

INTERNATIONAL AND EUROPEAN RESEARCH AND TECHNOLOGY INFRASTRUCTURE DATA BASES IN AVIATION

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Abstract

Aviation is undergoing a profound transformation driven by urgent needs to decarbonise transport, strengthen resilience, and maintain global competitiveness. Worldwide, major players are heavily investing in next-generation aviation systems, including hydrogen, hybrid-electric concepts, sustainable fuels, AI-based optimisation or advanced lightweight materials. Achieving such future ambitions depends critically on the availability, accessibility, and sustainable use of Research and Technology Infrastructures (RTIs). Despite progress, there is still fragmentation, duplication of efforts, and limited cross-border cooperation. There is a need to update the current needs, gaps, and overlaps; propose new governance and funding models; and create a consolidated, web-based database of RTIs with enhanced accessibility and functionality. The organisations EREA (Association of European Research Establishments in Aeronautics, [1]) and IFAR (International Forum for Aviation Research, [2]) intentionally developed two separate RTI databases [3, 4]. The EREA database was developed within the association, following the job done in the EU project RINGO [5]. IFAR developed the infrastructure database through a dedicated IFAR working group. Both databases contain main facilities, such as wind tunnels, propulsion facilities, research aircraft, or structural testing facilities of their respective members and are available to any prospective user and stakeholder. The current EREA and IFAR databases are already advanced; however, they remain incomplete and should be expanded to include emerging aviation topics and technologies, such as batteries, hydrogen technologies, and circular economy concepts. The STARLET project (Strategies for Technology Infrastructures in Aviation) [6] addresses these challenges by developing a comprehensive database based on the existing EREA and IFAR resources and complemented by additional infrastructures. This paper presents an overview of the current EREA and IFAR databases, as well as the strategies and concepts for the future database to be developed within STARLET

Keywords: Infrastructure Databases, Wind Tunnels, Propulsion Facilities, Research Aircraft, Structural Testing Facilities

1. EREA – Association of European Research Establishments in Aeronautics [1]

EREA is a non-profit organisation that brings together Europe's leading aerospace research institutes. Its mission is to foster collaboration, and strengthen Europe's competitiveness in aeronautics and air transport, to promote and coordinate aeronautics research across Europe, enhance the competitiveness of the European aerospace industry, and foster innovation through

collaborative projects. EREA members include major European aeronautics research centres from various EU Member States. EREA actively represents its members' interests at the European level, particularly in shaping European Union research and innovation policies (such as Horizon Europe) and proposing strategic directions for the aviation research sector to the relevant stakeholders. Collaboration facilitates networking, joint research initiatives, and knowledge exchange among European research establishments to avoid duplication of efforts and to tackle complex aerospace challenges collectively.

Within the EU project RINGO [5] a European database of aeronautics RTIs was developed in 2020 [2]. Since then, the EREA working group TRIG (Technology and Research Infrastructure Group) has maintained the EREA database covering its members' infrastructures (see Figure 1). TRIG fosters collaboration by maintaining contacts with bodies such as the European Commission and ACARE [8], promoting best practices, coordinating member participation in working groups, and facilitating joint projects and a shared catalogue of research and technology infrastructures. In such a context, TRIG actively supported the European Commission in the realization of ARTI - Aviation Research & Technology Infrastructures Pilot Action [6], an initiative under the European Research Area (ERA) Policy Agenda whose goals was to identify main future needs for updating/constructing technology infrastructures and fostering collaboration in aviation research.

