



**ACARE**  
**Advisory Council for Aviation Research and Innovation in Europe**

# Activity Summary 2014-15

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## Executive Summary

It has been almost 15 years since ACARE came into being. Over this period significant progress has been made in European Air Transport to support society's need for mobility as well as maintain global leadership for Aviation as a sector.

Progress towards the integrated transportation system is slow. More research is needed and very little progress has been made with regards to basic key areas of the integrated transport system laid out in the White Paper on Transport and the Strategic Research and Innovation Agenda (SRIA), e.g. the architecture of an integrated door-to door transport system, its interoperability standards, regulatory framework and business cases.

There is no SRIA equivalent to address the intermodality issue. The biggest challenge lies in getting a critical number of stakeholders in different transport modes, business environments and geographical regions involved to develop, agree upon and implement new systems, procedures and business models.

Research and Innovation in Europe continues on two primary axes: Product Performance and Customer/Operator Value. There is a need to support the entire research and innovation chain in order to provide a long-term technology base for a competitive Europe. Such instruments need to be defined and realized on European and National regional level.

The European aviation community is broadly on track to meet the noise and emissions 2020 objectives. However these objectives will only be reached with sustained significant effort, including noise and emissions technologies at the aircraft, engine ATM & flight operation levels and all technology readiness levels, wider implementation of low noise operational procedures, pursuing effort on atmospheric research, addressing the newly raised concern on particles and working on alternative fuels Life Cycle Analysis, composition and modelling. Regarding renewable aviation fuels, Europe must set clear quantitative targets and establish a specific strategy supported by a stable framework of policies and incentives, for a successful ramp-up of sustainable production. A European scientific and technical initiative on aviation alternative fuels is urgently needed.

Aviation security is beginning to overtake safety in public perception and more research is needed in this area. Consideration should be given to launching a platform (Coordinate Support Action - CSA) on security research like we have of safety. More effort is also needed on (Big) data analysis of safety across the entire aviation system, for the development of predictive and real-time safety intelligence using an aviation safety research dashboard at the European level. In addition, better integration of Human Factors across the aviation industry to improve overall safety is key to achieve Flightpath 2050 goals.

ACARE has focused on developing and maintaining aviation research infrastructure and on education, life-long learning and outreach activities. A CSA on ensuring quality in education has commenced and a further CSA is being planned to support proposed work on the implementation of a roadmap on strategic research infrastructures.

The ambitious goals addressed by Flightpath 2050 continue to challenge all ACARE stakeholders. The ACARE Strategic Research and Innovation Agenda (SRIA) provides a phased roadmap to guide this effort. However, as the global economic, transport and environmental baseline changes, so this Research Agenda must be updated to reflect such developments. A number of new factors including the following now prompt a further review:

- Results of FP7, Clean Sky and SESAR delivering new technologies, common concepts and opportunities such as electrical flying.
- Emergence of new manufacturing processes that are vital for competitiveness.
- Impacts on EU Airline competitiveness resulting from rising operators from the Gulf.
- Recent accidents including MH370 and the Germanwings flights showing that additional issues need to be addressed.
- Development in more remotely piloted air systems (RPAS) is delivering new ideas and concepts which need to be taken into account.
- Application of IT including cyber security.

Some of the above developments and changes could not have been foreseen five years ago.

**Thus ACARE believes that the time is now right to review and update the content where necessary from the Research Agenda published in 2012.**

This update shall include amendments that will reflect the progress of Research and Innovation in Aviation since the publication of the SRIA as well as the changing European and Global environment in which the sector is now operating so as to identify essential research avenues in the years to come.

In addition to the update of the SRIA, ACARE and its working groups are committed to continually monitor the progress of the SRIA implementation, address as appropriate research needs from emerging issues and take their findings into account for providing strategic recommendations for future SRIA implementation.

The ACARE working groups will continue to cooperate with the EU-funded CSAs for the monitoring activity.

Further outreach actions will be organised including appropriate engagement with policy makers including the European Parliament as well as other stakeholders.

## FOREWORD

The Advisory Council for Aeronautics Research in Europe (ACARE) was created almost 15 years ago, serving as the European technology platform for the aviation and air transport sectors.

Recognising the need by the sector to address significant new challenges and longer term goals, under the chairmanship of Siim Kallas, Vice-President of the European Commission and Commissioner for Transport and Maire Geoghegan-Quinn, Commissioner for Research, Innovation and Science, the High Level Group on aviation research published "**Flightpath 2050 - Europe's Vision for Aviation**" in 2011. Flightpath 2050 underlines the need for aviation's active involvement in the integration of transport modes to enable customer-centric, seamless and integrated door-to-door journeys as well as further emissions reductions, maintaining and extending Europe's leadership, improving safety and security as air transport needs grow and developing excellent research infrastructure and education for the sector.

In response to Flightpath 2050, ACARE developed and published a new Strategic Research and Innovation Agenda in 2012 that provides policy and technical guidance to the aviation sector and policy makers in order to achieve the ambitious goals set by Flightpath 2050.

The input for SRIA was provided by five working groups (WG) involving more than 300 experts and aligned along the five Flightpath 2050 challenges:

- **Mobility (WG1)**
- **Competitiveness (WG2)**
- **Environment & Energy (WG3)**
- **Safety & Security (WG4)**
- **Resources (WG5)**

For horizontal and organisational issues, ACARE consists of four more groups:

- Strategy & Integration Board
- Member State Group
- Implementation & Review Group
- Communication Group

Additionally, the Implementation and Review Group considered opportune in 2014 to re-activate the ACARE International Cooperation (INCO) ad-hoc Working Group, with the view to drafting an INCO strategy document.

Subsequent to the publication of the SRIA, ACARE, remaining very much anchored in its "think-tank" role, is now directing its work towards monitoring and stimulating the implementation of the SRIA in European, National, regional Public and Private Programmes, while maintaining an integrated view of aviation research and providing early identification of emerging issues, formulating strategic advice and recommendations for consideration by the sector.

A number of Coordination and Support Actions funded by the European Commission are currently running to evaluate and quantify the level of achievement with respect to the goals. The findings identified and the progress of the implementation will continue to be published in ACARE annual reports.

The current chair of ACARE is Peter Hartman, Vice Chairman of the Board Air France - KLM, supported by the two vice-chairs Michel Wachenheim, Chair ASD Civil Aviation Business Unit /Advisor to CEO of Airbus, and Johann-Dietrich Wörner, Director General European Space Agency and former Chairman of the Board of DLR.

From the numerous challenges of Flightpath 2050, the ACARE chairs have identified the following major action lines for communications in 2014:

## **1. Enabling future growth:**

- Seamless and affordable ATM processes
- Airport capacity
- Passenger experience and door-to-door mobility/intermodality
- A regulatory framework that facilitates the global leadership of our sector
- Improve public perception of air transport

## **2. Securing a competitive industry (OEM, supply chain and operators):**

- Preparing a competitive industry (OEM, supply chain and operators)
- Proposing innovative aircraft, equipment and engines
- EASA implication in order to quickly certify and put new products on the market
- Preparing factories of the future
- Ensure low TRL research to prepare the technological basis

## **3. Reduce environmental impact:**

- Reduction of CO<sub>2</sub> footprint
- Mitigating air transport related noise

## **4. Safety and Security:**

- Setting up an OPTICS-like CSA for Security
- Reducing key accident types further
- Collection and analysis of 'Big' data to inform pan-European safety intelligence
- A concerted focus on human factors and automation
- Development of a stakeholder-owned European safety research Dashboard

## **5. Excellent Skilled and motivated staff in aviation and Research Infrastructure**

- Skills of Aviation Related Staff
- Identification of the aviation Research Infrastructure within Flightpath 2050.
- Realisation of strategic aviation Research Infrastructure roadmap.

The subsequent sections of the report describe the above five priorities in more detail.

## ACARE Action Lines

### 2.1 Enabling Future Growth

Air transport has become a well-accepted mode of transport, however, improved customer experience, better integration of the air segments into integrated door-to-door journeys, an ATM- and airport system providing capacity according to demand levels in a regulatory framework that facilitates aviation and more effective and more-coordinated efforts to improve public perception of air transport by travelers and airport neighbours alike have been identified as major action areas to enable future growth for air transport. While ATM-related issues including exploratory research are well addressed within SESAR, more research is required to address the basic foundation, architecture, legal framework business enablers and properties of an integrated transport system. This is not an aviation only specific topic, so ACARE has to find ways with other European Technology Platforms (ETP) and the European Commission to handle this.

