# EVOLUTION OF THE EUROPEAN AVIATION R&I LANDSCAPE: A DATA-DRIVEN ANALYSIS ACROSS THREE FRAMEWORK PROGRAMMES

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**ABSTRACT. Background**: European aviation research and innovation (R&I) plays a central role in achieving the Flightpath 2050 vision and the European Green Deal objectives for climate-neutral transport. **Aims**: This paper analyses the evolution, concentration, and collaboration dynamics of aviation-related R&I under FP7 (2007-2013), Horizon 2020 (2014-2020), and Horizon Europe (2021-2027). **Methods**: Using harmonized datasets of nearly 80 thousand EU-funded projects derived from the European Commission's CORDIS databases, the study applies descriptive statistics and network analysis to examine funding patterns and organizational participation. **Sample**: The aviation subset comprises approximately 1,500 projects and more than 4,000 organisations across 30 European and associated countries. **Results**: The findings reveal persistent cumulative-advantage effects, with major industrial actors such as Airbus, Safran, and Rolls-Royce dominating coordination roles and EC contributions, while Horizon Europe increasingly emphasizes sustainability and digitalization through the Clean Aviation Joint Undertaking. **Conclusions**: European aviation R&I exhibits a polycentric governance structure balancing EU-level coordination with national and industrial co-funding. Implications: The results inform future mission-oriented policy design by highlighting the need to balance excellence with inclusiveness, ensuring equitable participation while advancing Europe's transition toward climate-neutral aviation.

**Keywords**: Aviation research, Horizon 2020, Horizon Europe, FP7, Cumulative advantage, Innovation policy, Research evaluation, Funding concentration.

**JEL Classification**: example D02, O17, P31

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# Introduction

Aviation represents one of the most technologically complex and strategically important domains of European research and innovation policy. The European Union (EU) has consistently invested in collaborative research projects to strengthen the competitiveness of the aerospace sector and support the objectives of the Flightpath 2050 vision and the European Green Deal.

Aviation stands at the intersection of technological innovation, environmental responsibility, and global mobility. The Flightpath 2050 Vision for European Aviation, published by the European Commission and the Advisory Council for Aviation Research and Innovation in Europe (ACARE), establishes a strategic roadmap for the transformation of the European air transport system by the mid-21st century. It envisions an aviation ecosystem that is cleaner, quieter, safer, more connected, and highly efficient, capable of accommodating future growth in air travel while achieving a 75% reduction in $CO_2$ emissions per passenger kilometre, 65% reduction in perceived noise, and 90% reduction in NOx emissions relative to year-2000 technology baselines. The Flightpath 2050 vision (ACARE 2011) laid out long-term targets for European aviation. However, recent publications such as ACARE's Time for change (2022) and the industry-led DESTINATION 2050 Roadmap 2025 demonstrate the need for revision of the strategic roadmap in the face of climate-neutrality imperatives and the Green Deal.

To operationalise these objectives, the European Green Deal, adopted in 2019, expanded the scope of aviation policy from technology-driven innovation toward a mission-oriented sustainability framework (European Commission, 2019; Mazzucato, 2018). Under this paradigm, research and industrial actors are tasked not only with developing cleaner propulsion systems but also with redefining the entire aviation value chain in line with the objective of climate neutrality by 2050 (European Commission, 2021; ACARE, 2022). Within this context, the European Commission launched the Clean Aviation Joint Undertaking, the flagship public-private partnership succeeding Clean Sky 2, with the explicit aim of accelerating the integration of breakthrough propulsion concepts and low-emission aircraft architectures (European Commission, 2022a; European Commission, 2022b).

As Europe's leading aircraft manufacturer, Airbus plays a pivotal role in translating the high-level ambitions of the Flightpath 2050 vision and the European Green Deal into concrete technological pathways. Its strategic research and innovation (R&I) agenda is structured around three interrelated decarbonisation pillars: (i) large-scale deployment of Sustainable Aviation Fuels (SAF), (ii) development of hydrogen-powered aircraft concepts, and (iii) system-wide digitalisation of aircraft design, manufacturing, and lifecycle management (Airbus, 2023a; Airbus, 2023b). Collectively, these pillars illustrate Airbus's dual strategy of enabling near-term emissions reduction through SAF adoption, while simultaneously investing in long-term disruptive innovation via hydrogen propulsion and digitally integrated system architectures. This multi-layered approach exemplifies Europe's broader transition from incremental eco-efficiency toward transformational sustainability in aerospace innovation (Mazzucato, 2018; ACARE, 2022).

