58 PARE RECOMMENDATIONS FOR AERONAUTICAL RESEARCH IN HORIZON EUROPE

PARE

Covering
- the 23 ACARE Flightpath 2050 Goals
- + 35 complementary PARE Objectives
- 68 priorities ranked in 4 levels

Based on
1st Year Report of the PARE Project

58 PARE RECOMMENDATIONS

www.pareproject.eu/publications

TABLE OF CONTENTS

INTRODUCTION

The ACARE (Advisory Council for Aeronautical Research in Europe) [1] has provided guidelines for aeronautical research to the European Commission embodied in its Framework Programs. ACARE has produced SRIA (Strategic Research and Innovation Agenda) [2] setting out the challenges for aeronautics in the coming decades. More specifically the report Flightpath 2050 [3] lists a set of 23 goals organized into 5 groups. The main motivation for the project PARE (Perspectives for Aeronautical Research in Europe) is to assess the progress towards each of the 23 ACARE goals, the gap remaining and to propose measures leading to their achievement. To 23 ACARE goals in five areas, the PARE project adds five supporting areas, leading to 35 PARE objectives that complement the 23 ACARE goals in a set of 58 Recommendations for Aeronautics Research in Horizon Europe.

The five areas grouping the 23 ACARE goals are: (i) meeting social and market needs; (ii) maintaining and extending industrial leadership; (iii) protecting the environment and the energy supply; (iv) ensuring safety and security; (v) prioritizing research, test facilities and education. The five supporting areas grouping the 35 PARE objectives are (vi) long-range air transport and related markets; (vii) emerging aviation technologies; (viii) cooperation beyond Europe´s borders; (ix) attracting young talent to aeronautics; (x) increasing the participation of women. Each of these 10 areas was the subject of one paper in the PARE session at EUCASS 2019 Symposium, highlighting the PARE recommendations in that area, based on an extensive background document, the PARE second Year Report, available online at [4].

Each of the 58 PARE Recommendations for Aeronautics Research in Horizon Europe has a similar structure consisting of eight elements: (a) statement: text of the ACARE goal or PARE objective concerned; (b) recommendation(s), one or several brief statement(s) of the action(s) to be taken; (c) rationale: current situation and future prospects motivating the recommendation(s); (d) stakeholders: institutions that could contribute to the implementation at academic, research, industrial, regulatory and operational levels in national and international contexts; (e) relevance: expected impact of the initiative; (f) priority: justification of the priory rating on a scale from three asterisks (top) to zero asterisks; (g) justification: reference to the section of the PARE report containing detailed supporting information. The few highest priorities are given to the issues that could have the greatest impact on the future of aviation in Europe. The more numerous lower priorities remain as essential contributions to the balance and completeness of the European aeronautical activity.

The 58 PARE recommendations have been classified in a hierarchy with 4 levels of priority. The present paper will illustrate the overall review of the PARE project with a brief mention of the recommendations with the highest priorities. The highest priority has been assigned to 4 out of 23 ACARE goals and 4 out of 35 PARE objectives, addressing: (i) the global competitiveness of the European aeronautical industry, not only for long-range air transport, but also in other sectors where it leads (like helicopters) or lags (like drones); (ii) the challenges of airspace capacity and environmental impact that could become impediments to the future growth of aviation; (iii) the strengthening of institutional

cooperation in aeronautical clusters covering all stages of development from basic research to product innovation and market penetration and operational utilization; (iv) the enhancement of safety and security through high certification and operational standards, that support the unique position of aviation as the safest mode of transport regardless of location on the globe.

PART II considers several specific aspects related to the Flightpath 2050 objectives, such as market, competitive and cooperative conditions, emerging technologies and material and human resources.

The latest 2nd year version of the PARE report adds to the 1st report a first outline of two "What If ?" studies concerning two topics that could change the landscape of commercial aviation as we see it now: (i) the possible emergence of a middle-of-the-market aircraft (MMA) category, intermediate between the two main current categories short long-haul single/twin-aisle small/large; (ii) the possible emergence of a strong Chinese or Sino-Russian aircraft sector and its implications for regional and global aircraft markets including the Airbus-Boeing duopoly. The What If? study on the MMA focuses on such issues as the current size of the market and the extent to which it could grow with the availability of more efficient aircraft for long thin routes that could expand with low-cost carriers; it could consider side issues such as the engine for the MMA proving suitable for revitalizing the ailing breed of four-engine long-haul aircraft. The What If? Study on Chinese or Sine-Russian cooperation takes into account the magnitude of the internal market and its implications for the international market, it could consider the major role played by equipment suppliers (engines, systems, avionic (s) that account for a large fraction of the value of current aircraft, for different airframe integrators. The PARE session at EUCASS aims not only to disseminate the results of the project detailed in the 2nd year report [4] but also and most importantly to collect suggestions, comments and other inputs to be incorporated in the final 3rd year PARE report.

This introduction is followed by the 58 PARE recommendations to Aeronautics Research in Horizon Europe in the same order as the 23 ACARE Goals followed by the 35 PARE Objectives, one per page, with illustrations from the PARE 1st Year Report. Each page includes:

1. Recommendation(s): a brief statement of the actions to be taken;

2. Rationale: current situation and future prospects motivating the recommendation;

3. Stakeholders: institutions that could contribute to implementation: European Union (EU), Member States (MS), Aerospace Industry (AI), Research Centres (RC), Universities and Academia (UA), Certification Authorities (CA), Accident Assessment Organizations (AA), Air Navigation Service Providers (AN), Airlines (AR), Airports (AP), Professional Associations (PA);

4. Relevance: potential impact of the initiative;

5. Priority: justification of the priority rating on a scale from 3 asterisks (top) to zero asterisks;

6. Justification: reference to the section of the PARE Report containing more detailed information.

ACARE Goal 1

An air traffic management system is in place that provides a range of services to handle at least 25 million flights a year of all types of vehicle, including unmanned and autonomous systems that are integrated into and interoperable with the overall air transport system with 24-hour efficient operation of airports. European air space is used flexibly to facilitate reduced environmental impact from aircraft operations.

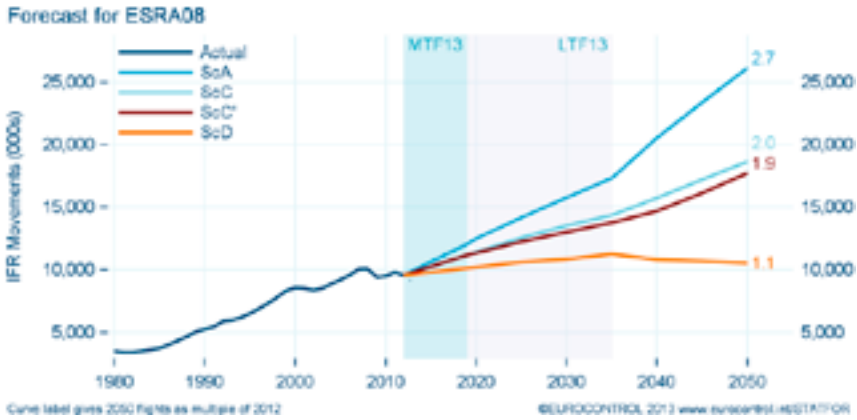


Figure 1 – EUROCONTROL scenarios for 2050

(Source: https://www.eurocontrol.int/sites/default/files/article/content/documents/official-documents/reports/201306-challenges-of-growth-2013-task-7.pdf)

RECOMMENDATION 1

A broad and deep research effort must be maintained concerning all aspects of Air Traffic Management (ATM) that can contribute to increasing airspace capacity with equal or greater safety.

RATIONALE

The growth of air transport puts increasing demands on air traffic capacity with undiminished safety. The foreseen operation of UAVs in manned airspace will increase the demand for capacity. As capacity limits are approached there are more delays that cause inconvenience to passengers and increase emissions and fuel costs. Together, airport noise and air traffic capacity, could become the two main bottlenecks for the growth of aviation.

STAKEHOLDERS

EU MS AN AP AR AI RC UA

RELEVANCE

The air traffic capacity must increase with undiminished or improved safety to accommodate traffic growth and UAVs without incurring major delays.

PRIORITY

Air traffic capacity could potentially become an obstacle to the growth of aviation and past experience shows that approaching capacity limits can cause major disruption in terms of flight delays and operating costs and emissions.

JUSTIFICATION

PARE report Section 2.1 and Topics T2.1 and T2.2.

ACARE Goal 2

A coherent ground infrastructure is developed including airports, vertiports and heliports with the relevant servicing and connecting facilities, also to other modes.

Figure 2 – The map of Europe with the marked airports

(Source: https://www.researchgate.net/figure/The-map-of-Europe-with-the-marked-airports-Source-Own-elaboration_fig1_276779968)

RECOMMENDATION 2

Urban and land planning methodologies need to be developed to optimise on a regional basis the location of airports, vertiports and heliports to simultaneously provide convenient links to other transportation nodes and minimise environmental impacts and disturbance of populations.

RATIONALE

The integration of airports into regional planning must include interfaces with other modes of transport and also the compatibility with other land users.

STAKEHOLDERS

EU MS AP AR AN

RELEVANCE

The airport network should cover population needs at regional, national and European and intercontinental level.

PRIORITY

There is the need to harmonize inter-modal transport at the regional level and fast air transport or a European scale.

JUSTIFICATION

PARE report Section 2.2 and Topic T2.3.

ACARE Goal 3

European citizens are able to make informed mobility choices and have affordable access to one another, taking into account: economy, speed, and level of service (which can be tailored to the individual customer). Continuous, secure and robust high bandwidth communications are provided for added value customer applications.

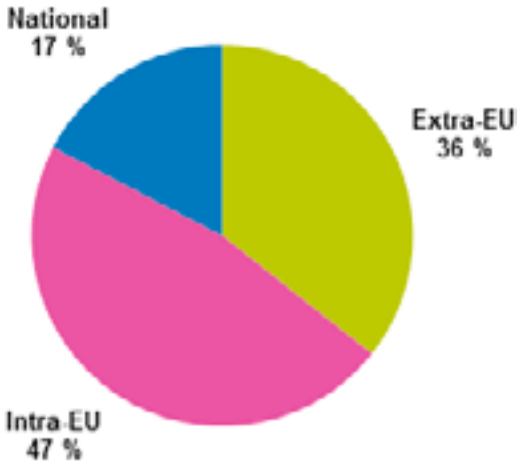


Figure 3 – Overview of EU-28 air passenger transport in 2016.

(Source: http://bit.ly/2YGXzVn)

RECOMMENDATION 3

Promote a one-shop centralised travel information site where the EU citizen can readily find the alternative options for connecting any two locations, including costs and timetables, with links to reliable booking.

RATIONALE

There are many sources of travel information and services with different objectives and priorities making a choice confusing and often non-comparable.

STAKEHOLDERS

EU MS AR AP CA AR PA

RELEVANCE

An independent, reliable and comprehensive source of comparable and reliable travel information would serve the interests of the citizen and fair competition to offer the highest quality and most efficient air travel, promoting the growth of air transportation

PRIORITY

The information is available, although in a scattered and inconsistent form, with plenty of scope for improvement.

JUSTIFICATION PARE report Section 2.3 and Topic T2.4.

90% of travellers within Europe are able to complete their journey, door-to-door within 4 hours. Passengers and freight are able to transfer seamlessly between transport modes to reach the final destination smoothly, predictably and on time.

Figure 4 –High-speed rail network mostly develops in Western Europe.

(Source: http://bit.ly/2OHwuln)

RECOMMENDATION 4

Revise the goal to take into account (a) the distance and duration of the flight and (b) cover the time period from arrival at the departure airport to exit from the destination airport.

RATIONALE

The aviation sector (b) cannot be responsible for what happens outside the aircraft and airports and cannot influence travel time between home/work and the airport. The flight distances within the EU can go up to 3 000 Km, and some aircraft are slower (propeller driven) than others (jet-powered) so travel times can differ.

STAKEHOLDERS

AR AP MS EU

RELEVANCE

The realistic information that can be provided to a traveller consists of: (i) Flight time that airlines can provide; (ii) Time for departure and arrival procedures that the airport can manage. Travel beyond the airport is out of control of the aviation sector.

PRIORITY

The information is available or predictable but not as reliable or accurate as of the business traveller needs and can disrupt leisure travel connections and plans.

JUSTIFICATION PARE report Section 2.4 and Topics T2.5, T2.6 and T2.7

Flights arrive within 1 minute of the planned arrival time, regardless of weather conditions. The transport system is resilient against disruptive events and is capable of automatically and dynamically reconfiguring the journey within the network to meet the needs of the traveller if a disruption occurs. Special mission flights can be completed in the majority of weather, atmospheric conditions and operational environments.

ARRIVAL AIRCRAFT	ICAO CODE	AVERAGE DELAY PER FLIGHT (MINS	AVERAGE DELAY PER FLIGHT PERCENTAGE CHANGE	AVERAGE DELAY PER DELAYED ARRIVAL	PERCENTAGE OF DELAYED ARRIVALS
LONDON/GATWICK	EGKK	21.6	7%	46.0	46.9%
MANCHESTER	EGCC	16.1	24%	35.1	45.8%
LISBON	LPPT	15.9	26%	32.8	48.5%
LONDON/LUTON	EGGW	15.0	8%	34.6	43.4%
LONDON/STANSTED	EGSS	14.6	16%	34.2	42.7%
TEL AVIV/BE GURION	LLBG	14.5	26%	29.7	48.8%
BIRMINGHAM	EGBB	13.9	27%	31.7	43.9%
COLOGNE-BONN	EDDK	13.9	17%	33.9	41.0%
MILAN MALPENSA	LIMC	13.8	12%	35.7	38.6%
ANKARA-ESENBOGA	LTAC	13.5	24%	27.6	48.8%

Table 1 – All - causes delay. The Top 10 Affected Arrival Airports 2017. *(Source: http://bit.ly/33fcd9l)*

RECOMMENDATION 5.1

More comprehensive weather data is made available to ATM and airlines to assist in achieving punctuality targets (see recommendations 13 and 15.1).

RECOMMENDATION 5.2

A rapid near real-time simulation capability is developed for ATM to (a) accommodate special emerging flights and (b) adjust to major disruptive events.

RATIONALE

Punctuality of air transport in adverse weather conditions depends on the availability of meteorological date sufficiently in advance for efficient re-routing. Disruptive events and special flights that require reconfiguration of multiple flight paths can be made efficiently if supported by fast and reliable simulation tools.

STAKEHOLDERS

EU MS AN AC AR AI RS NA

RELEVANCE

Being able to maintain a steady flow of air traffic is particularly relevant, and more difficult, during major disruptive weather events, like ash clouds or freezing conditions.

PRIORITY

This is an area of gradual progress where steady effort should be maintained, but nothing revolutionary is expected.

JUSTIFICATION PARE report Section 2.5 and Topic T2.8

"The whole European aviation industry is strongly competitive, delivers the best products and services worldwide and has a share of more than 40% of the world market."

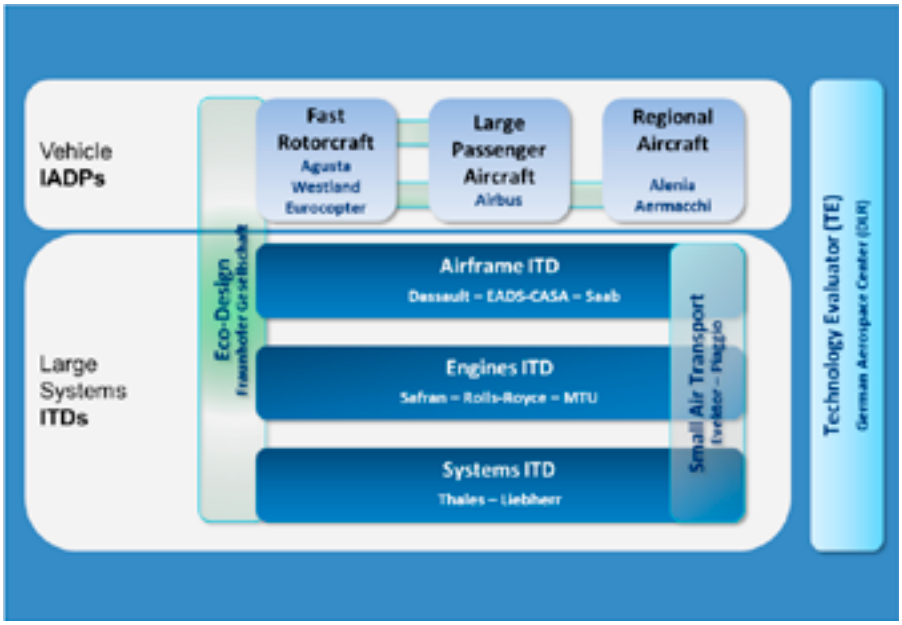


Figure 5 – Structure of the Clean Sky 2 Programme.

