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Alignment of national and European R&I aviation funding programmes: Clean Sky 2 case study

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Abstract
This work attempts to shed some light by showing the Clean Sky 2 case study to implement different methods and results of alignment between Horizon 2020 funds managed at EU level through Clean Sky JU, and the European Structural and Investment funds managed at national/regional level for aviation, in the period 2014-2020. Through the analysis of existing information, and later interviews to national/regional funding programme owners, it concludes which are the best practices, barriers, and recommendations to improve the procedure of synergies between funding programmes in the next phase 2021-2027, which is one of the main objectives of the EC for this period.

1. Introduction

During the 1990s, the European Union (EU) faced a sectoral crisis and economic decline compared to other economic regions. In response, the European Council recognized the need for a new long-term strategy to ensure growth and competitiveness. The focus shifted towards creating a knowledge-based economy and implementing structural reforms to stimulate employment [1]. Over the following decade, various policies and measures were introduced to achieve these goals, but the pivotal moment came in March 2000 at the Lisbon session, where the European Council established a new strategic objective for the EU: to become the world's most competitive and dynamic knowledge-based economy. This was accompanied by the Lisbon Strategy, a plan to realize these ambitions [2].

A fundamental concept for implementing the strategy was the creation of the European Research Area (ERA), which encompassed all research and innovation (R&i) policies in Europe [3]. Two of the main objectives were:

- the transnational cooperation
- alignment of European and national/ regional funding programs

To try to achieve these objectives, the European Union sought to encourage the establishment of sectoral European Technological Platforms (ETPs) that fostered collaboration among stakeholders and Member States [4]. These platforms worked on developing a long-term strategy through the creation of a Strategic Research Agenda (SRA), which later expanded to include innovation [5]. ETPs main aim was to ensure coherence and coordination among different European and national funding sources in order to maximize the impact of investments.

Regarding the transnational cooperation, it has been addressed through a centralized approach managed by the EC and a decentralized approach through the cooperation of Member States and Associated Countries (AC). The centralized financing has been successfully implemented under the EU R&I Framework Programmes (R&I FP), with the main aim of defining the objectives, areas and topics on which research cooperation could be funded at Community level [1]. However, beyond the transnational funding that is managed by the EC through the FPs, the coordination of national policies at a decentralized approach was poorly covered.

Regarding the alignment of funding programmes, it was not until the period 2024-2020 when there was a real opportunity to implement it through the concept of Research and Innovation Strategies for Smart Specialization (RIS3) [6].

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How did it affect to the aviation sector?

During the 1990s, the aerospace industry faced significant challenges, including a sharp decline in global demand. However, the inclination toward cooperation did not wane, and the need for restructuring and cross-border competitiveness became more prominent [7]. In 1997, the European Commission identified the aerospace sector as crucial for economic recovery and building an innovative and knowledge-based Europe. The Commission's communication, 'The European Aerospace Industry - Meeting the Global Challenge' (COM, 1997), called for supportive policies to enhance the global competitiveness of the aerospace industry [8].

Within the European aeronautic industry, key companies recognized that global competition could only be achieved through transnational cooperation [9]. Moreover, the aerospace sector's political and regulatory framework closely interacted with governmental policies, emphasizing the importance of cooperation and commitment from the private sector [10], as well as with Member States and the European Commission. This reinforced the importance of having a competitive aerospace industry while emphasizing the alignment of European and national efforts [9].

In line with ERA directives and to fulfill the objectives outlined in the "European Aeronautics: A vision for 2020" high-level report [11], the establishment of the first European Technology Platform (ETP) took place in 2001. This platform, known as ACARE (Advisory Council for Aeronautic Research in Europe), was tasked with creating a research network comprising influential experts. Its primary role was to provide guidance to the European Commission (EC), Member States, and stakeholders in defining research priorities in the field of aeronautics [5].

