at very early stages of preparing new initiatives, Strategic Research and Innovation Agendas and roadmaps need to be aligned, particularly for partnerships that develop enabling technologies that are needed in other Partnerships. The goal should be to achieve greater impacts jointly in light of common challenges.
- **Efficiency for impact:** Potential efficiency gains could also be achieved by joining up the operational functions of Joint Undertakings that do not have a strong context dependency and providing them through a common back-office³⁴. A number of operational activities of the Joint Undertakings are of a technical or administrative nature (e.g. financial management of contracts), or procured from external service providers (e.g. IT, communication activities, recruitment services, auditing) by each Joint Undertaking separately. If better streamlined this could create a win-win situation for all partners leading to better harmonization, economies of scales, and less complexity in supervision and support by the Commission services.

³⁴ See Annex 6 for an overview of key functions/roles that could be provided by a common back office.

2.4.2. Analysis of coherence of the overall portfolio of candidate initiatives at the thematic level

Looking at the coherence of the set of initiatives at the thematic level, the “**digital centric**” initiatives have a strong focus on supporting the digital competitiveness of the EU ecosystem. Their activities are expected to improve alignment and coordination with Member States and industry for the development of world-competitive EU strategic digital technology value chains and associated expertise. Addressing the Key Digital Technologies, the 5G and 6G connectivity needs as part of a Smart Networks and Services initiative and the underlying supercomputing capacities through a European High Performance Computing initiative present potential for synergies that can be addressed through cooperative actions (e.g. joint calls, coordinated support activities, etc.). They may as well profit from and contribute to Partnerships envisaged for Photonics, AI, data, robotics, Global competitive space system and Made in Europe, together with the EIT Digital. Synergies between these initiatives and several programmes (Digital Europe and Connecting Europe as well as cohesion programmes) are needed in areas where EU industry has to develop leadership and competitiveness in the global digital economy. They are expected to impact critical value chains including on sectors where digital is a strong enabler of transformation (health, industrial manufacturing, mobility/transport, etc.).

The **transport** sector have to respond to systemic changes linked to decarbonisation and digitalisation. Large scale R&I actions are needed to prepare the transition of these complex sectors to provide clean, safer, digital and economically viable services for citizens and businesses. Past decades have shown that developing and implementing change is difficult in transport due to its systemic nature, many stakeholders involved, long planning cycles and large investments needed. A systemic modernisation of the air traffic management infrastructure through an Integrated Air Traffic Management initiative should ensure safety and sustainability of air transport, while a Clean Aviation initiative should focus on the competitiveness of tomorrow’s clean aircrafts made in Europe. The initiative for Transforming Europe’s rail system would comprehensively address the rail sector to make it a cornerstone in tomorrow’s clean and efficient door-to-door transport services, affordable for every citizen as well as the most climate-friendly mode of transport for freight. Connected and Automated Mobility is the future of road transport, but Europe is threatened to fall behind other global regions with strong players and large harmonised markets. The initiative Safe and Automated Road Transport would bring stakeholders together, creating joint momentum in digitalising road transport and developing new user-based services. Stronger links and joint actions will be established between initiatives to enable common progress wherever possible. The Clean Hydrogen initiative would be fundamental to that regard. Synergies would also be sought with partnerships driving the digital technological developments.

To deliver a deep decarbonisation of highly emitting industrial sectors such as the steel, transport and chemical industries would require the production, distribution and storage of **hydrogen** at scale. The candidate hydrogen initiative would have a central positioning in terms of providing solutions to the challenges for sustainable mobility and energy, but also is expected to operate in synergies with other industry related initiatives. The initiative would interact in particular with initiatives on the zero emission road and water transport, transforming Europe’s railway system, clean aviation, batteries, circular industry, clean steel and built environment partnerships. There are many opportunities for collaboration for the delivery and end-use of hydrogen. However, the Clean Hydrogen initiative would be the only partnership focused on addressing hydrogen production technologies.

Metrology, the science of measurement, is an enabler across all domains of R&I. It supports the monitoring of the Emissions Trading System, smart grids and pollution, but also

contributes to meeting demands for measurement techniques from emerging digital technologies and applications. More generally, emerging technologies across a wide range of fields from biotechnologies, new materials, health diagnostics or low carbon technologies are giving rise to demands requiring a world-leading EU metrology system.

The initiative for a **Circular Bio-based Europe** is intended to solve a shortage of industry investments in the development of bio-based products whose markets do not have yet certain long-term prospects. The **Innovative Health Initiative** and **EU-Africa Global Health** address the lack of investments in the development of solutions to specific health challenges. The initiative on **Innovative SMEs** supports innovation-driven SMEs in participating in international, collaborative R&I projects with other innovative firms and research-intensive partners. As a horizontal initiative it is expected to help innovative SMEs to grow and to be successfully embedded in global value chains by developing methodologies and technologies for potential application in the other partnership areas or further development by the instruments of the European Innovation Council.

The description of the interconnections between all initiatives for each Horizon Europe cluster is provided in the policy context of each impact assessment and further assessed in the coherence assessment for each option.

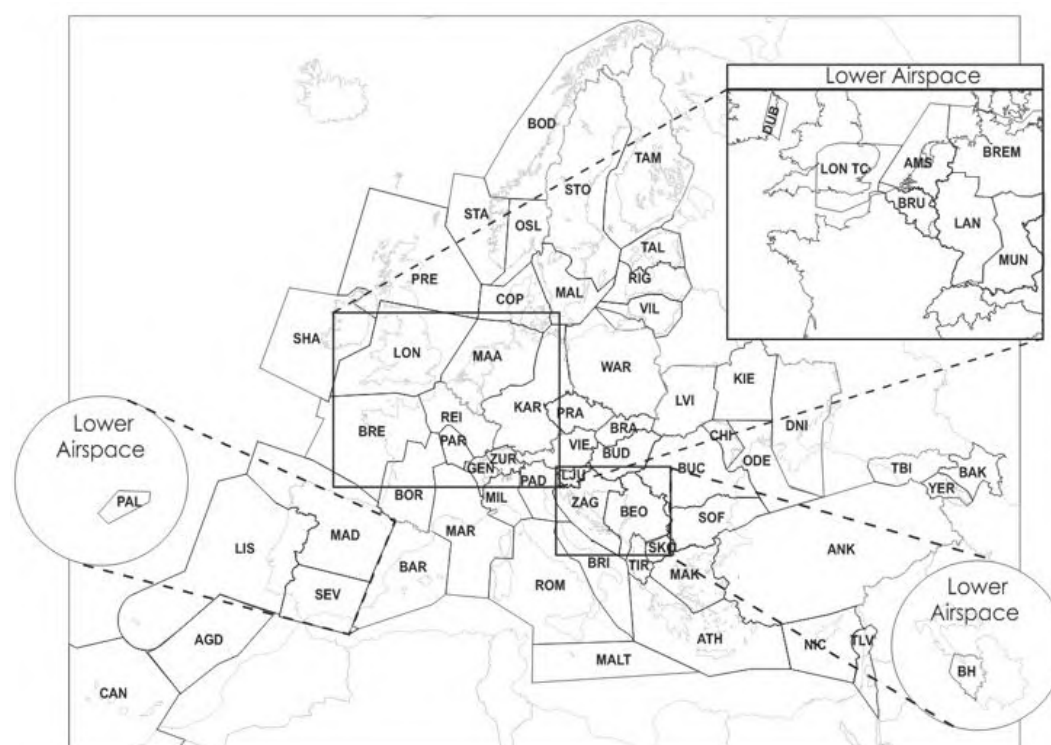
PART 2 - THE CANDIDATE EUROPEAN PARTNERSHIP FOR INTEGRATED AIR TRAFFIC MANAGEMENT

1. INTRODUCTION: POLITICAL AND LEGAL CONTEXT

Free movement of people and goods within the internal market is one of the cornerstones of the European Union's society and economy. The EU transport policy ultimately aims to serve the interests of European citizens and businesses by providing ever greater connectivity³⁵, the highest level of safety and security and barrier-free markets.

Air Traffic Management (ATM³⁶) is an activity for air transport encompassing ground and airborne systems that assist all types of manned and unmanned aircraft to safely depart from an aerodrome, transit airspace, and land at a destination aerodrome. Typically, before a flight takes place, any aircraft files a Flight Plan and sends it to a central European repository. However, for safety reasons, Air Traffic Controllers (ATCOs) can handle only a limited number of aircraft at one time. Computers used for flow management across the European network calculate the intended trajectory where an aircraft will be at any given moment and check that the ATCOs in that airspace can safely cope with the flight. If they cannot, the aircraft has to wait on the ground until it is safe to take off.

Figure 6 – A map of the European airspace



During the flight (en route) ATM ensures that aircraft are safely separated and safeguarded from adverse weather in the airspace and at the airports where they land and take off. Control

³⁵ Connectivity is also key in ensuring the economic, social and territorial cohesion of Member States enshrined in the Lisbon Treaty as a fundamental objective of the Union

³⁶ Regulation (EC) No 549/2004, Article 2(10): 'air traffic management (ATM)' means the aggregation of the airborne and ground-based functions (air traffic services, airspace management and air traffic flow management) required to ensure the safe and efficient movement of aircraft during all phases of operations'

towers at airports are a concept familiar to the public, but aircraft are also separated en-route by various “invisible” Air Traffic Control Centres (ACCs) as illustrated in the map above³⁷.

The current areas of responsibility of ACCs are designed mainly based on national boundaries. There are some examples of ACCs involving cross-border management of airspace. Each ACC works with sub-divided portions of airspace called sectors which may be grouped together or operated individually depending on level of traffic.

These subdivisions are clearly suboptimal and were addressed by the Single European Sky initiative of the Union's in 2004 seeking to reform the European air traffic management system through a series of actions carried out in four different levels (institutional, operational, technological and control and supervision) with the aim of improving the performance of the European airspace in terms of capacity, safety, efficiency and environmental impact.

In this context, the Single European Sky ATM Research (SESAR) project constitutes the fundamental “technological pillar” of the Single European Sky initiative, driving the ATM innovation cycle that brings new concepts through inter-related definition, development and deployment activities into operations, as illustrated below:

Figure 7 –SESAR and the ATM innovation cycle



R&I is the core of the SESAR project, driven by the European ATM Master Plan³⁸. The Master Plan is periodically updated to reflect new technology breakthroughs, evolving aviation expectations, and evolutions in EU policy and economy adjusting to emerging challenges within ATM.

The latest version of the Master Plan, adopted in December 2019 and supported by the entire aviation community and the EU Member States, identifies the vision for achieving a Digital European Sky³⁹ by 2040. This is a vision of a digital aviation infrastructure which is resilient, flexible and able to handle the future growth and diversity of air traffic safely and efficiently,

³⁷ Eurocontrol/Network Manager, 2018

³⁸ <https://www.sesarju.eu/masterplan>

³⁹ Blueprint for a Digital European Sky, Publication Office of the European Union, ISBN 978-92-9216-129-3

while minimising the environmental impact. The Master Plan defines what the current R&I programme is expected to deliver by 2035⁴⁰ and describes what the future programme still has to develop to implement the vision.

The Master Plan is therefore a clearly established and agreed roadmap for the future of ATM industrial and academic research, beyond the current or the potential upcoming partnership.

Building on the ATM Master Plan, parties interested to invest in the upcoming partnership have already prepared a detailed Strategic Research and Innovation Agenda laying down nine roadmaps for the technologies that need to be developed and demonstrated during the next Union long-term budget cycle.

It is to be noted that the brand ‘SESAR’ comprises development AND deployment (for more detail see Box 3 below). For the latter distinct financing and a distinct governance (outside the R&I domain) are in place.

This document focuses on assessing the most effective, efficient and coherent way of implementing an initiative under Horizon Europe that would focus on joint European research and innovation activities for modernising and integrating Air Traffic Management systems in Europe.

1.1. Emerging challenges in the field

Achieving the ambitious goal of climate neutrality by 2050 calls for the EU to ensure a deep decarbonisation of the air transport sector. The aviation industry has committed in the long-run to bring into service a new generation of aircraft that will be cleaner and quieter (based on alternative propulsion systems, new airframes and energy sources). However, this ambitious target cannot be achieved if ATM does not allow aircraft and airspace users to fully exploit their potential and thus to reduce emissions to a maximum.

Therefore, ATM must evolve at a faster pace than today to bring environmental benefits in the shorter term. Indeed, despite the ATM modernisation efforts undertaken in the past years, 5 to 10% of CO₂ emissions⁴¹ generated by flights are still thought to be avoidable and caused by a fragmented ATM infrastructure that does not fully exploit the advantages of digitalisation and automation. The avoidable emissions can be explained by unnecessarily long trajectories, congestion in the air and at airports, and thus higher CO₂ emissions, delays and higher costs for the provision of air navigation services.

Furthermore, while the economic outlook resulting from the COVID 19 pandemic is too early to predict, it is clear that due to its nature, air transport has been among the hardest hit sectors. IATA, the aviation industry’s trade body, has warned that some 25 million jobs in both the aerospace and aviation sectors are at risk if governments do not step in with lifelines⁴². These are not normal times and the pressure on the ATM infrastructure to embrace a more digital future to become more cost efficient, resilient and scalable to fluctuations (up or down) in demand for air transport has never been higher. Moreover, experiences from previous crises situations have shown that traffic will pick-up and increase beyond the pre-crises levels.

⁴⁰ Date at which it is deemed possible to secure full entry into operations of the technology and processes developed by the existing Programme

⁴¹ European ATM Master Plan Edition 2020

⁴² IATA Press Release No 28 07 April 2020

Innovation in ATM has progressed over the past decade thanks to the SESAR programme. However, there are still a number of remaining challenges, including the very sub-divided ATM systems as explained above, which will require a more rapid digitalisation of the ATM infrastructure to further focussing efforts and acceleration of the development, industrialisation and market uptake of innovations that would increase the level of collaboration and automation in ATM through a data rich and cyber-secured connected ATM ecosystem. Such an evolution also poses a number of regulatory challenges as the sovereignty of Member States in relation to their airspace needs to be respected and a higher degree of digitalisation and automation would make service delegation agreements between States less important.

The sector is still at the early stages of decarbonisation and digitalisation, and massive investments across the entire air transport value chain are necessary to shorten the innovation life cycles (from approximately 30 years today to 5-10 years). In order to achieve this acceleration, ATM must tackle risks such as market failure for first movers, fragmentation among players and lack of critical mass. The ATM industry supports a wide range of applications in transport (passengers and cargo, new emerging forms of mobility such as urban air mobility), defence & security (military, law enforcement), the digital economy (such as drones for the collection of data or to bring Internet connectivity to rural and remote communities).

Addressing these multiple challenges in a rapidly evolving and demanding context requires a significant collective effort in boosting cooperation and investment on breakthrough innovations that cannot be addressed by any single stakeholder or Member State alone as, by essence, aviation is international and requires common and coordinated action.

1.2. EU relative positioning in the field

Air transport is a key driver for European integration and economic prosperity. The aviation sector employs close to 2 million people and overall supports between 4.8 million and 5.5 million jobs in Europe⁴³, directly and indirectly. Altogether, this generates EUR 110 Billion in GDP in the EU, while the overall impact, including tourism, is as large as EUR 510 billion⁴⁴. Europe's citizens and businesses are connected today thanks to the 30 000 daily flights carrying about 1.1 billion passengers per year.