#### Changing boundary conditions

The following changes in boundary conditions should be addressed in an update to the SRIA:

- The need to integrate remotely piloted aircraft systems for a significantly increased number of vehicles and an enlarged scope of applications (e.g. Amazon) may become more rapid than anticipated. This will not only create new opportunities but will interfere with other air traffic.
- Recent changes in the European air transport market have been very dynamic. European hub carriers and airports, both essential for connecting Europe to the world, struggle to keep their market position. Hub airlines are challenged due to global competition (e.g. by the Gulf carriers) mainly of carriers that are based in regions with more favourable operating conditions as well as an increasing traffic share of the low-cost carriers, which reduces margins on feeder traffic. Airports suffer from limited operating hours and the immense obstacles to expand capacity, whereas new mega-airports are built in competing markets. Aircraft tend to get bigger and many regional aircraft have become uneconomic to operate and almost disappeared. There may be a major structural change in European air transport and its consequences on mobility, services for its customers and the European economy have to be analysed.
- Data availability from information sources formerly unthinkable ('big data') is increasing significantly and new approaches to data and complexity science are being developed. The usability and impact of these 'unconventional' data sources on aviation and WG1s scope of work e.g. in the context of customer (passenger, freight and other users of the system) services & data, research, data models, mobility performance and patterns have to be investigated and understood in more detail. Big data also opens opportunities for a more critical analysis of transport enablers, business enablers, intermodality shortcomings or weak points, and passenger decision chains.

#### State of the Art – are we doing the right Research?

The assessment of state of the art is solely based on expert judgment within WG1. More support from the CSA contracted to support WG1 would be beneficial to complete the overview of the State of the Art. The performance of the assessment is time-consuming but it also helps to establish more direct links with projects and stakeholders as WG1 regularly invites project consortia and relevant industry stakeholders (e.g. International Air Transport Association - IATA, Amadeus) to present their

related activities at meetings. This benefits members and presenters alike as it brings relevant people together, updates ACARE members on the current state of the art within our scope of work, fosters additional input for projects and raises the awareness of ACARE and WG1 in industry and projects.

Three very interesting projects have been awarded contracts in the first call of H2020:

- DATASET 2050 - Data driven approach for a Seamless Efficient European Travelling in 2050
- DORA - Door to Door Information for Air Passengers
- PASSME – Personalised Airport Systems for Seamless Mobility and Experience

These projects address an assessment of mobility performance in Europe, future customer expectations and profiles, the provision of real-time status information to passengers for door-to-door journeys on a selected city pair as well as improvements with regards to passenger experience and decision-making processes at airports. WG1 will follow these projects very closely and provide input as required to support the achievement of useful project results.

Other activities of high relevance are e.g. the All Ways Travelling support action, which was appointed by the European Commission to develop and validate a model for a multimodal pan-European passenger transport information and booking system, and industry activities by Amadeus and IATA, especially the new distribution standard NDC (New Distribution Capability), which could be considered a potential nucleus for distribution of related services (e.g. airport services, transfer to/from airport etc.) in a more integrated and passenger centric transport system. WG1 is now also represented in the IATA 'Simplifying the Business' think tank, a group that has a well-known record for initiating far-reaching innovation in air transport.

While there has been little funding for ATM-related exploratory and low-TRL-level research in recent years, SESAR now has a funding thread dedicated to that part. So WG1 is confident that the relevant research needs in that area can be well addressed. Of course, the creation of the SESAR deployment manager is very much welcomed by WG1 as it will bring a boost to the implementation of innovative concepts. However, WG1's assessment of research shows some areas where much more research is required:

- The basic architecture of a truly integrated transport system, the interoperability requirements, data definitions and data sources, protocols, business enablers, regulatory framework e.g. with regards to harmonised rules between modes etc. needs more attention. This is one of the core building blocks also for the single-contract & single-ticket functionality for door-to-door journeys, vastly improved disruption and recovery management processes or the creation of seamless intermodal airport processes.
- The European-wide mobility model with an ability to assess the contribution of transport infrastructures to European mobility performance and the 4-hour door-to-door goal today and in the future has not been addressed yet. We consider this a key element to demonstrate the contribution of airport infrastructure to European (and global) mobility which should be used in the network infrastructure planning and prioritisation process for transport infrastructure.
- Methodologies for unbiased assessment of the different modes of transport are a prerequisite for customers to make informed travel decisions within and between modes for their individual preferences. They are also one of the building blocks for a competitive and undistorted transport system. Research into these methodologies needs much more attention.

## Future trends

No new trends are seen that would have an impact on the goals of challenge 1. Of course, boundary conditions have to be monitored and analysed constantly and their effects evaluated to ensure the validity of proposed measures to achieve Flightpath 2050 goals.

## Progress on relevant SRIA goals

The majority of the goals in WG1s scope, e.g. the mobility performance or informed passenger goals, have not been part of former ACARE activities, so there is not much progress yet to report as some research projects have only been started very recently.

Progress towards the integrated transportation system is slow. More research is needed and very little progress has been made with regards to basic key areas of the integrated transport system laid out in the White Paper on Transport and the SRIA, e.g. the architecture of an integrated door-to-door transport system, its interoperability standards, regulatory framework and business cases. As this is the basis for integrated journeys from a customer's perspective (relevant/dedicated information, single contracts, tickets and payment, dynamic reconfiguration in case of disruptions etc.), progress in that field is critical. More leadership in achieving White Paper on Transport goals would definitely support a more coordinated and timely approach. The new Innovation and Networks Executive Agency (INEA) has been tasked to implement the Connecting Europe Facility (CEF) programme, parts of Horizon 2020 (Smart, green, and integrated transport & secure, clean and efficient energy) as well as the former TEN-T program with the aim to increase the efficiency of the technical and financial management. This offers new opportunities.

Headway has been made with regards to more efficient and more customer-centric airport processes, although some of these are affected by ever-increasing security rules so the potential benefit of reducing mandatory time of passengers spent at airports could not fully be exploited. There have also been quite a few studies that looked at the customers and their expectations for process improvement, which can be used to define further work.

Significant progress with regards to innovative ATM-procedures and an increase in airspace capacity can be expected once the SESAR concepts are increasingly implemented. This will very much be aided by the SESAR deployment manager.

## Where we need to go next

There is no SRIA equivalent for the White Paper on Transport of the European Commission. ACARE has provided some comments in the consultation process for the mid-term review of the White Paper highlighting the relevant aspects of the SRIA that are in-line or even go beyond the goals of the White Paper. This applies e.g. to the intermodal aspects covered by WG1, where 'Flightpath 2050' defines actual mobility performance goals and the ACARE SRIA identifies many research and innovation needs that would apply to a 'White Paper SRIA' or at least could be considered a very good basis for discussions with other stakeholders to develop a joint roadmap.

A very good opportunity where ACAREs Research and Innovation needs are analysed for their cross-modal applicability could be considered by the SETRIS CSA which has just started. It is not only tasked to support the different transport ETPs in updating their mode-specific SRIAs, but also to identify synergies between the transport ETPs and between these and relevant national platforms in Member States and associated countries. WG1 is committed to co-operate with other modes and actively supports and provides input to the SETRIS project.

The three new projects mentioned above (DATASET 2050, DORA and PASSME) have all originated in the aviation specific part of H2020, which is justified as they address transport issues that include air transport. However, as so many Research and Innovation needs of the SRIA cut across transport modes or rely on technologies developed outside of the aviation world, it is necessary to ensure that ACARE reaches out to other DGs and areas of H2020 as well. So WG1 welcomes the initiative of the SIB to have a meeting with relevant DGs other than DG MOVE and DG Research to inform them about the relevance of ACARE in general and the SRIA in particular and to advertise for their input to the SRIA update process or their participation at WG level.

WG1 has many goals that require more 'social' than technological innovation. That means that the biggest challenge lies in getting a critical number of stakeholders in different transport modes, business environments and geographical regions involved to develop, agree upon and implement new systems, procedures and business models. Such a process usually requires regulatory support and policy framework. It has to be noted that although the associated research needs have also been addressed in the SRIA we see only very limited activity in that field. ACARE will have to find ways with regulators, both public authorities and government agencies to more successfully address these issues as well.

## 2.2 Securing a competitive industry (OEM, supply chain and operators)

The European industry is currently a world leader in many aspects of aviation and it is therefore important to maintain the strategic role of this sector and extend its leadership through an appropriate policy and regulatory framework and an effective program of research and innovation actions.