Regarding the transnational cooperation in aviation, the centralized financing has been successfully implemented under the EU R&I Framework Programmes (R&I FP) with an important role of ACARE and the EC. However, the decentralized approach has been less success, using initiatives focused on aviation, such as Air Transport Net ERANET [12], or horizontal initiatives such as EUREKA network [13].

Concerning the alignment of European and national/regional funding programmes, in the recent years, a step beyond has been sought by the EC to ensure its implementation [15]. Focusing on the aviation sector, it took almost 15 years to address the most successful attempt, led by the JU Clean Sky 2 with the support of Air Transport Net Next Gen (AirTN NG) and ACARE Member States Group (ACARE MSG), that has firstly implemented the alignment with national and regional programmes through the use of European Structural and Investment Funds (ESIF) and the Research and Innovation Strategies for Smart Specialization (RIS3) [5].

This work attempts to shed some light by showing the Clean Sky 2 case study to implement different methods and results of alignment between Horizon 2020 funds managed at EU level through Clean Sky JU, and the European Structural and Investment funds at managed at national/regional level in the period 2014-2020. Through the study of existing information, with the support of ACARE MSG and AirTN NG CSA, and later interviews to national/regional funding programme owners, it concludes which are the best practices, barriers, and recommendations to improve the procedure of synergies between funding programmes in the next phase 2021-2027.

2. Policies and strategies of R&I funding alignment

2.1 ESIF and RIS3

The European Strategic and Investment Fund (ESIF) and RIS3 (Research and Innovation Strategies for Smart Specialization) are two interconnected components of the European Union's approach to regional development and research and innovation [16].

The ESIF is a financial instrument that combines several EU funds, including the European Regional Development Fund (ERDF) and the European Social Fund (ESF). Its primary objective is to promote economic, social, and territorial cohesion across EU member states. The ESIF provides financial support to regions and countries for a wide range of activities, including research and innovation [16].

RIS3, on the other hand, is a strategic framework developed by the EU to guide regions in their research and innovation efforts. It aims to identify and capitalize on each region's unique competitive advantages, or smart specialization areas, to foster economic growth and enhance competitiveness [17].

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The process of developing RIS3 involves a strategic analysis of the region's strengths, weaknesses, opportunities, and threats (SWOT analysis). It includes consultation and involvement of various stakeholders, such as businesses, research institutions, public authorities, and civil society organizations.

Once the smart specialization areas are identified, the region formulates a strategic framework that outlines the priorities, objectives, and actions to be pursued in research and innovation. This framework serves as a guide for the allocation of resources and the implementation of policies and initiatives [17].

The connection between ESIF and RIS3 [15] lies in the funding opportunities and alignment of strategies. Regions that develop and implement RIS3 strategies can access financial support from the ESIF to implement their research and innovation priorities. The ESIF provides funding for projects and initiatives that align with the objectives and priorities set out in the region's RIS3.

By integrating RIS3 into the ESIF[15], the EU aims to promote the effective use of funding and resources, ensuring that investments are strategically targeted towards areas of regional strength and potential. This alignment helps regions leverage their competitive advantages and enhance their research and innovation capacities.

Regarding the subject of this article, RIS3 is expected to foster synergies between European policies and funding, complementing national and regional schemes, as well as private investment [18]. Member States and regions have selected several priorities related to aviation technologies, and as the program owners of ESIF, they must allocate a significant portion of the budget, primarily through the European Regional and Development Funds (ERDF), to these chosen priorities.

2.2 Clean Sky 2 and Air Transport Net Next Gen

In the context of H2020, the aeronautics and air transport sectors were primarily encompassed within the "Smart, Green and Integrated Transport" Challenge, which fell under one of the pillars dedicated to addressing societal needs. Alongside the collaborative research topics introduced in the Transport Work Programme [19], there were two Joint Technology Initiatives (JTI) established in aviation. These initiatives were institutional public-private partnerships with funding from the European Union, aiming to foster long-term collaboration in research and innovation between the EU and the industry. The two initiatives were Clean Sky 2 and SESAR 2020, each managing their own Work Programmes and topics.