The European air traffic management (ATM⁴⁵) system supports mobility by providing the infrastructure to ensure the safe and secure separation of aircraft and the efficient flow of air traffic. It is a safety critical infrastructure, which is significantly regulated to ensure the highest possible performance standards. Put in other words, there can be no aircraft in the air without ATM which is currently provided in Europe at a cost to airspace users of about 10 billion EUR per year⁴⁶.

Europe hosts the world leaders in ATM technology and manufacturing industry^{47, 48}. Considering the shared and complex nature of this infrastructure, no single company or state can realise that digital transformation alone.

⁴³ Aviation Strategy for Europe: Maintaining and promoting high social standards, COM(2019) 120 final

⁴⁴ Source: European Commission, an Aviation Strategy for Europe, COM/2015/0598 final

⁴⁵ Regulation (EC) No 549/2004, Article 2(10): 'air traffic management (ATM)' means the aggregation of the airborne and ground-based functions (air traffic services, airspace management and air traffic flow management) required to ensure the safe and efficient movement of aircraft during all phases of operations'

⁴⁶ Source Eurocontrol, Central Route Charge Office, 2018 Report on the Operation of the Route Charges System

⁴⁷ Frost & Sullivan, Global Commercial Air Traffic Management Market, Forecast to 2025

Considering the cross-border and safety critical nature of air transport, developing the infrastructure and the underlying technology to support the realisation of the Single European Sky cannot be done by individual stakeholders or Member States.

The race for setting the next generation of standards requires more intensive global coordination in the context along the International Civil Aviation Organisation (ICAO). Europe's current leading position, through major players in ATM technology, SESAR and data platform providers, cannot be taken for granted. Competition is raising. New aviation nations like China are putting European leadership to the test, as is the renewed strengthening of protectionism worldwide. If the Union wants the European technology to continue to be backbone of global aviation infrastructure, the EU should continue its support for the European ATM innovation cycle⁴⁹. This cycle is a unique model of integration of different phases of innovation process involving a wide range of public and private partners governed by a dedicated EU-wide legal framework and incentive mechanisms linking technological innovation with policy and performance objectives. The political and economic weight of the initiative involving all EU Member States allows the Union to enjoy an influential position in global for a.

The safety of air traffic is and will continue to be the central focus of the partnership. This means that safety and cyber security are embedded in the design of every single solution coming out of SESAR and are regularly screened throughout validation and demonstration exercises under the close regulatory supervision of EASA, who should play an even bigger role in the upcoming partnership.

Box 3 Support for the field in the previous Framework Programmes – key strengths & weaknesses identified

What has been/is being done with EU research and innovation funding until now

European ATM Research & Innovation (R&I) is currently coordinated by the SESAR Joint Undertaking (SESAR JU)⁵⁰. Created in 2007⁵¹ under FP7 and extended in 2014⁵² under Horizon 2020, the SESAR JU currently manages the SESAR 2020 R&I programme (SESAR development phase) and will end its activities by 31 December 2024.

The objective of the SESAR JU is⁵³ “*to ensure the modernisation of the European air traffic management system by coordinating and concentrating all relevant research and development efforts in the Community*”.

What has or is being achieved so far

The current partnership has laid down a solid foundation that will enable a rapid start of activities under the new partnership/configuration. More specifically, the Master Plan (co-owned by industrial stakeholders, the Member States, the Commission and Eurocontrol)

⁴⁸ AeroSpace and Defence Industries Association of Europe (ASD) 2019 facts & figures report

⁴⁹ AeroSpace and Defence Industries Association of Europe (ASD) High-Level Position on Aeronautics in the next Framework Programme (FP9)

⁵⁰ an Institutionalised Partnership established under Article 187 of the Treaty on the Functioning of the European Union (TFEU)

⁵¹ See Council Regulation (EC) n°219/2007 of 27 February 2007

⁵² See Council Regulation (EU) No 721/2014 of 16 June 2014

⁵³ 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.

provides both, the vision of where the European ATM system should be by at the end of the next Union long-term budget (2035) and the common roadmap to achieve it. The two generations of the partnership preceding the upcoming initiative have solidified a close cooperation model sustained by clear governance arrangements and a multitude of working arrangements used by various specialists to cooperate at technical level.

To date, **the SESAR JU has delivered close to 100 ATM Solutions⁵⁴ that are being deployed and are delivering benefits at over 300 locations across Europe^{55,56}**, under the coordination of the SESAR Deployment Manager.

Whether implemented individually or in combination, the SESAR solutions can bring benefits in key performance areas, such as cost and operational efficiency, capacity, safety, security and the environment.

The SESAR JU has also changed the mind-set of the industry, who has become more cooperative and dedicated to achieving the common Union policy priorities in ATM.

There is also a close and well-tested cooperation with the industrialisation and deployment processes in the sector.

The main intervention areas for the upcoming partnership have already been central to the work of the current partnership. Some key achievements include:

- *Digitalisation*: the partnership was able to significantly advance the maturity of technologies enabling the virtualisation of ATM (Virtual & Augmented Reality applications, Remote Tower operations, Virtual Centres) some of which are already in implementation across Europe (Remote Towers).

- *Environment*: the partnership was able to advance the maturity of technologies promising to enable the reduction of CO₂ emissions per flight by up to 4% some of which are already in implementation across Europe such as Free Route operations (to fly more direct trajectories)

- *Drones*: in 2017, the European Commission mandated the SESAR JU to coordinate all R&I activities related to the safe integration of drone integration into airspace. As a result, 19 project were launched covering exploratory research and large-scale demonstration projects that addressed all aspects of drone operations, as well as the enabling technologies and required services. The results of these projects helped shape the first regulatory proposal to establish an initial harmonised framework for drone operations in Europe (EASA regulation on U-space).

How the new partnership will integrate the findings of previous evaluations

The partnership approach has proven to work in the context of ATM. It contributes to focusing and rationalising Research & Innovation efforts and investments in Europe on agreed priorities driven by the Union's policy objectives. The upcoming partnership will not only continue to engage all current types of stakeholders but it will expand its membership to new emerging actors in the sector, including drones manufacturers or drones services providers, as well as actors from the space and communications sectors.

As identified by the evaluation report, the administrative procedures and IT systems have caused concerns for the beneficiaries. The Commission has simplified the rules for

⁵⁴ <https://www.sesarju.eu/newsroom/brochures-publications/sesar-solutions-catalogue>

⁵⁵ Guidance Material for SESAR Deployment Programme Implementation Monitoring View 2019, SDM, September 2019

⁵⁶ Interactive map available at: <https://www.sesardeploymentmanager.eu/single-european-sky-deployment/>.

participation with the Proposal for the Horizon Europe Programme and has constantly been working to address IT concerns faced by the JUs and their members.

The work does not stop at the end of the research phase. To make a difference, the results of the partnership (SESAR solutions) have to be easy to standardise, certify and industrialise into products that can deliver tangible improvements into the real world operational environment.

To this end, the new Joint Undertaking will have a stronger role in coordinating and facilitating the industrialisation process for the SESAR solutions.

With the upcoming partnership, we also hope to break the traditional approach in aviation where innovation is often delayed by potential and non-documented safety concerns. The future partnership will develop & demonstrate the application of digital solutions (relying on higher levels of automation, AI, etc.) which will ultimately lead to smaller margins for human & system errors and improved safety.

What are the key areas for improvement & unmet challenges?

A number of systemic challenges already identified in the interim evaluation of SESAR JU⁵⁷ risk derailing the progress already achieved and will have to be better addressed in a new ATM research initiative. These challenges include:

- i) Defining and maintaining stable long-term objectives
- ii) Reinforcing the accountability of the SESAR JU and prioritising EU support to R&D solutions that promote defragmentation and a competitive environment⁵⁸.
- iii) Shortening the long research and industrialisation cycles, to secure a faster deployment and entry into operations of SESAR solutions;
- iv) Addressing funding concentration, and the need to ensure that there is enough transparency and openness to new participants, especially to entities from countries where participation was so far low;
- v) Improving knowledge management and transfer, links to academia and research institutes to improve the scientific base on ATM in the EU.

1.3. EU policy context beyond 2021

A new momentum to improve ATM is given by the "European Green Deal"⁵⁹, which identifies aviation as a key sector that needs a rapid change in paradigm to achieve the ambitious goal of climate neutrality by 2050. The European Green Deal refers explicitly to reducing aviation emissions.

The ATM infrastructure should be modernised at a more rapid pace to bring environmental benefits in the shorter term by improving the efficiency of ATM services in the European airspace. Digitalisation will radically transform Europe's ATM infrastructure contributing to a smarter, more sustainable, connected and accessible to all air transport.

⁵⁷ Commission Staff Working Document - Interim Evaluation of the Joint Undertakings operating under Horizon 2020, SWD (2017) 339 final

⁵⁸ European Court of Auditors Special Report No 18/2017

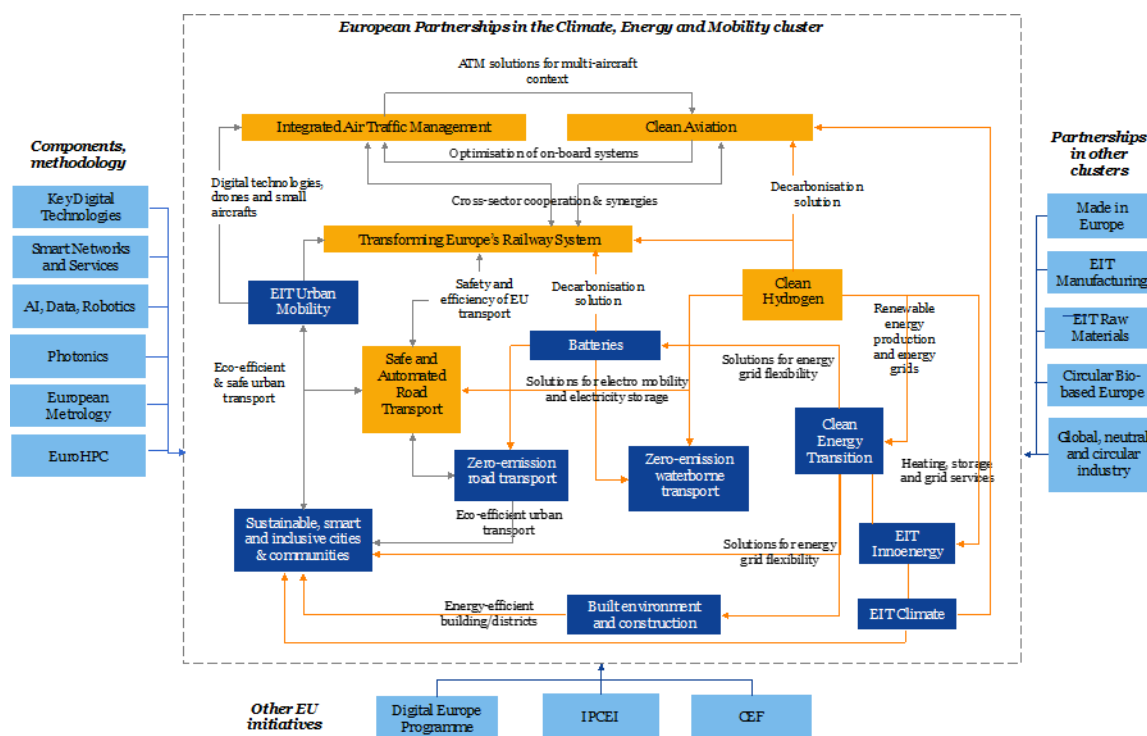
⁵⁹ European Commission (2019), COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS, The European Green Deal, COM(2019) 640 final

Under the proposed Horizon Europe programme, the R&I activities funded under the **Pillar II Cluster Climate, Energy and Mobility** aim at contributing to the attainment of three of the six main ambitions for Europe: ‘A European Green Deal’, ‘a people-centred economy’ and ‘A Digital Europe’. Pillar II supports several of the Sustainable Development Goals, particularly Climate Actions (SDG13), Sustainable Cities and Communities (SDG11) and Industry Innovation and Infrastructure (SDG9)⁶⁰.

The Integrated Air Traffic Management partnership is one of the European institutionalised Partnership candidates proposed to be established and funded under this cluster. It seeks to bring together a broad range of stakeholders in the sector (technology providers, innovators, start-ups, academia, airspace users, service providers and the military) to support the digital transformation of ATM infrastructure and services. It also falls under the new Commission’s vision of a digital European sky⁶¹ that by 2040 would eliminate any environmental waste caused by the aviation infrastructure.

Building upon the experience of the current SESAR Joint Undertaking, it is one of the envisaged European Partnerships to “accelerate competitiveness, safety and environmental performance of EU air traffic, aviation and rail”. There is a relatively high number of candidate partnerships in the mobility sub-cluster in different mobility application areas (i.e. air, rail and road transport). Fig. 1 shows the potential synergies between the candidate partnerships and the potential synergies with the energy and digital sub-clusters.

Figure 8: Potential interconnections between partnership initiatives in the Climate, Energy and Mobility cluster of Horizon Europe



Source: Technopolis Group (2020)

According to the European ATM Master Plan, the next generation of ATM systems underlying the digital European Sky shall be more automated and take greater advantage of

⁶⁰ Information on ATM contribution to SDGs is presented in Annex 6

⁶¹ Blueprint for a digital European Sky, EU Publication Office, December 2019

digital technologies such as big data and artificial intelligence (AI). Future ATM R&I therefore needs to be connected with wider R&I on:

- *Air Transport* (e.g. link with the candidate partnership on Clean Aviation). Traffic data from Eurocontrol shows that CO₂ emissions from aviation have grown by a higher percentage than the traffic growth⁶². Improvements in the environmental efficiency of aircraft may thus be negatively balanced by a fragmented ATM infrastructure. Therefore, the R&I roadmaps for ATM and Clean Aviation must be coordinated to maximise benefits, in particular on the environment.
- *Multi-modal transport*: ATM systems should be synchronised and exchange data with other transport modes (e.g. rail) to increase predictability and to enable through-ticketing or luggage reconciliation.
- *Digital technologies* (e.g. link with 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 evolution of technologies for data manipulation and distribution, cyber security, legal aspects (e.g. on data ownership, responsibility and liability issues), advanced decision making, including big data and artificial intelligence as well as scientific understanding of climatic impacts.