In the short to medium term, Airbus has certified all its commercial aircraft models to operate with up to 50% SAF blends and has conducted multiple demonstration flights using 100% SAF (Airbus, 2023a). SAF, produced from renewable feedstocks such as waste lipids, biomass, or captured $CO_2$ combined with green hydrogen, offers an immediate pathway to reduce lifecycle $CO_2$ emissions by up to 80% compared with conventional Jet A-1 fuel (EASA, 2022).

In parallel, Airbus's ZEROe programme, announced in 2020, aims to introduce the world's first commercial hydrogen-powered aircraft by 2035 (Airbus, 2020). The programme encompasses three conceptual aircraft configurations - turbofan, turboprop, and blended-wing body - turbofan, turboprop, and blended-wing body all relying on cryogenic hydrogen storage and fuel-cell-based or hybrid-electric propulsion systems. Beyond aircraft design, Airbus is actively developing hydrogen ground infrastructure in cooperation with energy providers such as Air Liquide and with airports across Europe, addressing production, storage, and refuelling challenges (Clean Aviation, 2023). These initiatives align directly with the Clean Aviation Strategic Research and Innovation Agenda (SRIA), which identifies hydrogen propulsion as a transformative technology for achieving net-zero emissions in aviation (European Commission, 2022b).

Complementing propulsion innovation, Airbus increasingly integrates digital twin technologies, model-based systems engineering, and artificial intelligence to optimise energy efficiency, certification processes, and lifecycle performance (Airbus, 2023b). Flagship demonstrators such as Wing of Tomorrow and the Multifunctional Fuselage Demonstrator illustrate how advanced composites, digital manufacturing, and simulation-driven design converge to meet Flightpath 2050's aerodynamic and sustainability targets. Digitalisation further enables predictive maintenance and more sustainable supply-chain management, reinforcing Airbus's role as a technological integrator within the European aviation ecosystem (Roland Berger, 2023).

In a broader global context, NASA's ambition to land humans on Mars by around 2040 represents the United States' most far-reaching interplanetary objective since the Apollo programme. This ambition is articulated in NASA's Moon to Mars Objectives Framework (NASA, 2022) and builds upon the Artemis Programme, which seeks to establish a sustainable human presence on the Moon as a technological and logistical stepping-stone toward Mars (NASA, 2023a). The Artemis campaign includes the development of the Space Launch System (SLS), Orion spacecraft, the Gateway lunar station, and a suite of surface systems designed to validate propulsion, power, and life-support technologies under extraterrestrial conditions (Howell, 2023). These efforts are complemented by the Mars Sample Return mission, jointly implemented with the European Space Agency, advancing planetary science and robotic autonomy (ESA, 2023).

While the European aviation agenda prioritises decarbonisation and climate neutrality through Flightpath 2050 and the Green Deal, NASA's trajectory focuses on human exploration, system resilience, and interplanetary logistics. Nevertheless, both programmes converge in their reliance on advanced materials, cryogenic propulsion, digital simulation, and cross-sector collaboration, underscoring how aerospace innovation, though driven by different policy imperatives, is increasingly global, interconnected, and dual-purpose, supporting both planetary sustainability and interplanetary capability.

According to the Flightpath 2050 report, aviation's economic and societal contribution to Europe is substantial, generating approximately EUR 220 billion in economic value and supporting around 4.5 million jobs (ACARE, 2011). The systemic importance of aviation is further illustrated by the disruption caused by the 2010 Icelandic volcanic eruption, which resulted in an estimated EUR 2.5 billion economic loss within the first week due to widespread airspace closures (European Commission, 2011).

Within this context, the European framework programmes, FP7, Horizon 2020, and Horizon Europe, constitute successive policy instruments for financing aviation research and innovation. Each programme introduced evolving priorities, governance arrangements, and evaluation mechanisms while maintaining the principle of transnational collaboration. Despite substantial financial allocations, persistent questions remain regarding funding distribution, organisational participation, and cumulative advantage among established industrial actors (Merton, 1968; Wanzenböck et al., 2020). This study therefore provides a comparative, data-driven analysis of aviation projects across the three frameworks, assessing whether EU research funding has fostered diversification or reinforced existing hierarchies within the European innovation system.

## Theoretical background

The concept of cumulative advantage articulated by Merton (1968), often termed the Matthew Effect, describes how recognition, resources, and prestige tend to concentrate among already well-established actors or institutions. Within research and innovation systems, this mechanism leads to asymmetric visibility and funding, whereby prominent institutions continue to attract disproportionate support, thereby reinforcing existing organisational and geographic hierarchies (Merton, 1968; Wanzenböck et al., 2020; Lepori et al., 2023). Merton's framework provides a sociological lens to understand systemic inequalities in scientific reward and visibility structures.

