

Strategy and Safety Management Director's office

## **AGENCY RESEARCH AGENDA 2019 – 2021**

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## Table of Contents

### The Agency's Research Agenda 2019-2021

Table of Contents .....	2
1 Introduction and structure of the document .....	3
2 Airworthiness Standards .....	4
2.1 Aerostructure / Materials / Engines .....	4
2.2 Avionics / Airborne Software and Electronic Hardware / Flight Control Systems / Communication - Navigation-Surveillance.....	4
2.3 Maintenance, repair and overhaul .....	5
2.4 Rotorcraft .....	5
2.5 General Aviation.....	6
3 Flight Standards.....	6
3.1 Human Factor Issues Assessment and Training Methods.....	6
3.2 ATM Standard .....	7
3.3 Operational Safety.....	7
3.4 Aircrew.....	8
4 Weather Hazards Protection .....	8
5 Security.....	8
6 Environmental Protection Standards.....	9
7 New Operations / Processes / Products .....	9
7.1 RPAS.....	9
7.2 Novel Technologies Assessment .....	10
7.3 Flight monitoring.....	10
8 Health.....	10
9 Other.....	10

## 1 Introduction and structure of the document

The document provides the current list of research requests identified by the Agency experts and external stakeholders in the fields of aviation safety, security and environmental protection.

The main general objectives associated to the research requests presented in this document are:

- Prepare the evolution of aviation standards
- Support the development of new safety and security management concepts/methods/tools
- Investigate safety and security threats, support reactive safety management
- Obtain knowledge and data on novel products, technologies or types of operation

The research topics have been grouped using the different aviation standards being addressed:

- Airworthiness Standards
- Flight Standards
- External Hazards / Weather Hazards Protection
- Security
- Environmental Protection Standards
- New Operations / Processes / Products incl. Drones
- Health
- Other

## 2 Airworthiness Standards

### 2.1 Aerostructure / Materials / Engines

New generations of aircraft under development introduce extensive use of new materials in damage-exposed applications, e.g. pressure hulls exposed to ground impact. In addition new engine designs increasingly require higher performance from the materials used.

#	Title	Short description
AW-01a*	Ageing Composites	Evaluation of ageing mechanisms in composite structure and development of a strategy for ensuring continued airworthiness.
AW-01b	Blunt impact on composite structures	Proposed projects are an evolution of existing ones involving significant EU partners and for supporting changes to standards for primary structure elements of large aircraft
AW-06	Hybrid Structure Certification	Project aims to better understand and standardise approaches to certifying hybrid structure.
FCS-01**	Seat Cushion Life Determination	To predict degradation over time of seat cushion performance, due to natural aging, physical wear-and-tear, in-service contamination, improper use and maintenance (storage conditions, wrong cleaning etc.) and possibly assess a typical service life.
IN-02***	Engine Damage Resistance	Develop new experimental methodologies for evaluating the extent and consequence of damage to engine rotor components
IN-25	Safety Implications Resulting from the Introduction of Additive Manufacturing (AM) into Aviation	Identification of the key AM methods likely to reach maturity in aviation applications, particularly those likely to be used in more critical applications. - develop a strategy for involvement for each method in each of EASAs regulatory activities

\* AW: Airworthiness  
 \*\* FCS: Fire and Cabin Safety  
 \*\*\* IN: Innovation

### 2.2 Avionics / Airborne Software and Electronic Hardware / Flight Control Systems / Communication-Navigation-Surveillance

New aircraft designs include items of integrated digital equipment with increasing level of complexity. As a result, current practices and techniques used for design verification (integrity, dependability) and airworthiness certification need regular evolutions.

Changes to avionics or other aircraft systems due to the introduction of new concepts and technologies require that the safety assessment methods included in airworthiness standards are maintained, as well as the related means of compliance are updated with the latest developments stemming from design methods.

#	Title	Short description
AW-02	Flight Control Systems Verification	New methods for verification of complex flight control laws and for error detection in air data systems
LOC-04*	Air Data Enhanced Fault Detection & Diagnosis	Develop new Fault Detection & Diagnosis (FDD) and Fault Tolerant Control (FTC) methods of the following types: <ul style="list-style-type: none"> <li>• Model-based analytical redundancy (e.g. virtual sensors),</li> <li>• Data-based (i.e. model free-methods), or</li> <li>• a combination of both types</li> </ul>

\* LOC: Loss of Control

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### 2.3 Maintenance, repair and overhaul

There is a lot of research into ergonomics of the workspace, but very limited into the ergonomics of manuals/documents. This research in MRO is intended to gain additional, specific scientifically supported knowledge about how to produce handbooks/instructions/procedures, in a way that it suits the human nature of the mechanics performing it.