Clean Sky 2, as the largest European research programme in Aeronautics [20], had a budget of 4 billion euros, comprising 1.8 billion euros of EU funds and 2.25 billion euros from private contributions. Its primary objective was to develop cleaner air transport technologies for early implementation. The technological framework consisted of various components. Specifically, in this article, we will focus on three Integrated Technology Demonstrators (ITDs): airframe, engines, and systems. Additionally, there were three Innovative Aircraft Demonstrator Platforms (IADPs): fast rotorcraft, large passenger aircraft, and regional aircraft.

Public and private entities [21] could become CS JU members by participating in competitive calls for core partners, or being selected as leaders at the beginning of the programme. Members had certain obligations and responsibilities, such as financial support or contributing to the activities of Clean Sky JU through in-kind contributions (IKCs).

One of the advisory bodies of Clean Sky 2 was the Clean Sky 2 States Representative Groups (CS SRG). Article 14 of the Council regulation [21] (Clean Sky 2 JU third amended bi-annual work plan and budget 2018-2019, 2018) highlights that one of the primary goals of the CS SRG was to serve as a conduit of information and interface with the Clean Sky 2 Joint Undertaking. This involved keeping the Joint Undertaking informed about the progress and status of pertinent national or regional research and innovation programs, as well as identifying potential areas of collaboration and cooperation. In other words, CS2 SRG aims to support the alignment between Clean Sky 2 funding and national/regional funding programmes based on ESIF.

In December 2013, the AirTN Next Generation (AirTN NG) [22] project started as a follow-up to AirTN-FP7 project, funded by the Coordination and Support Action (CSA) instrument within the FP7. The main objective was to enhance coordination and to stimulate cooperation in research and innovation among European Union (EU) Member States and Associated States to the EU Framework Programme. This project was always very closed to the Member States Group of ACARE.

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In order to facilitate the establishment of a procedure for fostering synergies, the European Commission requested the CSA AIRTN NG to allocate a portion of its resources towards supporting Clean Sky JU [22].

All these three initiatives, ACARE MSG, Clean Sky 2 JU, Clean Sky 2 SRG and AirTN NG, have been working closely in order to get the better approach of the alignment of public funding, maximizing its impact and avoiding gaps.

2.3 Alignment of R&i funding in the aviation sector. Clean Sky 2 case study

There is a crucial need emphasized in this article, which is the second goal of the European Research Area (ERA) as requested by the European Commission [3]. This need is to fully leverage the various public funding sources and maximize the real impact of research and development (R&D) policies and strategies through alignment and synergies between European, national, and regional funding programs.

While some attempts were made within the ACARE MSG between 2007 and 2013 under the 7th Framework Programme (7FP) for aviation research and technology [23], the first successful endeavour in achieving this goal occurred under the Clean Sky Joint Undertaking (CSJU) from 2014 to 2020 [24], operating within the framework of Horizon 2020. This success was supported by AirTN NG, ACARE MSG, and the Clean Sky 2 States Representative Group (CS2 SRG).

The objective was to align Clean Sky 2 technological objectives and calls with national and regional funding programs and strategies [24]. The focus was primarily on the European Structural and Investment Funds (ESIF), which are managed by EU countries themselves, and the concept of Research and Innovation Strategy for Smart Specialization (RIS3) [15].

As elaborated in the Clean Sky 2 consolidated Annual Activity Report (2020) [24], the CSJU capitalized on this situation by encouraging synergies with ESIF. This was achieved by allowing public and private CS JU members to propose complementary activities to CSJU calls and expanding the scope through the addition of parallel activities or continuation of CSJU co-funded projects/activities using ESIF in synergy with the Clean Sky 2 Program and its technology roadmap, the so called additional in-kind activities (IKAAs).