(Source: http://bit.ly/31hHOpE)

RECOMMENDATION 6

Maintain a broad-based application-oriented research and development activity covering all sectors relevant to the global competitiveness of the European aircraft industry.

RATIONALE

The importance of the aeronautical industry to the prosperity of Europe is well documented. Since aeronautics is a synthesis of advanced technologies it requires a mastery of all of them to remain competitive.

STAKEHOLDERS

EU MS AI RC UA AN AA AP PA

RELEVANCE

taking as an example the market for airliners with more than 100 seats, maintaining the Airbus share of 50% of the world market will require technological leadership in a broad range of technologies.

PRIORITY

This is the core of the aircraft market worldwide. The problems of the Airbus A380 with the passenger infotainment system and those of the Boeing 787 with the lithium-ion batteries show that even seemingly secondary aspects can cause major disruption.

JUSTIFICATION

PARE report Section 2.5 and Topic T2.8.

ACARE Goal 7

Europe will retain leading-edge design, manufacturing and system integration capabilities and jobs supported by high profile, strategic, flagship projects and programmes which cover the whole innovation process from basic research to full-scale demonstrators.

Figure 6 – Applications of small UAS

(Source: https://utm.arc.nasa.gov/index.shtml)

RECOMMENDATION 7

Support an observatory of global trends in aviation to ensure that major breakthroughs occur first in Europe or are matched without a delay in reaching the market.

RATIONALE

The industry does by itself a good job of ensuring its own competitiveness, although shorter-term needs may prevail over longer terms prospects. The EC and MS programs aim at long-term competitiveness on the basis of professional recommendations but could still benefit from a stable independent observatory of citizen needs, market trends and technological advances that could meet them.

STAKEHOLDERS

EU MS AI AR RC UA

RELEVANCE

Although the European aerospace industry is currently quite competitive there are a number of emerging technologies that could be used by current and new competitors to change the balance; these need to be monitored and supported to ensure Europe remains a leader in the aeronautical sector.

PRIORITY

Current mechanisms to remain competitive though still relevant in the future may not be sufficient.

JUSTIFICATION

PARE report Section 3.3 and Topics T3.4 and T3.5.

ACARE Goal 8

Streamlined systems engineering, design, manufacturing, certification and upgrade processes have addressed the complexity and significantly decreased development costs (including a 50% reduction in the cost of certification). A leading new generation of standards is created.

AIRCRAFT	YEAR OF FIRST SERVICE	DEVELOPMENT COSTS (CONSTANT 2014 $)	DEVELOPMENT TIME IN YEARS
Douglas DC-3	1936	4.9 Million	2
Douglas DC-6	1946	173 Million	3
Boeing 707	1958	1.5 Billion	6
Boeing 747	1970	5.8 Billion	4
Boeing 777	1995	8.0 Billion	6
Airbus A380	2007	16.5 Billion	7
Boeing 787	2012	13.6 Billion	7
Airbus A350 XWB	2014	15.6 Billion	8

Table 2 – Some data on recent widebodies.

(Source: Bowen, J. The Economic Geography of Air Transportation: Space, Time, and the Freedom of the Sky. London: Routledge, 2010. Adapted and extended)

RECOMMENDATION 8

Analyse the architecture of industrial aviation programmes, to identify the best practices in matching design, development, certification, production, operations and maintenance in the most cost-effective and time-efficient manner. The introduction of new technologies and stricter safety requirements should be accompanied by more efficient testing and validation to minimise time and cost.

RATIONALE

Emerging technologies like 4.0, Artificial Intelligence and Big Data offer the prospect of more efficient integration of the aircraft life-cycle from design through production to operations but require large investments in complex systems that should preferably be phased in a try-and prove approach.

STAKEHOLDERS

EU MS AI RC UA AR CA

RELEVANCE

The 4.0 factory is the next big trend in the industry, and aeronautics is no exception, adding operations and maintenance to designs and production.

PRIORITY

Developments in this area are widespread in the industry, and aeronautics requires specific adaptations.

JUSTIFICATION

PARE report Section 3.3 and Topics T3.4 and T3.5.

ACARE Goal 9

"In 2050 the technologies and procedures available allow a 75% reduction in CO2 emissions per passenger kilometre and a 90% reduction in NOx emissions. The perceived noise emission of flying aircraft is reduced by 65%. These are relative to the capabilities of typical new aircraft in 2000".

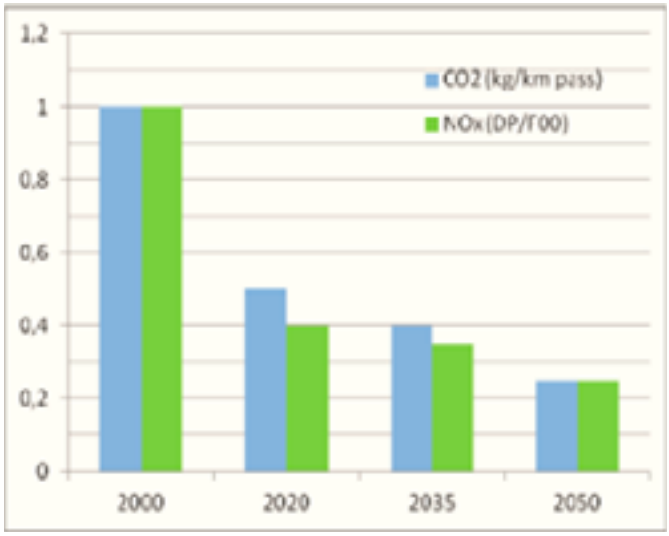


Figure 7 - ACARE CO2 & NOx goals calendar (using CAEP6 margin for NOx).

(Source: http://bit.ly/2GNvntU)

RECOMMENDATION 9.1

Support a broad research effort to reduce aircraft noise (a) at the source (b) through operating procedures and (c) taking into account psychoacoustic effects.

RECOMMENDATION 9.2

Besides struggling with short term solutions to an increasingly pressing noise problem a modest effort should be made towards a long-term definitive solution: aircraft inaudible outside airport boundaries.

RECOMMENDATION 9.3

Formulate a set of trade-offs between (a) different types of emissions (CO2, NOx, particles and water vapour) in (b) local airports and global cruise flights.

RECOMMENDATION 9.4

Besides struggling with short-term emissions problems put a modest effort towards a long-term definitive solution: the hydrogen-powered aircraft.

RATIONALE

The growth of air transport at a rate of 3 to 7% per year, leads to flights increased to the double by 2030, and triple by 2050; in order to avoid increased noise exposure near airports and emissions in cruise, the corresponding reductions must be made per flight. Noise is dominated by the engine at high thrust at take-off and by aerodynamics at approach with the engine at idle: thus, the full range of noise sources needs to be tackled, the operating procedures optimized, and psychoacoustic effects accounted for in order to succeed in this major challenge. The requirements for low emissions of CO2, NOx, particles and water vapour near airports and in cruise are sometimes contradictory and a reasonable compromise needs to be defined to guide engine design. The 'definitive' solutions to aircraft noise and emissions, such as aircraft inaudible outside airports and

STAKEHOLDERS

EU MS AI RC UA AN AR AP

RELEVANCE

Tolerance to airport noise is reducing and court or other actions to limit airport operations are likely to increase if overall noise exposure cannot be contained. Aviation should have a non-increasing and preferably decreasing role in global emissions.

PRIORITY

It is very challenging to contain total noise exposure at airports and failure to do so could limit airport operations and become a bottleneck for the growth of aviation. Emissions are a major local and global environmental concern and aviation should be an example of positive action. Beyond the pressing short-term issues of noise and emissions, a modest effort should be made to assess and mature in out-of-the-box long-term solutions.

JUSTIFICATION PARE report Section 4.1 and Topics T4.1 and T4.2.

ACARE Goal 10

Aircraft movements are emission free when taxiing.

Figure 8 - Boeing-787 relaunched the Li-ion battery system with the new design, adding an extra weight of 68kg to the weight of the airplane.

RECOMMENDATION 10

Develop a methodology to comprehensively assess the implications of electric aircraft taxying and electrical energy supply in terms of requirements, costs, land and environmental impact for a variety of airport configurations.

RATIONALE

Aircraft taxying under the power of its own engines and to a lesser extent auxiliary power unit (APU) running contribute to airport emissions that could be avoided by electric towing and power supplies.

STAKEHOLDERS

EU MS AP AR CA

RELEVANCE

Although electric towing and power supplies are feasible, the investment in vehicles and support infrastructure must be assessed as well as how costs are covered

PRIORITY

This is mainly an implementation issue that will be supported by progress in electric power, especially batteries.

JUSTIFICATION PARE report Section 4.2 and Topic T4.3.

ACARE Goal 11

Air vehicles are designed and manufactured to be recyclable.

Figure 9 – Use of batteries in a typical aircraft

RECOMMENDATION 11

Make a comprehensive assessment of materials used in aircraft production and assess recyclable alternatives and related issues of availability, ease of use, certification, maintenance and cost.

RATIONALE

The trend towards recycling is industry-wide, and in the case of aeronautics as others can be integrated as one of the objectives of goal 8.

STAKEHOLDERS

EU MS AI RC AU AR CA

RELEVANCE

Aviation must share the goal of preventing depletion of limited resources and making better and repeated use of materials already available.

PRIORITY

This is a wide effort among most industries, which aviation must share taking into account its specific needs.

JUSTIFICATION

PARE report Section 4.3 and Topic T4.4

ACARE Goal 12

Europe is established as a centre of excellence on sustainable alternative fuels, including those for aviation, based on a strong European energy policy.

Figure 10 - Possible pathways to obtain ATJ biofuel.
(Source: https://ec.europa.eu/energy/sites/ener/files/20130911_a_performing_biofuels_supply_chain.pdf)

RECOMMENDATION 12

Perform a comparative study of potential alternative fuels, their availability in the required large quantities and the feasibility and cost of large-scale production, distribution and use.

RATIONALE

There is a strong need to reduce the dependence on fossil fuels and although there are several potential alternatives it is not easy to match the energy density, usability and cost of kerosene in large quantities.

STAKEHOLDERS

EU MS Energy industry AI RC UA AR CA

RELEVANCE

Avoiding fast depletion of finite oil resources, finding alternative less polluting fuels and possibly also safer handling with undiminished energy density per unit weight and volume: demanding and necessary.

PRIORITY

This is an issue affecting all modes of transport, among which aviation is a major but not the largest user and should try to improve its position and contribution to the whole.

JUSTIFICATION

PARE report Section 4.4 and Topic T4.5.

ACARE Goal 13

Europe is at the forefront of atmospheric research and takes the lead in the formulation of a prioritised environmental action plan and establishment of global environmental standards.

REGION	YEAR OF FIRST SERVICE
Northern Europe	Temperature rise larger than European average Increased winter storm risk Reduction in ground frost depth and duration Increase in winter precipitation Reduction in snow cover but potential heavier snow events
North-Western Europe	Increase in winter precipitation Increased winter storm risk Increased flood risk Increased strong winds
Mountain regions	Temperature rise larger than European Average Reduced snow cover
Central and eastern Europe	Increase in warm temperature extremes Decrease in summer precipitation Reduction in cold spells and snow
Coastal zones	Sea – level rise More frequent and more intense storm surges
Mediterranean region	Temperature rise larger than European average Decrease in annual precipitation Increase in warm temperature extremes

Table 3 – Environmental issues impacts on aviation by region.

RECOMMENDATION 13

Use the regular airliner flights to collect in-situ atmospheric data and process this large amount of information to have near real-time knowledge of conditions along flight routes. This data could be supplemented by drones specially designed to fly in more remote regions of the atmosphere.

RATIONALE

It is possible to obtain much more comprehensive weather data both in time and location by using sensors aboard aircraft on regular flights. The collection, organization and processing of this data with quite homogeneous structure should be feasible by big data methods.

STAKEHOLDERS

EU MS AN AR CA AI RC UA

RELEVANCE

Detailed weather data with higher spatial and temporal resolution is the key to achieve several objectives of timeliness and safety of aviation, like ACARE goals 5 and 15.

PRIORITY

This major improvement in geographical and temporal coverage of weather data can be of use to other sectors as well as aviation.

JUSTIFICATION PARE report Section 4.5 and Topic T4.6.

Overall, the European air transport system has less than one accident per ten million commercial aircraft flights.

Figure 11 - Fatal accident rate of scheduled passenger and cargo fatal accidents per 10 million flights, by region of the world, using the regions defined by the ECCAIRS taxonomy from 2004 to 2013.

(Source: http://bit.ly/20CWD4x)

RECOMMENDATION 14

Consider accident causes by order of statistical occurrence and for each class identify and implement appropriate safeguards.

RATIONALE

The progress in aviation safety has been remarkable and steady on a timescale of decades by progressively identifying, investigating and virtually eliminating the major causes of accidents.

STAKEHOLDERS

EU MS AA AN CA AI RC UA AR

RELEVANCE

The safest mode of transport can only benefit from being made even safer, and this requires investigating accident classes, finding corrective actions and proving that they can be implemented.

PRIORITY

This is a long-term sustained effort, not a peak-and-done activity.

JUSTIFICATION

PARE report Section 5.1.

ACARE Goal 15

Weather and other hazards from the environment are precisely evaluated and risks are properly mitigated.

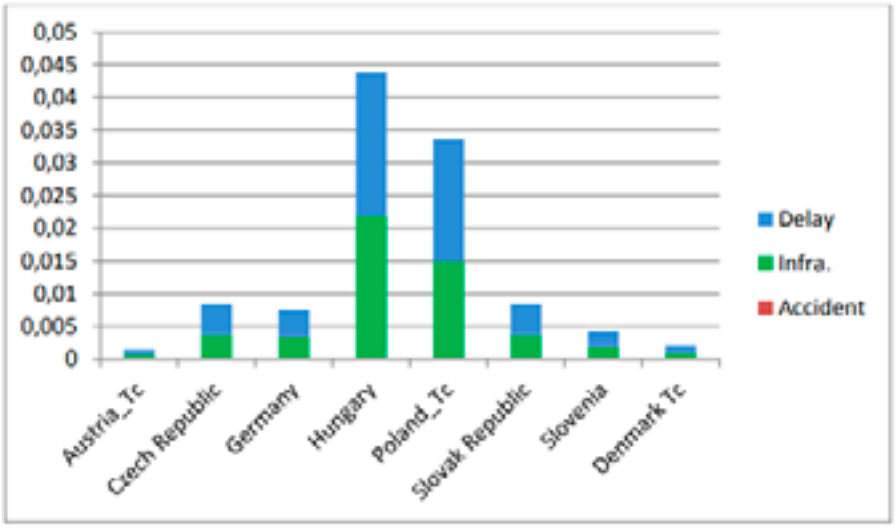


Figure 12 - Risk indicators in the Temperate Central region for aviation passenger's transport due to extreme weather events.

(Source: http://bit.ly/2YLXS5w

RECOMMENDATION 15

Promote low-cost basic research on a flight in adverse weather conditions (wind, rain, ash clouds, lightning, icing, storms and weather fronts) and select promising advances for demonstration.

RATIONALE

Besides collecting higher-quality and more comprehensive weather data with higher spatial and temporal resolution (ACARE goals 5 and 13) its effects on aircraft dynamics must be modelled to identify effective prevention/corrective actions that must be simulated/validated.

STAKEHOLDERS

EU MS UA RC AI AA AN CA AR

RELEVANCE

High-quality weather data and accurate knowledge of its effects on aircraft promote general timeliness of air transport (ACARE goal 5) and can prevent major accidents (ACARE goal 14).

PRIORITY

This must be a long-term sustained effort of learning from incidents on how to prevent them from becoming accidents.

JUSTIFICATION PARE report Section 5.2 and Topic T5.1.

ACARE Goal 16

The European air transport system operates seamlessly through interoperable and networked systems allowing manned and unmanned air vehicles to safely operate in the same airspace.

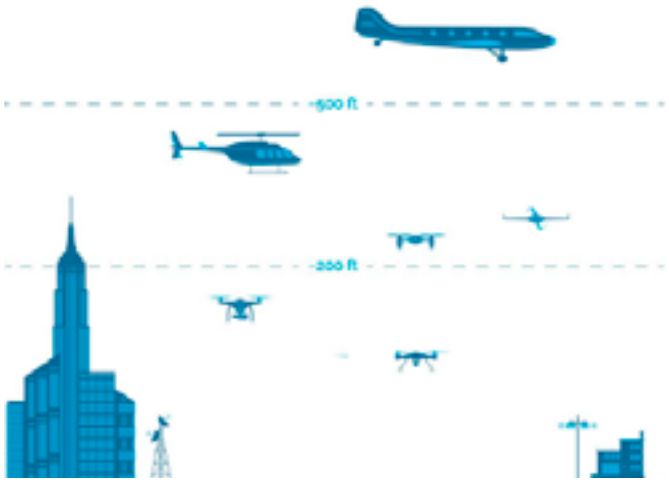


Figure 13 - UAVs operations by altitudes.