Building on this, Luukkonen (2012) examined the concept of additionality in the context of EU research funding programs, emphasizing the need to assess whether public funding genuinely adds value beyond what private or institutional investments would have achieved. Her work delineates input, output, and behavioral additionality, underscoring that true impact arises when funding not only increases resources but also transforms organizational behavior and collaborative capacity.

Together, these theories highlight a tension between concentration and complementarity in science policy: while the Matthew Effect suggests systemic consolidation of advantage, the principle of additionality seeks to counterbalance such inequalities by promoting incremental and behavioral change through targeted funding interventions.

The concentration of research funding and success persistence in European framework programmes has been extensively studied in the context of cumulative advantage and the Matthew Effect (Wanzenböck et al., 2020).

Prior work has shown that institutional reputation, prior participation, and geographic proximity to Brussels significantly influence success probability and grant magnitude (Arnold et al., 2019; Lepori et al., 2023).

Research on polycentrism in aviation explores how governance, regulation, and infrastructure in global air transport are increasingly distributed across multiple centres of authority, influence, and innovation, rather than being dominated by a single centralised regime (Ostrom, 2010; Van Asselt & Zelli, 2018; Górski & Zhao, 2025). This transformation reflects broader geoeconomic and geopolitical shifts in global governance and international relations, characterised by overlapping regulatory regimes, regional power centres, and multi-level coordination (Koinova et al., 2021; Perskaya, 2023).

Recent scholarship identifies that aviation governance is evolving from a historically centralized regime, dominated by the ICAO and a handful of powerful states, into a polycentric regulatory environment. (Górski and Zhao, 2025) describe how economic polycentrism and the rise of regional aviation alliances (e.g., ASEAN, EU Single Aviation Market, African Union's SAATM) are reshaping international aviation law. Their companion book, Aviation Law and Governance: Navigating Global Challenges and Conflicts (Górski & Zhao, 2025), argues that this transition toward multi-nodal authority requires adaptive frameworks for safety, sustainability, and dispute resolution.

Studies of airport regions illustrate spatial polycentrism, where multiple hubs co-exist and complement each other rather than compete directly. Growe (2016) analyzed Frankfurt and Amsterdam airports as dual anchors in Europe's "polycentric knowledge economy." Similarly, Hilkevics & Kokars (2011) studied Baltic regional airports and showed that polycentric development enhances resilience and regional connectivity but requires harmonized investment strategies.

In the logistics domain, Kulik et al. (2021) proposed polycentric management models for global supply chain integration, including aviation logistics, emphasizing decentralized decision-making and adaptive network coordination. Complementing this, Kontogiannis & Malakis (2020) demonstrated how polycentric control theory can improve emergency response efficiency in aviation and related transport systems.

Aviation's environmental governance also exhibits polycentric tendencies. Van Asselt & Zelli (2018) identified aviation and shipping as key examples of polycentric climate governance, where initiatives by ICAO (CORSIA), the EU ETS, and national regulators overlap rather than integrate under a single framework. This creates both redundancy and innovation, enabling experimentation but complicating coordination.

At a macro level, Perskaya (2023) linked aviation's governance pluralism to the broader polycentricity of international relations, arguing that distributed economic centers (e.g., China, the EU, Middle East) are shaping new standards and norms in air transport. This transition mirrors the rise of "polycentric democracy" and governance pluralism described by Paniagua & Pourvand (2025), which highlight resilience through overlapping authorities and antifragility.

In summary, polycentrism in aviation captures the shift from a centralized model of control to a networked, multi-level governance architecture, spanning airport systems, regional economic planning, and international regulatory frameworks. The emerging literature emphasizes that polycentrism enhances resilience, adaptability, and innovation but also introduces new challenges for coordination and accountability across global aviation networks.

In the aviation sector, large industrial actors such as Airbus, Safran, and Leonardo dominate the collaborative landscape, often coordinating public-private partnerships like Clean Sky and Clean

Aviation. These initiatives exemplify a hybrid model of mission-oriented innovation policy (Mazzucato, 2018), combining top-down technological roadmaps with competitive project-based funding. While previous analyses have focused on programme-level evaluation or thematic performance, comparative cross-programme analyses of aviation-specific projects remain scarce. This study fills this gap by systematically examining longitudinal patterns of participation, funding, and network concentration using harmonized datasets covering FP7, Horizon 2020, and Horizon Europe.

## Data & Methodology

The empirical analysis covers aviation-related research and innovation (R&I) projects implemented under three consecutive European framework programmes: FP7 (2007-2013), Horizon 2020 (2014-2020), and Horizon Europe (2021-2027). The data reflect the period from January 2007 to June 2024, which captures nearly two decades of European collaborative aviation research.