### Changing boundary conditions

During 2014/15 there were significant changes in the environment within which European companies had to maintain their competitiveness. Some of these were at a policy or economic level, such as the repercussions of the financial crisis, and others at a technological level, such as increasing digitalisation. Taken all together they highlight that there is high rate of change that industry must accommodate to succeed. ACARE Working Group 2 considered that the more significant aspects were:

- **Emerging from Recession:** As acknowledged by the European Commission in its 2012 Communication on the EU's External Aviation Policy ("the EU's External Aviation Policy - Addressing Future Challenges"), "Europe has been harder hit by the global recession than other region and the competitive position of its international airlines in particular is under threat from a number of different challenges. Europe's airlines are on the front line of this competitive challenge and are fighting to survive in a tough international market that is characterised by diverse regulatory frameworks and cultures, by bilateral air services agreements which restrict market access and by competition that is often distorted in third countries by unfair subsidies or practices.
- **Market Share:** Due to below-average growth rates, EU carriers will be losing market shares to non-EU airlines in most regions. In 2003, EU carriers had a market share of 29% of all inter-regional capacity in the world. By 2025, this share is expected to have fallen to 20%. This trend means that, if nothing is done, European airlines will be less able to generate benefits and growth for the European economy, with a strong impact on employment. IATA states that profitability of European airlines in 2014 only amounted to 1.8%<sup>1</sup> while Europe represented approximately 30% of commercial air transport movements that year (\$4.27 per passenger). Only African airlines rank lower in terms of regional profitability (\$2.51 per passenger).
- **Global Competition:** Governments in the Gulf region have invested heavily in aviation infrastructure, de facto turning aviation into a strategic instrument to promote the global role of the region. Thanks to these sizeable investments, non-EU carriers have reinforced their global position. For example, the fastest regional traffic growth in the world is expected to be in the Middle East, where by 2030 the region's airlines will represent 11% of world traffic, up from 7% in 2010. The global competitive pattern has changed significantly with the rise of the Gulf carriers, increasing their market shares, positioning themselves aggressively for the future with massive new investments in aircraft and airport. Passenger traffic growth is fastest in the Asia Pacific region.
- **New EC/EP:** 2014 has been a year of change in the European institutional landscape. A new European Parliament entered into office and the President Juncker's Commission started its work. A new structure and way of working were introduced focusing on jobs and growth. Juncker wants a European Union that is bigger and more ambitious on big things, and smaller

<sup>1</sup> <http://www.iata.org/pressroom/pr/Pages/2014-12-10-01.aspx>

and more modest on small things. The previous Barroso Commission focused on a green economy through sustainable growth.

- **Financing:** In 2014 access to finance became more difficult. Before the financial crisis there was ample choice for financing opportunities. Following the economic crisis banks had to restructure and increase their reserves. This made them very cautious in financing. Despite the presence of the European Investment Bank and the European Fund for Structural Investments it still seems difficult to arrange financing for airline operators. Investments by aviation supply chain in new capacity or capability are constrained by the availability of financing, despite historic low interest rates.

### **Are we doing the right Research?**

New aviation vehicles were launched in 2014/15, bringing new technologies into the marketplace. For example, the A350 airliner embodied many advanced technologies, notably including its all carbon composite airframe. However, this notable event is the culmination of a multi-year product development process, which was itself preceded by an extended phase of research and technology development.

Research and Innovation in Europe continues on two primary axes: Product Performance and, Customer/Operator Value. The Research and Innovation (R&I) capability Europe continues at a high level, building upon the scientific excellence of the Universities, the applied capabilities of the research centers and the investment risk of industry. There are active R&I programs at European, National and Regional levels, as well as private investments. There is little evidence of duplication or overlap in these programs, as alignment using ACARE SRIA and scarce funding drive efficient careful project decision making.

At the European level the Aviation relevant programmes in H2020 are done in the Joint Undertakings of SESAR and Clean Sky. President Barroso launched the JTI's in July 2014 for their next phase of work, until 2020, following an extensive consultation process. The Clean Sky JTI is a partnership between EC and industry, with open competition for 60% of activity, doing demonstration at high TRL for competitive technologies. There were some concerns at the outset that there was little room for Research Centers or Universities in such programs, but this fear has not been realized in the first tranche contracts awards. Separately, there was a clear disappointment, notably amongst universities, that the Collaborative Research Programme in H2020 could not be funded at the proposed level.

### **Future trends**

**Global Market Grows:** The trend to double passenger traffic every 15 years has been reinforced in 2014/15, with no reduction in the trend foreseen amongst analysts. The major of growth is located in the Asia/Pacific region, which poses practical challenges for European operators.

- **Global Competition Grows:** New entrants to the commercial aircraft marketplace, from Canada, Japan, Russia and China have made practical progress towards real products in 2014/15. Product certifications are ongoing.
- **Incremental Product Development:** A consensus is evident in the civil aircraft market towards incremental product developments, providing modifications or upgrades to existing products. For example, introducing new engines (NEO/MAX). This approach builds on the proven success of

existing platforms, maintains fleet commonality with its safety and economic benefits, and provides performance improvements, with associated environmental benefits, in a shorter timeframe. The strategies for transition from one product standard to the next must be carefully managed to maintain residual values and production stability.

- **Digitalization** is accelerating as the concepts and the capability to handle the challenges of “big data” are developed. This has impacts throughout the aviation sector. For example, for operators with mobile passenger services and for manufacturers, with advanced vehicle health monitoring, prognostics and maintenance. Increased digitalization has the potential to change some business models in the aviation sector: Underpinned by strong IP protections it implies less dependency on fixed infrastructure and an opportunity for new market entrants, notably in terms of passenger service provision.
- **Industrial Automation:** To meet the increased market demands for aviation products the volumes of production have continued to increase in 2014/15. This has required manufacturers to increase capacity, invest in equipment and improve productivity. Production volumes are at a level which can justify the investment in flexible automation.
- **Graphene** is a new class of material which offers potential in both structural and electronics applications: The European Commission Flagship Programme builds on European research excellence and seeks to accelerate industrialization. Aviation sector is actively engaged in “pulling” this new technology to meet the demanding requirements of the sector

## Progress on relevant SRIA goals

The SRIA states the industry will have a worldwide market share of (at least) 40%. This will prove to be very challenging for European airlines: During the 2008-2014 period the market share of Gulf carriers between Europe and India/South-East Asia has grown from 22 to 34%, while the market share of the EU carriers fell down from 23 to 16%. Exemplary is that the Gulf carriers together now operate 80% of the total capacity between Europe and the Middle-East, making the capacity flown between Europe and the Gulf higher than the capacity offered between Europe and China, Japan and Korea take together. As a consequence European carriers have closed routes and reduced overall capacity.

The ACARE community recognizes that changes to the current EASA involvement in research are needed and is awaited eagerly for the changes to materialize. Since the review of EASA’s Basic Regulation will become part of the Aviation Package, the Regulators attention to this issue is appreciated.

The ACARE community furthermore is happy to see progress on the level of involvement (LOI) and the possible granting of new privileges to Design Organisation Approval (DOA) holders which hopefully will become a major contributor to the common goal of reducing the cost of certification by 50% until 2050.

Finally, in spite of implementing a risk based approach (LOI), the current staffing of EASA is inadequate to the role EASA needs to play in order to support the aeronautical industry in certification activities. While industry understands that the lack of human resources is due to the economy measures which are undertaken at Commission level, industry needs to point out that as a consequence of these budgetary reductions the entry into service of new or modified aeronautical products is unnecessarily delayed. Sale contracts are at risk and customer satisfaction is at stake.

## **Where we need to go next?**

The European Commission has indicated that the Aviation Package that is part of the 2015 Commission Work Program will address the competitiveness of the air transport industry. Part of this Package seems to be a revision of Reg. 868/2004 concerning “protection against subsidization and unfair pricing practices causing injury to Community air carriers in the supply of air services from countries not members of the European Community“. Giving the described state of the industry we strongly support the Commission to revise this Regulation. Also the Commission indicated to ask for negotiating mandates with some non EU States. The encompassing air transport agreements the Commission wishes to conclude aim to balance market access issues with a regulatory framework that caters for fair competition and will create instruments that can adequately address violations.

## 2.3. Reducing Environmental Impact

Aviation has an important role to play in reducing greenhouse gas emissions as well as noise and local air quality issues. The Vision 2020 and Flightpath 2050 goals relative to the environmental impact of aviation are recalled in the following table.

	Noise	CO <sub>2</sub>	Other emissions	Green life cycle	Alternative fuels
Vision 2020 objectives (ref 2000)	<ul style="list-style-type: none"> <li>• Halve perceived noise = -10 dB per operation</li> <li>• 65 LDEN at airport boundaries (no one impacted outside airport boundaries)</li> </ul>	Decrease CO <sub>2</sub> by 50%	Decrease NOx by 80% (eq. - 80% /CAEP6)	Progress in reducing the environmental impact of the lifecycle of aircraft	None
Flightpath 2050 objectives (ref 2000)	<ul style="list-style-type: none"> <li>• Reduce by 65% perceived noise = -15 dB per operation</li> </ul>	Decrease CO <sub>2</sub> by 75%	<ul style="list-style-type: none"> <li>• Decrease NOx by 90%</li> <li>• Europe at the forefront of atmospheric research</li> <li>• Emission-free taxiing</li> </ul>	Air vehicles are recyclable	Europe centre of excellence on sustainable alternative fuels

Three EU-funded projects are coordinating European research activities and positions and have provided technical input to WG3:

- X-NOISE EV deals with aviation noise research<sup>2</sup>
- FORUM-AE deals with aviation and emissions<sup>3</sup>
- CORE-JetFuel deals with sustainable alternative fuels for aviation<sup>4</sup>.