RECOMMENDATION 16.1

Assess the evolution of air traffic capacity in Europe compared with the growth of air transport to identify the spare capacity available to other users like UAVs.

RATIONALE 16.2

Establish the qualifications required of operators of UAVs and other aircraft compared with airline pilots and air traffic controllers to ensure that aviation remains the safest means of transportation.

RECOMMENDATION 16.3

Define the design, production, certification and maintenance procedures for UAVs and other aircraft to preserve or improve on the safety levels of current airliners that operate in the same airspace.

RATIONALE 16.4

Explore the increased use of partially underused airspace to enable the expansion of operations by new types of aircraft.

RATIONALE 16

The air traffic capacity needs to increase to keep up with the growth of air transport and the operation of UAV's in manned airspace will require additional capacity within the total achievable. The record of aviation as the safest mode of transportation is based on the highest engineering standards and professional qualifications as regards aircraft and cannot be compromised for UAV's operating in the same airspace. The use of partially unused airspace could provide testing area and additional capacity for UAV's to prove at least equal to manned aircraft in terms of safety, which is far from the case at present.

STAKEHOLDERS EU MS AI CA RC UA AR AA

RELEVANCE

UAV's offer an immense potential to expand air operations that will be realized sooner if the design and operational issues are addressed to prove they are at least as safe as manned aircraft.

PRIORITY

Is high for safety issues related to engineering standards of UAVs and qualifications of operators. Is medium for issues of sufficient airspace capacity to add UAVs as another class of users. The maturation of UAV technologies and operations to the safety standards of aircraft is the baseline fundamental effort on which other objectives depend.

JUSTIFICATION PARE report Section 5.3 and Topic T5.2.

ACARE Goal 17

Efficient boarding and security measures allow seamless security for global travel, with minimum passenger and cargo impact. Passengers and cargo pass through security controls without intrusion.

Figure 14 - Key themes, under which GASeP specific goals and targets could be pursued.
(Source: http://bit.ly/2ML2MJk)

RECOMMENDATION 17

Develop non-intrusive passenger screening methods and foolproof luggage checking that allow fast flow through registration, border and boarding procedures.

RATIONALE

Unfailing detection of dangerous individuals and objects can be combined with fast and efficient passenger and luggage screening only by developing better technology at the level of detector sensitivity and data processing.

STAKEHOLDERS

EU MS AP AR CA PA

RELEVANCE

Although passengers should understand that their safety is paramount, it is preferable not to test their tolerance and patience with intrusive and lengthy airport checking procedures.

PRIORITY

Like many other issues in aviation, again a matter of sustained unrelenting effort to adopt the most recent effective technologies.

JUSTIFICATION PARE report Section 5.4 and Topic T5.3.

Air vehicles are resilient by design to current and predicted onboard and on the ground security threat evolution, internally and externally to the aircraft.

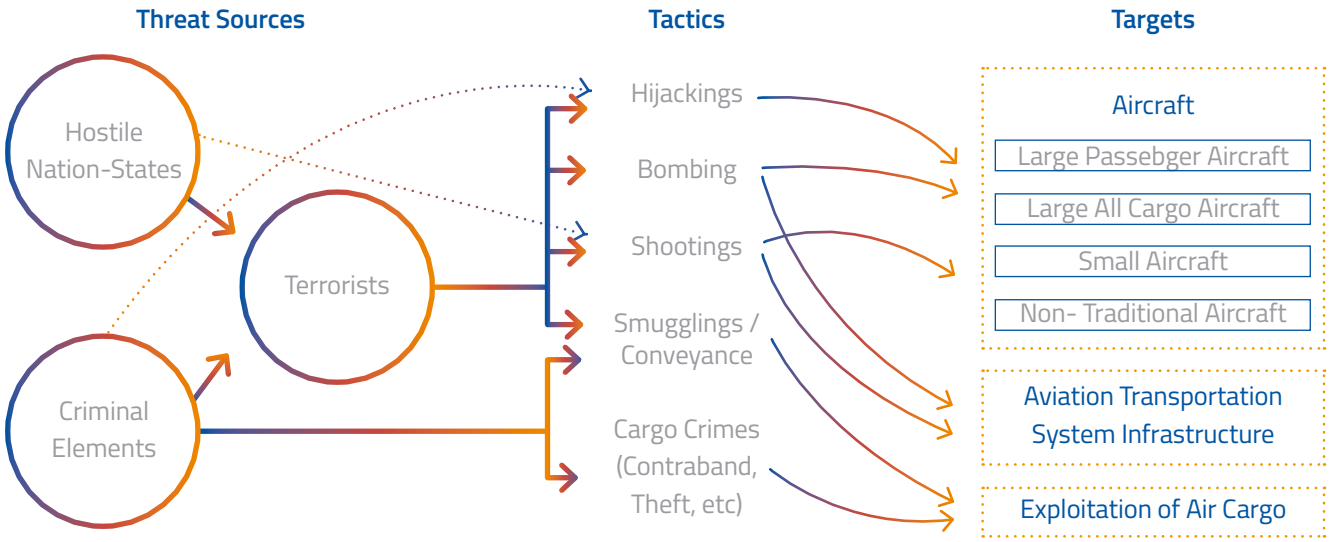


Figure 15 - Aviation Security Threat Sources, Tactics, and Targets.

RECOMMENDATION 18.1

Design aircraft and establish procedures to (a) prevent unauthorised entry into the cockpit, (b) allow remote take-over up to safe landing in the case of an identified flight anomaly while (c) designing the system to be immune to the most sophisticated hacking.

RECOMMENDATION 18.2

Set up an independent observatory of external risks to aircraft overflights to advise airlines or failing that warn passengers.

RECOMMENDATION 18.3

Design a worldwide airliner flight monitoring system and accident data recorders to ensure that accident/incident data is available regardless of time and location of occurrence.

RATIONALE 18

Threats to aircraft can come not only from hijackers but also from aircrew disabilities and in some cases remote control may be the only solution that must be immune to hacking or interference. The ICAO mandated national reporting of risks to aviation safety in areas of conflict has proved inadequate in Ukraine and elsewhere, and an independent observatory is needed to advise airlines and warn passengers. The occurrence of accidents that cannot be explained or take years to be investigated should be avoided in the future by worldwide monitoring of aircraft flights and mandatory fitting of air data recorders that can survive nearly all conditions, e.g. separate from the aircraft, float in the ocean and emit location.

STAKEHOLDERS

EU MS CA AN AR AI RES AU

RELEVANCE

Aircraft overflights of unsafe regions must be avoided. Interference with safe flight procedures must be prevented. If an accident occurs, its causes must be known to prevent a recurrence.

PRIORITY

It is imperative to prevent interference with safe flight or overflight of conflict regions. Accident investigation should be feasible even in the most extreme cases.

JUSTIFICATION

PARE report Section 5.5 and Topic T5.4

The air transport system has a fully secured global high bandwidth data network, hardened and resilient by design to cyber-attacks.

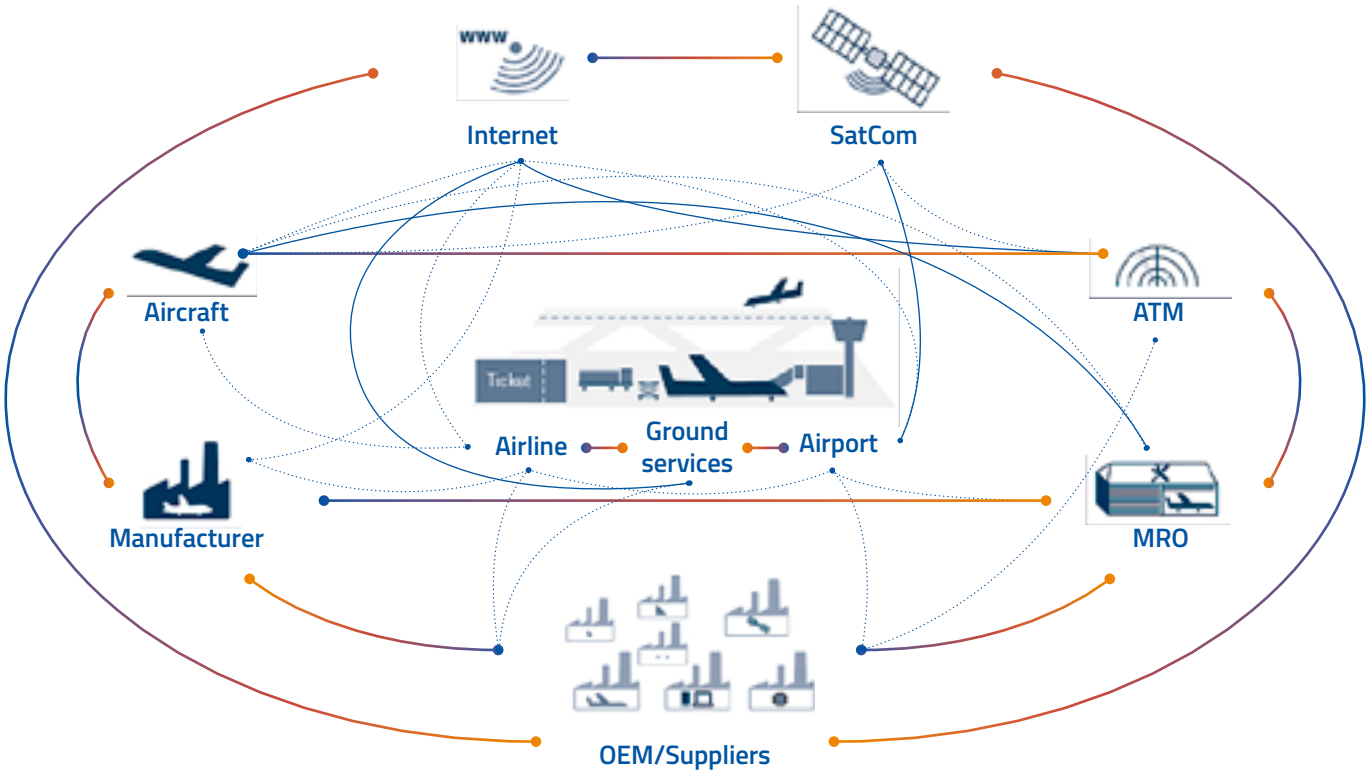


Figure 16 - Interconnection of the air transport system: arrows indicate the interfaces for information exchange and, thus, represent risks for contagion effects in the case of false or missing information.
(Source: http://bit.ly/2YJFyKc)

RECOMMENDATION 19.1

Assess the evolution of bandwidth requirements required to cope with increasing telecommunication needs associated with improved navigation, on-board systems monitoring, passenger connection and other services.

RECOMMENDATION 19.2

Establish evolving standards for protection against cyber attacks, with different levels, the highest for flight systems and the lowest but non-trivial for ticketing, bearing in mind the risk of intrusion from lower levels.

RATIONALE

The increase in bandwidth is a pre-requisite for more efficient and safer air transport in such aspects as navigation and air traffic management, systems and safety monitoring and general communications. More data on more flight critical functions require cyber protection to a higher level. The vulnerability to disruption by cyber-attacks goes to the lowest level of airline ticketing. Countering cyber-attacks at all levels also requires blocking access up to the criticality chain.

STAKEHOLDERS

EU MS AN AR AP AI RC UA

RELEVANCE

Aviation has been one of the preferred targets of malicious actions that could extend from hijacking to hacking. The cyber-attacks should be prevented in the future better than hijacking has been in the past.

PRIORITY

It is important to ensure cyber resistance at all levels, and in particular flight critical systems on board and on the ground. The challenges of larger bandwidth are shared by aviation with other sectors that may be competing for the electromagnetic spectrum.

JUSTIFICATION PARE report Section 5.6 and Topics T5.4, T5.5 and T5.6.

ACARE Goal 20

European research and innovation strategies are jointly defined by all stakeholders, public and private, and implemented in a coordinated way with individual responsibility.

GENERAL STATISTICS ON THE FUNDED AEROSPACE R&D COLLABORATION NETWORK

	FP2	FP3	FP4	FP5	FP6	FP7
EUROPEAN FRAMEWORK PROGRAMMES	1987 - 1991	1990 - 1994	1994 - 1998	1998 - 2002	2002 - 2006	2007 - 2013
NUMBER OF PROJECTS	390	714	241	196	255	217
NUMBER OF PARTICIPANTS	2171	4066	2301	2385	3899	2791
AVERAGE NUMBER OF PARTICIPANTS PER PROJECT	5,6	5,7	9,5	12,2	15,3	12,9

Table 4 - General information concerning the aerospace sector funded from FP2 to FP7 in the time period 1987 to 2013
(Source: http://bit.ly/2OCTdin)

RECOMMENDATION 20

Safeguard the long-term competitiveness of European aviation by supporting a broad program with a wide variety of low-cost applied basic research up to TRL3, to bridge the gap between the fundamental research of ERC and near-market driven focus of JUs, ensuring that Europe does not miss out the promising new ideas that could be exploited first by others to their advantage.

RATIONALE

The EU aeronautics programme has had remarkable growth in the allocation of resources from 36M€ in FP2 to 3.6B€ in FP7. This has been accompanied by a shift in projects from basic research (less than 1M€), to industrial cooperation (4-10M€), to large-scale demonstration (20-120M€) to the Joint Undertakings (more than 1B€). This shift to large scale near-market research and development has led to a neglect of basic fundamental research essential to the long-term competitiveness of the aeronautical sector.

STAKEHOLDERS

EU MS UA RC AI

RELEVANCE

There is a large gap between the high-quality scientific research sponsored by the ERC and the market-oriented near term developments of the JUs that needs to be filled by fundamental applied research with an aeronautical focus, to ensure that Europe retains a source of new ideas that are the basis of innovation and long-term competitiveness.

PRIORITY

The prosperous current state of the aeronautical sector could be undermined by a lack of long-term vision and new ideas that can be supported at a small fraction (1-3%) of what is invested in JUs.

JUSTIFICATION PARE report Section 6.1.

ACARE Goal 21

Creation of a network of multidisciplinary technology clusters based on collaboration between industry, universities and research institutes.

ONE – TIME PARTICIPANTS		
ORGANIZATION TYPE	**AMOUNT**	**PERCENT**
Industrial Group (IND)	2834	73,3%
Research Organizations (ROR)	355	9,2%
Education and Science Facilities (EDU)	199	5,1%
Government and other public authorities (GOV)	87	2,3%
All other organizations (OTH)	390	10,1%
Sum	**3865**	**100%**

Table 5 - One-time participants by organization type.
(Source: http://bit.ly/2OCTdin)

RECOMMENDATION 21

The creation of multidisciplinary technology clusters requires a balanced and proportionate support of 4 levels of projects: (a) basic (3-5%); (b) collaborative industrial (15-17%); (c) large-scale demonstrators (20-30%); joint undertakings (50-60%).

RATIONALE

A balanced aeronautical research programme should have 4 levels: (i) 50-100 basic research UA up to 1M€ each exploring up to TRL3 all sorts of novel promising ideas; (ii) 20-40 industrial research projects (4-10€) joining AI, RC, UA develop further the more prospects; (iii) 5-10 large scale demonstrators (20-100 M€) to reach practical scale on the best results at lower level; (iv) 1-2 joint undertakings (Clean Sky and SESAR) lead by industrial shorter term applications (1-2) B€. The EU FP Programs have shifted from one end to the other and should be rebalanced.

STAKEHOLDERS EU MS AI AN RC UA AR AP CA

RELEVANCE

The technology clusters could provide the filtering of results up the basic-industrial-demonstration-development chain. The basic projects as sources as new ideas should be based on peer review by UA as the ERC. The three higher levels would be based on selection by industry to ensure the focus of larger investments.

PRIORITY

Only a balanced allocation of resources at all 4 levels can promote the new ideas and links to practical application that can sustain competitiveness from the present to the future.

JUSTIFICATION PARE report Section 5.4 and Topic T5.3.

ACARE Goal 22

Identification, maintenance and ongoing development of strategic European aerospace test, simulation and development facilities. The ground and airborne validation and certification processes are integrated where appropriate.

Figure 17 - Downstream view into Test Section of the European transonic wind tunnel (ETW).

(Source: https://www.etw.de/wind-tunnel/aerodynamic-circuit)

RECOMMENDATION 22

Compare (a) a list of simulation, testing and certification needs with (b) an inventory of existing facilities to identify the needs currently satisfied and those requiring upgraded or new facilities.