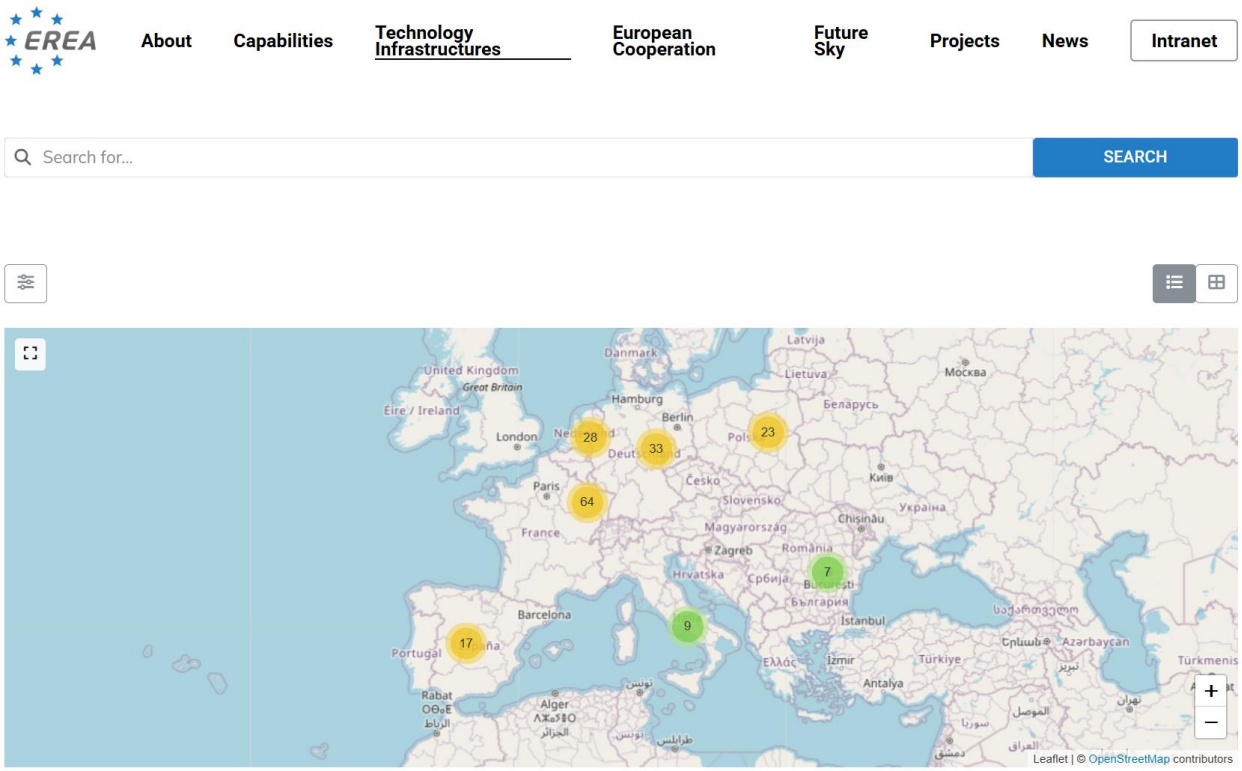


Figure 1 – Distribution of Test Infrastructures among EREA members

2. IFAR – International Forum for Aviation Research [4]

IFAR, the International Forum for Aviation Research, is the world's only aviation research establishment network. IFAR is established on a voluntary, non-binding basis. IFAR aims to connect research organisations worldwide, to enable the information exchange and communication on aviation research activities and to develop among its members a shared understanding on challenges faced by the global aviation research community. IFAR develops views and recommendations, e.g. the IFAR Framework Document on future research strategies and facilitates opportunities for networking and partnerships. The focus of IFAR is on low TRL (Technology

Readiness Level) non-competitive aviation research and development related to global technical challenges.

IFAR consider four core activities:

- Information Exchange and Networking among member organizations
- Information Exchange and Discussion on Technical Issues to enable multilateral international collaboration
- Human Resources Development to support Early Career Researchers
- Working with External Partners – ICAO and ICAS

IFAR organisation and IFAR members

Membership in IFAR is open to national aviation research organizations, including universities active in aviation research, that are (1) non-profit, (2) owned or funded by governments, and (3) committed to conduct civilian research activities in aviation. Only one member organization is nominated to represent its respective country. Currently, IFAR's 26 active aviation research organizations span all inhabited continents. More than 40,000 researchers work across the IFAR member organizations.