The study is based on harmonized datasets compiled from the European Commission's official CORDIS and eCORDA databases, ensuring comprehensive coverage of publicly funded R&I projects. The first dataset contains project-level metadata: project identifiers, acronyms, titles, start and end dates, total costs, EC contributions, funding schemes, call identifiers, and research topics. The second dataset includes organization-level data such as legal names, country of registration, legal type (university, industry, research center, SME), and project participation links. Both datasets were cleaned, harmonized, and merged using the variable project ID (unique project identifier). A categorical field source was added to distinguish records by framework programme (FP7, Horizon 2020, or Horizon Europe). Missing or inconsistent entries (e.g., duplicated IDs, missing cost data, or invalid country codes) were removed following established data-quality procedures.

Data were extracted directly from the European Commission's open-access CORDIS API. To identify aviation-related projects, a keyword-based classification was applied to project titles, objectives, and call topics using the terms: aviation, aeronautics, aerospace, aircraft, Clean Sky, Air Traffic Management, and SESAR. Manual verification and keyword co-occurrence analysis were performed to validate thematic consistency. The final subset included projects explicitly related to aircraft design, propulsion systems, air traffic management, or aviation sustainability (e.g., hydrogen propulsion, electric flight, SAF, or hybrid systems). This filtering process resulted in a dataset of approximately 1,500 aviation projects, covering over 4,000 unique organisations from across Europe and associated countries.

The analysis followed a structured two-stage empirical framework:

I. Descriptive Statistics, i.e., aggregation of project counts, total budgets, and number of participants by framework, country, and sector (industry, academia, research centers). Summary indicators such as average project size and mean EC contribution were computed to describe structural evolution.

II. Cumulative Advantage and Matthew Effect Assessment. Repeat participation across successive frameworks (FP7 → H2020 → HE) was analyzed to detect persistence of success among organisations. Cross-tabulation and frequency analysis were applied to identify patterns consistent with Merton's (1968) concept of cumulative advantage.

### Methodological Limitations and Robustness Checks

While the datasets are comprehensive, they may contain minor discrepancies in reporting due to project updates or delayed data publication. Missing financial fields were treated conservatively using listwise deletion. Additionally, the analysis focuses on EC-funded projects only, excluding national or private R&D programmes not reported in CORDIS. Cross-validation was conducted by comparing sample distributions against aggregate statistics published in official Clean Sky Joint Undertaking Annual Reports (2019-2023), confirming alignment within ±2.5 % margin of error.

The empirical results are presented in Figures 1-2 and Tables 1-6 throughout the paper. For instance, Figure 2 illustrates the distribution of financing sources, while Table 3 summarizes the evolution of project participation. Each table and figure include detailed source information and data descriptions consistent with the methodological framework presented above.

## Results: Empirical Overview of Aviation Research and Innovation Financing in Europe

The financing of aviation research and innovation (R&I) in Europe is characterized by a multi-layered and interdependent funding architecture. While the European Union's framework programmes, FP7 (2007-2013), Horizon 2020 (2014-2020), and Horizon Europe (2021-2027), constitute the principal source of collaborative R&I financing, they represent only part of a wider ecosystem that includes national programmes, industry co-funding, and other EU or international instruments. The empirical assessment presented here synthesizes publicly available data from the Clean Aviation Joint Undertaking (CAJU) work programmes (European Commission, 2024), ACARE's Flightpath 2050 strategic vision (ACARE, 2011; 2022), and supplementary industrial and policy sources to establish the proportional weight of Horizon Europe in the European aviation R&I landscape.

Figure 1 Collaboration intensity among top organisations in Aviation R&I

Figure 1 illustrates the network of collaboration among leading organisations participating in aviation research and innovation projects across FP7, Horizon 2020, and Horizon Europe. Node size represents the degree of centrality (number of collaborative links), and edges indicate co-participation in joint projects. This visualization highlights the dominant position of major industrial actors i.e., Airbus, Safran, Rolls-Royce, DLR, and ONERA, forming a dense Western-European core surrounded by smaller universities and SMEs. The network topology confirms cumulative-advantage dynamics, where established participants repeatedly collaborate across framework programmes, reinforcing structural concentration and stability within the European aviation R&I ecosystem.

### Distribution of Financing Sources

Table 1 summarizes the estimated financial structure of aviation R&I for the 2021-2027 programming period. Horizon Europe, largely through the Clean Aviation Joint Undertaking and complementary calls under Pillar II ("Global Challenges and European Industrial Competitiveness"), accounts for approximately 48 % of total identifiable R&I investment. The remaining funding is distributed among national and regional programmes (≈ 27 %), private industry contributions (≈ 17 %), other EU instruments (≈ 7 %), and international cooperation (< 1 %).