RATIONALE

The large simulation and test facilities are essential institutional support to the aeronautical industry. They represent large investments of the Member States that have been coordinated on some occasions (DNW, ETW). An overall approach should compare what is needed with what is available, to prepare a program of upgraded and new facilities.

STAKEHOLDERS

EU MS RC AI AU AN

RELEVANCE

Duplicate facilities may be justified by high demand at European level or nationally funded objectives. Some facilities may have multiple uses besides aeronautics. The cost, maintenance and benefits (or indispensability) of facilities are essential issues.

JUSTIFICATION

PARE report Section 6.3

ACARE Goal 23

Students are attracted to careers in aviation. Courses offered by European Universities closely match the needs of the aviation industry, its research establishments and administrations and evolve continuously as those needs develop.

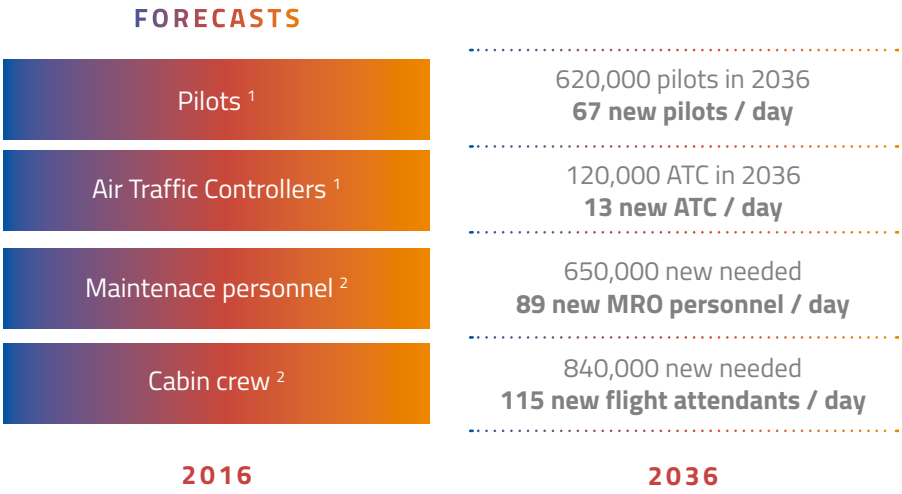


Figure 18 - Need for aviation professionals in the US

RECOMMENDATION 23

Foster a comprehensive program of attraction of talent to aeronautics to all education levels, complemented by job satisfaction measures at a professional level, with special measures to promote gender equality and increase the participation of women.

RATIONALE

The attraction of young talent to aeronautics should focus equally on both genders, start with the fascination of flying in youngsters, and continue with access to high-quality diversified university courses, followed by challenging and interesting careers in the industry.

STAKEHOLDERS

EU MS UA AI RC

RELEVANCE

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: thus aviation industry must engage promising young talent of both genders as early as possible, and sustain interest through industry visits and contact with professionals.

PRIORITY

A good talent pool exists in students and educators that must be supported to continue to provide the industry with the best engineers, as countries with large population outnumber Europe in aerospace graduates.

JUSTIFICATION

PARE report Section 6.4 and Topic T6.2

PARE OBJECTIVE 24

Promote a level playing field in the large aircraft market.

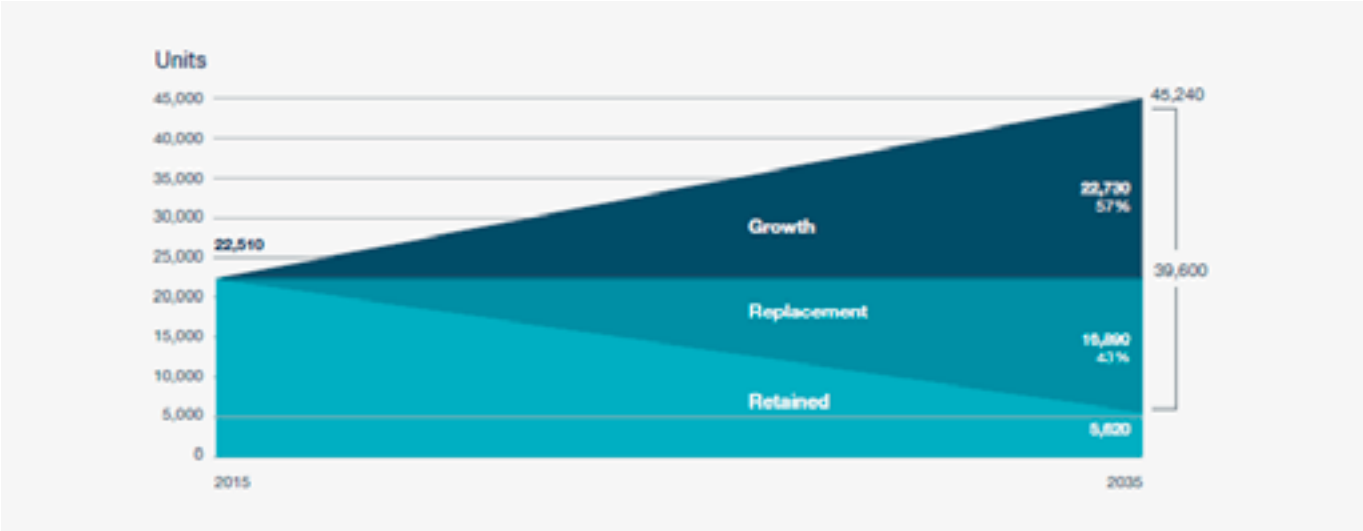


Figure 19 – Boeing fleet forecast 2015-2035
(Source: http://bit.ly/2YsFE9N)

RECOMMENDATION 24

develop a strong legal, commercial and technical basis to (a) in any case, if necessary, deal with litigation at the WTO, and (b) preferably, if possible, renew the large aircraft agreement between the EU and the USA.

RATIONALE

The airlines that want a competitive choice of aircraft are least interested in the Airbus-Boeing duopoly becoming a monopoly. This has not deterred the long-running dispute at the WTO that may become a permanent nuisance.

STAKEHOLDERS

EU MS AI AR

RELEVANCE

The distorted charges made at the WTO should not be allowed to question the fact that European success in the airline market is based on the merits of engineering quality and efficient operations.

PRIORITY

Bears in mind mean that engineering excellence is the market winner, and legal challenges should not become an obstacle.

JUSTIFICATION

sections 7.1 and 7.2 and topics T7.1, T7.2, T7.3 and T7.5.

PARE OBJECTIVE 25

Strengthen the position of the EU in the regional aircraft market.

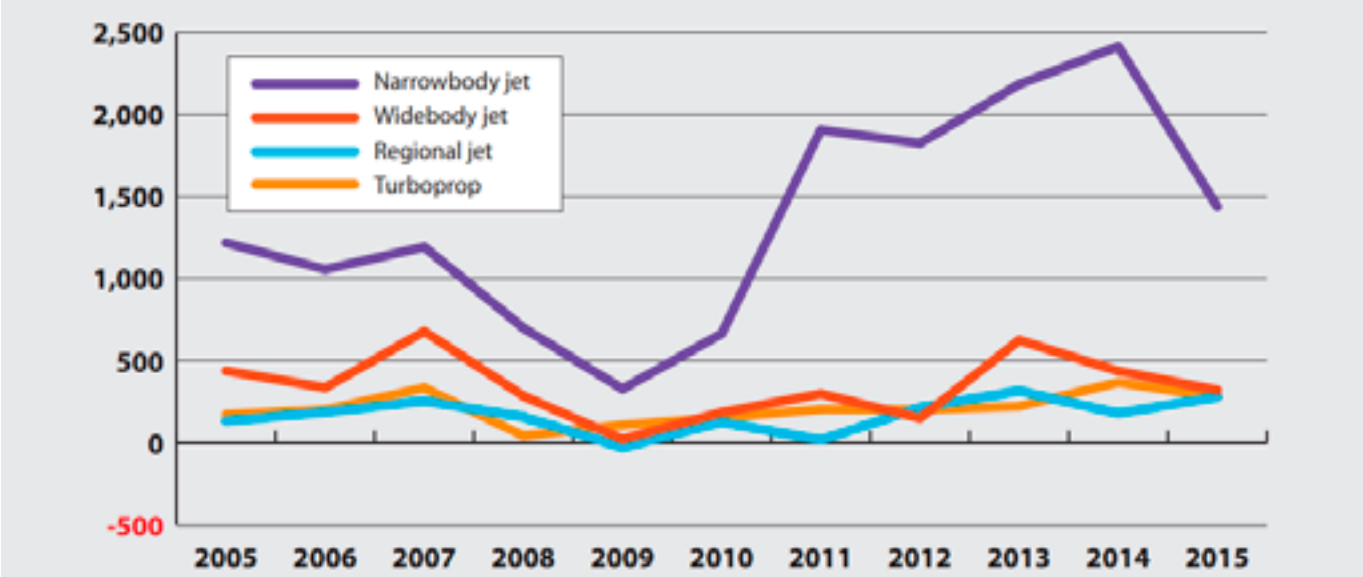


Figure 20 - Airliner Orders 2005-2015.
(Source: http://bit.ly/2GM7dzW)

RECOMMENDATION 25

Support the development of European regional aircraft in a world market with an increasing number of competitors and additionally consider synergistic tie-ups between large and regional aircraft suppliers.

RATIONALE

the majority stake of Airbus in the Bombardier C-series renamed A220 has extended the market reach to all jet airliners above 100 seats, with Boeing-Embraer as the only major competitor. In the regional market below 100 seats, the leading position of ATR faces multiple challenges from Canada, Japan, Russia and China.

STAKEHOLDERS

EU MS AI RC UA AR

RELEVANCE

The under 100-seat regional aircraft market is relevant both as a feeder to major hubs and as a direct link between smaller communities, both in Europe and worldwide, amounting to a large and growing market, that attracts increased competition.

PRIORITY

The leading position of ATR needs to be maintained as the number and variety of challenges increases.

JUSTIFICATION

Sections 7.3 and 7.4 and topics 7.4 and 7.5.

Strengthen the position of the EU in the business jet market.

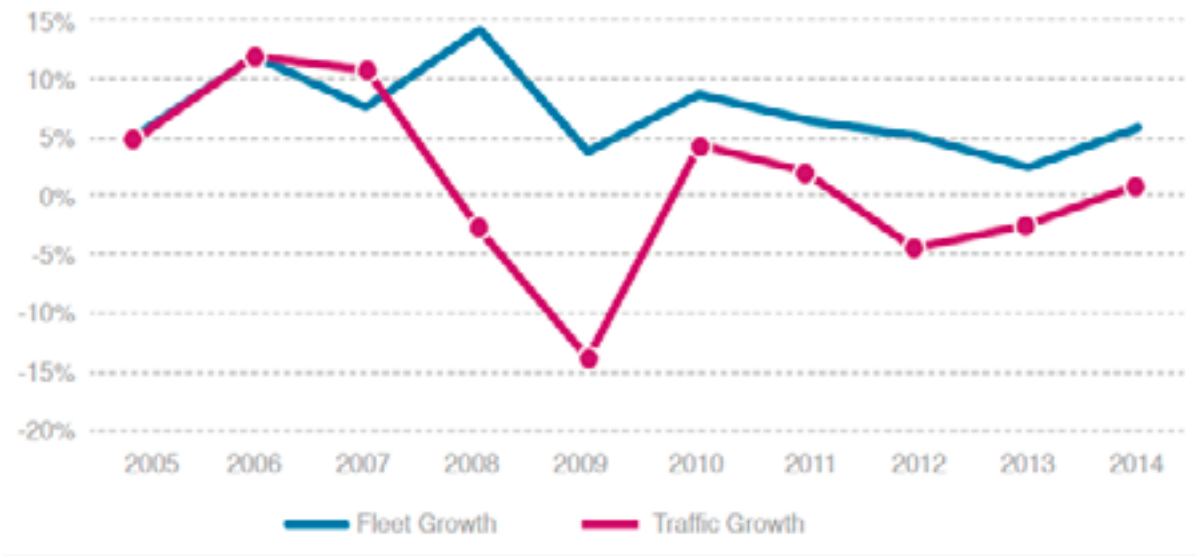


Figure 21 – Fleet growth vs Traffic growth
(Source: http://bit.ly/2ZCa8To)

RECOMMENDATION 26

Support the development of European business jets and their expanded use as sensor/surveillance/control platforms.

RATIONALE

Dassault, together with Gulfstream and Bombardier, is a world leader in large business jets, and European share of the rest of the market could increase.

STAKEHOLDERS

EU MS AI RC UA

RELEVANCE

The miniaturization of electronics allows business jets to be adapted to other missions like sensor platforms, patrol and surveillance, that are high-value extensions of the baseline business jet market.

PRIORITY

This is a successful area of European aviation that needs to be sustained and could be expanded.

JUSTIFICATION Section 7.5 and topics 7.4 and 7.5.

PARE OBJECTIVE 27

Maintain the EU leadership in the world helicopter market.

Figure 22 - Military helicopters (H145 (ACH), (ACH) Latest model).

(Source: Various manufactures)

RECOMMENDATION 27

Ensure that Europe keeps at least abreast of developments in high-power high-speed helicopters/convertibles with enhanced hot-and-high lift capabilities.

RATIONALE

The USA has started a major program FVL (Future Vertical Lift) to design helicopters/convertibles with (i) twice the range, (ii) 50% higher speed, (iii) over twice the hover payload in demanding hot and high conditions, using engines with double power but similar fuel consumption, size and weight. Although it is the military program it could have civil spinoffs: (i) double-range for off-shore oil exploration; (ii) higher speed for medical emergencies and executive transport; (iii) greater payload for rescue and transport missions. All this could challenge the position of Europe with over 50% of the world helicopter market.

STAKEHOLDERS

EU MS AI RC UA

RELEVANCE

The FVL program in the USA is justified by the need to counter threats from near peer adversaries in Europe and elsewhere: hence it is relevant to the defence of Europe. The implications in the civil market could be to reverse the tables passing dominance from Airbus Helicopters and Agusta-Westland to Bell and Sikorsky. The FVL contenders are the Valor tilt-rotor from Bell and Defiant dual rotor plus pusher-propeller helicopter from Sikorsky; Europe has analogues in the Augusta-Bell AB609 and Airbus X3 that holds the world helicopter speed record, and competitive turboshaft engines from Turbomeca and Rolls-Royce.

PRIORITY

There is a need for a program with a minimum investment to ensure that Europe does not fall behind. It is not necessary to match the massive US funding of FVL. The result of FVL could be as expensive as the Bell V-22 Osprey with small effect on the market, or it could like the RAH-66 Comanche lead to no significant production after years and billions of investment. The aim here is to safeguard against potential surprise breakthroughs that could change the European leading market position without making large speculative investments.

JUSTIFICATION PARE report Section 7.6 and topics 7.5 and 7.6.

PARE OBJECTIVE 28

Provide a European alternative to the drones used in Europe with the potential to also enter the world market.

Figure 23 – nEUROn drone in flight.
(Source: http://bit.ly/2MGqUwO)

RECOMMENDATION 28

Leverage the technological capabilities demonstrated in several prototype drones into a coherent European Programme covering all levels, to satisfy internal needs and complete in the world market.

RATIONALE

The market for MALE (Medium Altitude Long Endurance) drones is a sad example of lack of coordination in Europe: (i) of several prototype programs (Taranis in the UK, Mako in Germany, Hammerhead in Italy, Neuron Multinational led by France) none has yet reached operational status; (ii) in the meantime several European nations have bought American drones; (iii) in the international market China has emerged as the major competitor of the US through lower prices and less export restrictions.

STAKEHOLDERS

EU MS AI RC UA

RELEVANCE

Europe has the technology to develop all classes of UAVs that are increasingly relevant to a wide range of defence and civil missions, so the issue is one of coordination in the allocation of resources.

PRIORITY

There must be an end to the European dependence on foreign UAVs, and a move to enter the international market since there is the technology to achieve both targets.

JUSTIFICATION

PARE report Section 7.6.

PARE OBJECTIVE 29

Keep the EU at the forefront of progress in the electrification of aircraft.

Figure 24 – Aurora's electric vertical take-off and landing (eVTOL) aircraft PAV prototype.
(Source: http://www.aurora.aero/pav-evtol-passenger-air-vehicle/)

RECOMMENDATION 29

Make a thorough assessment followed by support measures on (a) emerging electric systems and propulsion technologies, (b) their potential to satisfy mission requirements and (c) the likely evolution of both.

RATIONALE

Although the automobile sector may lead to the electrification of transport vehicles, the specific needs of aeronautics and fast technological evolution will have increasing importance from drones to airplanes.