IFAR Focus Areas

IFAR focuses on non- and pre-competitive civil aviation R&D related to global technical challenges. IFAR members work across the full TRL range: 1-6 supporting basic and proof-of-concept research with universities; 6-9 supporting industry in technology development. IFAR members provide large-scale infrastructure and technology foresight (strategic R&D and technical services), foster consortia for large-scale technology demonstration projects, make connections between SMEs, higher-tier suppliers, and OEMs, and serve as independent consultants to the public on aviation technology. IFAR also supports the development of young researchers through mentorship, networking and collaboration opportunities.

Partners

IFAR and the International Civil Aviation Organization (ICAO) collaborate to expand and promote innovation in aviation in support of sustainable development. Information-sharing and research activities on innovation-driven areas such as Urban Air Mobility are at the heart of this collaboration. A Memorandum of Understanding was signed in April 2022. In partnership with the International Council of the Aeronautical Sciences (ICAS), the IFAR-ICAS Award honors individuals who have made significant contributions to Aeronautical Science with their doctoral thesis.

IFAR Infrastructure Database

In 2018 IFAR started the development of an Infrastructure Database regarding R&D testing facilities from all its member research organisations. Four types of categories are considered so far: Wind Tunnels, Propulsion Facilities, Research Aircraft, and Structural Testing Facilities (see Figure 2). The objective is to gather and maintain the data in order to facilitate 1) international collaboration on R&D projects and 2) to share R&D testing facilities between members based on availability. This Infrastructure Database in its current state publicly available in its current form at [4]. This is deemed practical for reviews in order to receive feedback but also to populate the data base Experts from NRC and DLR designed the structure of the database for these categories. The final database was discussed among all IFAR members before it was approved and then programmed in the online version of the database.



Figure 2 – Classes of infrastructures.

The public database gives the user several search options (e.g. dimensions, operating properties like speed, temperature, pressure, etc.) allowing users to identify a specific facility efficiently. Each IFAR member add, update and manage its own data independently. The corresponding managers of the infrastructures have specific admin rights to include, update and administer their own facilities in the data base. Figure 3 illustrates the starting page of the data base showing the IFAR member organisations and the categories.

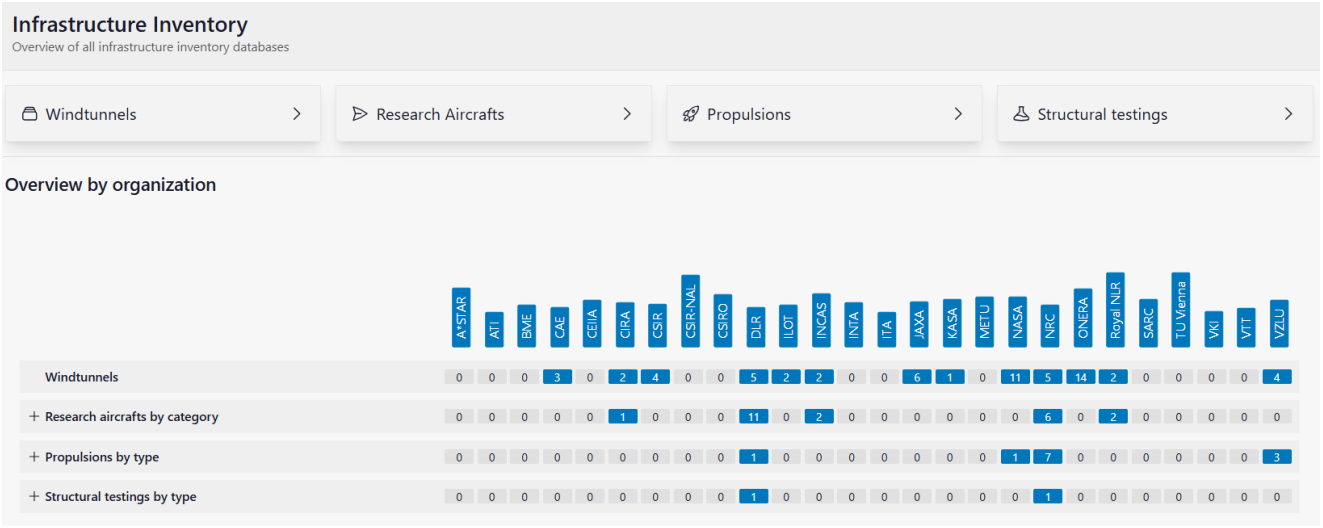


Figure 3 – Overview infrastructures in IFAR [4]