The X-NOISE EV project, in its June 2015 assessment report, provided a status including state of the art and future trends, a description of the methodology to support the assessment of the ACARE noise targets, a methodology to report progress achievement, the evaluation of the progress towards the Vision 2020 goals and recommendations for the next steps.

The FORUM-AE project, in its mid-term synthesis report of July 2015, provided a status including state of the art and future trends, status of the aviation effect on climate change, mitigation solutions for CO<sub>2</sub> and other emissions, utilisation of alternative fuels, regulations and standards, as well as the evaluation of the progress towards the Vision 2020 goals and recommendations for the next steps.

While FORUM-AE addresses alternative fuels as one of the means to mitigate emissions, the CORE-Jet-Fuel project is dedicated to the production and deployment from well to tank, *i.e.* from feedstock production and conversion over deployment to supporting policy framework and economic measures. Recent preliminary results in CORE-JetFuel are described in the project intermediate reports.

<sup>2</sup> [www.xnoise.eu](http://www.xnoise.eu)

<sup>3</sup> [www.forum-ae.eu](http://www.forum-ae.eu)

<sup>4</sup> [www.core-jetfuel.eu](http://www.core-jetfuel.eu)

## Changing Boundary Conditions

### Noise

The recommended approach presiding over the definition of the ACARE 2020 noise targets remains valid, based on the general Balanced Approach concept developed by ICAO which relies on three elements: noise reduction at source, noise abatement procedures and community impact management. The first two elements of the concept constitute, in practice, the identified contributors to the ACARE 10dB reduction aircraft noise target.

The SRA1 environmental targets (Noise, NO<sub>x</sub>, CO<sub>2</sub>) were originally established without considering possible interdependencies, either at technology or operational level. As a result of the increasing focus on climate change, there may now be a need for stakeholders to make more explicit choices about which environmental effects to prioritise when considering potential introduction of new technologies.

In parallel with this evolution driven by global environmental issues, there is evidence of increased sensitivity to noise in local communities impacted by aviation operations despite significant reduction of aircraft source noise over the years. It will be essential to address the key aspects of noise effects on communities in order to support the implementation of successful local noise policies taking advantage of the expected technological achievements.

### Emissions

New topics are emerging; they were not initially shaped but they are nonetheless of great environmental importance: ultra-fine particles (higher Air Quality concerns at European airports, perspective of a future ICAO international engine certification standard for non-volatile Particulate Matter emissions), cruise NO<sub>x</sub> emissions to be distinguished from LTO (Landing and Take-Off) NO<sub>x</sub>, cruise emissions influence on air quality, composition optimisation of fossil or renewable drop-in<sup>5</sup> alternative jet fuels, fuel sulphur content reduction, contrail avoidance strategy, possible trade-offs between CO<sub>2</sub> or non-CO<sub>2</sub> emissions and noise environmental impact, comparison with other transport modes (particles, CO<sub>2</sub>, NO<sub>x</sub>), introduction of a new aircraft CO<sub>2</sub> metric from future ICAO standard and other issues.

The FORUM-AE project will provide deeper insight into these emerging or connected themes.

### Alternative fuels

The development and deployment of alternative fuels is relatively new on the agenda of commercial aviation. The reasons are both environmentally and economically motivated. While air traffic is growing and fuel consumption accordingly increasing, aviation has to contribute its share to the global efforts to reduce CO<sub>2</sub> emissions. Sustainable alternative aviation fuels are amongst the most promising ways to achieve this. On the other hand, fuel consumption has an enormous impact on airline's operating costs. Given the fact that crude oil represents a finite resource, it can be expected that in future fuel prices will be subject to significant fluctuations and, ultimately, rise. This is another motivation for the search for alternatives not based on crude oil.

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<sup>5</sup> A drop-in fuel is an alternative fuel that is indistinguishable from conventional fuel, with no changes of aircraft, engine or supply infrastructure required.

## State of the Art and Future trends

### Noise

The SRA1 2020 high level objective of reducing noise emission of flying vehicles by half was translated in quantitative terms for fixed-wing aircraft as an **average reduction of 10 decibels per operation**. To achieve this, a phased approach was designed:

- Phase 1, taking into account Noise Reduction Technologies (“NRT”) Generation 1 as well as operational improvements (Noise Abatement Procedures), was to provide solutions for the mid-term target.
- Phase 2, with Generation 2 NRT and novel aircraft and engine/power plant architectures was to lead to the 2020 target.

As shown in the previous OPTI assessment and now supported by recent certifications for the technology part, the benefits associated with Phase 1 have been validated and the mid-term target set for noise **(-5 dB per operation) has been reached**. The full implementation of the recommended research strategy associated with Phase 2 is now needed to ensure achievement of the target set for 2020.

### Emissions

On impact assessment, a good mapping of air quality issues at airports was established knowing the most important pollutants to focus on are nitrogen dioxide (NO<sub>2</sub>), ozone (O<sub>3</sub>) particulate matter (PM) including ultrafine particles (UFPs). On climate impact side, better knowledge was achieved on non-CO<sub>2</sub> direct and indirect effect since the IPCC special report on aviation was published in 1999.

Current and future technological developments to achieve the challenging ACARE 2050 CO<sub>2</sub> goal are essential to mitigate substantially the increase of aviation CO<sub>2</sub>, with a realistic traffic growth assumption. A large part of the effort of the last decade was supported within Clean Sky, and other European projects like LEMCOTEC, ENOVAL and E-BREAK. Among investigated solutions, laminar wing, and Contra Rotating Open Rotor appear as promising medium term ones.

Non-CO<sub>2</sub> emissions reduction relies on future low emission combustor technologies. Until recently the focus was on NO<sub>x</sub>, but new concern on PM warrants that future combustor technology should jointly satisfy ambitious NO<sub>x</sub> as well as non-volatile Particulate Matter (nvPM) objectives.

Environmental benefits from drop-in alternative fuels are considered not only in terms of CO<sub>2</sub>, but also in their ability to reduce particulates. Fuel composition optimization for environmental impact mitigation and better engine compatibility appears as an important topic which is not properly covered today.

On the regulation side, it is important to note that a first CO<sub>2</sub> international standard and a first international standard on particulates will be agreed by the ICAO Environment Committee (CAEP) in February 2016 and subsequently adopted by the ICAO Council.

### Alternative fuels

Considering the great expectations focused on alternative fuels for aviation, it is important to have a research portfolio from high-maturity technologies for short-term applications to novel low-maturity

technologies for long-term application. The mapping of R&D landscape in this context represents an important task in CORE-JetFuel. However, it is too early to conclude if the research strategies currently in place are appropriate.

Meeting recognised sustainability standards for alternative fuels is a must for the aviation industry to be credible in its efforts. In this context, research efforts increasingly focus on sustainable feedstock supply. Examples are utilization of residues and wastes as feedstocks or cultivation of biomass on non-arable lands, e.g. microalgae. Another trend is the development of technologies for production of renewable fuels that are not based on biogenic feedstock, but e.g. on industrial waste gases or solar energy.

### Assessment of progress towards relevant ACARE targets

#### Noise

In dealing with the further steps towards the **-10dB target** (NRT Generation 2, Novel Architectures), the 2015 assessment exercise benefited from the achievements of the OPENAIR project as well as interim results from CLEAN SKY in specific areas related to business jets and regional aircraft in particular.

It can be concluded that a typical 2.5 dB additional benefit relative to the 5dB already consolidated (see State of the Art section) can be expected from Generation 2 NRT provided such technologies mature to TRL6 through static and flight demonstrations in time for 2020.

It should be pointed out that these expectations are based on benefits associated with ducted turbofan engine concepts. At the same time a radically new engine architecture, the Counter-Rotating Open Rotor (CROR), could also contribute to the increasing focus on climate change. Noise has been identified as a major challenge for such unducted concepts and a significant research effort dedicated to noise reduction within the European framework (DREAM, NACRE, Clean Sky). At this stage, based on results from model tests in anechoic wind tunnel (TRL4), CROR-powered aircraft with an Entry into Service (EIS) between 2025 and 2030 can be expected to produce noise levels similar to those of turbofan-powered aircraft currently under development.

Relative to the second ACARE 2020 noise target (no people impacted outside airport boundaries), a pilot study led to the following observations:

- Benefits of each individual element differ significantly (very airport dependent)
- The effect of Land Use Planning may be of the same order of magnitude as that of noise reduction at source
- A combination of actions is required to maintain the future population affected below 2000 levels.

#### Emissions

Towards the qualitative goal: “**Europe is at the forefront of atmospheric research and takes the lead in formulating a prioritised environmental action plan and establishes global environmental standards**”, Europe has achieved a major contribution both in atmospheric research and in developing technically appropriate standards. The completed European scientific project REACT4C in particular, brought significant progress in understanding the impact of aviation on climate. Concerning Air Quality, many gaps have been identified, in particular on emissions inventories and ultra-fine particles measurements.