3. Materials and methods

The methodology used to evaluate the CS2 case study to align ESIF with national/regional funding programs in aviation with research and development (R&D) efforts, as well as the synergies with European strategies, is grounded in the following aspects (Fig. 1):

- Analysis of all member states and associated countries and regions, using the European Smart Specialisation Platform, which serves as the Commission's information portal for RIS3-related documents and processes. The analysis was conducted in 2016 with the support of AirTN NG and ACARE MSG, covering the programming period of 2014-2020. In the initial stage, a search was performed on the platform to identify nations and regions that, while managing ESIF, had selected aviation or aviation-related priorities within their RIS3. This process allowed for the mapping of regions that prioritized aeronautics, as well as those that prioritized aviation-related technologies. In the subsequent step, interviews were conducted with some members of the CS2 SRG to gain a better understanding of their funding programs, strategies, and their willingness to participate in the action plan for synergies.

- Questionnaires and later interviews to national/regional programme owners to corroborate the obtained results from the European Smart Specialisation Platform, as well as to deepen in the knowledge of their funding programmes.

- Analysis of the implementation process and results of synergies between clean sky 2 and national/regional programmes based on the RIS3, led by C2JU in the period 2014-2020. The analysis has been done based on the information available through Clean Sky 2 website.

- Interviews to CS2 SRG and national/regional programme owners to analyse the efficiency, barriers, and best practices of the implemented synergies.

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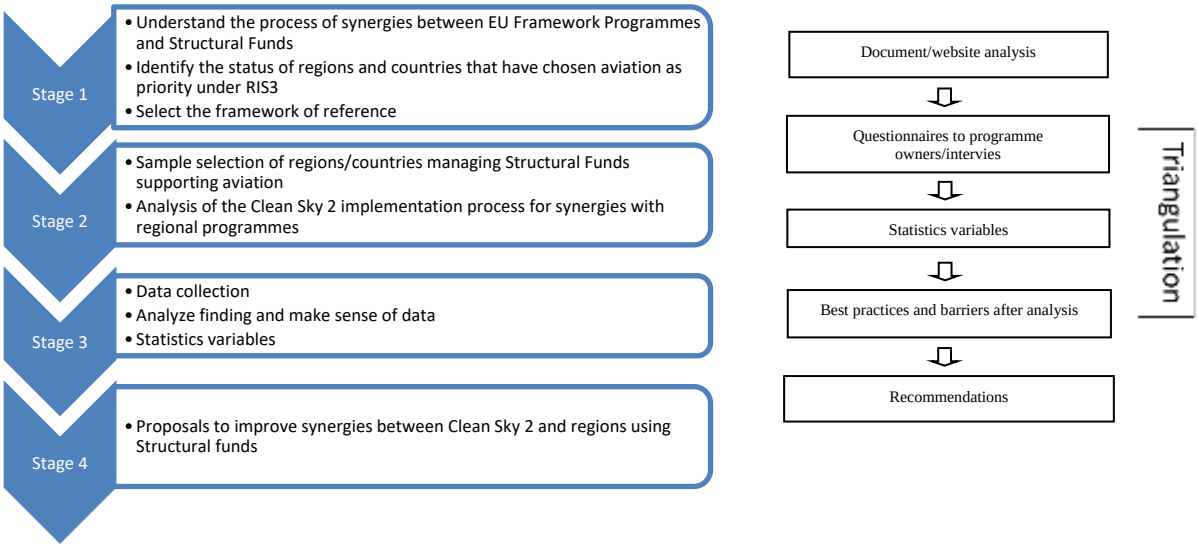

Fig. 1. Countries and regions choosing aeronautics in RIS3

4. Results

AirTN Next Gen primary objective was to analyse the scenarios that could lead to the alignment of European, national, and regional funding programs in aviation, primarily based on the management of ESIF by countries and regions. This analysis was conducted in cooperation with ACARE MSG, Clean Sky JU, and Clean Sky 2 SRG.