3. EU-project STARLET – Strategies for technology infrastructures in aviation [7]

3.1 Introduction / Objectives

The EU project STARLET [7] supports the aviation sector in addressing future challenges by developing coordinated, future-oriented strategies for the European aviation TI ecosystem. The project will map needs, gaps, and overlaps in the current European TIs landscape; propose innovative governance and funding models for both already existing and future TIs; and deliver a consolidated, web-based database of TIs with improved accessibility and functionality. By strengthening the coherence and long-term sustainability of TI's, STARLET aims to accelerate Europe's capacity to develop, validate and deploy the technologies required for climate-neutral aviation.

3.2 Methodology

TIs must remain at the forefront of innovation, providing capabilities required to validate emerging aviation technologies, but also supporting directly the EU aviation industry in the development of their programs and certification of their products. At the same time robust strategies are needed to ensure efficient operational processes and sustainable financial models. Reducing access barriers is essential - particularly for innovators like SME's and start-ups that are driving technological breakthroughs. To support this ambition, and building on the use cases illustrated in Figure 4, the following objectives are defined:

- Map the European landscape of existing TIs related to aviation, including existing facilities, services, operating models, and typical users.
- Identify and understand the specific needs of current and prospective users, ranging from established industrial actors to SME's and start-ups, and conduct a gap analysis against the current state of the ecosystem.
- Develop improved and innovative strategic capabilities in aviation TI's, ensuring they are future-ready and aligned with sectoral transformation needs.
- Explore the feasibility and effectiveness of potentially relevant business and governance models, strategies and instruments for specific use cases (e.g. the development of disruptive technologies by start-ups or SME upscaling) to contributing to a coherent European approach to RTIs.
- Develop recommendations and a roadmap for upgraded and new TIs incl. concepts for governance, business, operating and funding models that facilitate broader and more equitable access to TIs.
- Strengthen knowledge continuity, relevance, and long-term value by enhancing the TI data platform and fostering transversal cooperation with other TI pilot initiatives.

The use cases addressed by STARLET reflect the multidisciplinary relevance of the topics in aviation and serve as a test bed to assess the effectiveness of the proposed approaches in achieving the objectives of the project.

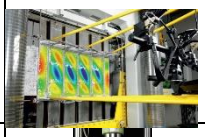
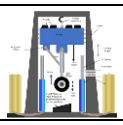
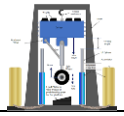
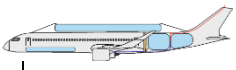
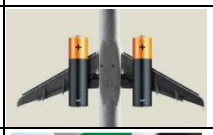
No.		Use case		No.		Use case	
Category 1 – Air board systems	1	Research aircraft + flight tests		Category 4 – Ground based testing	10	Wind tunnels + icing wind tunnel	
	2	Autonomy for UAS - Unmanned Aircraft System			11	Structure testing	
	3	Avionics			12	Material characterisation	
	4a	Measurement techniques			13	Turbine & Combustor Test Facilities	
Cat. 2 – Production technologies	5	Lightweight Production			4b	Measurement techniques	
	6	Circular materials		Category 5 - Operations	14	Air Traffic Management	
Category 3 – New energies	7	Hydrogen / Fuel cells			15	Safety & Security	
	8	Batteries			16	Automation & Human factors	
	9	SAF – Sustainable Aviation Fuels		Cat. 6- Digital Infrastructure	17	HPC- High Performance Computing	

Figure 4 - Use cases considered for RTIs in aviation and related to aviation

3.3 Results

Figure 5 summarizes the main expected results of the STARLET project. The centralized database builds on the already existing databases from EREA [3] and IFAR [4] and on previous work carried out in the framework of the RINGO EU Project [5]. STARLET will extend this database, applying lessons learned in data management and stakeholder engagement, and involving experts from industry, research, and regulatory bodies through workshops, surveys, and interviews. These outcomes will improve the availability, accessibility and quality services for future technologies across the EU, enabling faster validation and deployment, and will have a lasting impact beyond the project's duration. The roadmap and recommendations will strengthen strategic planning at the EU and national levels, supporting environmental and societal objectives, and reinforcing Europe's global competitiveness. By promoting the more efficient, accessible, and sustainable use of TIs, STARLET will accelerate innovation, facilitate faster market entry for breakthrough solutions, and help ensure that Europe remains a global leader in climate-neutral aviation.