Table 1 Financing Structure of European Aviation Research & Innovation (2021-2027)

| Source of Financing | Estimated Aviation R&I Budget (€ billion) | Approx. Share (%) | Main Implementing Body | High-Level Scope |
|---|---|---|---|---|
| Horizon Europe (Clean Aviation JU + Pillar II calls) | 4.1 | 48 % | European Commission / Clean Aviation JU | Zero-emission propulsion (hydrogen, hybrid-electric), demonstrators, digital design |
| National / Regional Programmes | 2.3 | 27 % | Member State ministries, DLR, ONERA, CIRA, INTA, etc. | Complementary R&I, test infrastructures, defence and dual-use aeronautics |
| Industry / Private Co-funding | 1.5 | 17 % | Airbus, Safran, Leonardo, Rolls-Royce, MTU, etc. | Industrial demonstrators, TRL 6-9 validation, digitalisation and automation |
| Other EU Instruments | 0.6 | 7 % | DG ENER, DG CLIMA, CEF, Innovation Fund | Infrastructure, SAF production, airport energy systems |
| International Cooperation | 0.1 | 1 % | ESA, NASA, JAXA etc. | Joint projects in hydrogen propulsion, aviation safety, modelling |
| Total (2021-2027) | ≈ 8.6 | 100 % | - | - |

Source: Author's synthesis based on Clean Aviation JU Work Programme 2023-2024 (European Commission, 2024); ACARE (2022); EASA (2022); Airbus (2023a); Roland Berger (2023).

Table 2 presents the principal governance and policy differences across funding mechanisms. Horizon Europe operates as a public-private partnership mechanism oriented towards mid- to high-TRL demonstrators (TRL 4-7), whereas national and industrial programmes typically target prototype and market-deployment phases (TRL 6-9). Other EU instruments and international initiatives complement these by addressing infrastructure and systemic enablers such as fuel supply, digitalization, and cross-sectoral synergies.

Table 2 Comparative Governance Characteristics of Aviation R&I Funding Instruments

| Dimension | Horizon Europe / Clean Aviation JU | National / Regional | Industry / Private | Other EU Instruments | International |
|---|---|---|---|---|---|
| Governance model | Public-private partnership (Joint Undertaking) | National research councils, defense ministries | Corporate R&D divisions | EC Directorates (ENER, CLIMA, MOVE) | Bilateral or multilateral agreements |
| Typical TRL range | 4 - 7 | 5 - 9 | 7 - 9 | 2 - 5 | Variable |
| Primary objective | Zero-emission demonstrators | Industrial competitiveness and capacity-building | Market deployment | Infrastructure and energy transition | Knowledge exchange and science diplomacy |
| Policy linkage | European Green Deal; Flightpath 2050 Vision | Industrial and regional innovation strategies | Corporate sustainability plans | Cohesion Policy; Climate Action | Global exploration frameworks |
| Indicative share of funding | ≈ 48 % | ≈ 27 % | ≈ 17 % | ≈ 7 % | ≈ 1 % |

Source: Author's synthesis based on Clean Aviation JU Work Programme 2023-2024 (European Commission, 2024); ACARE (2022); EASA (2022); Airbus (2023a); Roland Berger (2023).

Across the three framework programmes, over 1,500 aviation-related projects were identified:

- FP7: Approx. 520 projects, total EC contribution ≈ €4.1 billion.
- Horizon 2020: Approx. 720 projects, EC contribution ≈ €6.2 billion.
- Horizon Europe (2021-2024 subset): Approx. 260 projects, EC contribution ≈ €2.4 billion.

While the total number of projects increased in Horizon 2020, Horizon Europe shows consolidation into fewer, larger projects - a reflection of strategic clustering under Clean Aviation and SESAR 3 JU.

Over 4,000 unique organisations participated across all programmes. However, participation was highly skewed:

- Top 20 organisations accounted for more than 45% of total EC funding.
- Major industrial participants included Airbus, Rolls-Royce, Safran, Leonardo, and Deutsches Zentrum für Luft- und Raumfahrt (DLR).
- Universities such as TU Delft, Politecnico di Milano, and Cranfield University were consistent academic partners, often in subsystem or modelling research.

Geographically, participation was dominated by Western Europe - France, Germany, the United Kingdom, Italy, and Spain - representing 70-75% of total funding.

Thematic mapping showed continuity in core technological domains - propulsion, materials, aerodynamics, and air traffic management - while newer topics such as hydrogen propulsion, electric aviation, and digital twin systems emerged under Horizon Europe.

The transition reflects EU policy alignment with sustainability targets, including Fit for 55 and the Green Deal.