2. PROBLEM DEFINITION

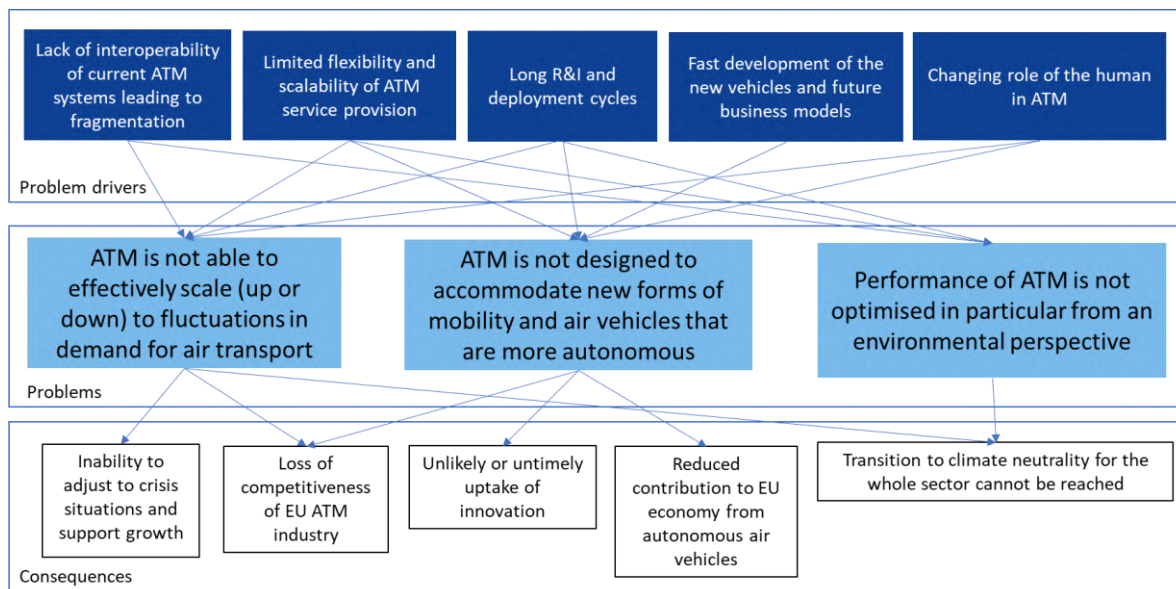
2.1. What are the problems?

Given the scale of the challenges identified in Section 1.1, the current scientific, technological and economic positioning of Europe in the field and the overarching Single European Sky policy context, three problems, all linked to limited scientific capacity and fragmentation of R&I efforts have been identified where coordinated EU research and innovation has an essential role to play:

- **Technological**: The current ATM systems and technologies in the EU are not digitalised and are therefore not able to effectively adapt to the fluctuations in demand for ATM services.
- **Economic**: The European ATM system and technologies are not designed to accommodate an increasing number of new forms of mobility and air vehicles that are more autonomous and use digital means of communication and navigation. Moreover, current technologies effectively prevent cross-border service provision in the internal market.
- **Environmental**: The performance of ATM is not optimised in particular from an environmental perspective resulting in unnecessary greenhouse gas emission of up to 10%.

Figure 9: Problem tree linked to the limited scientific capacity and fragmentation for the initiative on integrated Air Traffic Management

⁶² Comparison of January – October 2019 traffic vs January-October traffic 2017, for all Eurocontrol States departing flights: A 4.5% traffic increase generated a 7.5% increase in CO₂ emissions. Source: Eurocontrol, Network Manager.



2.1.1. The current ATM system has not been digitalised and is therefore not able to effectively scale (up or down) in line with fluctuations in demand for ATM services

Digitalisation has transformed a wide range of industries (with banking, media, retail, travel & tourism, and automotive as front runners) driven by data exchange, connectivity and automation. Transformation of the aviation industry and its supporting ATM infrastructure has already started, but in a post COVID 19 world, much deeper disruptions are expected to impact this traditional, vertically integrated, industry, characterised by slow development cycles and asset intensity.

These disruptions will come from increased and renewed demand to access the sky, new entrants reinventing mobility, new services enabled by data, faster innovation cycles, or customer expectations based on standards set by digital businesses.

They will come at a time of a very challenging outlook for the aviation industry that has been hit extremely hard by the COVID-19 crisis—even harder, perhaps, than by the events of 9/11 and the 2008 global financial crisis put together. However, this challenge will also come along with value migration within the value chain and between incumbents and new players – coming both from the digital industry and from regions such as Asia which may be in a position to benefit from the ongoing rebalancing of economic power.



The need to modernise the existing system through the development and application of emerging technologies such as digitalisation, automation and big data was a recurrent theme amongst the interviewed and throughout all the stakeholder categories⁶³.

Despite the successful deployment of some technologies developed under the SESAR project, Europe's ATM infrastructure is still fragmented⁶⁴ and operates with a low level of automation support⁶⁵ and data exchange intensity (the primary communication technology in ATM today is high frequency radio through which decisions are exchanged by voice between air traffic controllers and pilots). This is the result of years of bespoke operations by national air navigation service providers that have until recently not sufficiently embraced digitalisation

⁶³ For an overview of the consultation activities that were carried out, and the views of the stakeholders, see Annex 2.

⁶⁴ Single European Sky: a changed culture but not a single sky, Special Report 18/2017, European Court of Auditors.

⁶⁵ European ATM Master Plan, Edition 2020, Figure 4

and underlines the importance of acting on a this joint effort at European level. As such, the current systems are monolithic, rigid, not scalable (i.e. providing the service where it is needed, in the amounts needed) and unable to exploit emerging digital technologies.

As a result, the periodic (e.g. weekdays vs weekends schedule) or occasional capacity shortage (leading to congestion) caused by unexpected traffic developments cannot be adequately addressed, and the new challenges, mainly the emergence of new airspace users (e.g. delivery drones), risk worsening the situation unless a new impetus is given to ATM modernisation through innovation. Many of the innovations needed are not “business as usual” or incremental but breakthrough solutions that combine digital and physical infrastructure capabilities that needs to be deployed in the entire ecosystem by air navigation service providers, airlines or airports.

Bringing these innovations to scale in the market is challenging considering the high degree of technological, regulatory or market risk the aviation industry faces, which so far has deterred or delayed private investment in its infrastructure⁶⁶. Addressing the multiple ATM challenges requires significant R&I investment in boosting cooperation and investment on innovations that cannot be addressed by any single stakeholder or Member State alone as the ATM infrastructure is shared and needs to rely on homogeneous standards⁶⁷, fit for the digital age, to foster innovation.

As seen prior to SESAR, national R&I programmes aimed at solving local problems, rather than addressing the network perspective at European level. This resulted in duplication of efforts on similar topics⁶⁸, leading to the adoption of different solutions generating even more fragmentation and inefficiencies. Finally, substantial R&I effort and coordination is still needed to improve the manufacturability of tomorrows digital ATM platforms and time to market to reduce innovation cycle from about 30 years to about 5-10 years.

This is due to the complexity of facilitating interactions between innovators, early movers and regulators to help develop regulatory frameworks that allow the benefits of digital technologies to be fully realised in a safety critical sector of our economy.



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.

2.1.2. The European ATM system is not designed to accommodate new forms of mobility and air vehicles that are more autonomous

Over 23,000 daily flights carrying one billion passengers per year (in 2018) connect Europe’s citizens, businesses, communities and cultures.

Hence, under normal circumstances with a saturated aviation infrastructure, air traffic in Europe is hitting its limits both in the air and on the ground, resulting in growing delays and unnecessary emissions. In addition, a multitude of new types of air vehicles, such as delivery drones and air taxis, will soon be seeking access to the airspace. The need for continued and more focussed coordinated R&I and validation of commonly agreed concepts is clear and urgent, in particular to support a robust economic recovery of Europe after the COVID 19 crisis.

⁶⁶ Blueprint for a Digital European Sky, Publication Office of the European Union, ISBN 978-92-9216-129-3

⁶⁷ The role of standards is discussed further in Annex 6.

⁶⁸ R&I prior to SESAR is described in Annex 6

The current European ATM infrastructure is reaching its limit in terms of ability to manage an ever increasing volume of air traffic⁶⁹ which means that the problem will resume as the COVID 19 crisis is over (at the time of writing this report the estimated time to recovery for airlines is estimated at 3 to 18 months⁷⁰). In 2018, air traffic delay attributable to the ATM short-comings doubled⁷¹. With sustained long-term traffic growth forecasted for the next 17 years resulting in a total traffic increase of 50%⁷² there is a risk that the level of delays could be 15 times higher if the capacity of current systems is not increased⁷³.

Figure 9 shows the predicted levels of delay and congestion in 2035 if more flexible, scalable and interoperable ATM solutions are not developed and implemented.

Figure 10: The predicted levels of delays by 2035



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

When the airspace management 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 goals⁷⁴ of ATM⁷⁵.

Aircrafts flying in European skies are also becoming more autonomous, more connected, more intelligent, and more diverse⁷⁶. This means that there will be an emergence of a multitude of new types of air vehicles where there is no pilot to talk to: drones flying at low altitude, military medium altitude long endurance unmanned aircraft systems, automated air taxis, super-high altitude operating aircraft.

The markets for these “new entrants” are hindered by the lack of an integrated and harmonised 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 traditional airspace. Without such systems to ensure safe operations, rules tend to be more restrictive and divers between EU Member States⁷⁷.

⁶⁹ Annex 6 provides further details of the limitations of the current ATM system.

⁷⁰ The Post-COVID-19 Flight Plan for Airlines, The Boston Consulting Group, March 31 2020

⁷¹ Eurocontrol Performance Review Report 2018: ATFM delay in 2018 was 1.74 minutes per flight; in 2017 it was 0.82 minutes per flight.

⁷² European Aviation in 2040 Challenges of Growth, Annex1 Flight Forecast to 2040, EUROCONTROL, 2018

⁷³ A proposal for the future architecture of the European airspace, SJU, 2019

⁷⁴ ATM performance requirements are regulated under Commission Implementing Regulation (EU) 2019/317 of 11 February 2019 laying down a performance and charging scheme in the single European sky

⁷⁵ 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>).

⁷⁶ Blueprint for a Digital European Sky, Publication Office of the European Union, ISBN 978-92-9216-129-3

⁷⁷ See for example: <https://dronerules.eu/en/professional>



Interviews: A majority of stakeholders agree that one of the needs of R&I in ATM is the inclusion of the key emerging challenges such as drones, U-space and other aerospace vehicles into 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 (which includes these emerging challenges).

2.1.3. The performance of ATM is not optimised in particular from an environmental perspective resulting in unnecessary greenhouse gas emission

There is growing pressure on the aviation sector to reduce its environmental footprint. Citizens in general and air passengers in particular increasingly expect eco-friendly, smart and personalised mobility options that allow them to travel seamlessly and efficiently. They want quick and reliable data to inform their travel choices, not only on schedules, prices and real-time punctuality, but increasingly also on environmental impacts. To deliver this new era in aviation, leveraging technology is key, as in the upcoming future new aircraft and infrastructure capabilities combined with regulatory changes hold the greatest promise to address climate changes in a post-pandemic aviation sector.

Indeed, while an energy transition (e.g. sustainable aviation fuels) is the only way in the long term (2050) to ensure carbon neutral air transport in the future, the ATM infrastructure in particular can be modernised at a more rapid pace and bring significant environmental benefits in the shorter term⁷⁸.

Today 5-10% of air transport's CO₂ emissions could be avoided due to inefficiencies in the ATM infrastructure⁷⁹ as aircraft trajectories are not sufficiently optimised from gate-to-gate perspective to reduce the environmental footprint of each flight (see figure 10 below). This is not negligible and would save 28 million tonnes of CO₂ per year, which is roughly equivalent to the CO₂ produced by 3.2 million people or the population in the metropolitan area of a city like Madrid⁸⁰.

To further understand the problem it is important to stress that the contribution of ATM infrastructure in reducing the climate change impacts of aviation can best be achieved by enabling aircraft to fly on their optimum (where applicable cross-border) 4D trajectory on the ground, in the climb, on-route and descent phases of flight - the optimum horizontal path from departure to destination flown at the most fuel efficient altitude. This is not the case today as illustrated by Figure 11 below. There are several factors that may influence whether such an optimum trajectory may be flown. One factor is data sharing, as all actors (e.g. airline, airports at departure and arrival, network manager and often multiple national air navigation and data service providers) involved in the execution of a given flight will have to plan and execute their services based on a shared and agreed 4D trajectory⁸¹. This call for a very broad engagement of stakeholders in the future partnership as later described in section 4.

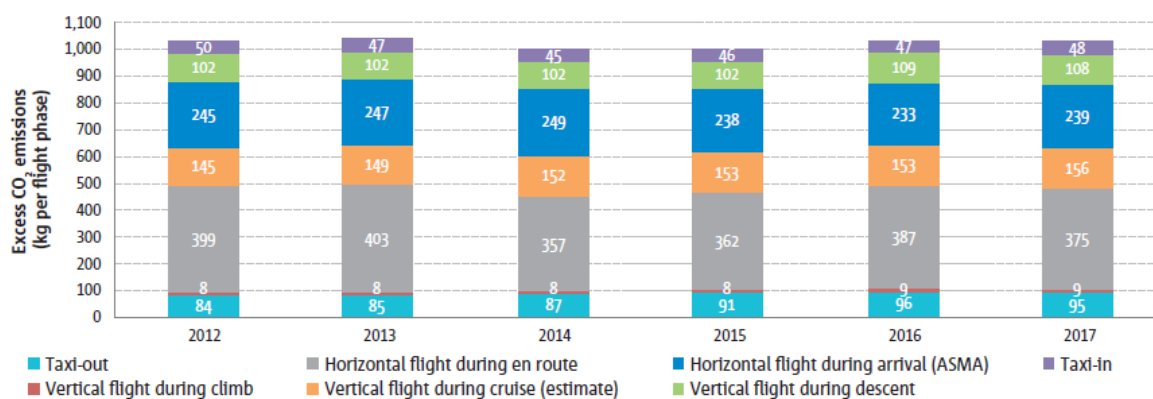
Figure 11: Breakdown of gate-to-gate excess CO₂ emissions for an average flight in Europe

⁷⁸ IATA, Aircraft Technology Roadmap to 2050 which provides an overview and assessment of technology opportunities for future aircraft, including improved engine efficiency, aerodynamics, lightweight materials and structures as well as radical new configurations and propulsion systems

⁷⁹ European ATM Master Plan, Edition 2020, Figure 10

⁸⁰ European ATM Master Plan Companion Document on the Performance Ambitions and Business View

⁸¹ ICAO Environmental Report 2019



Source: European Aviation Environmental Report 2019, EASA, EEA and Eurocontrol.

Significant R&I effort is still needed to develop ATM technology enabling “perfect flights by design” (including for the next generation aircraft that will be cleaner and quieter) from an emission perspective eliminating all possible ATM infrastructure constraints that would result into a degradation of the optimum and thus generating extra emissions.

2.2. What are the problem drivers?

2.2.1. Lack of interoperability and fragmentation of current ATM systems

ATM infrastructure and services are provided by the Member States’ air navigation service providers, over their territories⁸². 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 EUR 900m - EUR 1 400m annually, approximately 20-30% of the annual costs of air navigation service provision⁸³.

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 operations⁸⁴.

To date however, as evidenced by the interim evaluation of the SESAR JU, the initiative has focussed on maturing solutions that optimise specific elements of ATM but has made slow 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 technologies⁸⁵.



Stakeholder views: Interoperability was highlighted by many interviewees from ANSP, ATM institution, 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

⁸² This is the set-up for all the States members of ICAO. ICAO, Convention on International Civil Aviation, and its Annexes.

⁸³ Report commissioned by the Performance Review Commission - The impact of fragmentation in European ATM/CNS, Prepared by Helios Economics and Policy Services.