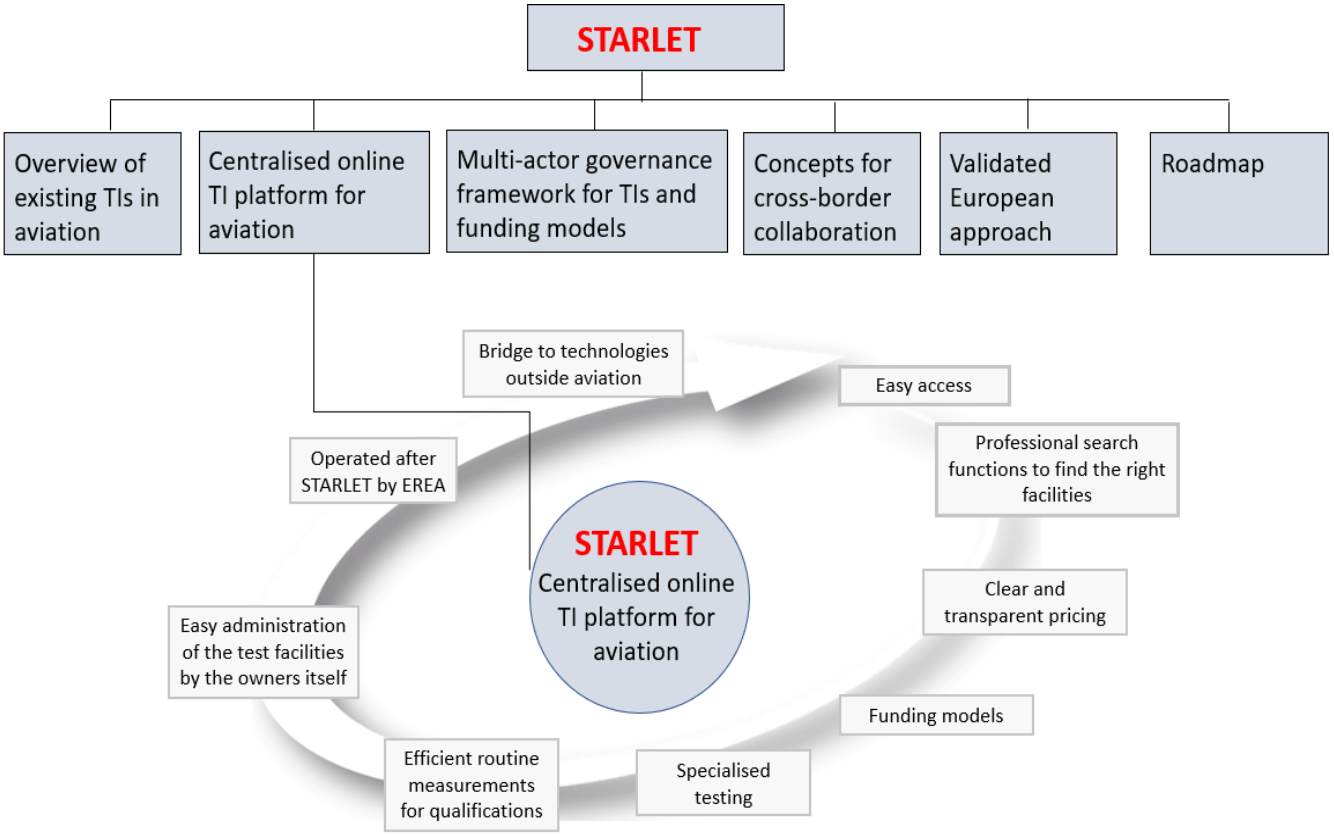


Figure 5 - STARLET results

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