Step 1:
The first step involved creating a map (Fig. 2) that displayed regions and countries that had incorporated aeronautics as part of their RIS3. The European Smart Specialization Platform was used for this purpose.

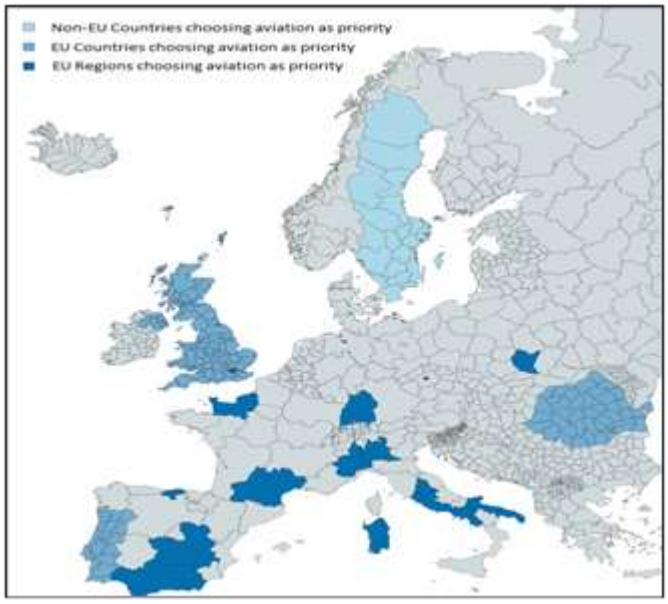

Fig. 2. Countries and regions choosing aeronautics in RIS3

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We discovered that 5 countries, Malta, Portugal, Romania, Sweden (non-EU), and the United Kingdom have chosen aeronautics as a specific priority sector under their national-level RIS3.

Besides, 16 regions have chosen aeronautics as a specific priority at the regional-level RIS3: Andalucía (ES), Baden-Württemberg (DE), Bremen (DE), Campania (IT), Cantabria (ES), Castilla-La Mancha (ES), Haute-Normandie (FR), Lazio (IT), Lombardia (IT), Midi-Pyrénées (FR), Piemonte (IT), Podkarpackie (PL), Praha (CZ), Puglia (IT), Sardegna (IT), and Umbria (IT).

The analysis did not mean that only those regions choosing aeronautics as a priority had significant aeronautics focus. In many regions, there is an integral supply industry for the manufacturing industry, materials and the ICT sector that can supply aeronautics as well.

Analysing different RIS3 priorities, it was found that areas such as eco-innovations (manufacturing), photonics, advanced materials, remote technology and sensing, and electronics were chosen as priority areas by regions that can provide support to aviation technologies, even if aviation itself was not chosen as a priority.

It is important to highlight that the RIS3 process is complex, and the same activity can be considered from various angles. In addition to the classification of "priority," we should also consider the aspects of "capabilities" and "market." There are numerous other categories and possible combinations where the result can lead to direct or indirect funding of activities related to aeronautics.

The RIS3 mapping revealed a significant potential for cooperation with over 50 Member States/regions that had aeronautics and or aeronautic-related priorities or capabilities. All the data used for this analysis were collected in 2016. It is important to note that the data is continuously updated based on inputs from regional and national authorities, as well as their stakeholders. This iterative process is commonly referred to as the "entrepreneurial discovery process" in the literature on smart specialization.

In September 2018, the mapping tool underwent a comprehensive upgrade. The filtering options were revised, and the previous categories of priorities, capabilities, and markets were replaced by three new approaches: economic, scientific, and policy domains.