Regarding the quantitative goals on CO<sub>2</sub> and NO<sub>x</sub>, the progress achieved today results from of a large variety of projects, including Clean-Sky, Enoval/Lemcotec/E-Break and a cluster of smaller projects focused in particular on combustor technology. Since the OPTI 2012 assessment, we observe some progress on CO<sub>2</sub>, and a modest one on NO<sub>x</sub> mainly in terms of technology maturity. Provided we maintain the level of effort on research, we are on track to reach the 2020 objectives with some remaining gap for CO<sub>2</sub>.

## Alternative fuels production and sustainability

No quantitative ACARE targets have yet been defined for alternative fuels. However, a preliminary assessment with respect to a number of relevant criteria has been carried out in CORE-JetFuel.

A preliminary selection of different types of renewable biogenic feedstock and fuel production technologies have been reviewed and evaluated and a preliminary assessment of selected integrated production pathways was conducted considering several criteria related to technical, economic and environmental issues.

The intermediate results show, among other aspects, that the economic competitiveness of all considered alternatives is insufficient to-date. This indicates that further technical R&D efforts should focus on the potential for significant cost reduction.

## Where we need to go next

### Noise

Relative to the **ACARE noise target of -10dB per operation**, the aircraft noise research effort can be considered as generally on track to meet its objective, but will require significant support in the few years remaining before 2020. Actions critical to the ultimate success of the comprehensive overall approach initiated around 2000 can be summarised in the following recommendations:

- Bring the most promising Generation 2 noise reduction technology to TRL6, through an appropriate full scale validation effort
- Very significantly increase the effort dedicated to Low Noise Aircraft configurations
- Consolidate wider implementation of low noise operational procedures

The noise reduction achievement of a CROR powered aircraft established at TRL4 needs to be further consolidated and it is important that the effort is maintained through dedicated research.

Relative to the second ACARE noise target (no people impacted outside airport boundaries), considering the evidence of increased sensitivity to noise in local communities impacted by aviation operations, it is essential that a greatly increased effort is launched at the earliest opportunity to address the key aspects of noise effects and impacts and ultimately support the implementation of successful policies complementing the technological achievements expected to be realised. While Europe benefits from world-class expertise in this area, a strongly coordinated and integrated approach would definitely provide a significant added value.

### Emissions

To reach the very challenging ACARE 2050 CO<sub>2</sub> reduction objective, it is essential to pursue a tremendous effort at the aircraft, engine and ATM & flight operation levels. Aircraft/Engine panel of key technologies must be further improved and introduced for evolutionary aircraft or engine

applications, unconventional configurations like aircraft equipped with ultra-high by-pass ratio engines such as CROR concept must be further matured (up to TRL6), and longer term disruptive applications like distributed propulsion aircrafts should be investigated (at lower TRL).

Regarding non-CO<sub>2</sub> emissions, future combustor technology should jointly satisfy ambitious NO<sub>x</sub> as well as non-volatile particulate matter objectives. There is a critical need for R&T on combustor technology with a maximum expected benefit from lean combustion, on the modelling of emissions and combustion related operability aspects and on experimental analysis which supports modelling or technology development.

Concerning Alternative Fuels, in addition to their expected CO<sub>2</sub> reduction benefit assuming harmonisation to converge on a common and technically satisfactory CO<sub>2</sub> Life Cycle Analysis methodology, significant particulates reduction potential is achievable by optimising their composition. In order to help fuel certification and fuel composition optimisation, developing predictive tools to model the fuel interaction with the aircraft fuel system or with the engine is necessary.

In order to progress on emissions environmental impacts on air quality and climate, various key issues identified by FORUM-AE should be addressed, like fine particles measurements at airports, inventories and modelling improvements, climate metric choice and cost function.

### **Alternative fuels production and sustainability**

At this point in time a number of preliminary recommendations and key messages can be stated:

There is a current lack of clear quantitative targets with respect to alternative aviation fuels at European level, e.g. in the “Flightpath 2050” and SRIA documents. A clear statement is needed about what is intended and expected to be achieved by implementing alternative fuels in commercial aviation, supported by a technical and production road-map.

It is important that there is a *specific* strategy for alternative *aviation* fuels and that the different related European policies are aligned. A stable framework of policies and incentives, providing reliable boundary conditions for investments, is needed for a successful ramp-up of production of alternative fuels for aviation.

It is crucial that any type of alternative fuel used by aviation is sustainably produced. Accordingly standards and certification schemes have to be harmonized internationally. A profound scientific and socio-economic understanding of the European potential for relevant resources has to be acquired.

The successful implementation of alternative fuels in commercial aviation requires establishing a *European* initiative, combining knowledge and experience of all relevant stakeholders (from academia, NGOs and industry) and benefitting from lessons learnt in national initiatives in an efficient and effective way. It is important to support, possibly through a dedicated funding strategy, the demonstration of full value chains for the production of alternative aviation fuels.

## 2.4. Safety and Security

2014 was one of the safest years on record for civil aviation, and yet there were tragic accidents that remind us how hard we need to work to ensure that aviation can continue to grow and at the same time maintain its excellent record as the safest means of travel. There were high-profile accidents like the disappearance of **MH370**, and the shooting down of **MH17** over Ukraine's conflict zone. In March 2015, the **Germanwings** air crash shocked the world, another game-changer that raises new questions about aviation safety and security.

But there were also reminders of the difficulties pilots can face when in difficult adverse weather conditions, the Air Asia crash reminiscent of AF447, and both of these accidents seem to suggest the pilots did not initially realise the true state of their aircraft, raising questions over the adequacy of the on-board automation, and whether the pilots could safely interpret what their cockpit displays were telling them. Research is already underway to support pilots' abilities to handle severe upset conditions, and EASA has also recently increased the training standards for such critical emergencies.

### Changing Boundary Conditions

The past two years have highlighted a number of new concerns that have enlarged the boundary conditions for safety and security considerations in aviation. The first is the disappearance of MH370, still unfound more than a year after its tragic disappearance. Many have asked how a large commercial airliner can simply go missing in this day and age. The second **game-changer** event was MH17, another commercial airliner, this time shot down over the Ukraine. There are plenty of conflict zones in the world, and the aviation industry is currently trying to determine how to manage safety and security of flights over such regions. The third was the Germanwings 9525 crash, itself a hybrid safety-security accident, which has raised new concerns and questions.

Boundary conditions will always change, particularly in a global, complex and evolving system such as aviation. What is needed is first a solid basis on which to respond to such events that can take us all by surprise. This means having the right research infrastructure in place, and a strong European institutional focus to derive rapid solutions that can restore safety and the trust of the travelling public. EASA is the obvious choice to lead Europe in the case of such events. However, **EASA** needs to have the right support mechanisms at its fingertips in order to respond in a research-informed and evidence-based fashion. This is set to improve towards the end of 2015, with EASA having a larger role to play in European aviation safety research.

With a general rise in global terrorism, and several scares on the **cybersecurity** front, security is becoming a hot topic, and may in the near future become a stronger passenger concern than pure safety. While there is already a good deal of research occurring in aviation security, it could benefit from the kind of assessment process that has been undertaken for safety research by the CSA OPTICS. Additionally, although safety and security traditionally have worked separately, perhaps it is time to look for closer integration – or at least more collaboration – between these two critical functions.

## State of the Art of safety research – are we doing the right research?

The EC-funded **OPTICS** Project commenced in September 2013, and has been analysing current research efforts in aviation safety to determine if we are doing the right research, and to find out where there are gaps or inefficiencies. Over a period of four years it compares ongoing safety research against the SRIA Roadmap to see if we are heading in the right direction. OPTICS also runs expert workshops (two so far) on areas as diverse as **human factors**, safety intelligence, self-healing aircraft, safe integration of **drones** into civil airspace, and managing aircraft safety in **adverse weather**.



The last area is one where we are making significant advances, something that is clearly needed given high profile accidents such as AF447 and Air Asia 8501. EC-funded projects such as **SUPRA** (a simulator that gives pilots realistic sensation of a deep stall on a large aircraft) and **MAN4GEN** (another simulation approach which pushes pilots to their limits by facing them with difficult and deteriorating scenarios) show a strong way forward to help make such accidents a thing of the past. Such projects need to be moved forward towards deployment so that good research can be translated into operational (safe) practices.

Similarly, projects such as High Altitude Icing Crystals (**HAIC**) are leading to a far better understanding of this dangerous phenomenon. But the safety research in the area of weather is itself patchy, with some weather problems being well-targeted, and others receiving attention. What is clearly needed is a comprehensive research programme to tackle adverse weather on all fronts.

The safe integration of drones (RPAS) into civil airspace, and for example their potential use in and around airports, is a controversial issue, and research is challenged to keep pace with technological developments and the development of ever-smaller models.