⁸⁴ Single European Sky: a changed culture but not a single sky, Special Report 18/2017, ECA.

⁸⁵ Interim evaluation of the SESAR Joint Undertaking (2014-2016) operating under Horizon 2020. Expert Group Report, European Commission (2017).

2.2.2. *Limited flexibility and scalability of ATM service provision*

Scalability is the capability to provide air traffic services at the right time and in the right place (in line with demand fluctuations – up or down). Although the situation has improved, each air navigation service provider optimises its resources and capacity locally (through airspace organisation and staff availability), with little coordination at European level. This is a crucial issue because the majority of flights in the EU airspace are cross-border. Today, this process takes a significant amount of time and results in limited flexibility for routing, flexibility for allocation of controllers, and leads ATM services to be either over or under-dimensioned at any given point in time.

As air traffic grows or is subject to severe fluctuations in demand (such as the ones observed during the COVID-19 crisis), it becomes more important to be able to take a network (or pan-European) view. Prior to the crisis some portions of the EU ATM network were running close to their structural capacity limit. In that case, any unplanned perturbation at local or network level results in significant disruptions and consequent delays and greater impact on the environment. “The analysis showed that the European core area where traffic density is highest remains the problem area”⁸⁶.

2.2.3. *Long R&I and deployment cycles*

The ATM infrastructure is safety critical and shared across all Member States. Changes to this infrastructure therefore require working together across the whole aviation value chain (aircraft manufacturing, aircraft operations and infrastructure) and synchronising actions, even if some may have a negative business case on a given investment that needs to be addressed and overcome by creating confidence not only on technical feasibility but also in terms of on market uptake potential by a critical mass of early movers. That is why the ATM innovation cycles are long, as it often takes more than ten years from concept definition to deployment and entry in operations⁸⁷. The efforts of the SESAR JU have allowed reducing the R&I from about 10 to an average of 6 years, but a similar effort remains to be carried out for the industrialisation phase that ensures the transition of solutions from development to deployment.

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 TRL⁸⁸s. This can be a lengthy and often expensive process of collecting safety evidence, since no ATM procedure or tool can be implemented if it is not approved by either a local or European regulatory body.

⁸⁶ Performance Review Report: “An Assessment of Air Traffic Management in Europe during the Calendar Year 2018”, Performance Review Commission, 2018.

⁸⁷ For example, it took 15 years for Time Based Separation, which 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.

⁸⁸ Technology Readiness Level, as defined in the General Annexes of the Horizon 2020 Work Programme 2014-2015, Commission Decision C(2014) 4995, https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf

During those time periods the solution under development evolves, due to the changing environment (i.e. economy, price of fuel, travel demand)⁸⁹. Innovations that are “robust”, in the sense of being solutions that address the changing requirements have the best chance of reaching deployment.

The ultimate decision to implement a new technology would need to be accepted by all the involved organisations to ensure interoperability across Europe. 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 - is required to finalise the R&I and transition towards industrialisation and deployment.

The need to accelerate innovation in ATM has been cited often in recent years⁹⁰.



The majority of stakeholders interviewed, 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 industrialisation⁹¹.

2.2.4. *Fast development of the new air 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) system⁹².

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 airspace⁹³. 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 drones require access – for example for aerial photography, crowd surveillance or domestic deliveries.

This leads to three different issues:

- a) 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?

⁸⁹ Bolić, T., 2012. Innovation Adoption and Adaptation in Air Traffic Control – Interaction of Organizations. Journal of Sociotechnology and Knowledge Development

⁹⁰ See for instance the Report of Wise Persons Group on the future of the Single European Sky, 2019

⁹¹ 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.”

⁹² 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>

⁹³ European ATM Master Plan: Roadmap for the safe integration of drones into all classes of airspace, SJU, 2018.

- b) 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.
- c) 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&I⁹⁴ 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. As the size and performance of drones are constantly changing, 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, that were interviewed, 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. *The changing role of the human in ATM*

ATM relies heavily on highly trained professionals able to solve complex situations on a regular basis. These professionals are able to handle a certain number of aircrafts and they represent about two thirds of the European ATM costs. On the other hand, the digital transformation of ATM triggers a radical increase in the dynamics of the system to secure its scalability (up - and also down, as the current crisis demonstrates) and resilience, ensuring that all air traffic is handled safely and efficiently, whatever the traffic scenario. In this context, the role of the human and of the interface between humans and the machines is a key driver for the success of the future system, as humans will continue to control the tools, use the support provided by machines to take decisions quickly and safely.

Digitalisation, automation virtualisation will generate a substantial change in the way ATM is organised and operated. No change of such magnitude can be successful without the implication and support of the staff concerned. R&I must have a strong connection with the operational staff and associate it to the development of the tools of the future, taking into full account the diversity of cultures, situations and labour laws within each State.

Change management, social dialogue, training and permanent staff involvement will be key requisites to the success of the European ATM modernisation and the achievement of the Digital European Sky.

2.3. **How will the problem(s) evolve?**

Unless the three problems linked to limited scientific capacity and fragmentation of R&I efforts are effectively addressed at EU level, it is likely that national programmes will re-

⁹⁴ Section 4.2.4 of European ATM Master Plan: Digitalising Europe's Aviation Infrastructure. SJU, 2019.

emerge on an ad-hoc basis, especially in a post-COVID 19 world, to solve specific local issues generating increased fragmentation⁹⁵.

In these circumstances, the technological problem will lead to:

- **Inability to adjust to crisis situations and to support growth:** after the financial crisis in 2008 it took until 2016 for the number of flights in Europe to return to the levels seen in 2007. In the current situation, not only have we seen airlines either stop flying or operate at a “de minimis” level, but airports close for flights too. Restarting is going to be a significant activity and should not be underestimated. This crisis provides nothing more than some “breathing space” for an ATM infrastructure that had already reached its structural capacity limits. The pressure on the ATM infrastructure to embrace a more digital future to become more cost efficient, resilient and scalable to fluctuations (up or down) in demand for air transport has therefore never been higher.
- **Loss of competitiveness of European industry players:** the industry has been one of the hardest hit with the COVID 19 crisis, with contracts cancelled, production halted and pleas for big bailouts. Unlike many other sectors in the digital economy, Europe is currently the world leader in aerospace and aviation infrastructure technology. Unless this opportunity is taken it is likely that Europe will lose its leadership position and become more dependent on imports from third countries.
- **Unlikely or untimely uptake of innovation** (i.e. lack of a common vision and needed evidence for standardisation and regulatory approval) that would therefore be less likely to be deployed to overcome inefficiencies at EU level, thus making it more difficult, time consuming and expensive to make the ATM system fit for addressing future challenges.

The economic problem described above will lead to:

- **Reduced contribution to EU economy from autonomous air vehicles:** drones provide new capabilities for government and defence applications, as well as for commercial business opportunities. The spread and development of civil drones depends on their ability to operate in various areas of the airspace. This requires significant R&I on drone traffic management⁹⁶ that, if not addressed, would reduce the estimated value of European drone market by EUR 10 billion annually by 2035 and over EUR 15 billion annually by 2050⁹⁷.

From an environmental perspective:

- **Transition to climate neutrality for the whole sector cannot be reached:** the aviation industry has committed in the long-run to bring into service a new generation of aircraft that will be cleaner and quieter (based on alternative propulsion systems, new airframes and energy sources) but this ambitious target cannot be achieved if ATM does not allow them to fly full exploiting their potential. ATM must evolve at a faster pace to bring environmental benefits in the shorter term.
- **Aircraft will fly inefficient routes, increasing environmental impact:** airspace congestion would impose inefficient routes on flights, increasing environmental

⁹⁵ See Annex X for further details on ATM R&I prior to SESAR.

⁹⁶ 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.

⁹⁷ European Drones Outlook Study – Unlocking the value for Europe, SJU, 2016.

impact (additional 30 to 60 million tonnes of CO₂ over the period 2019-2035⁹⁸), and costs to airlines and passengers.

3. WHY SHOULD THE EU ACT?

3.1. Subsidiarity: Necessity of EU action

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

- The Single European Sky defines the policy context;
- R&I is coordinated by the SESAR Joint Undertaking and
- Synchronised deployment is ensured through Common Projects.

Recent European Court of Auditors reports^{99,100} found that the current policy, R&I and deployment initiatives have generated a change process, but that more efforts are needed in order to realise the full benefits of ATM modernisation: *“It is therefore necessary to accelerate and better focus efforts on transforming the European ATM system into a digital, scalable and resilient network, through an approach coordinated at EU level”*.

This can only be achieved by transforming the current patchwork of national systems into a modern collaborative and distributed platform¹⁰¹, evolving from bespoke, product-based systems to a service, collaborative and adaptable network approach. Achieving an interoperable infrastructure is a prerequisite to unbundling the physical infrastructure from service provision and a fluid and secure access to ATM data. In this way air navigation services will be able to be provided irrespective of their physical location, at any moment and to any part of airspace. This requires significant R&I funding to develop and validate transformative technologies with a high degree of consensus from both Member States and the industry¹⁰².



Most stakeholders interviewed indicated that action from the EU was required to provide coordination and harmonisation across the ATM value chain. EU leadership will ensure that the European network benefits from a broad, synchronised implementation of the latest technology. Industrial stakeholders (suppliers and ANSPs) noted the need for long term benefits justify investment and overcome their individual interests. They support developing solutions based on a common architecture rather than developing their own products in isolation.

3.2. Subsidiarity: Added value of EU action

A modern, digital and efficient ATM system will support sustainable aviation growth in line with EU policies, namely the European Green Deal¹⁰³ and achieving a Europe fit for the digital age.

It is estimated that by 2050, a harmonised European ATM system could generate over EUR 1,800bn in benefits for Europe¹⁰⁴ that will boost EU competitiveness, innovation capacity and

⁹⁸ G.3.2 of A proposal for the future architecture of the European airspace, SJU, 2019.

⁹⁹ Single European Sky: a changed culture but not a single sky, Special Report 18/2018, ECA.

¹⁰⁰ 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.

¹⁰¹ A proposal for the future architecture of the European airspace, SJU, 2019.

¹⁰² Further details on the necessary transformational technologies are provided Annex 6.

¹⁰³ COM(2019) 640 final

¹⁰⁴ See Table 38 in Annex 6 for a detailed breakdown.

the position of its industry in the global market. 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 not created, the transformation will likely take significantly longer with negative implications for the environment, jobs and growth in Europe.

Addressing this challenge in a rapidly evolving and demanding context requires a significant collective effort in boosting cooperation and investment on innovations that cannot be addressed by any single stakeholder or Member State alone as, by essence, aviation is international and requires common and coordinated action. This is particularly true for the European infrastructure supporting aviation due to the scale and cross-border nature of the problems and the wide range of stakeholders involved. Only action at EU level can improve results in such a fragmented sector.



All stakeholders interviewed 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?

4.1. General objectives of the initiative

Based on the identified problems, the overall objective of the proposed initiative is to develop and validate ATM technological solutions that support the achievement of the Digital European Sky making the European airspace the most efficient and environmentally friendly sky to fly in the world and support the competitiveness and recovery of the aviation sector in a post-COVID crisis Europe.

The work to be carried out by the initiative will enable a substantial transition from current ATM systems to the new Digital European Sky vision of the European ATM Master Plan and will produce noticeable, quantifiable contributions to growth and climate targets in 2030 and pave the way for climate neutrality by 2050.

There is a significant change in scope compared to the current SESAR JU, with more focus on breakthrough innovations, industrialisation and market uptake. The following general objectives have been identified:

- Strengthen and integrate the EU's research and innovation capacity in the ATM sector, helping bring the European ATM into the digital age to make it resilient, scalable to fluctuations in traffic while enabling the seamless operation of the next generation of aircraft, which will be cleaner, quieter and more autonomous,
- Strengthen through innovation the competitiveness of manned and unmanned EU air transport and of the ATM services market to support a robust economic growth and recovery in a post-COVID 19 world in the EU,
- Develop and accelerate market uptake of innovative solutions to establish the Single European Sky airspace as the most efficient and environmentally friendly sky to fly in the world

These objectives address the aviation value chain, which was severely affected by the COVID 19 crisis, from a broad perspective and are aligned with the objectives of the Horizon Europe framework. Their achievement will contribute to several Sustainable Development Goals with

the most impact on SDG 9 (Industry, Innovation and Infrastructure), SDG 13 (Climate Action) and SDG 8 (Decent work and economic growth).

4.2. Specific objectives of the initiative

The future partnership will only be successful if all partners will continue to remain committed to the objectives established by the European ATM Master Plan. Significantly more efforts and investment than in the past are needed from all stakeholders involved to ensure the delivery of technical solutions able to advance smoothly through standardisation and certification processes.

Therefore, in order to achieve the general objectives, six specific objectives are defined. They respond to each of the problem drivers discussed in Section 2.2.:

- Develop a R&I ecosystem covering the entire ATM and U-space value chains allowing to build the Digital European Sky¹⁰⁵ defined in the European ATM Master Plan, enabling the collaboration and coordination needed between air navigation services providers and with airspace users to ensure that a single harmonised EU ATM system for both manned and unmanned operations;
- Develop and validate breakthrough ATM solutions supporting high levels of automation;
- Develop and validate the technical architecture of the Digital European Sky;
- Support an accelerated modernisation of ATM infrastructure through a network of demonstrators and facilitate the development of standards for industrialisation.
- Maintain a consensus-led strategy for EU ATM modernisation

Meeting the afore-mentioned specific objectives should be measured against the capacity of the future partnership to execute the following core activities:

- Organise and coordinate the SESAR definition (maintenance of the European ATM Master Plan), development and industrialisation phases (further developed in the SRIA) to stimulate and reinforce the EU scientific, operational and industrial ecosystem for innovation in aviation infrastructure;
- Develop and validate breakthrough ATM solutions, supporting high levels of environmental performance, resilience and scalability. The objective by 2030 is to deliver the solutions identified in the European ATM Master Plan for Phase D (“Digital European Sky”) at TRL 6;
- Accelerate market uptake by establishing a European network of large-scale digital sky demonstrators to build confidence and bridge the gap between research and implementation. The demonstrators should be closely connected to the standardisation and regulatory frameworks to advance the maturity of the solutions smoothly through standardisation and certification processes. The objective by 2030 is to accelerate market uptake (up to TRL 8) for a critical mass of “early movers” representing minimum 20% of the targeted operating environment in Europe.
- Facilitate interactions between innovators, early movers and regulators to help develop regulatory frameworks that allow the benefits of digital technologies to be fully realised with due consideration for the human dimension.

¹⁰⁵ ‘Digital European Sky ’ refers to vision of the European ATM Master Plan, seeking to transform Europe's aviation infrastructure enabling it to handle the future growth and diversity of air traffic safely and efficiently, while minimising environmental impact.

- Support the Union in coordinating global interoperability efforts and promote European R&I results in relevant international fora.

It is important to note that issues related to the policy, regulatory and financial framework have to be addressed in parallel and/or factored in so that the initiative is able to achieve its objectives and effectively contribute to the relevant EU policies and targets from a broader perspective. This could be addressed by future developments of the regulatory framework and EU aviation relevant policies and strategies.



Many of the respondents to the Open Public Consultation took the opportunity to underline key messages regarding the initiative:

The initiative 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.