Although the focus of this article has been primarily on the initial mapping conducted in 2016, a new data collection was carried out in 2018 to allow for a comparison with the previous classification. This time, the new tool was used to specifically search for any economic, scientific, and policy domains that directly mentioned aeronautics. The results revealed that 42 countries/regions made direct references to the sector in their domains, indicating a significantly more ambitious level of engagement compared to the results obtained from the initial mapping.

Step 2:

Based on the aforementioned factors, the CSJU initiated an action plan on synergies, developed through close interactions with the identified Member States and regions. Bilateral Memoranda of Understanding (MoUs) were signed to facilitate discussions on strategies and cooperation possibilities. The primary objective was to identify areas of technical cooperation that could complement the CS2 program and support its overall goals, promoting synergies between ESIF and Clean Sky 2 funding [24] (Clean Sky 2 Consolidated Annual Activity Report, 2020).

From 2016 to 2020, the CSJU signed a total of 18 MoUs. Among them, four were signed at the national level with the Czech Republic, Portugal, Greece, and Romania. Fourteen MoUs were signed at the regional level with Andalucía (ES), Brandenburg (DE), Campania (IT), Catalonia (ES), Castilla la Mancha (ES), Castilla y León (ES), Flevoland (NL), Nouvelle-Aquitaine (FR), Occitanie (FR), Östergötland (SE), Podkarpackie (PL), Sterea Ellada (GR), Zuid-Holland (NL), and Västra Götaland (SE).

At the time of the analysis, Brandenburg (DE), the Czech Republic, Catalonia (ES), Castilla y León (ES), Flevoland (NL), Greece, Nouvelle-Aquitaine (FR), Östergötland (SE), Sterea Ellada (GR), Västra Götaland (SE), and Zuid-Holland (NL) had not chosen aviation as a priority. However, they had selected other priorities that involved technologies related to aviation. Some of these regions later modified their priorities to include aeronautics.

Step 3:

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Five scenarios were identified to address the implementation of synergies through project funding at the national and regional levels, aligned with Clean Sky 2 objectives [24] (Clean Sky 2 Consolidated Annual Activity Report, 2020):

- Scenario 1: upstream support: Developing capabilities and infrastructures with ESIF support.
- Scenario 2: parallel funding: Complementary activities to Clean Sky 2 with ESIF support, evaluated separately, mainly targeted at Clean Sky 2 applicants or beneficiaries.
- Scenario 3: sequential/downstream support: Continuation or amplification of projects by Clean Sky 2 beneficiaries with ESIF support.
- Scenario 4: thematic approach: National or regional specific thematic calls related to Clean Sky 2 with ESIF support.
- Scenario 5: top-ranked proposals: Proposals with a high score in a Clean Sky 2 call, not retained for funding, but supported by ESIF.

The interviews with CS SRG showed that a common approach in scenarios 2, 3, and 5 was the "Clean 2 Sky Synergy Label," which meant that the proposal was evaluated by the CSJU, and a quality label could be awarded to allow ESIF funding by regions or countries. In scenario 1, the CSJU was involved in the process but did not need to provide a quality label. In scenario 4, the CSJU was typically invited to assess the evaluation but did not need to provide a quality label.

Programme owners answered during the interviews that in cases 1, 2, 3, and 4, CSJU private members frequently used funded projects by ESIF to provide their IKAA contributions. The CSJU was involved in all cases to ensure project relevance and alignment with Clean Sky 2 objectives. However, the final decision always rested with the regional or national owners.

These scenarios have been implemented on a case-by-case basis, and through a review of literature published by the CSJU and interviews with CS2 SRG members, we have analysed all regions and countries that have funded projects related to Clean Sky 2 (table 1).

Through the 18 MoUs signed until 2020, 14 nations/regions have utilized their ESIF to fund 52 pilot projects with a total budget exceeding 50 million euros. As depicted in the table 1 and table 2, all of them have chosen multiple scenarios for implementation (table 1 and table 3).