STAKEHOLDERS

EU MS AI RC UA AR

RELEVANCE

Small electric drones, emerging electric air taxi, more electric airliners with bleedless engines and advances in electric propulsion and systems all point towards increasing electrification.

PRIORITY

Progress in electrification is rapid and although the major market impact could be years away those caught unprepared may take a long time to catch-up.

JUSTIFICATION

PARE report Section 8.1.

Promote and exploit advances in additive manufacturing.

Figure 25 – Interior 3D – printed functional lightweight seat belt buckles made of high – quality Ti64 titanium.
(Source: https://www.eos.info/industries_markets/aerospace/interior)

RECOMMENDATION 30

Consider the implications on prototyping, series production and spares supply of additive manufacturing regarding (a) usable materials, (b) quality standards and (c) life-cycle costs.

RATIONALE

Although additive manufacturing is an industry-wide activity, aeronautics may be the leader in some areas and should keep up with progress in other areas.

STAKEHOLDERS

EU MS AI RC UA AR CA

RELEVANCE

Additive manufacturing allows the production of complex pieces with fewer parts and could replace spare part inventories with local production, as limitations in series production, choice of materials and quality finish are overcome.

PRIORITY

Aeronautics needs to benefit from general progress and lead only where necessary.

JUSTIFICATION

PARE report Section 8.2.

PARE OBJECTIVE 31

Incorporate the experience from other sectors to achieve more efficient and economical production in aeronautics.

Figure 26 – Final assembly line of the Airbus A330neo production process in France.
(Source: https://www.airbus.com/newsroom/stories/how-an-aircraft-is-built.html)

RECOMMENDATION 31

Consider the best combination of 4.0 technologies, including automation and information, as applicable to various production rates and scales of equipment in aeronautics.

RATIONALE

Aeronautics can benefit from 4.0 technologies, especially by integrating the full life-cycle design-production-operation-maintenance.

STAKEHOLDERS

EU MS AI AR CA RC UA

RELEVANCE

The 4.0 factory requires significant investment and reliance on big data and artificial intelligence and could lead to a reduction in development time and cost of production and operation.

PRIORITY

Aeronautics is a user more than a leader except in specific areas with the large-scale integration over a long-lifetime as the main issue.

JUSTIFICATION

PARE report Section 8.3 and topic 8.1

PARE OBJECTIVE 32

Provide the telecommunications capacity needed for connected aircraft, navigation, monitoring and other services.

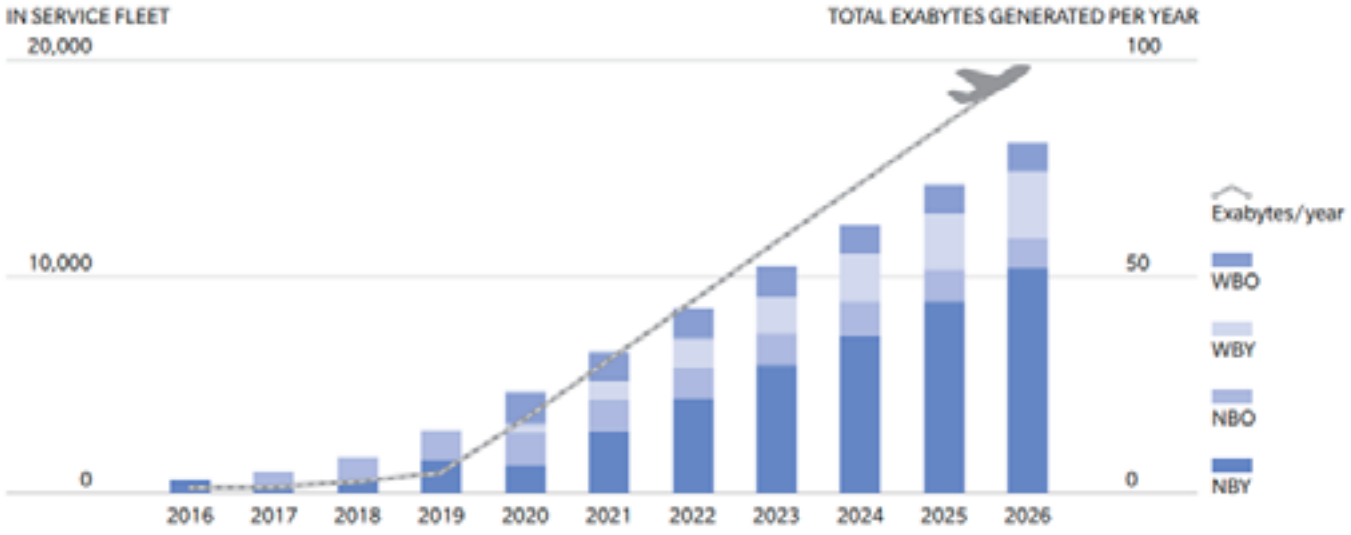


Figure 27 - Data generated from the aircraft fleet.
(Source: https://owy.mn/2OFm59K)

RECOMMENDATION 32

Assess the growth of capacity needs for navigation, systems monitoring and passenger services, and how the required bandwidth can provide free from unintended or malicious interference.

RATIONALE

Increases in air traffic capacity and safer and more efficient aircraft operations will require increased data sharing and larger telecommunications bandwidth protected from unintended or malicious interference.

STAKEHOLDERS

EU MS AN AR AI RC UA AP

RELEVANCE

The growth of air traffic and progress in safety plus passenger services may require more than proportional increases in data sharing and telecommunications.

PRIORITY

This is an issue for society in general, with a particular incidence in aviation.

JUSTIFICATION

PARE report Section 8.4 and topic 8.2

PARE OBJECTIVE 33

Monitor threats in cybersecurity and devise timely protection for all levels of aviation systems.

Figure 28 – Data Streams vulnerable to cyber attack.

RECOMMENDATION 33

Consider the levels of cyber protection needed for the various aeronautical activities, and how to monitor and counter threats.

RATIONALE

The informatics incidents at specific air traffic control facilities and with airline reservation systems suggest possible vulnerabilities that could be also exploited in malicious attacks.

STAKEHOLDERS

EU MS AN AR AP AI CA

RELEVANCE

Security in aviation would be enhanced by a comprehensive cyber protection system with several levels, highest for flight critical tasks and lowest for commercial ticketing.

PRIORITY

The consequences if cyber-attacks have been seen elsewhere, aviation in the past has been a preferred target of malicious actions and thus preventive measures are desirable.

JUSTIFICATION

PARE report Section 8.5 and topics 8.3 and 8.4

PARE OBJECTIVE 34

Assess the implications in aeronautics of advances in big data, including the use of what is already available.

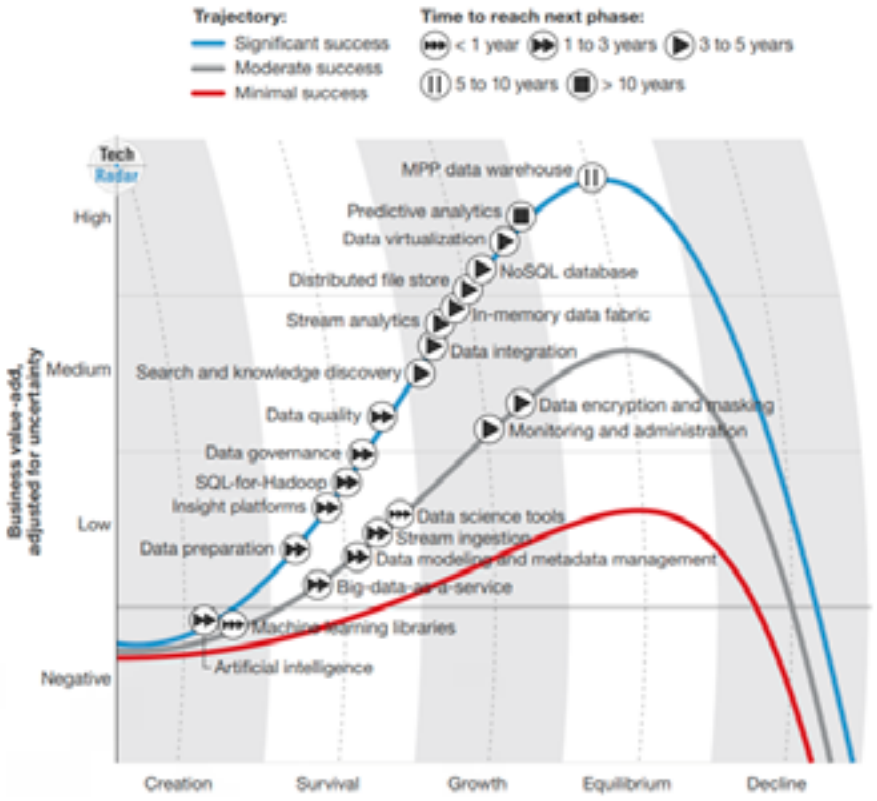


Figure 29 - Big data technologies.
(Source: TechRadar™: Big Data, Q1 2016)

RECOMMENDATION 34

Consider the expected benefits versus the required investment in using big data techniques in aeronautical activities for which relevant data already exists or has to be newly sourced.

RATIONALE

Large amounts of systems data are already recorded by aircraft in flight and its use for maintenance, safety or other purposes could be enhanced.

STAKEHOLDERS

AR AN AP EU MS AI RC UA

RELEVANCE

More benefit could be taken out of currently collected data and there is the prospect of gathering more data with awell-targeted strategy.

PRIORITY

This is part of a global trend shared by aviation.

JUSTIFICATION PARE report Section 8.6 and topics 8.5, 8.6 and 8.7

PARE OBJECTIVE 35

Assess the potential benefits and risks of the use of artificial intelligence in aeronautics.

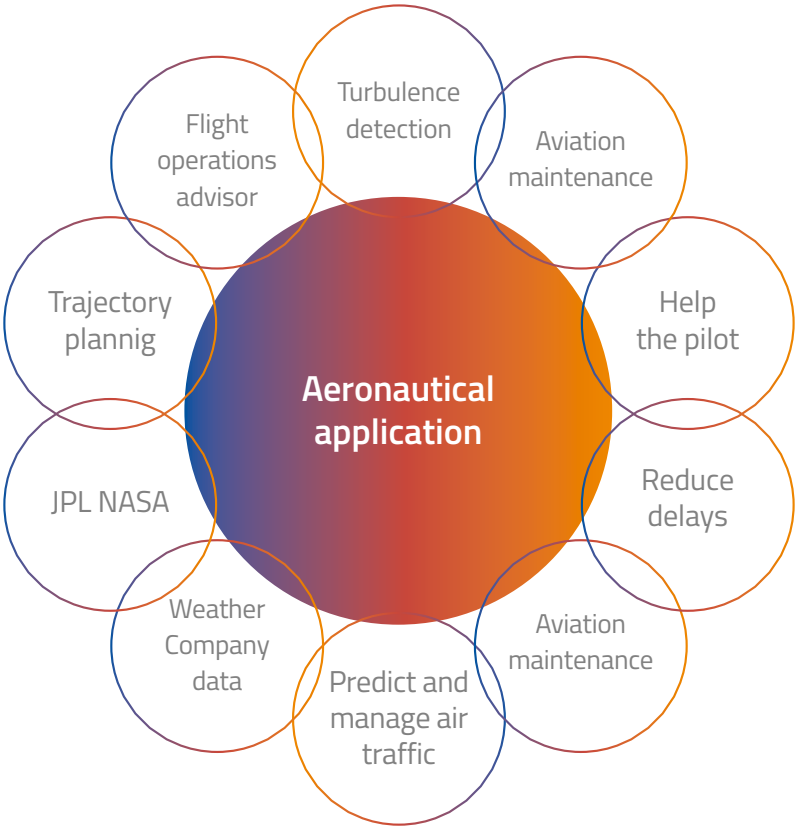


Figure 30 - Aeronautical applications of cognitive computing.

RECOMMENDATION 35

Identify the situations in aeronautics in which the learning processes of Artificial Intelligence can be efficient and safe and distinguish those where there is limited training material or potential dependence on imagination.

RATIONALE

Artificial Intelligence has the advantage of systematic learning from large amounts of data ('Artificial Imitation') but lacks any form of imagination when facing untrained situations.

STAKEHOLDERS

EU MS AI RC UA AR AN AP

RELEVANCE

The use of artificial intelligence can lead to much more efficient and reliable implementation of known tasks, but care is needed concerning unforeseen or untrained situations when it cannot replace human imagination, resourcefulness or true and real intelligence.

PRIORITY

Part of a general trend that aviation may share without losing an eye on risks.

JUSTIFICATION PARE report Section 8.7 and topics 8.8 and 8.9.

PARE OBJECTIVE 36

Assess the implications on aircraft design, certification, operation and maintenance of new developmental and breakthrough materials and structures.

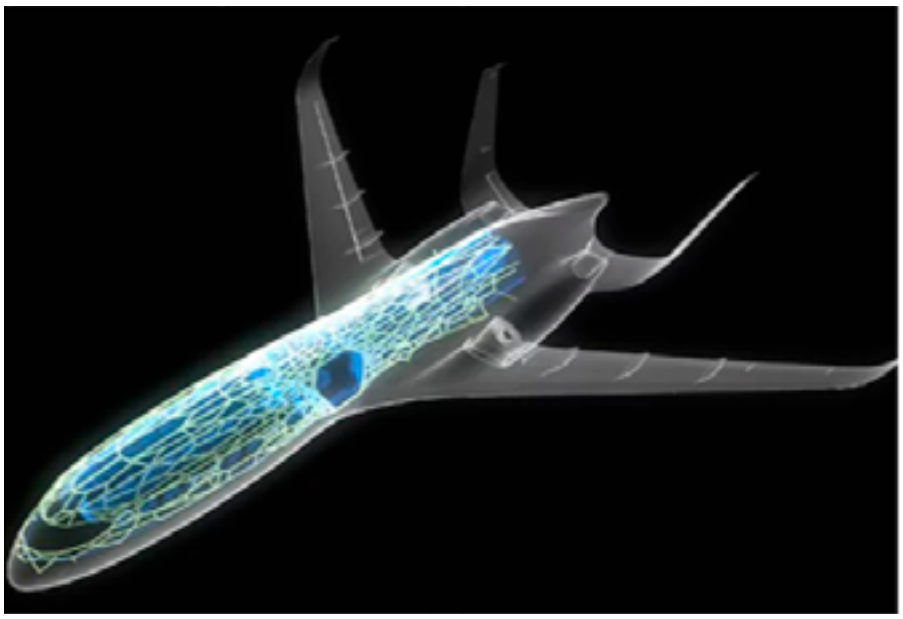


Figure 31 – More efficient designs of aircraft with quantum computers.
(Source: http://bit.ly/2YJkvDp)

RECOMMENDATION 36

Consider the progress in advanced materials like composites, ceramics and special alloys and also the prospects of less mature developments like nanotube structures and other nanotechnologies.

RATIONALE

Progress in material, structures and production methods have a main steady gradual element (composites, ceramics, alloys) and there is also a potential for revolutionary breakthroughs (nanotube structures, microelectromechanical devices).

STAKEHOLDERS

AI RC UA EU MS AR CA

RELEVANCE

Research on materials, structures and production is a major topic, and a complement is some forward look at the maturation of long-term prospects.

PRIORITY

Maintaining current high level of activity perhaps with a little more emphasis on promising developments still lacking maturity.

JUSTIFICATION

PARE report Sections 8.8 and 8.9, and topics 8.10, 8.11, 8.12 and 8.13

PARE OBJECTIVE 37

Promote the seamless compatibility of Air Traffic Management (ATM) systems worldwide, across continents and oceans.

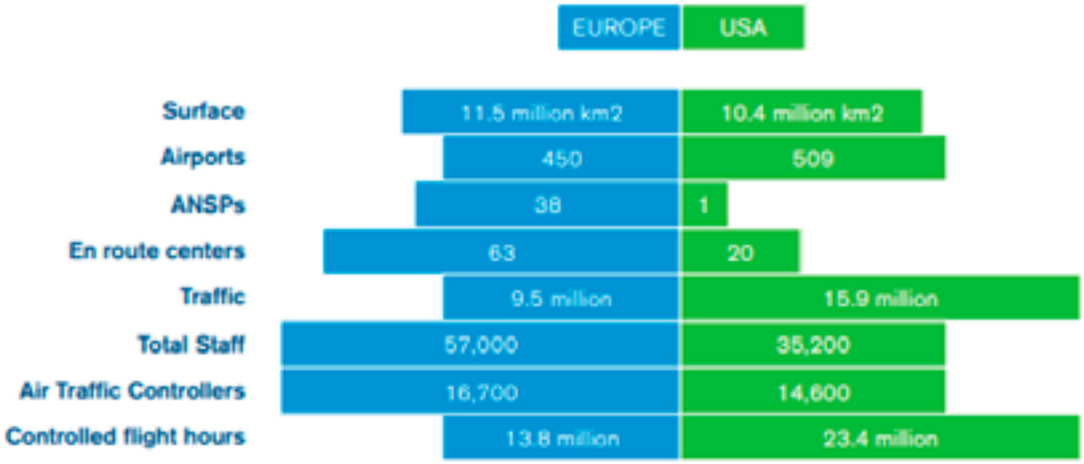


Figure 32 - 2010 U.S./Europe Comparison of ATM-Related Operational Performance.
(Source: http://bit.ly/2OHzWwl)

RECOMMENDATION 37

Support cooperation between SESAR in Europe and NextGen in the US to ensure compatibility across the North Atlantic and provide the basis for progress in the world ATM market as the growth of air travel increases capacity needs elsewhere.