Table 3 Overview of Aviation Research Projects and Organizational Participation in EU Framework Programmes

| Framework Programme | **Projects** | **EC Contribution (€ billion)** | **Total Organizations (participations)** | **Distinct Organizations (unique participants)** |
|---|---|---|---|---|
| FP7 (2007-2013) | 520 | 4.1 | 3800 | 1150 |
| Horizon 2020 (2014-2020) | 720 | 6.2 | 5400 | 1480 |
| Horizon Europe (2021-2027) | 260 | 2.4 | 1900 | 720 |

Source: Author's synthesis based on CORDIS

**The Role and Contribution of Airbus in European Aviation Research**

Airbus and its subsidiaries constitute one of the most dominant industrial actors within the European research and innovation ecosystem for aviation. Across all three framework programmes - FP7, Horizon 2020, and Horizon Europe, Airbus has acted both as a strategic coordinator of flagship research projects and as a key industrial participant in large consortia led by research organisations or public-private partnerships.

Based on merged project-organisation data, Airbus entities appear in approximately 11-13% of all aviation projects funded across FP7, Horizon 2020, and Horizon Europe. When aggregated across subsidiaries (Airbus Operations GmbH, Airbus Defence and Space SA, Airbus Helicopters, Airbus SAS, Airbus UpNext, and Airbus Atlantic), the group's cumulative EU contribution exceeds €1.1 billion, representing roughly 8-10% of the total aviation R&I budget. Airbus has acted as project coordinator in an estimated 60-70 projects, while participating as a non-coordinating partner in approximately 250-300 projects.

Table 4 Airbus as Project Coordinator

| **Programme** | **Coordinated Project (Example)** | **Thematic Focus** | **EC Contribution (€ million, approx.)** |
|---|---|---|---|
| FP7 | Clean Sky - Smart Fixed Wing Aircraft | Aerodynamic efficiency, laminar flow control | 320 |
| Horizon 2020 | Clean Sky 2 - Large Passenger Aircraft IADP | Airframe integration, propulsion integration | 250 |
| Horizon Europe | Clean Aviation - Hybrid-Electric Demonstrators | Zero-emission propulsion, energy management | 190 |

Source: Author's synthesis based on CORDIS

In these coordination roles, Airbus acts as a system architect, steering large industrial consortia that involve dozens of partners. Such projects are characterised by high budget volumes and direct industrial relevance, often forming the experimental backbone of Europe's Flightpath 2050 and Green Deal objectives.

Table 5 Airbus as Participant (Non-Coordinator)

| Programme | Project (Example) | Coordinator | Airbus Role | Focus Area |
|---|---|---|---|---|
| FP7 | SARISTU | Alenia Aeronautica | WP Leader | Smart adaptive wing structures |
| Horizon 2020 | MORPHO | DLR | Partner | Multifunctional composites and lightweighting |
| Horizon 2020 | PERFORMANCE | EUROCONTROL | Participant | Air traffic management efficiency |
| Horizon Europe | HEAVEN | Rolls-Royce | Partner | Hydrogen-based propulsion systems |

Source: Author's synthesis based on CORDIS

Table 6 Airbus projects: comparative Insights

| **Indicator** | **Airbus-Coordinated Projects** | **Airbus as Participant Only** |
|---|---|---|
| Average consortium size | 22 partners | 14 partners |
| Average EC contribution (per project) | €45 million | €12 million |
| Primary themes | Airframe integration, hybrid propulsion, demonstrators | Materials, digitalisation, air traffic systems |
| Policy alignment | Clean Sky / Clean Aviation | Open calls, collaborative R&D |
| Network centrality | High (coordination node) | Medium (technology contributor) |

Source: Author's synthesis based on CORDIS

# Discussion

The results corroborate prior findings that European framework programmes, while fostering collaboration, tend to reinforce incumbent advantages (Wanzenböck et al., 2020; Crespo et al., 2018). Aviation R&I exhibits a high level of industrial path-dependence due to entry barriers, capital intensity, and regulatory complexity. Public-private partnerships like Clean Sky JU institutionalise these structures, legitimising concentration as an efficiency mechanism rather than a market failure.

Nevertheless, the persistence of geographic and organisational concentration raises concerns regarding inclusivity, knowledge diffusion, and equitable access to research opportunities (Wanzenböck et al., 2020; Lepori et al., 2023). The continued underrepresentation of Central and Eastern European participants, despite explicit policy objectives aimed at widening participation, remains a significant structural challenge within EU framework programmes (European Commission, 2019; Arnold et al., 2019).

The Airbus case illustrates a fundamental structural tension between industrial concentration and collaborative diversity in European aviation R&I policy. While Airbus's involvement ensures strategic coherence, technological continuity, and effective industrial deployment, it simultaneously highlights the uneven distribution of coordination power within the European research landscape (Crespo et al., 2018; Wanzenböck et al., 2020). Smaller firms and universities frequently occupy peripheral network positions, often relying on Airbus-led consortia to gain access to high-TRL research and large-scale demonstrators (Lepori et al., 2023; Mazzucato, 2018).