Air navigation service providers and manufacturers agree that European R&I ATM has a strong position worldwide due to having built over years a coordinated programme, which has allowed Europe to have a strong voice in ICAO and set trends parts of the world. Interviewees also noted that closer cooperation and involvement of EASA and EUROCAE would support narrowing of the gap between the R&I and industrialisation phases.

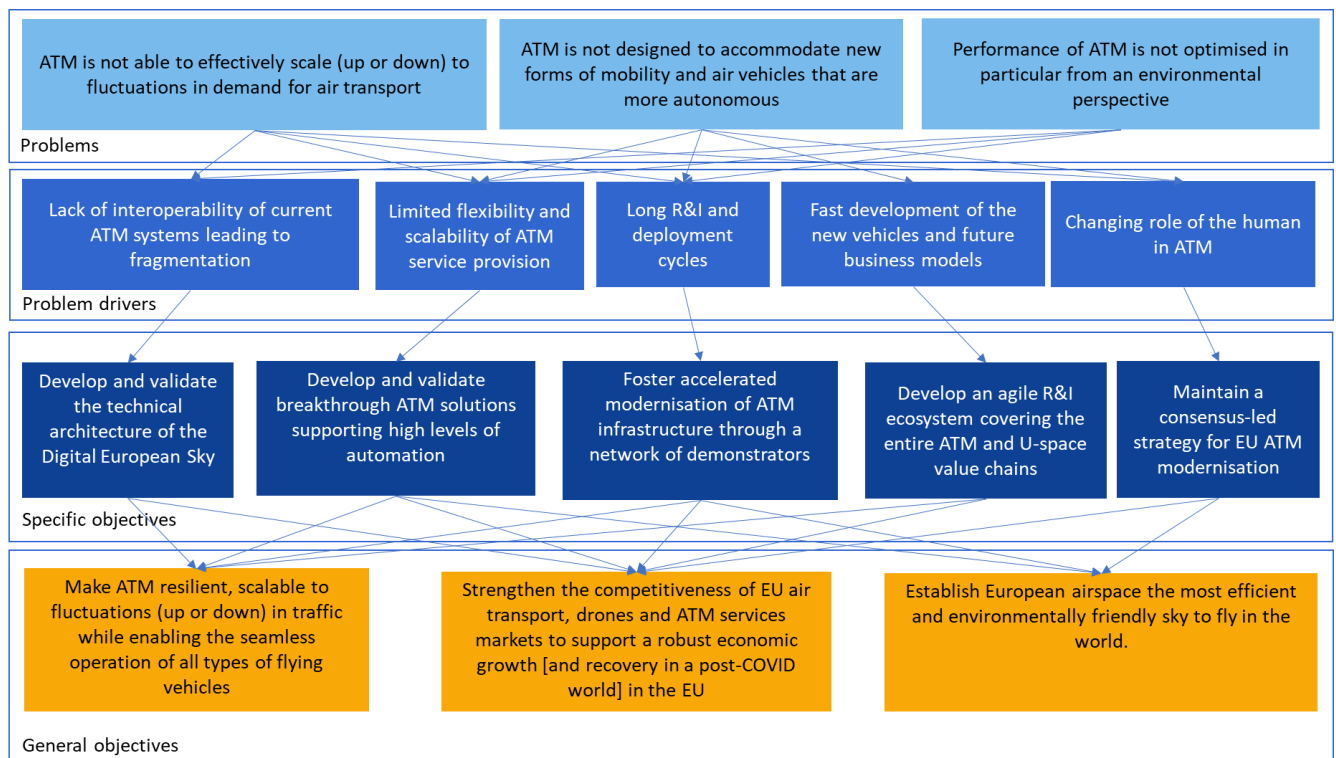
Stakeholders with long experience in ATM research recalled the period prior to the establishment of the SESAR JU and the adoption of the European ATM Master plan. They agree that in ATM, European network benefit is only achieved if efforts are coordinated and building on a commonly agreed Roadmap/Plan agreed between the industry, the Union and the Member States.

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

4.3. Intervention logic

The relationship between the general and specific objectives of the initiative on integrated ATM R&I is shown in Figure 11.

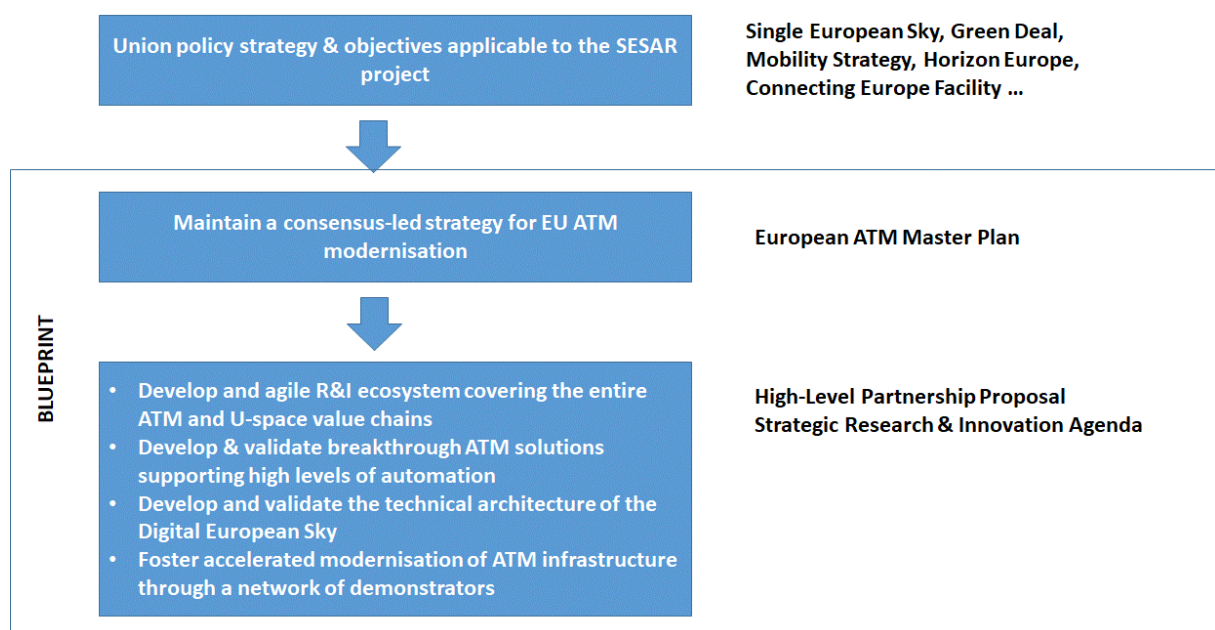
Figure 11: Intervention Logic for the initiative on integrated ATM



How the intervention logic fits in the broader policy context

As explained in Chapter 1, the investment into this initiative facilitates the development of technologies which support the success of the Single European Sky policy of the Union. Figure 12 below outlines how different planning instruments link with each other and relate to the policy.

Figure 12: Intervention Logic in the policy context



How would success look like?

Should the initiative deliver on its specific objectives, it is expected that it would result in the following impacts:

Scientific impacts

New scientific knowledge and reinforcement of EU scientific capabilities

If successful, the R&I ecosystem established and supported by this initiative would develop and validate new technological and operational ATM solutions that help develop 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.

The development of ATM solutions would make use of new scientific methods, in particular digital technologies (e.g. big data, automation, AI, virtualisation). This would generate new data, use cases and applications that test and reinforce these technologies.

The planned R&I activities would require and involve a wide range of expertise from various scientific and engineering disciplines, such as aviation and infrastructure engineering, communications, operations research, computer science and thus helps build the cooperation and scientific exchanges between these branches.

Enhanced capacity among the next generation aviation professionals:

The benefits of bringing the ATM infrastructure into a digital age to users and businesses in the whole aviation value chain (i.e. including aircraft manufacturers and aircraft operators) and the economic growth that could come via their productivity contributions, are compelling¹⁰⁶. This will not only contribute to a more resilient and sustainable EU economy that creates jobs but also help expand the knowledge base and skill sets of academia and companies' staff.

In order to be able to develop the needed ATM solutions, and to facilitate the best performing ATM in the future, next generation ATM professionals would need to be aware of this science. Apart from performing research, the goal of academia, in general, is to promote knowledge transfer to the next generation of professionals through the involvement of Ph.D. students and post-doctoral students in the R&I research activities. This would enhance the capacity among the next generation of aviation professionals, which would likely have a strong impact on the education of the next generation of experts. This impact would start being evident at the medium term and continue throughout the lifetime of the initiative.

Economic/technological impacts

Overall, this initiative will facilitate the setup of an aviation infrastructure that supports the growth and recovery of Europe in a post-COVID world and that opens up digital opportunities for people and business while enhancing Europe's position as a world leader in the digital economy.

If successful, the initiative would allow for an accelerated delivery of innovative ATM solutions needed for all types of aircraft operations that help improve the flexibility of the European ATM network and systems. This would allow for the **handing of additional flights and thus facilitating growth in the air transport sector**.

¹⁰⁶ European ATM Master Plan Edition 2020

Safely and efficiently integrating drones and drones traffic management systems with the ATM systems would facilitate **the ramp up of drones-related economic activities**, opening up the market for new types of drones services operators and drones traffic management service providers.

A Europe-wide agreed ATM architecture relying on inter-operable ATM solutions standardised and certified at European level would give Europe a strong voice at international level, where European technologies can and should be the backbone of global ATM modernisation plans coordinated by ICAO. This would boost the EU industry globally by enabling international agreements and contracts.

The economic impacts have been evaluated as part of the recent European ATM Master Plan update campaign¹⁰⁷ and assume an effective roll-out of R&I results into operations are summarised in Table 1.

The figures represent an estimated direct gross domestic product (GDP) contribution generated by SESAR in the ATM value chain (ATM equipment manufacturers, aircraft manufacturers, military, airspace users, ANSPs, Network Manager and airports). All calculations are available in the supporting document to the European ATM Master Plan Edition 2020 (titled “Master Plan Companion Document on the Performance Ambitions and Business View”).

Table 1: Expected economic impacts

Expected impacts	Quantification Method	Value
Ability to handle additional flights enabling growth in air transport	Direct benefits of ATM value chain Cumulative Benefit up to 2050	€510b
Enable new economic activity based on drones	Direct benefits of the U-space value chain Cumulative Benefit up to 2050	€350b
Boost 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 up to 2050	€84b

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

Aviation is a resilient industry which has been hit by a number of shocks in the past. Whereas COVID-19 is currently creating unprecedented low traffic levels, in the medium to long term, there is little doubt that aviation will return to growth. Moreover, the COVID-19 crisis does not change the need for the European ATM system to become more automated, more scalable and more resilient in its support of European aviation while reducing the environmental impact and improving cost efficiency.

Societal impacts (including environmental impacts)

The contribution of ATM to passenger experience and to the implementation of efficient multimodality, including urban air mobility, will be a major factor in how the society will view the aviation industry in the future. The passenger experience will be optimised by

¹⁰⁷ Master Plan Companion Document on the Performance Ambitions and Business View. 1.0, SESAR, 2019.

focusing on departure and arrival punctuality on the aviation legs of the multimodal journey, reducing time spent at airports. Optimisation will also be achieved through the effective sharing of multimodal connection data with other modes of transport, enabling an integrated approach to reducing door-to-door travel time.

A digital European sky will ensure that passengers do not lose time at airports or in the air in Europe. In doing so, it could save yearly up to 14.5 million hours that passengers will be able to spend instead with their family or at work.

If the initiative is successful, and the R&I results implemented, the expected societal impacts would be reduced travel times, improved predictability, reduced delays and lower costs. This would improve both the passenger experience and business opportunities.

Table 2: Societal Impacts

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

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

The figure of EUR 760bn corresponds to a monetisation of the societal impacts of SESAR to EU citizens. It was calculated by independent experts who assessed the passengers benefits from the additional mobility (more flight options) and time saved (lower delays and shorter flights). It also assesses the benefit for the European society of having lower air pollution and lower climate change impact - driven by lower fuel burn - per flight. All calculations are available in the supporting document to the European ATM Master Plan Edition 2020 (titled “Master Plan Companion Document on the Performance Ambitions and Business View”¹⁰⁸, section 4.2.3.3. “Indirect benefits for passengers and European citizens”).

In more concrete terms, focus areas include emission-free taxiing and solutions to optimise airport and terminal airspace operations, such as exceptional holdings and more continuous climb and descent operations, while curved, steep and/or segmented approaches and noise-preferential routes are being considered for deployment to address noise reduction. Urban air mobility will depend on electric or hydrogen-powered vehicles that will be emission free, with R&I ensuring that noise levels are minimised for the general public.

Environmental impacts

A digital European sky could save 28 million CO₂ tonnes per year, which is roughly equivalent to CO₂ produced by 3.2 million people or the population in the metropolitan area of a city like Madrid.

The technological progress resulting from this initiative would ultimately lead to optimising flight trajectories and traffic flow, i.e. planes being able to fly the cheapest, shortest route possible while maintaining the required high safety levels. This would contribute to the long-term goal of reducing aviation noise and gas emissions (i.e. 5-10% less CO₂ emissions per flight by 2035) from an ATM-operational perspective.

¹⁰⁸ <https://www.atmmasterplan.eu/>

The EUR 12bn. estimated impact corresponds to the fuel savings (and reduced emissions) that could be realised by aircraft operators with the current fleet.

Table 3: Expected Environmental Impacts

Expected 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 up to 2050	€12b

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

Open public consultation: A majority of stakeholders, across all stakeholder groups, pointed out that the initiative can and should make a 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%).

Social impacts

In ATM as in all industries, the human capital is a critical and an integral element of the system. Changing demands on ATM require a radical increase in the dynamics of the system to secure its scalability (up and down) and resilience, ensuring that all air traffic is handled safely and efficiently, even under the highest traffic growth forecast or during stagnation or unexpected downturn.

The goal of automation is not to replace the human but to optimise the overall performance of the socio-technical ATM system and maximise human performance. This will require the development of the role of the human in parallel with ATM concepts and technological developments. New tools are needed to support continuous, system-wide monitoring of all critical processing, including during degraded modes of operation or, for example, cyberattacks. New tools must also enable humans to make effective decisions, including where collaborative, co-adaptive and joint intelligence modes of decision-making are used. A move from executive control to supervisory control will require a thorough understanding of the implications for the humans and their interaction with the systems. The human-to-technology balance is likely to vary between domains, where some problems might be solved by automation with little human intervention, while other areas might require a human, monitored by an automated safety capability to solve the problem. Research will need to address all the roles, responsibilities and tasks of the different actors (airborne and ground, ATM and U-space, operating and technical), training needs and change management for the evolving roles as per the recommendations provided by the Expert Group on the Human Dimension of the Single European Sky.

4.4. What is needed to achieve the objectives – Key functionalities needed

Given the focus of the impact assessment on comparing different forms of implementation, the identification of “key functionalities needed” allows making the transition between the definition of the objectives and what would be crucial to achieve them *in terms of implementation*. These functionalities relate to the type and composition of actors that have to be involved, the type of range of activities that should be performed, the degree of directionality needed and the linkages needed with the external environment.