#	Title	Short description
HF-08	Human factors in maintenance documents (ICA)	The project will recommend best practice for the content and format of handbooks/instructions/procedures in a way that it suits the human nature of the mechanics implementing these ICA. The research should also take into account the current trend away from printed handbooks to electronic documents, as it is unclear whether all this new technology is really helping the human mechanic, or just produces overload and confusion.

\* HF: Human Factors

### 2.4 Rotorcraft

The wide range of rotorcraft types and the often very different and specialised types of operation lead to a variety of incidents and accidents. Consequently, research areas for safety improvement are very diverse and include technical as well as operational issues. A practical way to identify such thematic areas is to review the applicability of technologies and operations, which have proven to provide a safety gain on larger rotorcraft and/or even on fixed wing aircraft.

#	Title	Short description
IN-10	Rotorcraft Gearbox health monitoring - In-situ failure detection	New technologies for in-situ detection of helicopter gearbox failures
IN-20	Transmission reliability and safety standards	Preparation of an integrated strategy for improving transmissions reliability and safety standards with advent of new technologies (e.g. new materials), looking at cert procedures, regulations, research, DOA, POA, 145.
RC-01*	Power reserve for rotorcraft	Demonstration of the technical feasibility of equipping a helicopter with a reserve of power to be utilized in case of an engine failure
RC-02	De-icing of smaller helicopters	Study the implementation of a rotor de-icing system for smaller helicopters
RC-04	Enhanced emergency floatation systems for helicopters	Enhanced emergency floatation systems for helicopters to enable post capsizing floating attitudes that provide for a portion of the passenger cabin to remain above water to enable occupants to breathe whilst making their escape.
RC-05	Rotorcraft main gear box (MGB) design to guarantee integrity of critical parts and system architecture to prevent separation of the main rotor following any MGB failure.	Recent continued airworthiness events have shown that failure of Critical Parts of helicopter Rotor and Rotor Drive Systems represents a significant risk for helicopter airworthiness. Deeper investigation of the critical design parameters and characteristics of Critical Parts, the threats they face during their service life and the methods used to substantiate the integrity and flaw tolerance of these parts, is proposed in order to investigate opportunities to minimize the likelihood of failure. Additionally, Rotor and Rotor Drive System architecture concepts should be reviewed that could reduce exposure to catastrophic failure modes
RC-06	Ditching in water or a Survivable water impact (SWI) for Rotary wing aircrafts (Helicopter, Tilt	Sufficient real floatation time (2-3 Minutes) before any capsizing or side floating movement to provide opportunities for the occupants to escape a rotary wing aircraft, taking into consideration sea state 6 conditions (irregular waves), in case of ditching in water or in the event of a (SWI).

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	Rotor, Compound Rotorcraft)	
RC-07	Underwater Evacuation from Helicopters	A Review of Current Research Data and Possibilities for Enhancement. An initial review of the currently available research data regarding underwater escape from helicopters is required. Further to this, an assessment is to be performed of the feasibility of performing further focussed research aimed at correcting any shortfalls that may be identified in this initial review, if justified on the basis of safety gains versus costs.

\* RC: Rotorcraft

## 2.5 General Aviation

The proposed research actions are aimed at improving General Aviation (GA) flight safety through new technical means, as well as at preparing the deployment of new technologies and ensuring the continued airworthiness of existing designs.

#	Title	Short description
AW-04	Ageing Aircraft	Development of maintenance schedules for old GA aircraft (e.g. wood structures)

## 3 Flight Standards

### 3.1 Human Factor Issues Assessment and Training Methods

Assessment of human factor issues and development of training methods to cope with operational hazards or in the context of new technological developments.

Modern aircraft have an increasing amount of automation, which poses significant issues regarding the careful delineation of human-machine interactions, particularly covering unusual situations as well as the potential transfers between piloting and system monitoring skills.

In addition, the training requirements for aviation personnel need to be adapted to new learning techniques and forthcoming safety challenges, taking also into account the potential shortage of available instructors to meet the increasing demand.