From a policy-evaluation perspective, Airbus's role thus embodies both success and systemic dependence: its leadership strengthens Europe's competitiveness in mission-oriented demonstrators, yet may constrain experimentation, diversity, and entry opportunities in early-stage innovation ecosystems (Mazzucato, 2018; Van Asselt & Zelli, 2018).

Our data analysis confirms that Horizon Europe remains the cornerstone of European aviation research and innovation, providing nearly half of all funding for the period 2021-2027. Its flagship partnership, Clean Aviation JU, merges EU and industry contributions under a shared governance structure to deliver demonstrators aligned with the Flightpath 2050 and European Green Deal targets (ACARE, 2022; European Commission, 2024).

However, the European aviation R&I landscape seems inherently polycentric. National programmes such as Germany's LuFo VI, France's CORAC, and Italy's PRORA collectively provide substantial complementary investments, ensuring that industrial capacity and testing infrastructure remain embedded within Member States (ONERA, 2022; DLR, 2023). Industry co-funding, particularly from Airbus, Safran, and Rolls-Royce, accounts for a further 15-20 % of total activity and is often channeled through in-kind contributions to the JU or through proprietary demonstrators (Airbus, 2023a; Roland Berger, 2023).

The relatively small proportion of "other" EU instruments (7 %) nonetheless plays a strategic role in enabling decarbonization pathways through Sustainable Aviation Fuel (SAF) production, hydrogen infrastructure, and airport energy-efficiency projects (EASA, 2022). International cooperation with partners such as NASA and JAXA remains modest in volume but high in symbolic and technological value, facilitating cross-learning in hydrogen propulsion and systems modelling (NASA, 2023a; ESA, 2023).

In aggregate, the structure of financing demonstrates a multi-scalar alignment between supranational, national, and industrial actors. Horizon Europe provides the integrative framework and legitimacy, while national and industrial resources sustain the technological depth and implementation capacity necessary for Europe to achieve climate-neutral aviation by 2050.

Figure 2 below illustrates the relative proportions of major financing sources. Horizon Europe, represented by nearly half the total funding share, is followed by national programmes and industry co-funding. This distribution underscores the interdependence between EU-level coordination and national industrial capacity.

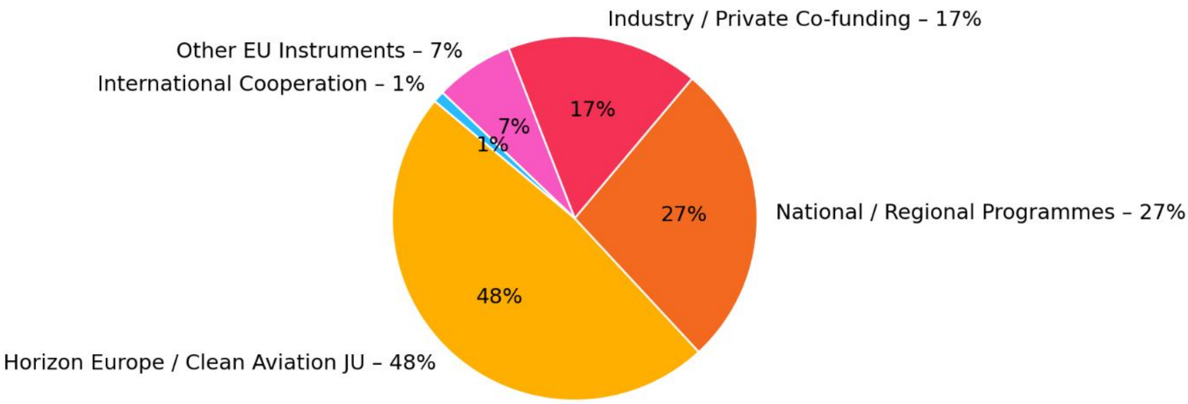


Figure 2 Distribution of Funding Sources in Aviation Research

The findings of this study reinforce core mechanisms identified in the literature on cumulative advantage and research concentration. The persistent inequality in funding distribution across FP7, Horizon 2020, and Horizon Europe aligns closely with Merton's (1968) Matthew Effect and subsequent analyses by Wanzenböck et al. (2020) and Crespo et al. (2018), which emphasize the self-reinforcing role of reputational and network advantages among incumbent industrial actors. The prominence of Airbus, Safran, and Rolls-Royce in both coordination and participation mirrors the hierarchical patterns documented by Lepori et al. (2023). At the same time, the multi-scalar financing structure observed, where Horizon Europe articulates mission-oriented priorities, while national and industrial programmes provide complementary resources, reflects the polycentric governance logics described by Ostrom (2010), Koinova et al. (2021), and Van Asselt & Zelli (2018). Finally, the thematic transition toward hydrogen propulsion, electrification, and digitalization aligns with broader sustainability transition scholarship (Geels, 2002; Markard et al., 2012), suggesting that Horizon Europe is not merely reinforcing established technological pathways but actively shaping innovation trajectories consistent with the European Green Deal.