To better understand if there is a relation between the number of used scenarios (Xi) and the number of funded projects (Yi), we have calculated the correlation coefficient (Table 1).

$$Correl(X,Y) = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sqrt{\sum (x-\bar{x})^2 \sum (y-\bar{y})^2}}$$

Where Xi are the number of used scenarios by each country/region and Yi are the number of funded projects by each country/regions.

$$Correl(X,Y) = 0.15$$

It shows that the number of selected scenarios does not impact significatively on the number of funded projects.

Only Flevoland (NL), Castilla y León (ES), Sterea Ellada (GR), Brandenburg (DE), and Nouvelle-Aquitaine (FR) did not have the opportunity to fund Clean Sky 2 related projects until 2020, although some of them received proposals with the synergy label. Additionally, it is worth noting that the Provence Alpes Cotes d'Azur (PACA SUD) region did not sign the MoU but participated in and supported one project.

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Table 1: Number of funded projects and the chosen scenario/s for synergies with Clean Sky 2.

	Priority sector (ris3)	**Scenario**	**Number of used scenarios (Xi)**	**National/ regional authority**	**Number of projects funded (Yi)**
Andalucía (ES)	Aerospace	2, 3, 5	3	Andalucía Region	4
Campania (IT)	Aerospace	2, 3, 4	3	Campania Region	9
Castilla la Mancha (ES)	Aerospace	2, 3, 5	3	Castilla La Mancha Region	3
Catalonia (ES)	Others related to aeronautics	2, 3, 5	3	Catalonia Region	2
Czech Republic	Aerospace (national level)	2, 3, 5	3	Ministry of Industry and Trade	6
Greece	Aerospace (national level)	2, 3, 5	3	GSRT	1
Midi Pyrenees - Occitanie (FR)	Aerospace	2, 3, 4	3	Occitanie Region	8
Östergötland (SE)	Aerospace	1, 2, 3	3	Swedish Agency for Economic and Regional Growth	3
Podkarpackie (PL)	Aerospace	2, 3, 5	3	Podkarpackie ROP	1
Portugal	Aerospace (national level)	2, 3, 4, 5	4	National Innovation Agency	3
Provence Alpes Cotes d’Azur (FR)	Others related to aeronautics	2, 3	2	Regional Council of Provence Alpes Cotes d'Azur -PACA SUD Region	1
Romania	Aerospace (national level)	2, 3, 5	3	National Authority for Scientific Research and Innovation	4

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Västra Götaland (SE)	Aerospace	1, 2, 3	3	Swedish Agency for Economic and Regional Growth	6
Zuid Holland (NL)	Aerospace	2, 3, 5	3	Zuid-Hollande Region	1

Countries and regions have chosen multiple scenarios for the implementation of synergies, allowing the flexibility in the implementation methods (table 2). The absolute frequency illustrates that most of governmental agencies (12 out of 14) choose 3 different scenarios.

Table 2: Frequency of the number of used scenarios

	Choosing 1 scenario	**Choosing 2 scenarios**	**Choosing 3 scenarios**	**Choosing 4 scenarios**	**Choosing 5 scenarios**
Absolute frequency	0	1	12	1	0
Relative frequency	0	0,071	0,857	0,071	0

As depicted in the table 3, the frequency of selected scenarios varies a lot, however the absolute frequency shows that 14 governmental agencies go for the scenario 3 and 9 for scenario 5. Only 2 of them choose scenario 1.

Table 3: Frequency of used scenarios

	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**
Absolute frequency	2	4	14	3	9
Relative frequency	0,048	0,333	0,333	0,071	0,214

The interviews with CS SRG and programme owners also showed that there are three main barriers identified for them in the future implementation of synergies:

- The management of ESIF by nations/regions is complex, and the reporting of funded activities to the EC requires a strict and intricate procedure. Applicants also face a high administrative burden during project application and implementation, with overly complex management, control, and audit systems.
- Program owners often utilize ESIF without transnational/regional cooperation.
- The MoU reflects the lack of commitment between countries/regions and the CSJU.