4.4.1. Type and composition of the actors to be involved

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 on integrated ATM should therefore be open to:

- a) Suppliers of “ATM solutions”, i.e. air and ground system manufacturers and ATM data service providers.
- b) New entrants particularly active on emerging autonomy and connectivity solutions (such as but not limited to urban air mobility, U-space, mobile network operators).
- c) Operators and users of the system namely air navigation service providers, airport operators and airspace users – including both civil and military organisations.
- d) The Meteorological community such as MET service providers
- e) EASA and national authorities to ensure smooth progress through certification and regulatory processes.
- f) EUROCAE and other standardisation bodies to deliver the next generation standards
- g) EUROCONTROL (an inter-governmental organisation) as a key actor in European ATM with a large R&I capability and specific operational roles in terms of managing the ATM network.
- h) The European Space Agency (ESA) and satellite communication providers as the sector may allow to develop highly innovative solutions for the benefit of aviation
- i) Research establishments that mainly perform applied research and are increasingly engaging in supporting the introduction of breakthrough innovation into the market
- j) The ATM R&I community of universities and specialist SMEs that currently support exploratory research.
- k) The professional staff associations to ensure the involvement of operational staff in the development of new concepts as well as R&D validation activities
- l) 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.

4.4.2. Type and range of activities needed

Flexibility in the selection of projects, implementation and membership will be crucial to ensure that the partnership is empowered enough to deliver. In practice, there is need for a balance between long term vision and stability of the programme and flexibility (e.g. evolution in partners, adjustments in investment levels to advance – or not – to higher TRL levels etc.) to ensure it remains relevant and responsive to new market, industry and technological developments.

In order to ensure flexibility of implementation so as to reach its intended objectives the initiative should conduct the following activities:

- (I) Seek synergies with R&I programmes of other sectors and initiatives. In particular, strong links are already identified (but not limited to) with the candidate European Partnerships on clean aviation

- (II) Coordinating R&I actions ranging from concept to demonstration activities for a critical mass of early movers (covering all Technology Readiness Levels), ensuring inclusion of new actors and integration of extended value chains
- (III) Organising and coordinating the European ATM Master Planning activities defining the SESAR vision and the related development and deployment priorities and plans securing due involvement of all Member States
- (IV) Coordinating industrialisation processes fostering and acceleration of market uptake and solutions able to advance smoothly through open standardisation and certification processes
- (V) Co-creating solutions with end-users, emphasising the importance of flexibility in addressing different target groups over time (potential down-stream and end-users, public authorities and broader stakeholder communities), including industrial end users beyond the transport sector
- (VI) Facilitating flexible and efficient interactions between breakthrough innovators, early movers and regulators to help develop regulatory frameworks that allow the benefits of digital technologies to be fully realised with due consideration for the human dimension
- (VII) Coordinate global interoperability efforts and promote European R&I results in relevant open international fora and
- (VIII) Ensuring the necessary funding for these activities in accordance with the ATM Master Plan and SRIA.

4.4.3. Priority setting and level of directionality required

Europe's common vision to replace the current fragmented national systems with a new collaborative platform at EU level is the Digital European Sky defined in the European ATM Master Plan. The Master Plan is the basis on which the strategic research and innovation agenda (SRIA) for the future R&I programme is built, as it has the support of the ATM stakeholder community and of the Member States. It is critical that stakeholders with strategic roles in the sector remain committed to the partnership. Industry should be ready to continue to improve the performance, cost and reliability of solutions. A partnership naturally encourages the cooperation between stakeholders who are otherwise competitors, working together on the basis of a jointly agreed multi-annual plan addressing common goals for the sector.

A first draft of the SRIA was developed with the full involvement of the members of the current SESAR JU, as well as with potential future partners of the new partnership. The process for finalising it will include a public survey to solicit input and comments from the wider ATM stakeholder community, including new entrants.

Less mature solutions should also continue to be supported. Political support from both the Member States and the Union is needed and often the technological solutions (e.g. for safety) are not necessarily economically viable.

To conclude, the level of directionality should be as high as possible for the initiative to reach its expected impacts. The strategic vision should be shared and implemented as much as possible by the key stakeholders along the whole value chain.

4.4.4. Coherence needed with the external environment

As the infrastructure is shared but still fragmented across all EU Member States, often used by a wide (and ever widening due the potential offered by drones) range of both civil and

military use cases, ATM modernisation should be addressed through close collaboration frameworks with other programmes and initiatives to create synergies and limit duplications. Regarding other initiatives such as (but not limited to) Clean Aviation, it is crucial to share views on the ways to integrate the next generation of aircraft that will be cleaner and quieter and ideally to share a common vision to define where to concentrate efforts. Joint or coordinated calls, including their funding and management, would be the next step to ensure full coherence with other initiative's agendas. Beyond air transport ATM R&I should also ensure that it remains coherent with wider R&I initiatives such as:

- Multi-modal transport (such as candidate partnerships related to road, waterborne and rail transport), as ATM systems need 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, where ATM needs to be aware of and adapt to the ATM context the technologies for data manipulation and distribution, cyber security, advanced decision making including big data, artificial intelligence and findings and recommendations on climate change.
- Similar R&I programmes in other World regions, in particular the US or China to ensure the global convergence of technologies, standards and ultimately of the operational environment for the airspace users.
- Promote synergies with programmes at EU, national and regional level (e.g. Connected Europe Facility Programme, Digital Europe Programme) to ensure deployment.

Due to its interlinkage with other sectors and research initiatives, the initiative should be set up in close collaboration with other programmes and initiatives to create synergies and limit duplications. It is essential to ensure that the governance of the initiative appropriately addresses these collaborations to improve administrative procedures. An initiative able to provide support to potential project partners could also simplify the administration, in line with the recommendations of the Interim Evaluation for the initiative^[1].

Other key elements related to the framework conditions will play a role in the ability of the initiative to reach its objectives. This concerns in particular the next steps after R&I activities, namely the wider scale (beyond a critical mass of early mover) market uptake of R&I results across Europe (including e.g. standards evolution). To ensure supportive framework conditions, the initiative should ensure close collaboration and engagement with end users, citizen, policy makers and regulators as a central step in spurring the setting up of suitable regulatory frameworks and the establishment of market uptake conditions. Furthermore there is a need to link with other crucial funding and financing mechanisms (CEF in particular) to create synergies and realise the targeted impact for the partnership. Beyond CEF complementarity with other funds such as (but not limited) the European Green Deal Investment Plan (EGDIP) and the European Defence Fund (EDF) as well as risk capital players should be sought to finance scaling up activities to the market.

^[1] Recommendation 4 of the Interim Evaluation Report on the SESAR JU 2014-2016
<https://ec.europa.eu/research/evaluations/pdf/sesar2020.pdf>

5. WHAT ARE THE AVAILABLE POLICY OPTIONS?

This section describes the specific functionalities that could be provided under the baseline scenario of traditional calls as well as the different options of different types of European partnerships

5.1. What is the baseline from which options are assessed?

The baseline scenario used in this impact assessment is a situation without a Partnership building on traditional calls of Horizon Europe. Given that there is an existing Partnership as well as other funding sources in the area, these will continue generating effects even if there is no new Partnership. In particular it is expected that these already existing initiatives will still have an impact in the coming years. This is taken into account in the effectiveness assessment.

In parallel, the baseline situation means that the current implementation structure of the Article 187 would be closed, which entails winding down and social discontinuation costs. There would also be financial cost-savings related to the closing of the structure, related to operations, staff and coordination costs in particular. This is taken into account in the efficiency assessment

Table 4: Key characteristics of the baseline situation, i.e. Horizon Europe calls

	Functionalities of the option
Enabling appropriate profile of participation (actors involved)	<ul style="list-style-type: none"> • The Commission would need to consult extensively with a wide range of stakeholders to translate the existing European ATM Master Plan (covering priorities for both R&I and implementation) into a more detailed R&I plan (a Strategic Research and Innovation Agenda (SRIA) and 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 will 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)	<ul style="list-style-type: none"> • Implementation would be limited to running R&I projects relying on standard infrastructure underpinning the open calls procedure, drawing on resources of relevant executive agencies and Commission IT systems. • Without proper coordination there is a risk for delays in transitioning the R&I results into deployment. Moreover, due to the complexity, fragmentation and safety critical nature of ATM, this could be challenging also from a scientific perspective. • Administrative costs for the European Commission would be significantly reduced, but potential impacts, coverage and contribution to Union's policies are reduced as the full range of activities needed (see section 4.4.2.) could not be covered • Calls for proposals would be published in the work programmes of Horizon Europe. • Transparency and open publication of results would ensure their broad availability to all interested parties. • 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)	<ul style="list-style-type: none"> • Organising and coordinating at strategic level the European ATM Master Planning activities to ensure alignment between the R&I agenda and results into changes to the ATM infrastructure will be very difficult and may lead to reduced market uptake and a further lengthening of the innovation cycles in ATM. • 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.
Securing leveraging effects (additionality)	<ul style="list-style-type: none"> • Progress of R&I effort would depend largely on EU funding, with no expectation of (significant) commitment and contribution from the side of the industry. • Demonstration programmes would require significant in-kind support and collaboration from industry, but there is no certainty that critical mass could be reached.
Key differences compared to the current situation	<ul style="list-style-type: none"> • The long-term commitment to a common vision by a wide range of stakeholders would be lost at a time when the sector has been severely affected by the COVID-19 crisis. • The position of Europe as a world leader in technology supporting aviation infrastructure may be lost to emerging challenges from e.g. China • The leverage effect achieved today by the Union's intervention would be lost • No additional synchronised investments by the industry • The system would revert to a more national approach, undermining the achievements at EU level over the last 12 years. • Integration into the SESAR innovation cycle and links with industrialisation and deployment would be weakened

5.2. Description of the policy options

Table 5: Key characteristics of Option 1 – Co-Programmed European Partnership

	Implications of option
Enabling appropriate profile of participation (actors involved)	<ul style="list-style-type: none"> • The option would enable participation of key private stakeholders committed to support the development and implementation of the programme of research and innovation activities (based on a joint strategic R&I agenda). • The direct participation of inter-governmental organisations and agencies who have already expressed interest to participate (Eurocontrol, European Space Agency) will be more difficult to secure compared to option 2. • 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 the broader industry and market needs. • Usually run by one or several associations or consortia, it is very flexible for new partners to join over time (e.g. to support new areas of activity in response to emerging results and changing priorities)
Supporting implementation of R&I agenda (activities)	<ul style="list-style-type: none"> • Implementation of EU funding would rely on standard administrative infrastructure underpinning the open calls procedure, drawing on resources of relevant executive agencies and Commission IT systems. The full range of activities planned could be implemented. • Integrating and transferring the outcomes of R&I results into day-to-day operations while keeping a focus on accelerating market uptake and shortening innovation cycles as defined in the European ATM Master Plan will require to put in place complex inter-institutional arrangements at EU level as well as with inter-governmental organisations such as EUROCONTROL and the wider industry to leverage and recognise the results delivered by the coordinating association/consortium. • 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. • Partners implement their additional activities separately. A coordinating association/consortium would provide back-office that provides support to facilitate the coordination of activities (e.g. organising meetings, events, drafting inputs, papers, etc.)

	<ul style="list-style-type: none"> • By using the HE standard implementation, calls are more transparent and accessible for applicants.
Ensuring alignment with R&I agenda (directionality)	<ul style="list-style-type: none"> • 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 partnership would be responsible for ensuring that priorities for calls were specified in line with RD&I priorities, including demonstration projects • Programme Committee has an important role in ensuring alignment with overarching policy objectives and coordination with related programmes. • Coordination of global interoperability efforts and the promotion of European R&I results in relevant international fora (such as ICAO) will be difficult to achieve
Securing leveraging effects (additionality)	<ul style="list-style-type: none"> • Aspirations for partner contributions would be clearly defined in the MoU. • Commitments from the industry are expected to match the Union contribution (most likely only in-kind contributions). • Expected in-kind contributions from the private sector would be identified in the work programme. • The commitment of Eurocontrol to allocate financial resources to the initiative, matching the Union's contribution in value is at risk.
Key differences compared to the current situation	<ul style="list-style-type: none"> • No Union body to coordinate all ATM research & innovation in Europe and to provide policy and technical assistance to the Commission. • Fewer mechanisms to project the Union's policy priorities versus the industry's individual goals. • Limited/reduced participation from Eurocontrol. • Limited ability to boost the European industry globally through international agreements and the setting of global standards. • Limited ability to coordinate and reinforce the Union's scientific capabilities

Table 6: Key characteristics of Option 2 – Institutionalised European Partnership (Article 187 TFEU)

	Implications of option
Enabling appropriate profile of participation (actors involved)	<ul style="list-style-type: none"> • This option would enable participation of major key stakeholders (see section 4.4.1) through a clearly defined membership structure, including the participation of Eurocontrol or the European Space Agency. • It will be more difficult for smaller players, like SMEs and academia to be able to join as full members. • It would provide a platform 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)	<ul style="list-style-type: none"> • A dedicated administrative structure would be established to coordinate the full range of activities defined in section 4.4.2, to manage implementation and report on the results (with administrative expenditure limited to up to 5% of the budget). • Calls for proposals would be published broadly in the Funding & Tenders Portal by the administrative structure. • Dissemination of knowledge and share of practices would happen among the stakeholders of the community, with potential diffusion activities managed by the partnership structure. • As an EU body, upon a mandate from the Commission, this type of partnership can represent the EU at international bodies such as ICAO and with international governments – supporting the coherence and interoperability of ATM systems world-wide.
Ensuring alignment with R&I agenda (directionality)	<ul style="list-style-type: none"> • Based on a joint Agenda, this form of partnership allows the development of 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 build a synergy between the Union's policy objectives and the

	<p>technical capabilities of the industry.</p> <ul style="list-style-type: none"> • Commission participation in the partnership governance arrangements and approval of the work programme would help to ensure alignment with overarching policy objectives and enable integration with other programmes.
Securing leveraging effects (additionality)	<ul style="list-style-type: none"> • Funding requirements would be clearly defined at the outset, with the private sector and inter-governmental organisation partners (EUROCONTROL) more leverage than a simple matching of Union funding.
Key differences compared to the current situation	<ul style="list-style-type: none"> • This option would continue and build on the achievements of the current partnership, preserving the good practices and improving any remaining weak points. • Continued engagement of all stakeholders in the sector ensures that the sector maintains its status and competitiveness as world innovation leader. • The synchronised investments by the industry will be maintained. • Links with the industrialisation and deployment phase of the SESAR project will be strengthened, by reinforcing the JU's role as facilitator for the progress of SESAR solutions through standardisation and certification processes, all the way to supporting market uptake for a critical mass of early movers. • Stronger participation of EASA, the standardisation bodies, the Member States and new entrants in the governance

5.3. Options discarded at an early stage

The Co-funded Partnership and an Institutionalised Partnership created under Article 185 of the TFEU are not considered beneficial for the integrated Air Traffic Management initiative.

In the public-public partnership options (co-funded or Art. 185), the partners do not include private sector companies or private research organisations and instead include only public authorities who fund research (or governmental research organisations) and other public authorities at the core of the consortium. These types of partnerships rely on pooling and/or coordinating national programmes and policies with Union policies and investments, to help overcome fragmentation. Due to the limited existence of national R&I programmes in the area of ATM and the lack of relevant public bodies, there is little interest for Member States and their agencies to be involved in such partnerships.

