PARE Article

Prioritizing Research, Testing Capabilities And Education

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PERSPECTIVES FOR AERONAUTICAL RESEARCH IN EUROPE

PARE

INTRODUCTION

In 2050, Europe's aviation industry must be underpinned by world-class capabilities and facilities in research, test and validation and in education. Europe must have the world's leading research infrastructures covering the entire aviation system from wind tunnels through simulation facilities to test aircraft. At the same time, Europe's students in aviation-related university courses, which should be academically challenging and support the evolving needs of industry and research, must perform highly.

To ensure that all of these goals are met, the Advisory Council for Aeronautics Research and innovation in Europe (ACARE) established the specific Flightpath 2050 goals 20 to 23, which are addressed in the 6th chapter of PARE's 1st yearly report, entitled "Prioritizing Research, Testing Capabilities and Education".

EUROPEAN RESEARCH AND INNOVATION AGENDA

There is a large gap between the high-quality scientific research sponsored by the European Research Council (ERC) and the market-oriented near term developments of the Joint Undertaking (JUs), e.g. "Clean Sky" and "SESAR", that needs to be filled by fundamental applied research with an aeronautical focus, to ensure that Europe remains a source of new ideas that are the basis of innovation and long-term competitiveness. Taking this into account, by 2050, European research and innovation strategies should be jointly defined by all stakeholders, public and private, and implemented in a coordinated way covering the entire innovation chain.

KEY FINDINGS

- European research is defined and funded in a coherent and agile way, to avoid duplication and inefficiencies, prioritising initiatives resulting from strategic roadmaps defined and agreed by European stakeholders, satisfying actual needs (industry pull) and potential future demands (technology push);

- The European Union (EU) aeronautics programme has started with a budget of 36 M€ in the 2nd Framework Programme (FP) for Research and Technological Development (FP2) and had a steady growth to 3.6 B€ in the 7th Framework Programme (FP7), which testifies its success and the growing importance of this initiative;

- The growth of the aeronautics programme has seen a shift from (i) basic research (less than 1 M€), to (ii) industrial cooperation (4-10 M€), to (iii) large-scale demonstration (20-120 M€) to (iv) integration activities or JUs (more than 1 B€). This growth should be considered as an efficient element of integral European transport system growth that "provides completely safe, secure and sustainable mobility for people and goods;

- Technological innovation can achieve a faster and cheaper transition to a more efficient and sustainable European transport system by acting on three main factors: vehicles' efficiency through new engines, materials and design; cleaner energy use through new fuels and propulsion systems; better use of network and safer and more secure operations through information and communication systems;

- The ERC has sponsored high-quality research in basic science, including mathematics and physics, with some underrepresentation of engineering;

- Research facilities, used for different disciplines and specialities, differ greatly in size and range of application but are often linked to one another through a complex immaterial network that transforms basic scientific knowledge into competitive products while integrating environmental, safety and security requirements.

KEY ACTIONS

It is recommended that the long-term competitiveness of European aviation is safeguarded by supporting a Basic Research Programme (BRP) with a wide variety of low-cost applied basic research up to the 3rd Technology Readiness Level (TRL3), entitled “Experimental proof of concept”, to bridge the gap between the fundamental research of ERC and near-market driven focus of Jus. This broad programme will ensure that Europe does not miss out the promising new ideas that could be exploited first by others to their advantage.

INDUSTRY-RESEARCH-ACADEMIA CLUSTERS

As seen before, the EU FP have shifted from one end to the other and should be rebalanced. For this, by 2050, a network of multi-disciplinary technology clusters should be created based on collaboration between Aerospace Industry (AI), Universities and Academia (UA), and Research Centres (RC).

KEY FINDINGS

- The creation of these technology clusters could be the result of 3 initiatives, two ongoing and one to be restored from the past: (iii) demonstration and (iv) integration activities existing in the JUs Clean Sky and SESAR; the fundamental research in mathematics, physics and engineering existing in the ERC; and restoring the (i) basic and (ii) industrial research that existed in the aeronautics programme since the beginning and lapsed with increasing scale;

- The following existing networks should be considered: Association of European Research Establishments in Aeronautics (EREA); Aerospace Engineering Universities (PEGASUS); Aviation Noise Research Network and Coordination (X-NOISE EV); and FORUM on Aviation and Emissions (FORUM-AE) project;

- From FP2 to FP7, the involvement of EU countries in FP projects suffered an evolution from a more uniform distribution towards a more concentrated one. Such change may be reasonably associated to the evolution of the relative importance of the different thematic categories (used to classify EU funded projects related to the aeronautic sector) and to the identification of a less fragmented and more specialized cooperation network;

- Considering all FPs, on average, an industrial actor participated in a mean number of 3.2 EU funded projects, with a standard deviation of 14.6, a research organization in 3.0 (11.1) projects, and a university in 2.6 (6.1) projects.