RATIONALE

Air Traffic Management is the major potential bottleneck to the growth of aviation on a global scale, with the particular incidence in developed regions with dense traffic like Europe and Eastern US, but gradually spreading to other regions.

STAKEHOLDERS

EU MS AN AR AP AI RC UA

RELEVANCE

Air Traffic Management should be seamless across continents and oceans, and the needed increases in capacity combined with safety and security are a major market for equipment suppliers in areas of European leadership

PRIORITY

It is essential to avoid the congestion and delays of the past and cope with traffic growth and new users like UAVs.

JUSTIFICATION

PARE report Section 9.1 and topic 9.1 and 9.2

PARE OBJECTIVE 38

Promote harmonized certification standards worldwide as already exist in other sectors to ensure the growth of aviation as the safest mode of transport.

Working Method #1 EASA Takes the Lead	Working Method #2 FAA Takes the Lead	Working Method #3 Authorities Cooperation
The general process is the ASA rulemaking procedure. This working method aims at giving the FAA sufficient involvement in the EASA rulemaking project to understand the content of the draft rule and to be able to contribute to this process as necessary to allow it, where appropriate, to launch an equivalent Notice of Proposed Rulemaking ("NPRM") or take other equivalent rulemaking decision The EASA focal point should lead the rulemaking process in regular coordination with the FAA focal point.	The general process is outlined in the FAA Office of Rulemaking's Rulemaking Manual. This working method aims at giving EASA sufficient involvement in the FAA's rulemaking project to understand the content of the NPRM and be able to contribute to this process as necessary to allow it, where appropriate, to launch an equivalent NPA or take other equivalent rulemaking decision. The FAA focal point should lead the rulemaking process in regular coordination with the EASA focal point.	FAA and EASA intend to develop their rulemaking projects separately, but concurrently (to the extent practicable). However, as appropriate, the FAA and EASA focal points may follow the process described in Working Methods #1 and #2 in sharing information during concurrent development of the rule.

Figure 33 - FAA and EASA rulemaking agreement foresee 3 possible working methods
(Source: http://bit.ly/2YLOjzk)

RECOMMENDATION 38

Strengthen the cooperation of EASA/FAA on common certification standards and their adoption worldwide to avoid duplication or degradation in specific regions.

RATIONALE

The coordinated and mutually accepted certification by either the FAA and EASA is a major breakthrough in avoiding costly duplication and preventing misuse of certification as a trade barrier. The Russian example of local certification is being followed by China, whose aircraft have faced long delays and major difficulties in obtaining EASA or FAA certification. Resorting to 'local certification' leads to lower safety standards that can affect not only locals but also Europeans travelling in those countries. The export of such EASA/FAA uncertificated aircraft could damage the unique overall safety record of aviation.

STAKEHOLDERS

The EU and MS, possibly with US coordination, since there is a common interest in supporting EASA/FAA standards.

RELEVANCE

The EU and MS could insist on cooperation with China and Russia being conditional on progress towards worldwide certification standards. Although aircraft not certificated by EASA or FAA cannot operate in Europe, US or other developed regions their use as cheap unsafe transport elsewhere cannot be encouraged and puts European visitors at risk.

PRIORITY

It is prudent to prevent the emergence of a parallel market of local or third world aviation with degraded safety standards that are already lower elsewhere than in Europe/US. Will require diplomatic and negotiation skills.

JUSTIFICATION PARE report section 9.2 and topics 9.6 and 9.7

PARE OBJECTIVE 39

Minimize the effects of aviation on the environment on a global scale.

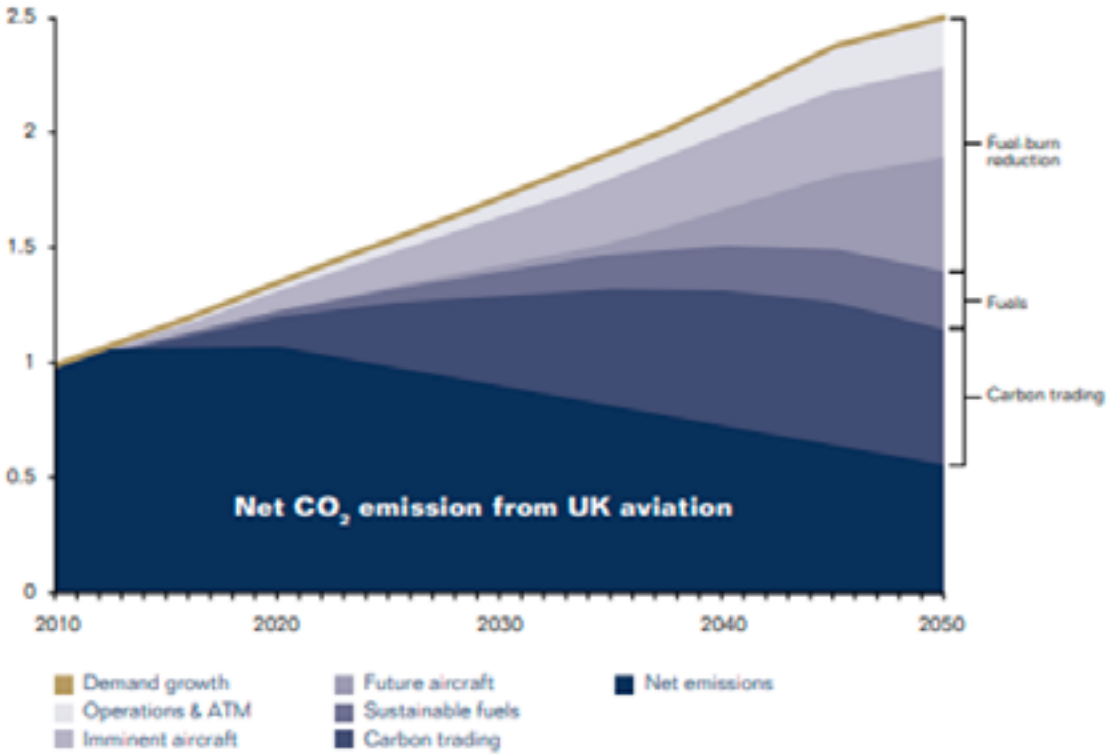


Figure 34 - Sustainable Aviation Carbon Roadmap.
(Source: http://bit.ly/2OCvGhs)

RECOMMENDATION 39

The reduction of environmental effects of aviation on a global scale should be a key point in the EU cooperation with other countries.

RATIONALE

The EU has played a leading and exemplary role as champion of environmental protection in all areas including aviation and this is a worthy effort to pursue.

STAKEHOLDERS

EU MS AN CA AI RC UA AP

RELEVANCE

Although aviation is not the biggest polluter in general or among means of transport the objective should be to reduce its percentage by doing better than average progress.

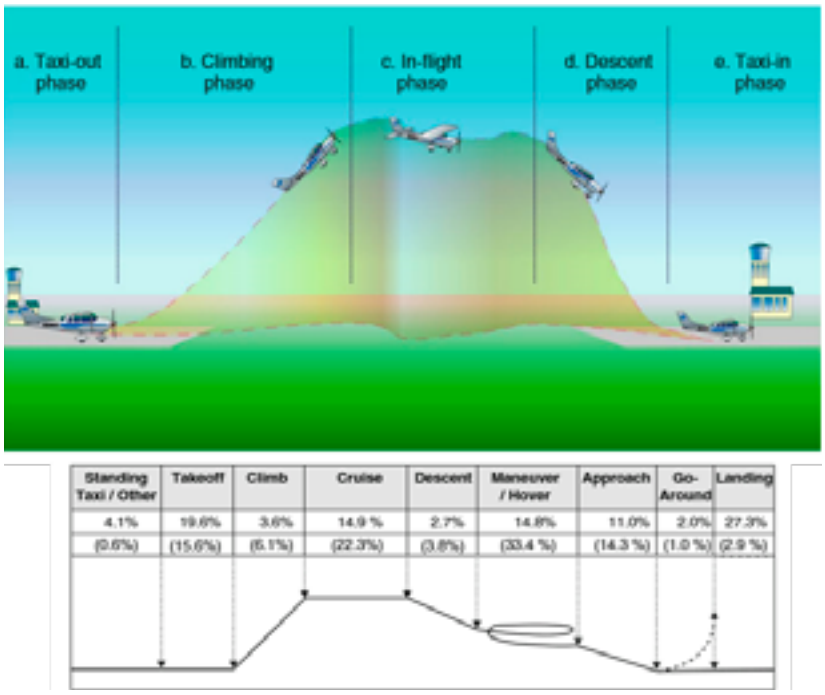
PRIORITY

There is already a significant effort, although airport noise and en-route emissions are increasing concerns.

JUSTIFICATION

PARE report Section 9.3 and topic 9.5.

Promote aviation safety worldwide including for European and other passengers flying with non-European airlines.



Standing Taxi / Other	Takeoff	Climb	Cruise	Descent	Maneuver / Hover	Approach	Go-Around	Landing
4.1%	19.6%	3.6%	14.9 %	2.7%	14.8%	11.0%	2.0%	27.3%
(0.6%)	(15.6%)	(5.1%)	(22.3%)	(3.8%)	(33.4 %)	(14.3 %)	(1.0 %)	(2.9 %)

Figure 35 - Upper panel: typical phases of flight, and bottom panel: related - phases percentages of total accidents.

(Source: I. Schagaev, B.R. Kirk, Active System Control, DOI 10.1007/978-3-319-46813-6_1 Springer International Publishing AG 2018)

RECOMMENDATION 40

Support activities raising the aviation safety standards to more uniform high levels across the globe, in particular helping the improvement of airlines banned from flying into Europe that may still carry European passengers elsewhere.

RATIONALE

The differences in aviation safety standards among airlines from different countries justify banning some from flying into Europe, and the provision of some technical assistance could help to lift the bans and improving safety in less developed regions.

STAKEHOLDERS

EU MS CA AN

RELEVANCE

Besides ensuring safety (and security) of air travel in Europe it is desirable to promote similar standards in less developed regions of the world, both for the locals and for the European business or leisure travel.

PRIORITY

This is an extension of current preventive bans to cooperative improvement for non-European airlines and aviation authorities.

JUSTIFICATION

PARE report Section 9.3 and topic 9.5.

PARE OBJECTIVE 41

Promote aviation security worldwide, including at airports and destinations frequently used for European business and holiday travel.

Figure 36 – Airport security and screening methods.

(Source: https://apex.aero/2017/07/28/paxex-faq-airport-security-screening-methods)

RECOMMENDATION 41

Support high-security levels at airports outside Europe by cooperating with authorities eager to keep European business/tourism travel, and otherwise warn travellers of risk.

RATIONALE

European travellers may be at greater risk when travelling in less developed regions where extremist groups target aviation and foreigners and thus support to cooperative local authorities is important to boost security.

STAKEHOLDERS

EU MS CA AP AI

RELEVANCE

Local authorities in third world countries may have an interest in attracting business and tourism and welcome assistance in making foreigners and their own citizens safer.

PRIORITY

This is a continuous, gradual and moderate effort.

JUSTIFICATION

PARE report Section 9.5 and topic 9.8

PARE OBJECTIVE 42

Promote as far as possible an open and fair market for aircraft at least in the civil sector.

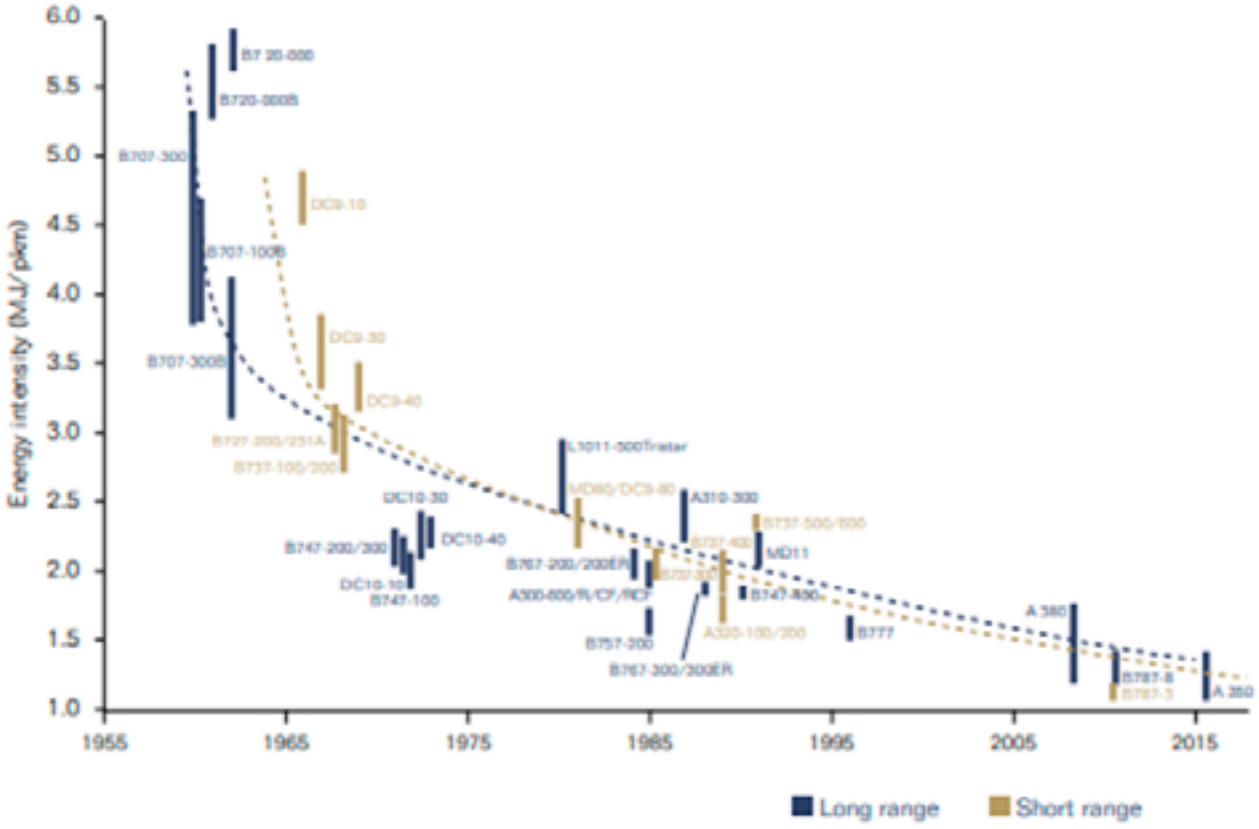


Figure 37 - Aircraft Efficiency Gains since 1955.
(Source: http://bit.ly/2OCvGhs)

RECOMMENDATION 42

The advances in efficiency and compliance with the highest environmental, safety and security standards can contribute to a competition based on quality rather than other interests.

RATIONALE

Making available safe and efficient aircraft may help undermine protectionist and biased local choices.

STAKEHOLDERS

EU MS AI RC UA

RELEVANCE

Promoting a level playing field is not easy and desirability and quality may function in a more effective and subtle way than harsh political pressures.

PRIORITY

It is a matter of good business practice.

JUSTIFICATION

PARE report Section 9.6 and 9.7 and topics 9.9 and 9.10

PARE OBJECTIVE 43

Stimulate the interest of children with entertaining stories about flying.

Figure 38 – Super Wings Poster.

RECOMMENDATION 43

Make available online and accessible to primary schools and parents, children stories and cartoons involving flying that are both entertaining and educational.

RATIONALE

Flying and space can be fascinating subjects for children and can be used to make interesting stories.

STAKEHOLDERS

EU MS AI families, primary schools

RELEVANCE

In the history of aviation many of the pioneers and major contributors started their interest at an early age.