Nevertheless, Member States are keen to be active in ATM R&I but through the national ATM service providers (funded by the airspace users) rather than the public purse.

Furthermore, the ATM R&I programme requires strong consensus 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 manufacturers and building on inputs received from the broad range of stakeholders in the ATM community.

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

6. HOW DO THE DIFFERENT POLICY OPTIONS COMPARE?

Based on the objectives pursued by the initiative and the key functionalities identified to be able to achieve them, each option for implementation is assessed in terms of effectiveness, efficiency and coherence compared to the baseline scenario of traditional calls. The analysis is primarily based on the degree to which the different options would cater for the key needed

functionalities. All options are compared to the baseline situation of traditional calls, which is thus consistently scored at 0 to serve as reference point.

6.1. Effectiveness

To be in line with the Horizon Europe impact framework, the fulfilment of the specific objectives of the initiative is translated into ‘expected impacts’ - how success would look like, differentiating between scientific, economic/technological, and societal (including environmental) impacts. This section considers to which extent the different policy options would allow delivering these expected impacts – confronting what is needed (functionalities) with what each form of implementation can provide in practice. The assessments in this section set the basis for the comprehensive comparative assessment of all retained options against all dimensions in Section 6.4, based on a scoring system¹⁰⁹.

Scientific impacts

A) Strengthening the EU’s scientific capabilities and improving the scientific knowledge in ATM can be achieved by continuing to support and reinforce an ATM R&I ecosystem that is capable of rapidly developing and validating modern technologies that build on the upcoming digital transformation elements, such as automation, AI, big data and cyber-security. Due to the specific challenges related to ATM infrastructure modernisation (safety critical, significantly regulated), without a long-term focus and commitment from both the research and the industry communities across multiple research disciplines, Europe’s ATM sector will not be able to adapt quickly enough to help the aviation sector to grow out of the COVID-19 crisis more sustainable and smart.

The baseline option (open calls) is flexible to adapt to the changing needs of the sector, in particular concerning rapidly emerging technologies, such as drones. This option could manage fundamental/exploratory R&I activities well enough (and could be complementary to partnerships) if there was a centralised research agenda. However, this option does not provide an effective EU (and global) coordination platform for science transfer to advance the application of exploratory research results with industry to find common solutions to specific questions of a concrete nature.

Option 1 could deliver more impact than the baseline option, in particular concerning industrial research at higher TRL levels, where large players investing in a partnership could lead to a strong push for breakthrough technologies. SMEs and academia, as smaller stakeholders who find it harder to join the partnership may have a reduced role. The option scores **good** compared to the baseline (+).

Option 2 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. Whilst, the core membership may naturally prioritise short-term solutions that do not fully embrace the innovation agenda, the long term aim of an Institutionalised Partnership will ensure a balance between developing advanced solutions and maturing deployment-ready solutions¹¹⁰. It score would therefore be **high** compared to the baseline (++).

¹⁰⁹ A more in depth and detailed analysis of each policy option is provided in Technopolis Group Study (2020)

¹¹⁰ As stated in interviews with stakeholders from both research and industry institutions available at <https://www.sesarju.eu/interviews> and notably the interviews titled “The new face of aviation research” as well as “Nothing ‘elementary’ about air traffic management research, says SESAR researcher”

B) Enhance capacity among next generation aviation professionals. The modernisation of ATM will have a fundamental effect on the professionals employed by the aviation community, including traffic controllers and engineers. It is thus essential to involve universities who train the next generations of experts in the R&I programme **to secure a steady flow of competent professionals to the sector.**

The baseline option provides for a dissemination platform allowing knowledge and ideas sharing, mostly in academic settings (e.g. conferences). The results are loosely linked with the industry. As work and coordination of various topics is linked to the duration of grants, it is unlikely that research results would be followed into high level education programmes, having thus a limited effect on upskilling for both researchers and aviation professionals.

Option 1: As long as the members of the partnership see the added value for strong sharing and knowledge transfers, there is potential to build strong relationships with academia and innovative SMEs or with other ATM R&I programmes beyond Europe. This option scores **good** compared to the baseline. A more stable structure improves the focus and continuity of links with educational programmes.

Similar to Option 1, an institutionalised body (**Option 2**) implementing all Union research activities in the sector can facilitate a steady flow of exchanges and cooperation activities with educational actors. The current JU has a good tradition of organising targeted events¹¹¹ that facilitate knowledge dissemination and transfer. This is a good practice that has proven valuable in the past. This option also scores **good** compared to the baseline (+).



Stakeholders view an institutional partnership for ATM as the best option to address the fragmented and conservative industry, which, without coordination will engage in 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.

To ensure better transition through the R&I pipeline and acceleration of development processes. Exploratory research is essential to feed the SESAR innovation pipeline and must be reinforced whilst accepting uncertainty to allow innovation.

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.

Economic/Technological impacts

C) An accelerated delivery of innovative ATM solutions needed for aircraft operations that help improve the flexibility of the European ATM network and systems allows for the handling of additional flights and thus facilitating economic recovery and growth in the air transport sector. It also increases the efficiency of the network, thereby reducing the environmental impact of aviation.

¹¹¹ E.g. SESAR Innovation days, Young Scientist Awards or Hackatons. See examples including stakeholder interviews at: <https://www.sesarju.eu/news/young-talent-celebrated-2019-sesar-innovation-days> as well as an article covering the Hackathon through the eyes of the winners <https://www.sesarju.eu/news/innovation-aviation-digital-sky-challenge-through-eyes-winners>

The baseline option has the potential to support the development of innovative concepts, without a coordinated approach of the industry there is little potential for industrialisation and deployment to make significant impacts on the real operations.

Option 1 would bring together a broader community of private stakeholders than the baseline, who coordinate their work to deliver R&I according to Union priorities. The limited role of the Union in managing interdependencies within the partnership could hamper the overall success if the industry's business models and priorities take precedence on what is delivered. This option scores **good** compared to the baseline (+).

Supported by long-term commitment from the industry, **Option 2** would build on the experience of the current JU who has built a successful Large Scale Demonstrations platform and accelerated the innovation pipeline, reducing the duration needed for a technical solution to reach the market¹¹². As a Union body coordinating the ATM research programme, the institutional partnership would be able to take an independent position towards diverse and diverging industry interests, pushing for Union priorities in the interest of European citizens and businesses¹¹³. This option scores **high** compared to the baseline (++).

D) Safely and efficiently integrating drones and drones traffic management systems with the ATM systems facilitates **the ramp up of drones-related economic activities**, opening up the market for new types of drones services operators and drones traffic management service providers¹¹⁴.

The **baseline option** can support the innovation required to integrate drones into ATM systems, enabling new entrants to be involved without the overhead of fully committing to a partnership. However, the complex nature of the European airspace requires new solutions that are interoperable with an ever-changing ATM system and architecture. Without a strong coordination at EU level, open calls are unlikely to generate the momentum that would secure the interoperability needed to ramp up drones activities in the coming years¹¹⁵.

Option 1 would see an improvement compared to the baseline, as a coordinated industry approach where drones manufacturers and drones service providers play an active role would generate the appropriate levels of investments and technological progress to put in place a European drones' traffic management system that would in turn facilitate the ramp up of drones economic activities in the next decade. This option scores **high** compared to the baseline (++).

¹¹² As affirmed comprehensively in interviews with stakeholders from both research and industry institutions available at <https://www.sesarju.eu/interviews>

¹¹³ See Annex 2 Synopsis report on the stakeholder consultation

¹¹⁴ According to the European Drones Outlook Study (SESAR Joint Undertaking 2016) by 2050, it is estimated that there will be some 7 million consumer leisure drones in operation across Europe, including a fleet of 400 000 drones offering important services across the agricultural, energy, e-commerce, transport as well as public sectors. With an estimated value of EUR 15 billion annually, this market represents a huge potential for Europe and its global competitiveness. The full report is available at: <https://www.sesarju.eu/index.php/newsroom/all-news/europe-needs-prepare-drone-market-boom-says-new-study>

¹¹⁵ According to the European Drones Outlook Study (SESAR Joint Undertaking 2016) building a designated 'home' for the drone traffic management R&D at European level has extended benefits related to the creation of a single market.

Similar to Option 1, **Option 2** would be in a much better position than the baseline to put in place the framework necessary to ramp up the drones-related activities in the EU. The advantage of Option 2 is that it would build on the experience of the current JU who has already 4 years of experience with these activities, having already developed a European blueprint for U-space drones' traffic management systems¹¹⁶ and having carried out already multiple drones services demonstration projects, under Horizon 2020, CEF and EP Pilot Projects funding¹¹⁷. The option scores **high** compared to the baseline (++).

E) A Europe-wide agreed ATM architecture relying on inter-operable ATM solutions standardised and certified at European level will give Europe a strong voice at international level, where European technologies should remain the backbone of global ATM modernisation plans coordinated by ICAO. This should boost the **EU industry globally by enabling international agreements and contracts**.

The **baseline option** could provide for call provisions requiring beneficiaries to participate and support standardisation activities. This option would lack the access to global level fora and would have limited capacity to promote European technologies and standards internationally.

Option 1 would be in a better position than the baseline to support the market uptake of technical solutions. However, as an industry body (as opposed to a Union body), the partnership would have no access to decision making bodies at ICAO level and would wield less influence overseas with ATM organisations which tend to have government status. This option scores **good** compared to the baseline. (+)

Option 2 brings the added value of having a Union body responsible for coordinating activities and representing the Union (upon a mandate received from the Commission, as it is currently the case with the SESAR JU) and stakeholders involved in international negotiations and ATM standard setting activities. This option scores **high** compared to the baseline (++).



Stakeholders's opinion (based on the Open public consultation)

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.

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.

¹¹⁶ Drafted by the SESAR Joint Undertaking, the U-space blueprint sets out the vision for the U-space, which aims to enable complex drone operations with a high degree of automation to happen in all types of operational environments, particularly in an urban context. When fully deployed, a wide range of drone missions that are currently being restricted will be possible thanks to a sustainable and robust European ecosystem that is globally interoperable. More information at: <https://www.sesarju.eu/u-space-blueprint>

¹¹⁷ SESAR U-space projects results published at <https://www.sesarju.eu/news/sesar-u-space-projects-results-published>

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.

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).

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.

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.

Societal impacts (including environment)

F) The technological progress resulting from this initiative would make the European airspace significantly more efficient and environmentally than today where 5-10% of air transport's CO₂ emissions could be avoided due to inefficiencies in the ATM infrastructure¹¹⁸.

With the European Green Deal driving the policy priorities, the **baseline option** would see significant funding allocated to open calls aimed at addressing the environmental challenges. However, without a coordinated approach across the whole industry, locally developed solutions would have limited impact on supporting end-to-end optimisation of flight paths.

Option 1 would improve the focus of R&I activities along the current Commission priorities. However, investment in climate research is expensive. However, conflicts of interest between industry interests may be difficult to effectively handle where there is no tangible direct benefits to the industry, leading to a risk of reduced innovation and delays in the delivery of sustainable solutions. This options scores **good** compared to the baseline (+).

Under **Option 2**, a Union Body would steer a common approach by all stakeholders in ATM and would be able to focus on the necessary ATM modernisation to enable environmental goals that can best be achieved by enabling aircraft to fly on their optimum 4D trajectory in the climb, on-route and descent phases of flight - the optimum horizontal path from departure to destination flown at the most fuel efficient flight level. This can only be achieved by compressive and wide coordination with all stakeholders that have been deeply impacted by the COVID 19 crisis (including intergovernmental organisations such as EUROCONTROL that have significant expertise in the domain) as defined in section 4.4.1. The Union body 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).

¹¹⁸ European ATM Mater Plan, Edition 2020, Figure 10

In addition, as previously done with the SESAR JU, the Union body would be tasked by the Commission to develop technical support for EU Regulations in the sector, monitor the coherence between the results of R&I and the EU ATM Master Plan and the Single European Sky policy.

This is the Option that would best support ATM modernisation with the necessary coordination and acceleration leading to the timely environmental optimisation of ATM, hence this option scores **high** compared to the baseline (++).

G) The expected societal impacts are reduced **travel times, improved predictability, reduced delays and lower costs**. This improves both the passenger experience¹¹⁹ and business opportunities.

The **baseline option** would facilitate the involvement of innovative SMEs. However, similar to the environmental impact, the lack of a mechanism to manage interdependencies between emerging solutions has a potential negative impact on the overall coherence of the R&I programme and may not lead to solutions needed for the emerging ATM architecture¹²⁰.

Option 1 would use a coordinated approach to deliver solutions that improve the performance of the system. However, without a strong Union steering in the governance a partnership lead by air navigation service providers and airlines would prioritise solutions benefitting their economic activities, rather than the passenger experience or the interest of the citizen in general. The option scores **good** compared to the baseline (+).

Option 2 provides for a strong role for a Union steering in the governance of the partnership that would ensure that the priorities and activities take into consideration the interests of all stakeholders, including citizens¹²¹. This option scores **high** compared to the baseline (++).



Stakeholders's opinion (based on the Open public consultation)

The need to modernise the existing system through 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.

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.

Fundamental Rights impacts

None of the above options is expected to impact fundamental rights in the EU or abroad.

Directionality and additionality required

¹¹⁹ ACI Europe publication “SESAR and the digital transformation of Europe’s airports” available at <https://www.sesarju.eu/sites/default/files/documents/reports/SESAR%20and%20the%20digital%20transformation%20of%20europe%20airports.pdf>

¹²⁰ Results from the open calls under previous framework show that a partnership approach was required to support exploitation of the results.

¹²¹ As affirmed comprehensively in interviews with stakeholders from both research and industry institutions available at <https://www.sesarju.eu/interviews>

As regards the level of directionality and additionality required, **the baseline option** would not be able to facilitate the synchronised actions necessary to support policy objectives. Even if this option could ensure partial alignment with EU strategies, it would not be effective enough to significantly contribute to achieving them.

With the ability to prepare and implement a medium term plan, **Option 1** could ensure compliance with the Union and Member States strategies. However, in the absence of a strong EU involvement in the partnership, it would be more difficult to steer the industry-led partnership towards achieving the Union’s policy priorities linked to the digital transformation of ATM or the ambitious environmental targets of 2030 and 2050.

A long-term vision and strategy for ATM is essential for successfully transforming the sector. By involving research organisations, all relevant types of economic actors and the public sector, **Option 2** is considered as the most appropriate since it ensures a long-term commitment. Integrating the Strategic R&I Agenda into a broader spectrum is also essential. Option 2 will ensure a coherent approach across the whole ATM innovation cycle, from R&I to market uptake, addressing in particular the “valley of death” challenge of industrialisation.

Table 7 summarises the scores assigned for each policy option, based upon the assessments above, as well as taking into account the support expressed by the different stakeholders.

Table 7: Overview of the options’ effectiveness compared to the baseline

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

Notes: Score ++: Option presenting a *high* potential compared to baseline; Score +: Option presenting a *good* potential compared to baseline; Score 0: Potential of the baseline.