In the expert workshop related to **Human Factors**, more than seventy experts agreed on the top two priorities: an approach that can integrate the effects of various human factors – fatigue, situation awareness, workload etc. into a single performance envelope prediction. This will enable us to monitor and predict when pilot or controller performance will degrade to a level that is unsafe, whereupon technology should warn them and even take over if necessary. This ambitious area has now started as part of the Horizon 2020 '**Future Sky Safety**' programme of work, and is an example of where ACARE (via OPTICS) has helped inform the EC's funding strategy.



The second main Human Factors area that needs to be addressed is better **automation**. New systems and advances are often putting more automation in front of the pilot, the controller, and

other operatives, and all too often the Human Factors of such automation has not been thought through, ignoring knowledge and processes to make the automation a good fit to the task. This results in poor return on investment, costly post-deployment re-design, or even rejection and disuse of the automation, as well as poor human-automation interaction during critical events.

This leads to the third main gap in Human Factors research, since it is also clear that in Europe Human Factors is not sufficiently well-placed to deliver what it is capable of, and what the industry needs. Given the clear importance of getting the Human Factors right, across the entire air transport system, there is an urgent need to develop a better **culture** of integrating Human Factors into our design and operation processes – this is already far better integrated in the US, for example.

### Future Trends

As Data Science becomes smarter at analysing **Big Data**, we need to harness this in aviation, turning data into ‘**safety intelligence**’ that can be acted upon in fast and ultimately real-time-frames.

Data collection and analysis (data mining) on a large scale is an area where the US has been ahead of Europe in aviation for some time, because data availability in European aviation is fragmented. This needs to be redressed quickly, or else Europe will remain in reactive mode whereas other major players will move ahead.

Safety and Security have never truly worked hand-in-hand, rather they tend to work in parallel, respecting each other from a distance, using different methods and different data, and security, by its nature, often needs to be confidential, whereas safety wants to share and be open. It is time to re-evaluate this position. Passengers who step onto a plane expect to get off at the other end, and do not want an accident to happen, no matter the cause. ACARE WG4, although mainly focusing on Safety due to the composition of its members, intends to focus more on Security from 2015 onwards. In particular it is setting up a sub-group to review SRIA priorities and also to develop new ideas and ‘game-changers’ that could revolutionise security.

### Progress on the SRIA

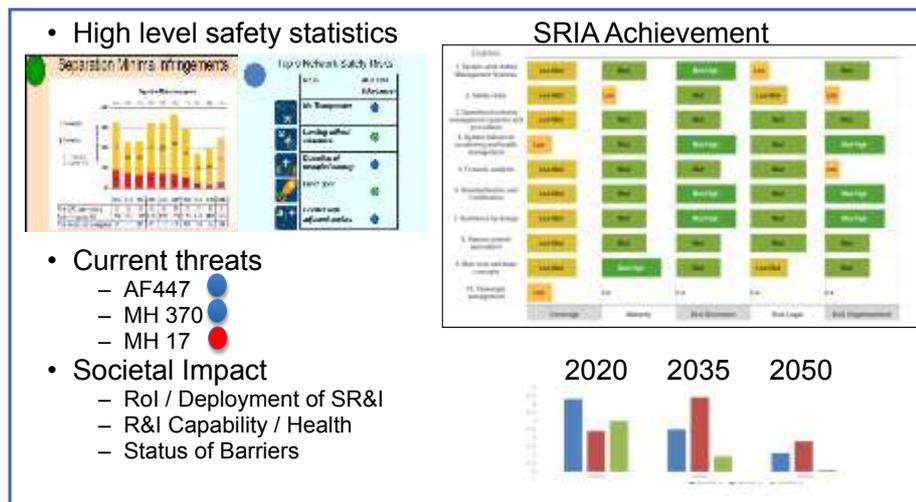
The OPTICS analyses so far suggest that the **SRIA roadmap**, for safety at least, is fit-for-purpose, with almost all safety projects and programmes mapping onto its Enablers and Capabilities. The first wave of analyses found that about half the SRIA was covered, with most projects contributing at a Medium level to the ambitions of the Enablers. What this means is that despite some significant advances that can augment aviation safety, most projects reviewed only focus on one part of the aviation system, e.g. the cockpit.



This picture is already changing as OPTICS evaluates the safety contribution of **SESAR**, the ATM upgrade programme, and Future Sky Safety, the Horizon 2020 programme that aims to develop transversal safety advances, affecting a much more complete aviation chain including airframe manufacturers, airlines, air navigation service providers and airports. These two research programmes, as well as **Clean Sky**, will help make the safety research and innovation picture more 'three-dimensional'.

Since there are some excellent safety research 'performers' already identified, it needs to be ensured that these mature into deployment, so that their safety advances can become reality. This is the point of safety research. But this needs to be monitored. Usually it is not. The assumption is that once the research reaches a certain level (TRL 6) it can be handed over and someone will deploy it, and others will follow until it is deployed system-wide. Meanwhile, the researchers will turn to the next idea and project. There is a serious danger that good ideas are not deployed, and safety advances are lost. There needs to be a closer connection between the research and the operators: effectively this should be more like a supply chain than a market-place. Three elements are needed in order to connect research more closely with operators: a safety research dashboard, a roadmap, and a research partnership capability.

The **Dashboard** will monitor how well the industry is using research to respond to today's safety challenges as well as those of the medium and long term (until 2050). It presents the progress of research against the longer term systemic challenges, but can also ask what is being done for more recent safety concerns and those that are emerging, or new 'game-changers' (such as MH370 and MH17). It can also ask whether we have truly solved problems such as handling aircraft in adverse weather, by implementing the research and seeing less incidents and accidents attributed to such causes.



The **Roadmap** can ask not only by when the research should be completed, but by when certain accident typologies should disappear. For example, the fast-tracking of means to prevent losing all trace of a commercial airliner (MH370) are being planned now, and measures will be put in place

before 2020. So, does that mean that we cannot lose a plane after this time? If so, or if it will take a little longer for the changes to spread to all airlines and all legacy commercial aircraft types, this can be put as a target on the roadmap (this is like aiming to eradicate a disease for good, as in Smallpox). The same can be done for landing in heavy snow, for handling high altitude ice, etc. Such a roadmap would bring a great focus to the research, and bind research and industry closer together, because it would also gain public (passenger) scrutiny.

There are excellent aviation safety **Research Facilities** spread across Europe, but it is unlikely that anyone knows where they all are; we remain fragmented. We need to develop a map of European research institutions to show the full portfolio of research capabilities and competencies, and to be able to connect them efficiently and effectively wherever appropriate (see section 2.5 on WG5 activities).

### Where we need to go next

If we take the gaps identified by OPTICS, and what the ACARE WG4 experts are telling us, there are some clear high priority safety and security research areas that should be funded and fast-tracked:

1. Manual handling in adverse weather
2. Develop an integrated research programme covering all weather hazards
3. Safe integration of drones into civil airspace
4. Collection and (Big) data analysis of safety and performance data from across the entire aviation system, for the development of predictive and real-time safety intelligence ('safety radar')
5. Smarter human-automation partnerships for safety
6. Better integration of Human Factors across the aviation industry
7. Determine better working arrangements between safety and security, particularly in 'grey areas' such as the Germanwings crash.
8. Develop an aviation safety research dashboard at the European level, dealing with urgent threats, short-term, mid-term and long-term challenges, and an associated safety research roadmap with targets for progressive eradication/mitigation of known accident types
9. Develop a landscape map of European safety research institutions and their associated research capabilities, highlighting 'centres of excellence' or research clusters.
10. Consider funding an OPTICS-like CSA on Security Research.

## 2.5. Excellent Skilled and Motivated Staff in Aviation and Research Infrastructure

The overall mission of ACARE WG5 is to support European aviation research and innovation activities towards the Flightpath 2050 goals by giving advice for:

- Prioritizing future research
- Developing and maintaining aviation research infrastructure
- Education, lifelong learning and outreach

In 2014 the group's activities focussed on the two latter key priorities: "developing and maintaining aviation research infrastructure" and "education, life-long learning and outreach". With the start of Horizon 2020, WG5 will now also intensify its activities on the third priority "prioritizing future research".

### Prioritising Future Research

This activity includes the identification of stakeholders, clarification of their role and an appropriate involvement in the European research and innovation process chain.

The group identified the following specific objectives/tasks for this priority:

- Monitor and review European aviation research
- Identify and propose criteria for setting research priorities
- Prepare strategy on research planning and instruments, so that the entire research and innovation process is covered appropriately
- Prepare guidelines (incl. proposal of topics) for the complete innovation chain, from basic research for a broad technological basis up to the preparation of future products

For this, WG5 started to team up with EASN, PEGASUS, EREA, GARTEUR and others, and will look for support from ASD to fulfil this task on "prioritizing future research". However, input from Working Group 1 - 4 is also required with regard to their research / research infrastructure needs as well as the demand on the next generation of aviation workforce. The structure of this links between WG 5 and the other WGs will be developed and installed in the near future.