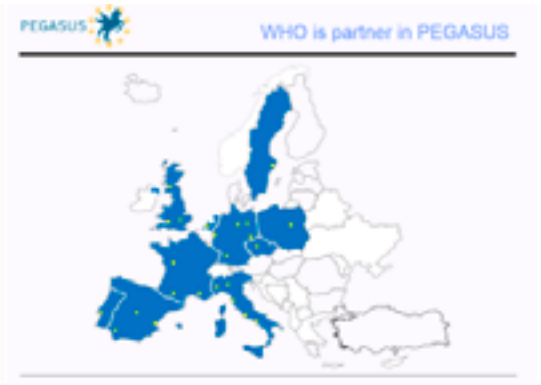
PRIORITY

Normal activity to be sustained.

JUSTIFICATION

PARE report Section 10.1 and 9.7 and topics 10.2 and 10.3

Motivate secondary school students to choose university degrees in aerospace engineering.



Country	Institution
	Politecnico di Milano Politecnico di Torino Università degli Studi di Napoli Università degli Studi di Pisa Università degli Studi di Roma
	Ecole-air de Salon de Provence ENAC Toulouse ENSMA Poitiers ISAE Toulouse
	TU Delft
	UPM/ETSIA Madrid US/ESI Sevilla UPV/ETSID Valencia
	IST Lisboa

Country	Institution
	RWTH Aachen TU Berlin TU Braunschweig Universität Stuttgart TU Dresden
	Cranfield University University of Bristol University of Glasgow
	KTH Stockholm
	CVUT Prague
	Politechnika Warszawska

Figure 39 - Academic Institutions (as of 2014) members of the PEGASUS Partnership.
(Source: http://bit.ly/31IfUZT)

RECOMMENDATION 44.1

Make available from the early teens, online and to secondary schools, a set of easy to implement flight experiments and challenges such as drones now so commonplace and cheap.

RECOMMENDATION 44.2

Give secondary school students at later stages the opportunity to come to presentations and laboratories at a university, together with a parent/mentor or trusted friend.

RATIONALE

There are readily available inexpensive 'toy' drones that give real flying experience and can teach also responsible use. Complemented by visits to university laboratories and presentations this would continue to attract good candidates of both genders.

STAKEHOLDERS

EU MS UA secondary schools families friends

RELEVANCE

Given the variety of university degrees that university candidates can choose from and the demands of 'hard skills' in STEM (Science, Technology, Engineering and Mathematics) aeronautics can attract the best as a combination of advanced technologies with bright future prospects.

PRIORITY

In addition to suitable dissemination, the visits to universities with aeronautical education can make all the difference in attracting the best candidates.

JUSTIFICATION PARE report Section 10.1 and 9.7 and topics 10.2 and 10.3

PARE OBJECTIVE 45

Make careers in aeronautical industry interesting relative to other alternatives by focusing on fascinating technology with adequate reward.

Attract the brightest graduates in aeronautical engineering to the industry before they are lured away by attractive, well-paid offers elsewhere, e.g. by consultant and financial services.

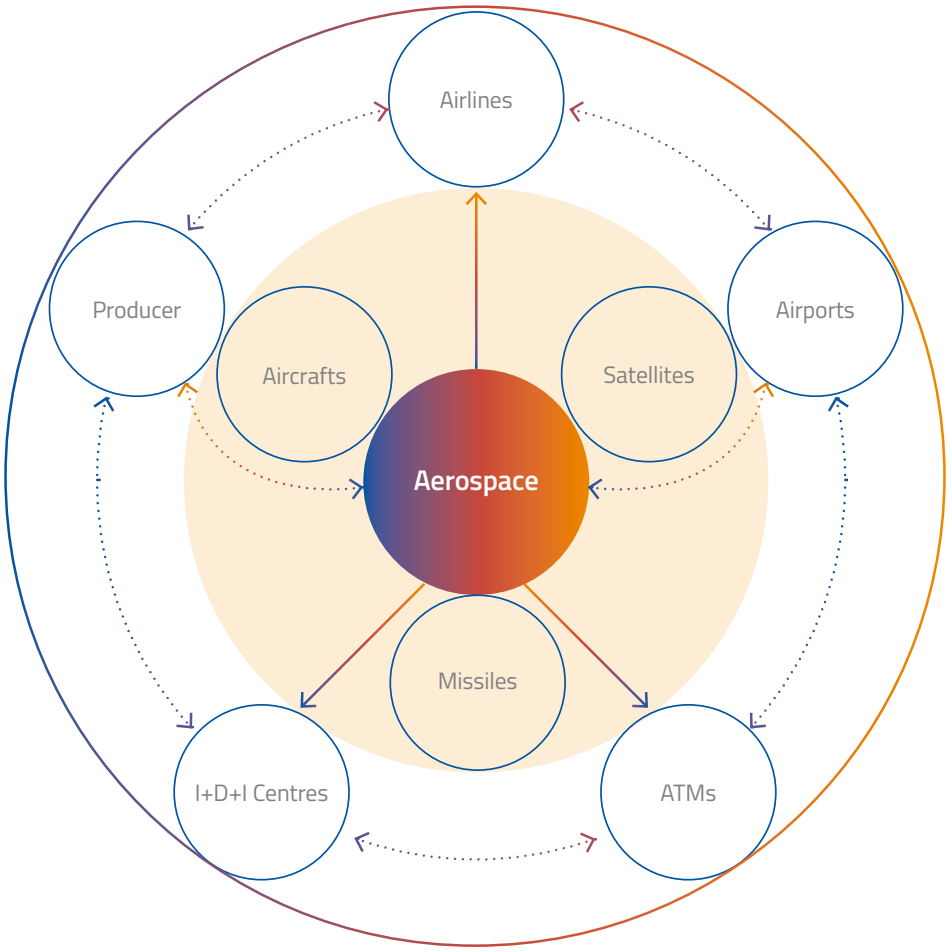


Figure 40 - The Aerospace System.

RECOMMENDATION 45

Provide industrial stays for students of aeronautical engineering with mentoring that values their skills and keeps track of the most promising for employment after graduation.

RATIONALE

in order to attract bright graduates in aeronautical engineering with many alternative enticing job offers, industry and other employers should engage them at an early stage through professional stays and follow-up with attractive job offers without delay after graduation.

STAKEHOLDERS

EU MS AI RC UA AN AR AP

RELEVANCE

The strong analytical and problem-solving skills of the graduates from the best aerospace engineering degrees are in much demand from other sectors in and out of engineering, so the aeronautical industry cannot afford to be slow in attraction measures.

PRIORITY

Attracting the best engineers is the key to progress in aviation, and an absolute must if Europe wants to remain a leader as other developed (US, Japan, Canada) or more populous (China, India) or lower cost (Russia, Brazil) regions strengthen their competitive challenge.

JUSTIFICATION PARE report Section 10.3 and topics 10.4 and 10.5.

PARE OBJECTIVE 46

Make careers in aeronautical industry interesting relative to other alternatives by focusing on fascinating technology with adequate reward.

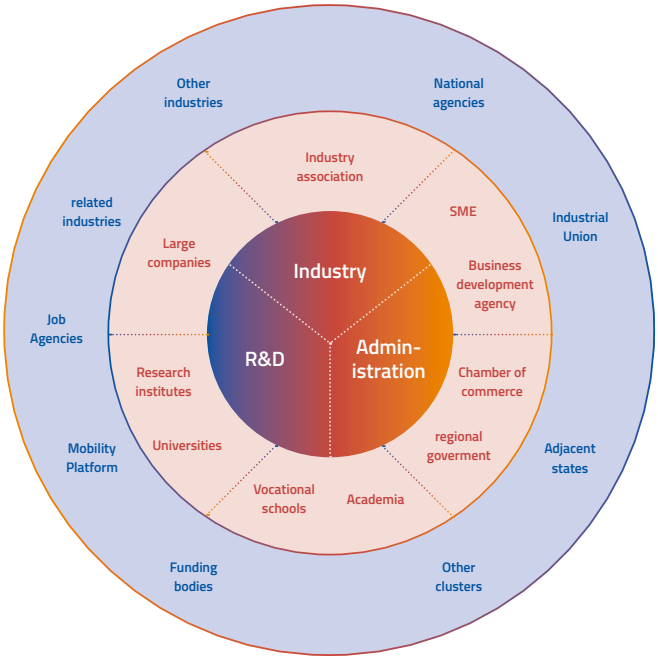


Figure 41 - Stakeholders represented within EACP.
(Source: http://www.eacp-aero.eu/)

RECOMMENDATION 46

Bring an aeronautical engineering student together with a mentor/relative/trusted friend to a one-day visit to industry to be remembered for life as a career choice.

RATIONALE

An in-depth one-day visit to the industry with briefings and access to facilities can be a day to be remembered for life and make a career decision. The company of a mentor/relative/trusted friend can play a major role in advising a mature choice.

STAKEHOLDERS

EU, MS, AI, RC, UA, AN, AR, AP, PA, other employers.

RELEVANCE

Perhaps the most important question when choosing a career is “What will I do or be my work?” and convincing answers with supporting evidence is the best reply.

PRIORITY

This kind of initiative already exists and the idea of a memorable one-day visit could be expanded.

JUSTIFICATION

PARE report Section 10.4 and topics 10.6 and 10.7

PARE OBJECTIVE 47

Motivate and reward the workforce to promote dedication, ingenuity, efficiency and loyalty.

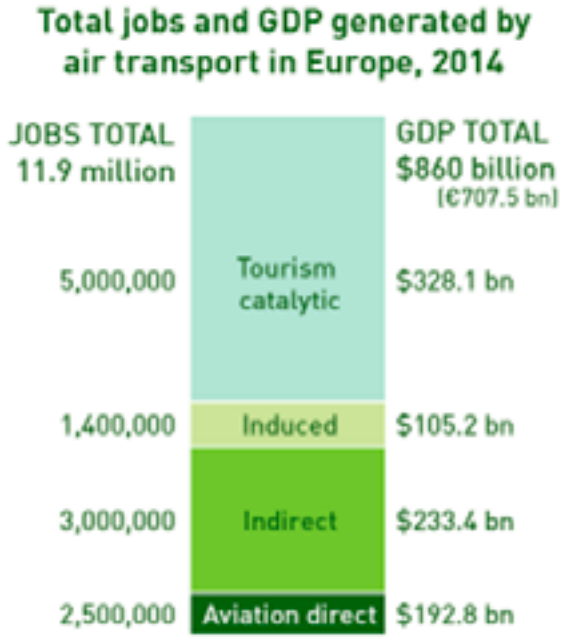


Figure 42 – Air Transport in Europe.

(Source: https://aviationbenefits.org/media/166711/abbb18_full-report_web.pdf)

RECOMMENDATION 47

Give employees opportunities for innovation, let them share important and interesting work, and recognise their contribution to the success of the company.

RATIONALE

Giving opportunities for the workforce to be creative and proactive rewards the commitments of employees, create links with receptive management and promotes the prosperity of the enterprise.

STAKEHOLDERS EU, MS, AI, RC, UA, AN, AR, AP, CA

RELEVANCE

The best way to keep a skilled and up-to-date workforce is to follow-up on their initiatives for progress with suitable mature support.

PRIORITY

Should be normal company practice and is well worth reminding and keeping in mind.

JUSTIFICATION PARE report Section 10.5 and topics 10.8 and 10.9

PARE OBJECTIVE 48

Retain a capable and faithful workforce by providing stable employment, interesting work, reliable benefits and a friendly environment.

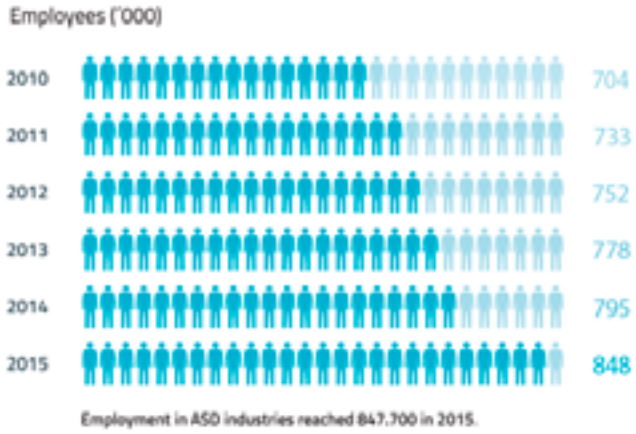


Figure 43 - Aerospace and Defence Industry Employment between 2010-2015.

(Source: Aerospace and Defence Industries Association of Europe)

RECOMMENDATION 48

A worthwhile alternative to job mobility is to have competent staff, able to adapt to change and to contribute to progress, sufficiently well integrated not to wish other careers and serve as example to relatives and friends.

RATIONALE

As an alternative to the modern high-mobility, short-term employment, and not excluding intermediate cases, there is nothing wrong with the old model of a company-family which support a dedicated workforce with long experience and attracts the next generation.

STAKEHOLDERS

EU, MS, AI, UA, AR, AN, AP, CA, other employers

RELEVANCE

The maintenance of a faithful long-experienced workforce can also attract new ideas and support further recruitment by proving a stable and progressive environment for progress.

PRIORITY

Should be normal company practice worth keeping.

JUSTIFICATION

PARE report Section 10.6 and topics 10.10 and 10.11.

PARE OBJECTIVE 49

Counter family and societal bias discouraging girls from an interest in vehicles, be it cars or planes.

Figure 44- Earhart, American aviation pioneer and author, in the cockpit of her Electra plane in 1937.

(Source: Beyond Amelia Earhart: Teaching about the History of Women Aviators. OAH Magazine of History, July 2010 (Courtesy George Palmer Putnam Collection of Amelia Earhart Papers, Purdue University Libraries))

RECOMMENDATION 49

Make available on the internet and to primary school's children stories and cartoons where girls drive cars and fly aeroplanes as much as boys do and let them play with vehicle models or ask for them as presents.

RATIONALE

The bias since childhood that "girls play with dolls and boys play with cars/planes" needs to be countered by gender-neutral stories about boys and girls flying or collaborating in making origami' planes.

STAKEHOLDERS

EU, MS, primary education, families, friends.

RELEVANCE

Flying has always been an inspiration for mankind from childhood through adulthood to old age, regardless of gender.

PRIORITY

This should be a normal steady activity.

JUSTIFICATION

PARE report Section 11.1 and topic 11.1.

Give girls and boys in primary schools the same opportunities to choose their games and entertainment.

Figure 45 – María Moliner, the first female teacher at the University of Murcia.

RECOMMENDATION 50

The primary and secondary school programmes and activities could include flight experiments equally accessible to boys and girls.

RATIONALE

Gender bias may be countered in a natural, non-dramatic, non-political fashion by simple neutral education since primary school by providing educators with suitable material that is attractive to children of both genders.

STAKEHOLDERS

EU, MS, primary schools, families.

RELEVANCE

The best way to avoid problems is not to create them by adopting a neutral attitude, and this also applies to gender in the education of children.

PRIORITY

Should be normal primary school practice and deserves further encouragement.

JUSTIFICATION

PARE report Section 11.2 and topic 11.2.

PARE OBJECTIVE 51

Encourage more girls to take aeronautical engineering degrees.

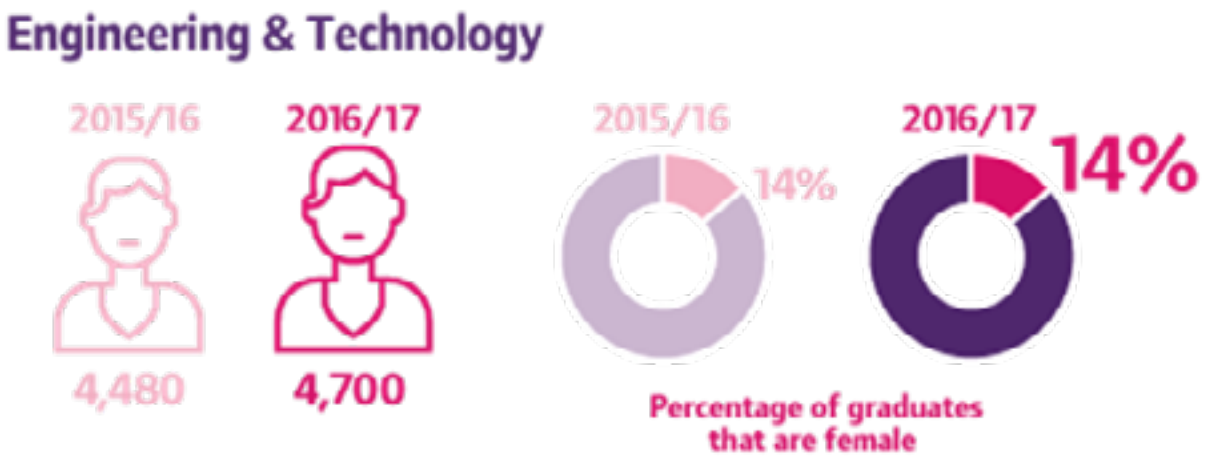


Figure 46 - Women in Engineering and Technology.
(Source: http://bit.ly/2YFuhXb)

RECOMMENDATION 51

Reinforce and accelerate this slowly growing trend by visits to universities and industry, role models of success stories and the same fascinating technologies.