KEY ACTIONS

It is recommend to create multidisciplinary technology clusters, which require a balanced and proportionate support of 4 levels of projects:

1. basic research (3-5%): having 50-100 UA up to 1M€ each exploring up to TRL3 all sorts of novel promising ideas;
2. collaborative industrial (15-17%): 20-40 industrial research projects (4-10M€) joining AI, RC and UA develop further the more prospects;
3. large-scale demonstrators (20-30%): 5-10 large scale demonstrators (20-100M€) to reach a practical scale on the best results at a lower level;
4. JUs (50-60%): 1-2 JUs lead by industrial shorter-term applications (1-2B€).

TEST, SIMULATION AND DEVELOPMENT FACILITIES

The large simulation and test facilities are essential institutional support to the aeronautical industry, representing large investments of the Member States that have been coordinated in some occasions (e.g. the joint Dutch-German aero-acoustic wind tunnel - DNW and the joint British-French-German cryogenic pressurized wind tunnel or European Transonic Wind tunnel - ETW). By 2050, strategic European aerospace test, simulation and development facilities should be identified, maintained and continuously developed, and the ground and airborne validation and certification processes should be integrated where appropriate.

KEY FINDINGS

- Strategic aviation infrastructure is of the highest quality and efficiency, providing the basis for world-class research and competitive product development while supporting education. It ranges from wind tunnels via iron and copper birds up to experimental aircraft and simulation capabilities for in-flight and airport operations;

- The data quality and operational efficiency of European aviation infrastructure helps the industry to minimise risks and development costs and helps society to determine the impact of aviation in benefits such as fast transport as well as in penalties such as the impact on the atmosphere;

- The main topics of these facilities are:
  - Improved and validated fluid dynamics, aerodynamic control, combustion, noise and thermal modelling based on high-performance computation, covering all needs for the aircraft and its engines, external and internal;
  - Methods and tools facilitating the evaluation of aircraft and engine configurations;
  - Results from the demonstration, allowing to assess not only improvements in vehicle development but also to verify and validate new modelling techniques.

KEY ACTIONS

It is recommended that (a) a list of simulation, testing and certification needs and (b) an inventory of existing facilities in Europe are compared in order to identify the needs (i) already met, (ii) those requiring upgrades to be met or (iii) those requiring new facilities.

YOUNG TALENT AND WOMEN IN AVIATION

Aeronautics requires mostly but not only hard skills in STEM (Science, Technology, Engineering and Mathematics), that are becoming less abundant and eagerly sought by other sectors. Moreover, the aviation sector is already and will face a shortage of skilled aviation professionals in the future. Thus, the aviation industry must engage promising young talent of both genders as early as possible and sustain their interest. In 2050, students should be attracted to careers in aviation and courses offered by European Universities must closely match the needs of the AI, its research establishments and administrations and evolve continuously as those needs develop. Additionally, lifelong and continuous education in aviation should be the norm.

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KEY FINDINGS

- The major demographic trend in Europe is characterised by an ageing population and declining younger age cohorts. In 2010, the industry employment was already assisting to a concentration of age structures in the middle age range (35-50 years) and experiencing lower recruitment rates of youngsters – in part due to longer education and training periods – but also due to broad use of early retirement schemes. This demographic tendency, in addiction with lower proportions of qualified young people who were (and are) choosing for STEM-related careers was (is) a concern for the aerospace industry;

- Initiatives to mitigate the threat of skills shortages were already put in place in Europe:
  - national clusters units and the new European Aerospace Cluster Partnership (EACP) established opportunities to develop and expand transnational education and training programmes;

  - the Hamburg Qualification Initiative (HQI) established an exchange in the field of training between the aviation clusters of Hamburg and the French aerospace valley of the regions Midi-Pyrénées (Toulouse) and Aquitaine (Bordeaux);

  - PEGASUS alliance was created with the purpose to optimise the higher education services offered in the best interest of Europe both in terms of continuing to attract the best students and also to offer highly relevant educational and research programmes;

- To attract more young talent and women to aviation, the following measures are highlighted: (i) promotion of diversity in types of education and training; (ii) implementation of awareness programmes regarding careers in aviation; (iii) organisation and promotion of scholarships, grants and prizes; (iv) improving knowledge transfer from experienced to young employees by e.g. mentoring programmes (v) improvement of recruiting processes as well as of the working environment.

KEY ACTIONS

It is recommended that a comprehensive programme of attraction of talent to aeronautics to all education levels is fostered, complemented by job satisfaction measures at professional level, with special measures to promote gender equality and increase the participation of women.

For more information about these topics, you can access the full chapter **here**.