6.2. Efficiency

In order to compare the policy options consistently in terms of their efficiency, a standard cost model was developed for the external study supporting the impact assessment for the set of candidate Institutionalised Partnerships. The model and the underlying assumptions and analyses are set out in the Common Part of this impact assessment, Section 2.3.2 and in the Methodology Annex 4. A dedicated Annex 3 also provides more information on who is affected and how by this specific initiative in line with the Better Regulation framework. The scores related to the costs set out in this context allow for a “value for money” analysis (cost-effectiveness) in the final scorecard analysis in Section 6.4.

In addition, for this specific initiative under the baseline scenario of traditional calls, there would be winding down (estimated at EUR 500K) and social discontinuation costs for the existing implementation structure of the current Article 187 initiative. There would also be longer term financial cost-savings related to the closing of the structure, related to operations, staff and coordination costs in particular. These can be estimated at EUR 4 million per year of operation (including Commission supervision costs saved). Overall it is estimated that the overall longer term cost savings from using traditional calls instead of an existing Article 187 initiative would thus considerably exceed the costs incurred for winding down operations. This overall situation is set as the starting point for the comparison of options. The score of this baseline scenario (traditional Horizon Europe calls) is set to 0 to be used as a reference point.

On this basis, the scores for the costs of the different options range from a value of 0, in case an option does not entail any additional costs compared to the baseline, to a score of (-) when an option introduces limited additional costs when compared to the baseline and a score of (-)(-) when substantial additional costs are expected in comparison with the baseline. In case the scores are lower than for the baseline scenario, (+) and (+)(+) are used.

It is considered that while there is a clear gradation in the overall costs of the policy options, the cost differentials are less marked when one takes into account the expected 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 (traditional calls) and the Co-Programmed policy options – and the least cost-efficient – the Institutionalised Partnership option. Indeed, in terms of cost-efficiency, the Co-Programmed Partnership (Option 1) is 2 percentage points more efficient than the baseline; and an Article 187 Partnership is 2 percentage points less cost-efficient than the baseline. A score of + is therefore assigned for **cost-efficiency** to the Co-Programmed options and a score of (-) for the Institutionalised Partnership policy option, as illustrated in Table 8 below¹²².

More specifically for the ATM partnership, building on the assumptions outlined in Figure 4 of Annex 4 and the known real costs, e.g. from the current SESAR JU implementation, the additional costs compared to the baseline are about 6-7% of the Union's contribution. When considering the fact that over 60% of these administrative costs are covered by private and inter-governmental partners (i.e. Eurocontrol), re-establishing the JU is roughly similarly efficient to the baseline scenario (96%-97%), and only one percentage point behind in efficiency to the co-programmed partnership. Considering the fact that the Art 187 initiative has the highest ability to deliver the highest expected impacts, it delivers the best value for the Union budget investment.

Additional assumptions regarding these costs:

- The potential for the crowding-in effects for the industry have been taken into account when assessing the effectiveness of the policy options, above.
- For the overall administrative, operational and coordination costs, in the case of a partnership the industry (including EUROCONTROL for Art 187 only and other industry partners) would contribute to the running costs of the partnership, which significantly reduces the costs to the Union for this partnership. Based on experience to-date with the JU it is assumed that the industry partners other than the EU could

¹²² The baseline (traditional calls) is scored 0, as explained above.

together contribute to approximately 60% of the running costs, thus minimising the additional cost of an Article 187 option for the EU.

- The above considerations on cost-efficiency do not take account of the additional leverage created by the full involvement of EUROCONTROL in the ATM partnership: indeed, in the case of SESAR and an Article 187 option only, EUROCONTROL and the industry would each match funding for the EU budget, leading to a gross leveraging ratio of up to 1:2,5, as shown in Annex 4. This additional leverage could not be guaranteed for the Baseline option and would only be partial (not including EUROCONTROL who would be a beneficiary) for the Co-programmed option.
- This analysis is based on costs only but should also consider a number of positive qualitative elements for the Union:
 - The Union has a higher level of control on the use of funds through the application of the Commission's internal control framework, through regular oversight by the Commission and through the direct discharge procedure by the European Parliament;
 - the added value in steering the overall activities and setting direction. The costs of setting up a Strategic Research and Innovation agenda are lower when using the currently established partnership as a platform to coordinate the preparation with the industry.

Based on the elements above, once leverage, sharing of running costs and level of control are taken into account, the overall costs are adjusted as follows:

Table 8: Matrix on 'overall costs' and 'adjusted cost scoring'

	Baseline: Horizon Europe calls	Option 1: Co-programmed	Option 2: Institutionalised Article 187 TFEU
Administrative, operational and coordination costs	0	0	-
Administrative, operational and coordination costs adjusted per expected co-funding (i.e. cost-efficiency)	0	+	0

Notes: Score 0 = same costs as for the baseline; score (-) = limited additional costs compared with the baseline; score (-)(-) = substantial additional costs compared with the baseline.

6.3. Coherence

6.3.1. Internal coherence

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

Baseline: Horizon Europe calls

Under this option, coherence between activities in the area of ATM R&I with activities under Cluster 5 of Horizon Europe and the other initiatives presented in Figure 1 is ensured by the European Commission. However, exploitation of synergies with other initiatives, including exchanges of knowledge and experience between project teams and stakeholders, would require an additional level of coordination beyond Programme Committees. The Baseline option could easily manage individual R&I activities. However, this option would lack the ability to build the long term strategic collaboration between stakeholders needed to advance rapidly the research results through industrialisation and deployment.

Option 1: Co-Programmed European Partnership

Under the Co-Programmed option, synergies could be exploited more easily than under the baseline option. The European Commission could ensure coordination at the level of research agendas, while the partnership would bring together projects and stakeholders from various initiatives to work together on common problems or tackle common challenges. However, considering the specificities of ATM R&I (outlined previously in sections 1, 2 and 4 in particular), the Co-programmed option does not promote a sufficiently broad community engagement framework outside of project consortia, limiting its ability to establish an effective long-term framework and vision, nor increase cross-sector collaboration. Option 1 could better manage all types of R&I activities thanks to a better agenda setting. However, Option 1 is not considered optimum to address the complex structure of the ATM sector and the broad range of actors. Its score would therefore be **good** compared to the baseline with +.

Option 2: Institutionalised European Partnership under Article 187 TFEU

The Institutionalised Article 187 partnership structure provides clear roles for the European Commission and for the industrial partners and is built on a central coordination layer which can increase the effectiveness of its efforts. Since its management body organises the funding and implementation of projects, the integrated ATM partnership could (together with other institutionalised partnerships) set concrete objectives and lay out a roadmap of activities and projects that can be implemented.

A dedicated body responsible for the development of a long-term strategy and supporting work programmes for ATM R&I makes it easier to ensure that these are fully aligned with relevant strategies and programmes developed by other partnerships and initiatives within the EU research and innovation landscape. Option 2 would manage all TRLs related activities, from fundamental R&D up to market-readiness. Good knowledge management is also an asset under this option - to allow the initiative to adequately assess projects in the selection process, to provide technical assistance where needed and even to challenge the industries in order to increase the speed of development. This would translate into a **high** score compared to the baseline set at ++.



A big majority of stakeholders interviewed highlighted the need to build the link with other initiatives, such as Clean Aviation in order to avoid duplication, to improve coordination and synergies on the topics of automation and environment in aviation.

6.3.2. External coherence

In this section we assess the extent to which the policy options show the potential of ensuring and maximising coherence with their external environment, including EU-level programmes and initiatives beyond the Framework Programme and/or national and international programmes and initiatives, as well as with overarching framework conditions such as Regulations, standardisation, etc.

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 with other ATM modernisation programmes in USA, Japan and China.

Baseline: Horizon Europe calls

Under this option, some coordination with other Union initiatives is possible at the level of priorities, but coordination at the level of implementation is very limited or even not possible.

This option typically remains focused on EU27 and does not allow the pursuit of an international coherent cooperation strategy, nor does it allow for the involvement of the Member States.

Option 1: Co-Programmed European Partnership

Under this option, the European Commission can contribute to some extent to the coordination with Union non-research initiatives at the level of the strategy. The industry-led partnership would have limited access to international decision making bodies at ICAO level and thus limited influence amongst overseas organisations responsible for ATM, which tend to have government status.

The possible participation of Member States provides the opportunity for coordination with the national programmes and initiatives and the regional clusters. Member States could coordinate with the national and industry efforts to ensure alignment with their own R&D agendas. Score would therefore be good compared to the baseline with +.

Option 2: Institutionalised European Partnership under Article 187 TFEU

This option would establish a strong implementing body for research that closely cooperates with industrial, institutional, national, standardisation & certification actors active at different steps of the SESAR innovation cycle and in particular supporting the SESAR deployment phase, mandated by Commission Regulation¹²³ and supported financially by the Connecting Europe Facility Programme. This option offers the best opportunity to involve Member States to discuss priorities and synergies, which is critical to the success of the initiative.

This option also provides the European ATM research sector with the best mechanisms to cooperate at international level, e.g. setting up a Union body capable of representing the Union (upon a mandate from the Commission) in international fora where global ATM standards and regulations are discussed, such as ICAO. This option would allow the continuation of already existing cooperation agreements on ATM research as the one between SESAR JU and the FAA's NextGen in the USA who have worked for the last decade on ensuring the interoperability between the European and American systems. This would translate into a high score compared to the baseline with ++.



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 open calls to be a feasible option.

In interviews, stakeholders with direct participation in the current JU have emphasised that continuing to have strong Union coordinated programme and a partnership/body that is able to take part in ICAO negotiations has given the EU a strong leadership position in ATM globally. This should continue.

Table 9 below, lists the scores assigned for each of the policy options, based upon the assessments above, as well as taking into account the views expressed by the different stakeholders.

Table 9: Overview of the options' potential for ensuring and maximizing coherence

	Option 0: Horizon Europe calls	Option 1: Co-programmed	Option 2: Institutionalised Article 187 TFEU
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¹²³ Commission Implementing Regulation (EU) No 409/2013 on the definition of common projects, the establishment of governance and the identification of incentives supporting the implementation of the European Air Traffic Management Master Plan

	Option 0: Horizon Europe calls	Option 1: Co-programmed	Option 2: Institutionalised Article 187 TFEU
Internal coherence	0	+	++
External coherence	0	+	++

Notes: Score ++: Option presenting a *high* potential compared to baseline; Score +: Option presenting a *good* potential compared to baseline; Score 0: Potential of the baseline.

6.4. Tabular comparison of options and identification of preferred option

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

Table 10: Overall scorecard of the policy options for all criteria

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

Notes: Scores for effectiveness and coherence: Score ++: Option presenting a *high* potential compared to baseline; Score +: Option presenting a *good* potential compared to baseline; Score 0: Potential of the baseline. Scores for efficiency: Score 0 = same costs as for the baseline; score (-) = limited additional costs compared with the baseline; score (-)(-) = substantial additional costs compared with the baseline.

Overall the implementation of the **integrated ATM** initiative through an **institutionalised partnership established under Article 187 of TFEU is the preferred option** as it would best ensure that private and public sectors remain fully engaged in the development and implementation of a long-term strategy for ATM R&I.

When compared to the baseline and Option 1, an institutionalised partnership has the following advantages:

- Maximises the impact of Union funding and the leverage, as EUROCONTROL and industry would each provide matching funding to the EU budget, leading to a gross leveraging ratio of up to 300%.
- Accelerates R&I by harnessing the momentum and knowledge of the current partnership.
- Facilitates the active participation of all relevant ATM stakeholders
- Builds synergies with other partnerships and initiatives within and outside the Climate, Energy and Mobility cluster, with an emphasis of international cooperation on ATM research.
- Overall the marginally increased costs are considered acceptable for the greater likelihood of achieving the significant environmental and economic benefits of timely ATM modernisation.

Box 2 Comparison between the preferred option & the current partnership existing in the area taking into account lessons from past evaluations

What continues	What is different
<ul style="list-style-type: none"> • Art 187 Union Body, with EC and Eurocontrol as founding members. • Blending of funds: Horizon, CEF • Strong link with the single European sky policy & strategic planning at EU level through the European ATM Master Plan. • Members contributing to running costs of the JU • Active role of operational stakeholders in the partnership • High leverage (beyond 200%) 	<ul style="list-style-type: none"> • Focus on breakthrough innovation • Open innovation policy, open calls as basic principle • More coherent life-cycle approach and higher impact of investments due to closer links with industrialisation/ market uptake • Simplified architecture & toolbox • Closer engagement of Member States in the Governance • Better synergies with other Horizon and national initiatives

7. THE PREFERRED OPTION - HOW WILL ACTUAL IMPACTS BE MONITORED AND EVALUATED?

7.1. The preferred option

In Table 12, below, the alignment of the preferred option of Institutionalised European Partnership under Article 187 TFEU with the selection criteria for European Partnerships defined in Annex III of the Horizon Europe Regulation is depicted. Seeing that the design process of the candidate Institutionalised Partnerships is not yet concluded and several of the related topics are still under discussion, the criteria of additionality/directionality and long-term commitment are covered in terms of *expectations* rather than *ex-ante* demonstration.

Table 11: Alignment with the selection criteria for European Partnerships

Criterion	Alignment of the preferred option
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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. An institutionalised partnership would be able to set up the appropriate 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.
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:¹²⁴ A big majority of stakeholders (70%) expressed support for establishing an Institutionalized partnership under Art 187.

7.2. Objectives and corresponding monitoring indicators

7.2.1. Operational objectives

Several operational objectives have been identified which would enable the partnership to achieve its specific objectives, as shown in Figure 11 below.

The figure also lists a range of actions and activities, going beyond R&I that can be implemented under Horizon Europe (which are highlighted in yellow). This reflects the definition of European Partnerships in the Horizon Europe Regulation as initiatives whereby 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.”

¹²⁴ 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.

Figure 13: Operational objectives of the initiative



7.2.1. Monitoring indicators

In addition to Key Impact Pathways indicators set centrally in the Regulation of Horizon Europe, additional monitoring indicators have been identified to enable the tracking of progress of the partnership towards meeting its objectives. These are shown in Table 12.

The societal impact and performance of ATM in Europe is currently measured by the Performance Review Body established by the European Commission. This body could be used to monitor the success of the R&I programme in terms of actual operational performance of solutions. Current metrics are limited and could be improved:

- 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)¹²⁵.
- 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 citizens¹²⁶.

Table 12: 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			

¹²⁵ See for example: <https://www.nats.aero/environment/3di/>

¹²⁶ Passenger-Oriented Enhanced Metrics, A. Cook, G. Tanner, S. Cristóbal and M. Zanin, SESAR Innovation Days 2012.

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 demonstrated	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 demonstrated	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 published
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

7.2.1. Evaluation framework

The evaluation of the Partnership will be done in full accordance with the provisions laid out in Horizon Europe Regulation Article 47 and Annex III, with external interim and ex-post evaluations feeding into the overall Horizon Europe evaluations. As set in the criteria for European Partnerships, the evaluations will include an assessment of the most effective policy intervention mode for any future action; and the positioning of any possible renewal of the Partnership in the overall European Partnerships landscape and its policy priorities. In the absence of renewal, appropriate measures will be developed to ensure phasing-out of Framework Programme funding according to conditions and timeline agreed with the legally committed partners ex-ante.