RATIONALE

The measures to attract young talent to aeronautical careers are similar and some extra effort needs to be put in compensating gender bias.

STAKEHOLDERS

EU, MS, UA, AI, RC, PA, other educators and employers.

RELEVANCE

Women perform at least as well as men in aeronautical engineering degrees and enlarge the talent pool both in quantity and diversity.

PRIORITY

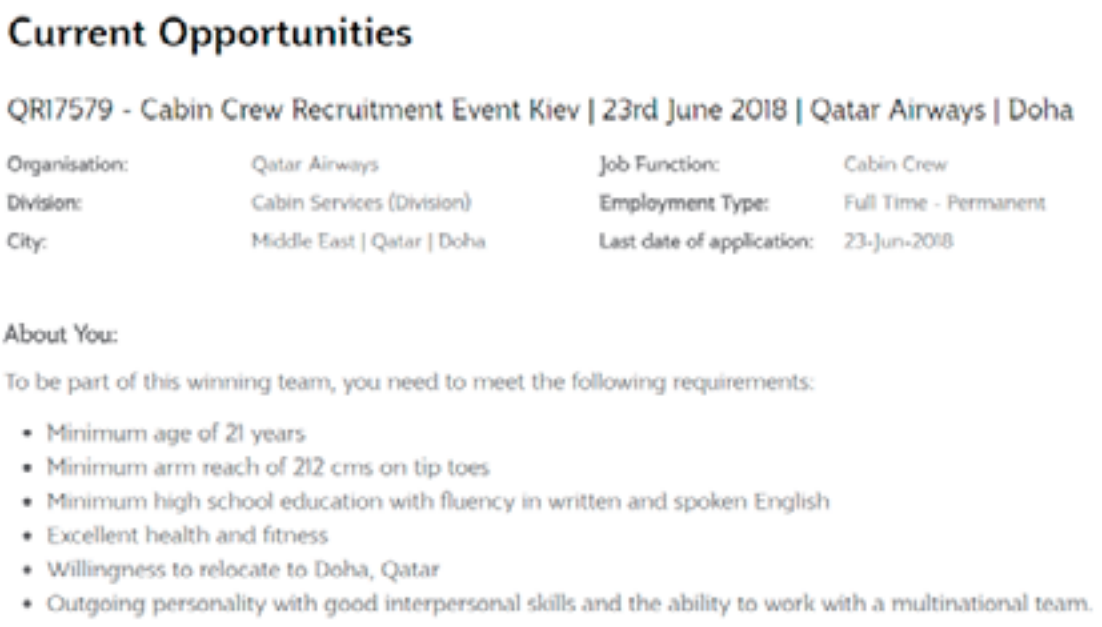
There is a vast potential of talent that is only modestly tapped.

JUSTIFICATION

PARE report Section 11.3 and topic 11.3.

PARE OBJECTIVE 52

Provide women with attractive careers in aeronautics in industry and academia.



Current Opportunities

QR17579 - Cabin Crew Recruitment Event Kiev | 23rd June 2018 | Qatar Airways | Doha

Organisation:	Qatar Airways	Job Function:	Cabin Crew
Division:	Cabin Services (Division)	Employment Type:	Full Time - Permanent
City:	Middle East | Qatar | Doha	Last date of application:	23-Jun-2018

About You:

To be part of this winning team, you need to meet the following requirements:

- Minimum age of 21 years
- Minimum arm reach of 212 cms on tip toes
- Minimum high school education with fluency in written and spoken English
- Excellent health and fitness
- Willingness to relocate to Doha, Qatar
- Outgoing personality with good interpersonal skills and the ability to work with a multinational team.

Figure 47 - Recruitment file from Qatar Airways.

RECOMMENDATION 52

Make all aspects of job recruitment, from the announcements to the interview, to the benefits, gender equal, and try to compensate for eventual gender differences.

RATIONALE

The outdated lingering view that aviation is a job for men except for attendants should be countering by recruiting campaigns that are carefully gender neutral and cleverly undermine any gender bias.

STAKEHOLDERS

EU, MS, AI, RC, UA, PA, AN, AR, AP.

RELEVANCE

Women bring similar competence and different skills and having both genders is a human resources asset.

PRIORITY

Should be normal practice and offers scope for improvement.

JUSTIFICATION

PARE report Section 11.4 and topic 11.4.

PARE OBJECTIVE 53

Discourage and prevent the continuation of abuse based on gender.

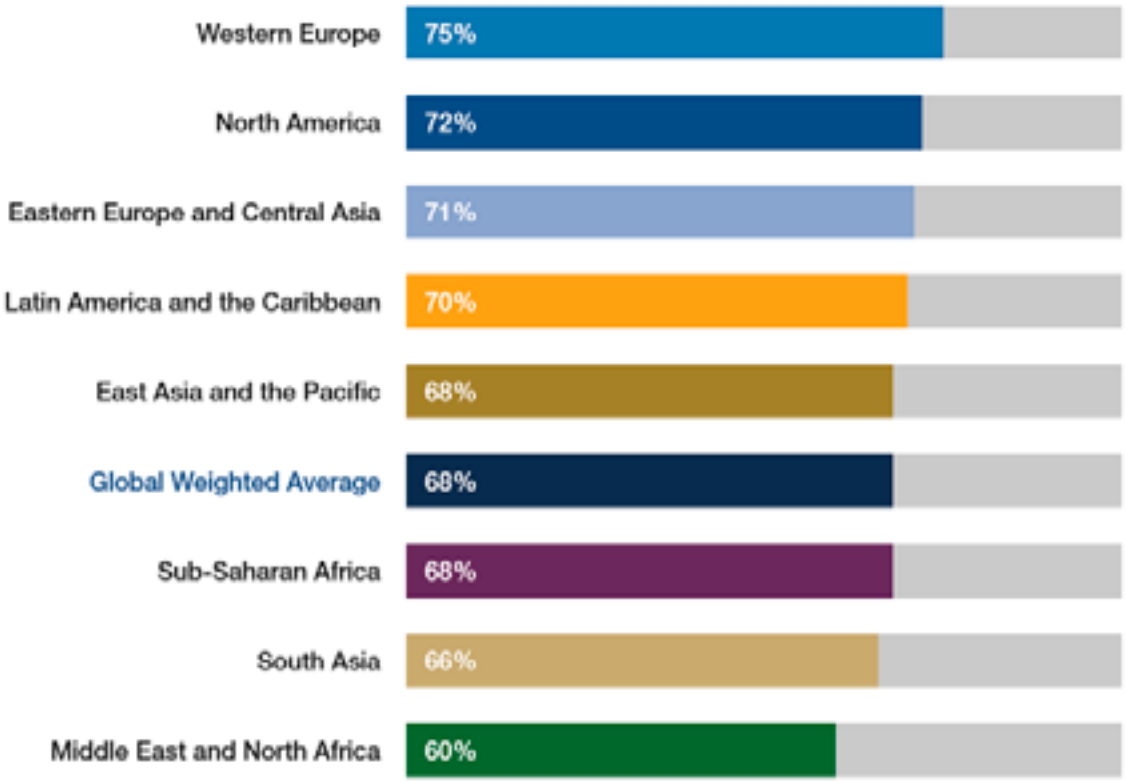


Figure 48 - Distance form gender parity 2017, by region.
(Source: http://www3.weforum.org/docs/WEF_GGGR_2017.pdf)

RECOMMENDATION 53

Take gender abuse as seriously as gross incompetence or major financial misconduct as concerns the consequences and leave no doubts on anyone's mind about this policy.

RATIONALE

The activity of a company and its hierarchical structure should not tolerate gender abuse as much as it should not tolerate gross incompetence or financial fraud.

STAKEHOLDERS

EU and MS legislations, AI, RC, UA, PA, AR, AN, AP, all other employers.

RELEVANCE

The tendency to ignore gender abuse or look the other way if it comes from up the chain are among the examples of non-acceptable attitudes.

PRIORITY

This is a human rights issue that is a fundamental principle.

JUSTIFICATION

PARE report Section 11.5 and topic 11.5.

PARE OBJECTIVE 54

Ensure that the protection of the family, maternity and parenthood is effectively implemented with its legal basis as a minimum.

AWARDS
Be a demonstrated leader in her field of aviation.
Be supportive of mentoring, educating and advancing women in the aviation profession.
Be a role model for young women and a professionally supportive peer to women in her field or company/firm.
Be a respected team player by both men and women.

Table 6 - Criteria for the ICAO-AIWA Aviation Awards.

RECOMMENDATION 54

Take family, maternity and parenthood in consideration in the assignment of tasks and giving a suitable working environment.

RATIONALE

In addition to faithfully implementing the legislation on the protection of family more can be done by goodwill towards dedicated employees.

STAKEHOLDERS

EU, MS, employers in general.

RELEVANCE

Respect for family values and culture should be part of company ethics.

PRIORITY

Normal practice to be encouraged.

JUSTIFICATION

PARE report Section 11.6 and topic 11.6.

PARE OBJECTIVE 55

Give equal recognition of achievements regardless of gender, taking into account the circumstances.

Figure 49 – Valentina Tereshkova, the first women to go into space, as an astronaut.

RECOMMENDATION 55

Avoid direct and reverse discrimination or bias by judging and rewarding achievements in an even, transparent and fair way that is not seen as gender bias.

RATIONALE

Perhaps the best way to achieve gender balance is to avoid direct or reverse discrimination and to recognise and compensate for legitimate differences.

STAKEHOLDERS

EU, MS, employers in general.

RELEVANCE

Women need no favours, only fair and equal treatment so that their merits are recognised and cannot be dismissed as reverse discrimination.

PRIORITY

Should be normal practice and it is still not always the case.

JUSTIFICATION

PARE report Section 11.7 and topic 11.7.

PARE OBJECTIVE 56

See the differences between the genders as an opportunity for a symbiosis of distinct talents that furthers smooth progress.

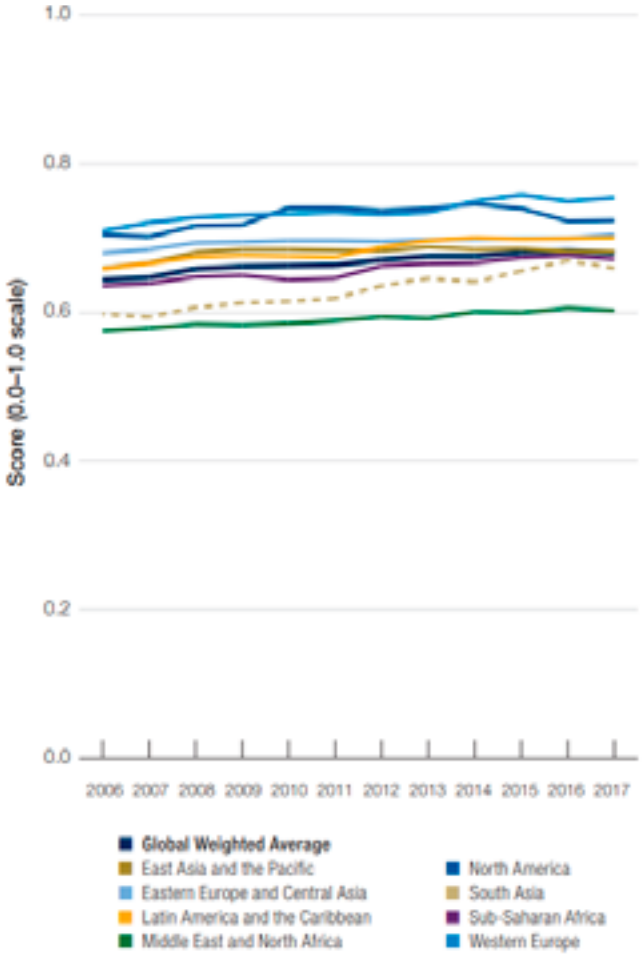


Figure 50 - Global gender gap index evolution, 2006-2017, by region.
(Source: http://www3.weforum.org/docs/WEF_GGGR_2017.pdf)

RECOMMENDATION 56

Assign positions and tasks using the best talents and skills available in both genders to promote creativity and efficiency.

RATIONALE

The equality of men and women does not exclude different talents that bring the most benefit in a symbiotic collaboration.

STAKEHOLDERS

EU, MS, all employers.

RELEVANCE

Choosing the right person on the team for the task should be based not only on experience but also the balance of skills in which gender can be one of many factors.

PRIORITY

Should be normal practice.

JUSTIFICATION

PARE report Section 11.8 and topic 11.8.

PARE OBJECTIVE 57

Increase the participation of women in aeronautics in the most effective way.

Figure 51 – Dana Newman, former Director of Technology and Policy Program at MIT (2003 – 2015).

(Source: http://web.mit.edu/aeroastro/www/people/dnewman/bio.html)

RECOMMENDATION 57

The greater numbers of women in aeronautics should be regarded as not just as a numerical enlargement of the workforce but also as a broadening of the talent available.

RATIONALE

The rationale for the increased participation of women in aeronautics is not just a potential increase in numbers but also an opportunity for broader individual and team skills.

STAKEHOLDERS

EU, MS, AI, RC, UA, other employers.

RELEVANCE

A broad view of the added talent brought by more women in aeronautics is needed to obtain the greatest benefit.

PRIORITY

A general policy issue.

JUSTIFICATION

PARE report Section 11.9.

PARE OBJECTIVE 58

Recognise the historic achievements of women, including in aeronautics, in biased or unfavourable circumstances.

Figure 52 - Female astronaut spacesuit designed by Dava Newman.

RECOMMENDATION 58

Consider the lives of outstanding women, including aviators and astronauts, not only from a biographical point of view but also recognising the challenges they had to overcome to realise their achievements.

RATIONALE

The achievements of great women in aeronautics and the gender unequal challenges they had to overcome are an indicator of the obstacles that should be removed

STAKEHOLDERS

EU, MS, employers

RELEVANCE

The role models serve as an example for women who should be assured to have more of a gender-equal treatment.

PRIORITY

It is an activity to counter unfounded and untrue preconceptions that could reduce the value of women contributions to aeronautics.

JUSTIFICATION

PARE report Section 11.10 and topics 11.9 to 11.13.

CONCLUSION

The ACARE Goals and PARE Objectives are complementary

- The **ACARE Goals** state broad aims, and deliberately do not detail how to achieve them since there are many possible contributions that can be used;
- The **PARE Objectives** detail some specific measures that could contribute to ACARE Goals without excluding other alternatives or complementary measures.

Thus, the ACARE Goals provide the broad overall justification of an aeronautics activity, and the PARE Objectives contribute to a more detailed work plan that will include additional ideas.
The 23 ACARE goals with 32 recommendations and 35 PARE objectives with 36 recommendations add to 58 initiatives with 68 recommendations.
While it would be easy to give many high priorities, this would not be helpful and would defeat the very purpose of prioritization.
To enforce some discipline for each of the sets of ACARE goals and PARE objectives as indicated in the following table, the highest priority of 3 asterisks was limited to 4, plus 6 two asterisks, 10 one asterisk and the rest no asterisks to total 68 recommendations.

INITIATIVES FOR HORIZON EUROPE 23 + 35 = 58	ACARE GOALS 23	PARE OBJECTIVES 35
Highest Priority ***** 4+4=8**	1, 6, 9.1, 21	27, 28, 29, 38
Very High Priority **** 6+6=12**	7, 9.3, 16.2, 16.3, 19.2, 20	33, 36, 37, 39, 45, 51
High Priority *** 10+10=20**	2, 3, 4, 9.2, 14, 15, 16.1, 18.1, 18.2, 23	25, 26, 30, 31, 32, 34, 35, 44.2, 53, 58
Medium Priority **12+16=28**	5.1, 5.2, 8, 9.4, 10, 11, 12, 13, 16.4, 17, 18.3, 19.1, 22	24, 40, 41, 42, 43, 44.1, 46, 47 48, 49, 50, 52, 54, 55, 56, 57
Total Recommendation **68**	32	36

Table 7 – Assignment of priorities to the 23 ACARE Goals and 35 PARE objectives.
(Source: own)

REFERENCES

1. https://www.acare4europe.org/
2. https://www.acare4europe.org/sria
3. https://www.acare4europe.org/documents/latest-acare-documents/acare-flightpath-2050
4. https://www.pareproject.eu/publications

58 PARE **RECOMMENDATIONS**

PARE

www.pareproject.eu/publications