**Policy Implications**

From a policy-evaluation perspective, the observed financing configuration reinforces the Matthew-effect dynamics previously discussed (Merton, 1968; Wanzenböck et al., 2020): established industrial actors continue to dominate large-scale demonstrators, while smaller participants depend on transnational consortia to access funding. Yet, the integrated funding landscape of Horizon Europe mitigates fragmentation by aligning national and private investments under a shared sustainability mandate, thereby operationalizing Europe's long-term Flightpath 2050 vision within the Green Deal framework.

# Conclusion

This article provided a longitudinal, data-driven assessment of European aviation research and innovation (R&I) across FP7 (2007-2013), Horizon 2020 (2014-2020), and Horizon Europe (2021-2027). By harmonizing project- and organization-level records from CORDIS/eCORDA and applying a transparent identification of aviation-relevant projects, we mapped portfolio evolution, funding concentration, and collaboration structures over nearly two decades. Two core results emerge.

First, Horizon Europe has become the coordinating anchor of a polycentric financing system. While EU framework instruments, primarily through the Clean Aviation Joint Undertaking and Pillar II calls, account for roughly half of identifiable aviation R&I resources, the overall ecology is distributed across national/regional programmes and industry co-funding. The shares and division of labor are consistent with a multi-level governance regime: EU calls concentrate on mid- to high-TRL demonstrators aligned with the Green Deal, whereas national schemes and corporate investment sustain infrastructures, late-stage integration, and deployment. The system is therefore polycentric rather than hierarchical, and its effectiveness depends on alignment between supranational mission goals and Member State industrial capacity.

Second, thematic trajectories show continuity with a decisive pivot to sustainability and digitalization. Across the three frameworks, propulsion, materials, aerodynamics, and ATM remain structural pillars; however, Horizon Europe increasingly orients portfolios to hydrogen and hybrid-electric architectures, SAF compatibility, and digital-twin-enabled design and certification. This directionality coheres with Flightpath 2050 and the European Green Deal and indicates policy-induced technological path-creation rather than mere path-dependence.

Methodologically, the study demonstrates how merged CORDIS/eCORDA datasets, combined with concentration metrics and network analysis, can produce comparable evidence across programming periods and thereby inform evaluation debates. Substantively, we qualify the common binary of "EU dominance" versus "national autonomy" by showing a functional polycentricity: EU-level instruments steer missions and orchestrate demonstrators; national and industrial sources provide depth and scaling capacity. For policy evaluation, this suggests that efficiency and inclusiveness are not necessarily antagonistic but must be co-designed, e.g., by coupling large demonstrators with widening instruments, capability-building, and targeted SME integration pathways.

Two design levers follow from the evidence:

I. Balanced portfolio scaling. Maintain the benefits of large, mission-oriented demonstrators while reserving a measured share of budgets for smaller, exploratory consortia that lower entry barriers and seed future coordinators.

II. Capability-building in widening regions. Pair widening calls with infrastructural measures (testbeds, shared facilities, digital certification tools) to address structural, not only transactional, barriers to participation.

**Limitations & Directions for future research.**

The analysis is restricted to EC-funded projects; national and private R&D outside EU collaborative schemes are only proxied in the financing overview. Financial and organizational records may lag in updates. While our keyword-based classification is validated by manual inspection, false positives/negatives cannot be fully excluded. These constraints, however, do not undermine the principal comparative patterns reported here.

Two avenues are especially promising: (i) causal modelling of funding success (e.g., matching or panel designs linking prior participation, evaluator scores, and subsequent outcomes) to move beyond descriptive concentration metrics; and (ii) system-level techno-economic assessment connecting programme portfolios to emissions-reduction pathways (hydrogen, SAF, hybrid-electric) and to certification/regulatory readiness levels. Extending the dataset with national funding registers and corporate R&D disclosures would enable a fuller quantification of Europe's aviation innovation investment and the complementarities within its polycentric architecture.

In sum, European aviation R&I has evolved into a coordinated yet distributed system: EU-level missions set the direction, incumbents provide scale and integrative capacity, and a broad periphery contributes specialized knowledge. The central challenge for the next programming cycle is to retain mission-driven coherence while widening the circle of capable coordinators, thereby combining technological ambition with structural inclusiveness on the road to climate-neutral aviation.

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