The Joint Research Initiative (JRI) "Future Sky" proposed by EREA is a good example for this team building exercise. Future Sky's overall goal is "Twenty four-Seven", enabling maximum mobility and maximum modal embedment with minimum impact on the environment. This concept describes the full airside mobility, 24 hours a day, 7 days a week, resilient against any impacts e.g. from disruptive events like extreme weather, as described in Flightpath 2050. The activities within this JRI will prepare the ground for the future of aviation beyond the next generation vehicle and air traffic management and thus they are fully in line with the activity of WG5 on research including the identified specific objectives. The details about the interface between WG5 and Future Sky are currently under discussion in the group.

### Developing and maintaining aviation research infrastructure

WG5 prepared a discussion paper on how to fund and start the proposed work on the implementation of a strategic roadmap on aviation research infrastructures. The group discussed this paper with the European Commission to seek guidance and financial support e.g. via a Coordination and Support Action (CSA) for this challenging as well as labour-intensive task.

Once the CSA is in place, the group will continue the work on the identification and categorization of strategic aviation research infrastructures in Europe, driven by the needs defined as goals in FP2050. Additional support is expected from EREA, in particular from the new EREA Research Infrastructure Group, Clean Sky 2, and other European stakeholders. The analysis of existing research infrastructures itself should not be performed directly by the owners of RI with respect to the Flightpath 2050 needs, in order to find gaps and unnecessary duplication.

### **Education, life-long learning and outreach**

“Flightpath 2050” recognised the quality and availability of skilled labour as a critical driver for the sector competitiveness; education and training of aeronautical engineers and researchers have to be adapted to the requirements of the aviation sector including industry, research organisations, operators and public authorities.

WG5 co-organised a workshop in June 2014 on “Education and Training Needs for Aviation Engineers and Researchers in Europe” in collaboration with the European Commission and the EU-funded support action AirTN-NextGen.

The workshop was aimed at reviewing the situation in Europe concerning the education of future researchers and engineers and identifying needs for action.

More than 50 participants were present from 18 countries (including Switzerland and Ukraine) representing a wide range of stakeholders from universities or training centres, major industries, SMEs, research centres, Government agencies, and a few other organisations.

It involved a number of presentations addressing the main aspects, followed by an open discussion. The workshop provided useful best practices and ideas for follow-on activities at ACARE level, but also for Education-Business partnerships in the frame of Erasmus+ Knowledge Alliances.

In this context, WG 5 has invited and will continue to invite educational activities on European and national level to join the group to discuss and identify the skill needs of the aviation sector. To give an example, the group will establish an open communication route with PERSEUS, an EU funded Support Action on “Improving skills and knowledge base in European aviation” and provide feedback and expert opinions when required.

In addition, it will also continue to look for best practices in other sectors and to propose possible actions to the stakeholders on how to strengthen the cooperation/exchange between education and industry.

A detailed summary including the main conclusions of the workshop held 13<sup>th</sup> June 2014 can be found on the ACARE website.

## 3 CONCLUSIONS and NEXT STEPS

The ambitious goals addressed by Flightpath 2050, continue to challenge all ACARE stakeholders to achieve these goals. The ACARE Strategic Research and Innovation Agenda provides a phased roadmap to guide this effort. However, as the global economic, transport and environmental baseline changes, so this Research Agenda must be updated to reflect such developments. A number of such developments including the following now prompt a further review.

- Results of FP7, Clean Sky and SESAR delivering new technologies, common concepts and opportunities such as electrical flying.
- Emergence of new manufacturing processes that are vital for competitiveness.
- Recent accidents including MH370 and the Germanwings flights showing that additional issues need to be addressed.
- Development in more remotely piloted air systems (RPAS) is delivering new ideas and concepts which need to be taken into account.
- Application of IT including cyber security.

Some of the above developments and changes could not have been foreseen five years ago. **Thus ACARE with its role to maintain the SRIA has decided to review and update the content where necessary from the Research Agenda published in 2012.** This should include amendments that will reflect where Research and Innovation in Aviation has reached thus far as well as the changing European and Global environment in which the sector is now operating. The Strategy and Integration Board is also planning to have a meeting with relevant Directorate Generals (DG) of the European Commission other than DG for Mobility and Transport and DG Research and Innovation to inform them about the relevance of ACARE in general and the SRIA in particular and to solicit their input to the SRIA update process.

In addition to the update of the SRIA, ACARE and its working groups are committed to continually monitor the progress of the SRIA implementation, address as appropriate research needs from emerging issues and take their findings into account for providing strategic recommendations for future SRIA implementation.

The ACARE working groups will continue to cooperate with the EU-funded Coordination and Support Actions (CSAs) for the monitoring activity.

Further outreach actions will be organised including appropriate engagement with policy makers including the European Parliament as well as other stakeholders and speeches at conferences and press interviews.

The remainder of the document includes detailed reports from:

**Annex 1: Member States Group**

**Annex 2: Implementation and Review Group**

**Annex 3: Communications Group**

## Annex 1 – Member States Group

### 1. Introduction

The mission of the ACARE Member States Group is to foster the optimum involvement of Member States in the formation and execution of the European aviation research and innovation strategy.

To achieve this mission, a number of activities and overall objectives have been identified. These are to:

- Provide up-to-date information on the ACARE activities, the Strategic Research and Innovation Agenda (SRIA), as well as latest aviation research plans and results to Member States representatives.
- Ensure proper feedbacks from the group and the incorporation of Member States in the most important ACARE activities.
- Provide the Member States position on strategic issues dealt within ACARE and to give feedback to the other ACARE bodies on various ongoing activities.
- Provide a forum to discuss aviation related issues including those on the agenda of the H2020 Programme Committee – Transport Configuration which have strategic importance.
- Enhance communication between the ACARE bodies and the H2020 Programme Committee – Transport Configuration representatives.
- Address national programs, national platforms and to check the links with the SRIA.
- Monitor the implementation of the SRIA at the national level.
- Support the integration of newer and less proficient states.
- Make a progress towards national co-operations in aviation research.
- Maintain coordination with the AirTN Nextgen aviation CSA.
- Enhance coordination with other fields of research.
- Start own initiatives in order to achieve the above mentioned goals.

### 2. Representation/participation in 2014

In 2014, three meetings have been organised on the day before the Programme Committee – Transport Configuration in the Commission's premises, as a default. In principle, representatives of all Member States are invited for the meetings of the ACARE Member States Group. In average 11 members participate to the meetings, including representatives of the Commission. This includes also participation of smaller aviation countries such as Croatia, Estonia and Slovakia.

During 2014, in total, 15 different Member State representatives participated in the various meetings. These represent Ministries, academia, public national bodies or have been duly mandated by their respective governments. Observing the enclosed map and comparing the participation of 2014 against 2013, it is clear that countries at the borders of the Union are less represented in these activities (marked in red on the map) and tend to disengage from the ACARE process.

2013



2014



### 3. Activities and results

2014 has been a year of new activities, due to a launch of the first calls of a new framework programme Horizon 2020. In addition, the extension of the important initiatives in Aviation, namely Clean Sky and SESAR came into existence as Clean Sky 2 and SESAR 2020. The work of the Member States Group in 2014 focused on:

- Exchange views and positions on Horizon 2020, e.g. roles of Programme Committees – various configurations,
- The views of the Member States towards the structure and duration of the Work Programmes in Horizon 2020,
- The role of the Programme Committee towards different funding instruments (H2020 new instruments: RIA, IA, Art187 Clean Sky 2 JTI and SESAR 2020 PPP),
- Possibilities of a coordination between different parts of the Specific Programme of Horizon 2020 (e.g. between KETs and Transport Societal Challenge),
- Relation and coordination of different EU funding mechanisms as well as potential information on national approaches.

During 2014 a new co-chair was elected, Prof. Ivica Smojver (Croatia) kindly accepted to take over this role. The need for a new co-chair arose as Robert Dehm had to finalise his involvement as co-chair of the ACARE MSG, due to a job change. However, as to maintain continuity, Gerben Klein Lebbink was kindly asked to perform the duty of Co-chair until the Aerodays 2015.

In 2014 the ACARE Member States Group continued its activities and discussions on relevant topics around the ACARE goals. The main focus in 2014 has been the approach of the Member States on aviation RTD complementarity towards H2020.

This has resulted in a survey that identified the main approaches of the Member States and the national initiatives that have been taken. The table below shows a first result of this inventory. Further and more detailed information is expected to be gathered through the AirTN study planned for 2015.

AT		Take Off	€6-8 mio	annually, 2002 - 2013
DE		LuFo	up to €150 mio	annually, 2014 - 2017
HU		USZT	n/a	
PL		PBS	n/a	
UK		NATEP	ca. €27.5 mio	annually
UK		ATI	ca. €179 mio	annually, for a 7-year period
IT	Inc. some regional funds	Various	€80 mio	2014 & 2015
ES			ca. 500 mio	2006 – 2012
FR		Corac		National Strategic Platform
NL		TO2 funding	ca. €16 mio	2014
NL	Public & Private Funds	Innovation Contract Aeronautics	ca. €57 mio	2014- 2016

Another issue that has been discussed is the possible synergy with structural funds (ESIF). Several countries concluded that there is a wide variety in approaches taken and national structures implemented, what makes joint initiatives difficult.