5. Discussion and conclusions

For the aviation sector, CSJU has developed a well-established methodology focused mainly on RIS3 and ESIF, which has demonstrated a successful history.

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The first conclusion of the study shows that although there are countries/regions that haven´t chosen aeronautics as a priority under the RIS3, they have chosen other technologies that can be related to aeronautics. In many regions, there is an integral supply industry for the manufacturing industry, materials and the ICT sector that can supply aeronautics as well. Besides, during the initial mapping phase, it was noteworthy that the interest generated was not limited to the traditional "aeronautics regions" in Europe. Regions that previously had not been associated with aeronautics also expressed interest, recognizing the potential to enhance their capabilities in cross-cutting areas of research and innovation with possible market opportunities.

Regarding the countries/regions that signed a MoU with CS JU to implement the alignment of funding, we conclude that most of them chose more than one of the proposed scenarios for synergies, because it gave them more flexibility in implementing the cooperation. Most of them for scenario 3 and scenario 5, because the continuation or amplification of projects by Clean Sky 2 beneficiaries, as well as de proposals with a high score (but not funded) in a Clean sky 2 call are the most effective and usual cases for participating entities.

The last conclusion is regarding the lack of commitment between countries/regions and the CSJU. Being a MoU only a compromise to study the way of collaboration, they are not obliged to implement the synergies within the framework of the memorandum and the number of funded projects with ESIF in some cases is low or even non-existent.

Through the interview with national/regional programme owners, several barriers to synergies have been identified through the interviews. The following is a list of these barriers, along with suggested solutions:

The management of ESIF by nations/regions is complex, and the reporting of funded activities to the EC requires a strict and intricate procedure. Applicants also face a high administrative burden during project application and implementation, with overly complex management, control, and audit systems. As a solution, the EC should define a smoother and clearer procedure for investing these funds, allowing program owners to be more flexible in implementation. Additionally, the EC should establish more structured links and cooperation between RIS3, Operational Programs, and European R&I initiatives such as Joint Undertakings, enabling commitments and the design of specific instruments.

Program owners often utilize ESIF without transnational/regional cooperation. While this may be acceptable for certain types of synergies with Clean Sky 2 on an individual project basis, it becomes complex when redirecting highly ranked projects from Clean Sky 2 calls to ESIF under scenario 5. The coordination between calls and programs in consortiums involving different nations/regions becomes challenging. To address this, the EC should define a clear procedure for transnational/regional cooperation using ESIF, rather than leaving program owners to figure it out on their own.

Due to the aforementioned situation, synergies had to be implemented on a case-by-case basis by CSJU. Each region/country has its own funding program and call characteristics, resulting in diverse technology and TRLs supported, timelines, submission, evaluation, and monitoring requirements. While the signature of MoUs and the bilateral work with CSJU have effectively addressed this issue, relying solely on a case-by-case approach is not ideal due to its time-consuming nature and the fast-paced changes in programs. Based on the experience gained in recent years, CSJU should define a limited number of cooperation possibilities, along with specific procedures for their implementation. Launching expressions of interest and providing detailed procedures would simplify the process for nations/regions to study and adopt synergy scenarios, reducing the time invested in bilateral cooperation.

Despite the barriers, implementing synergies has been considered a success story in aligning European, national, and regional funding programs. European policies have had a significant influence, with national/regional program owners aligning their strategies to fund projects that align with the Clean Sky 2 technology roadmap.

It is very important to point out that one of the main objectives of the European Commission in the period 2021-2027 - and the recently adopted European Research Area for Research and Innovation –is to implement synergies between European, national and regional funds for Research and innovation in an efficient way, to ensure coordination and complementarities. This work attempt to shed some light detailing the best practices, barriers and recommendations of the JU Clean Sky 2 pilot project to improve the procedure and expand it to others sectorial JUs.

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