In order to deepen discussions and background information for this topic, it was agreed to work together with the CSA for Aviation called AirTN Nextgen. The ACARE MSG advises this project and has asked AirTN Nextgen to look into the position in the different Member States in a structured way, and observe the link with the initiatives taken under Clean Sky 2. This should include updates of the Member States Capability study (2009), a review of the AirTN brochure on National Initiatives (2009) and a survey looking into regional activities. Furthermore, a Commission Representative (DG-RTD B5) has explained the view of the Commission related to synergies with the Structural Funds.

Finally the ACARE MSG Chairs have presented the view of the Member States and activities taken in the various Member States in the General Assembly of ACARE. The two main messages to the GA have been delivered:

- National Funds cannot compensate for the gap that is emerging in the lower TRL level research due to the focus on demonstration in the European research,
- Fully exploiting synergies between national, structural and Horizon 2020 funds also require use of the private stakeholders.

## Annex 2 – Implementation Review Group

The Implementation and Review Group (IRG) consolidates and maintains an overview of how and how far the ACARE Strategic Research and Innovation Agenda (SRIA) is being implemented. Based on the Working Groups' inputs, the IRG advises on potential priorities with regards to future research activities and has defined an initial framework for monitoring the success of SRIA implementation to date. This methodology will continue to be developed and fine-tuned as SRIA implementation progresses. The Implementation and Review Group is regularly informed of current activities and progress in Horizon 2020 calls, Clean Sky, SESAR, and related initiatives in order to ensure the alignment with the SRIA goals.

The ACARE Working Groups have mostly regained momentum and are now actively monitoring, prioritising and coordinating, together with the relevant Coordination and Support Actions (CSAs) launched under FP7 to support their activity, the SRIA implementation activities related to their respective challenge areas. The Implementation and Review Group integrates this output in a coherent manner across the whole field. In the perspective to optimize the relationship between the Working Groups and their supporting CSAs, the IRG has initiated, together with the Working Groups and the Strategy and Integration Board, a series of measures looking to improve these interactions and consequently the quality of the overall assessment. It is considered paramount that momentum is kept and even improved in the Working Groups and in the dialogue between ACARE and the CSAs, such as to allow for effective debate and continuous stakeholder engagement within the Implementation and Review Group and the ACARE process in general.

In addition, the IRG considered opportune to re-activate the ACARE International Cooperation (INCO) Working Group, with a view to updating and enhancing the "INCO Strategy Straw-man" produced in the context of ACARE in 2009, and therefore establishing a framework for identifying and prioritising strategic opportunities for initiating collaborative research activities with selected key third countries. The INCO Working Group has organised an open workshop which was instrumental in establishing a sound basis for their work and is progressing well towards delivering a full ACARE INCO Strategy Report, including related recommendations, in the context of the ACARE General Assembly 2015 (see details INCO report below).

Over the past year, IRG has identified infrastructure for co-modality as an area that needs to be picked up as both the preparation of the technology & the preparation of the infrastructure have to be run in parallel to achieve inter-modality between transport modes. Currently, aviation is the only ETP really addressing co-modality issues. Other game changers are digital manufacturing & cyber security which need to be addressed by ACARE. So far, ACARE WG4 has recognized it has been mainly focusing on Safety due to the composition of its members, but there is a clear need to focus more on security to ensure research in that field is covered. Based on lessons learnt from Horizon 2020 first calls, IRG will prepare a dedicated contribution to the mid-term review.

### ACARE INCO (INternational COoperation)

#### 1. Mission

The main mission of the ACARE INCO Working Group is to prepare a new INCO Strategy Report that – starting from the indications of the 2010 document – will provide more comprehensive and updated indications for future international cooperation activities as well as identifying strategic opportunities with selected key third Countries.

The potential topics for these research opportunities should be identified and selected in synergy with all the main European stakeholders of the sector, including universities, manufacturing industry, research centres as well as airlines, ATM (Air Traffic Management) ANSPs (Air Navigation Service Providers) and airports.

## 2. Deliverables

The main planned deliverables are:

- Material presented during the INCO workshop held in September 2014. This workshop balanced between 3 sessions (International Trade & Regulatory context - Successes and lessons learned from past and ongoing Aviation International Cooperation - International Cooperation as part of the EU R&I strategy and way forward) gathering a wide range of participants: policy and technical, public and private, European Commission (DG RTD, MOVE, TRADE etc.), Industry, ANSP, Research Organizations, Airlines, Airports, Academia, MS/NS, SMEs, Regional Clusters, EUROCONTROL.
- An ACARE INCO Strategy Report - containing recommendation and updating the previous “2010 document” - which will be available in 3Q 2015
- A synthetic and public version of this report is to be presented during the Aerodays 2015 in London.

## 3. Preliminary recommendations

The final recommendations will be available once the ACARE INCO Strategy Report is finalised but some preliminary recommendations can already be provided:

- European leadership in Aviation technology is now under threat by traditional and new Countries having ambitions in Aviation, in particular in aircraft manufacturing and ATM.
- International Cooperation with third Countries can be envisaged where there is equitable partnership, reciprocity, fair and equal treatment - in particular regarding IPR and access to public funding - common interest and mutual advantage, shared objectives and where excellent human resources, capabilities and win-win situations can be identified by European stakeholders.
- Difficulties in the granting and the enforcement of IPR constitute an obstacle to international cooperation, while research and innovation and trade policies are closely intertwined.
- Standardization and certification could also be addressed; Export Control regulations can be a partial showstopper considering Countries that are not part of Missile Technology Control Regime (MTCR).
- International Cooperation in Aviation should also interact with other sectors and transport modes such as automotive, railways, space and technological platforms (Fuel cells, Energy, KETs, materials, etc.) sharing lessons learned about INCO and status about enabling technologies development that could be useful for Aviation.
- The sharing of information should also involve different DGs from the Commission: RTD, MOVE, TRADE etc.
- In order to properly pursue the orientations of this ACARE INCO Strategy Report and support the related actions a specific CSA would be required.



For the future the ACARE INCO WG could also act as an efficient interface between Industries, Research Centres, Academia and the European Commission in charge of:

- Leading a potential CSA to complete the work initiated by this group,
- Updating the strategy concerning the international cooperation,
- Steering its implementation,
- Proposing topics for cooperation.

## Annex 3 – Communications Group

In order to support the direction and strategy agreed by the ACARE General Assembly the Communication Group retains the responsibility to execute a communications plan approved by the ACARE Strategy and Integration Board (SIB). It also supports the communication needs of the permanent and ad-hoc Groups of ACARE as appropriate, developing the relevant communication material and means, as necessary.

The principal aim of the Group has been to further enhance stakeholder engagement and influence policy makers to adopt the Strategic Research and Innovation Agenda (SRIA) by providing relevant communications which inform and raise awareness of the work of ACARE with specific target audiences.

Activity in 2014-15 included the completion of the dissemination of the SRIA across numerous venues at National and European level. This provided a useful opportunity to promote relevant information including awareness of technology programmes to encourage further participation of Member State organisations, small and large, in EU research programmes. This was facilitated by ACARE stakeholders (ASD and Research organisations) via FP7 project AERA-Pro in conjunction with the FP7 project NEARS that supported the development of the SRIA.

In May 2014 at ILA, the Berlin air show ACARE on behalf of its aviation stakeholders throughout Europe celebrated 75 years of Jet Engines in aviation and recalled the transformation that Jet technology has brought to air transport worldwide. Stressing the need to decouple future air transport growth from noise Prof. Johann-Dietrich Wörner stated “We know that the Flightpath 2050 goals are very ambitious, but their realization will help the aviation sector and thus calls for action”. Europe must lead the development of an integrated resilient air transport system that will meet the mobility needs of European citizens as well as the market needs with a substantial share for the development of new propulsion/engine technologies.

Significant effort was also devoted to support stakeholder events throughout the year and to ensure that the ACARE website is kept up to date including making available the latest ACARE documents as well as key documents from stakeholders. The Group has prepared a new public ‘leaflet’ titled “ACARE – Addressing New Horizons in Aviation” whose purpose is to provide an opportunity to engage with new Members of European Parliament and European Commission resulting from last year’s elections.





The Group routinely engage with the ACARE coordination and support actions (CSA's) underway to review and report progress on Flightpath 2050 goals with the aim to integrate dissemination events/workshops to capitalise on common audiences and to avoid duplication.

Looking forward the Communications Group will continue the above activities and support Aviation events and workshops where required. The Group is actively supporting the 7<sup>th</sup> EC Aerodays event and has prepared a comprehensive brochure detailing the success stories and key messages to celebrate “**15 years of ACARE**” in 2015 at the event to be held in London in October 2015.



[www.acare4europe.org](http://www.acare4europe.org)

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