#	Title	Short description
HF-01	HF issues and Training methods for complex automation in cockpit	Support aviation safety development in coping with new procedures and increasingly complex technologies - starting with flight path management
FS-01*	Effectiveness of FTL	Continuous review of the effectiveness of the provisions concerning flight and duty time limitations and rest requirements (FTL), initially for commercial air transport (CAT) by scheduled and charter operators)
IN-28	New technology training devices rules adaptation	The world of training devices is fast growing, with "out of the box" thinking which do not relate to the classic regulatory framework, i.e. CS Flight Simulator Training Device (FSTD). There is therefore a need to innovate in the area of FSTD qualification aiming first on their added value, i.e. pedagogic added value. A Study aiming on making best use of those training devices in the framework of Flight Crew Licencing and Operations (mission training) is therefore necessary
TRN-01**	Virtual reality - aviation blended learning solution	Within pilot training domain – study the effectiveness of alternative training devices and methods in initial and recurrent pilot training.

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#	Title	Short description
TRN-02	Competency Based Training and Assessment (CBTA)	Within pilot training domain – this research intends to investigate the options to move towards less prescriptive requirements based on training hours, rather assess pilot competence against a set number of competencies based on observable behaviours.

\* FS: Flight Standards

\*\* TRN Training

### 3.2 ATM standards

#	Title	Short description
IN-27	Definition of 'acceptable level of safety'	The New Basic Regulation (Article 41, 6, d) sets an obligation to the Member States to establish 'acceptable level of safety' to the Air Navigation Service Provider and to oversight and enforce compliance to it. This study should identify the best practices and propose a methodology for supporting the Member States when establishing the 'acceptable level of safety'.

### 3.3 Operational Safety

This research intends to help EASA to learn more about the safety challenges in air operations faced by airlines and manufacturers, such as preventing runway incursions/ excursions/ collisions, or issues resulting from new types of operations.

#	Title	Short description
HF-07	Assess the efficacy of pilot training as a safety barrier in the context EFVS operations	EFVS (Enhanced Flight Vision Systems) without the prior approval of the competent authority; considering that the procedural, equipment and pilot barriers are sufficiently robust. Although a risk assessment was conducted during the rulemaking task this research should confirm the initial assumptions. The scope of this research is to test the readiness of pilots with no or little exposure to EFVS to use such equipment.
OP-03*	Group Operations – assess regulatory obstacles and social implications at EU and international level	Operators consolidate their business at the level of multi-national business groupings. This is essential for their commercial viability on an international, fully liberalized market. However, most of the existing rules, including ICAO Standards and Recommended Practices are state centric
OP-04	Implementation of the "triple one" concept at aerodromes (or one runway, one frequency, one language)	Preventing runway incursions is a global and European priority. Increasing the situational awareness of pilots, Air Traffic Services personnel and vehicle drivers through the use of common frequency and language for runway operations is considered an effective prevention mechanism. The identification of the reasons that prevent the wide implementation of this operational solution at European aerodromes, as well as the alternative practices currently used, will allow the Agency to understand the different practices in place at European level, their actual benefits, and mainly the rationale/reasoning behind each one of them, including the way in which each solution was implemented at local level. This will allow the Agency to take future action in this area, as appropriate, while avoiding unnecessary impact on the operational stakeholders of an aerodrome.
OP-05	Passenger mass survey	Air Operations (OPS) rules, in the context of mass and balance calculations, prescribe the use of "standard passenger masses", which were taken from previous Joint Aviation Authority materials. A survey was conducted in 2008

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#	Title	Short description
		showed that the standard masses need to be updated; however, such an update was not included in the Air OPS package as the scope at that time was mainly geared towards transposing EU-OPS. A new, smaller survey was planned to start in 2018, to update the data collected in 2008. Since the associated rulemaking task was deprioritized, this survey should be re-planned for a later date (e.g. 2019-2020)

\* OP: Operations

### 3.4 Aircrew

Research should develop a tool to objectively analyse the data provided by MS; allow NAAs to objectively analyse the data provided by industry.

FS-04	<b>Compliance monitoring effectiveness</b>	<b>To measure performance of a compliant system in the context of FCL, MED, FSTD, in terms of qualitative and quantitative methods/tools for use in continuous monitoring.</b>
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## 4 Weather Hazards Protection

Weather hazards have always been a challenge for aviation. Although aircraft designs have been improved to extend the operational capability of the aircraft facing known severe weather events, associated risks may be influenced (positively, negatively, neutral) by a combination of the impact of climate change and the development of aircraft technologies and operations.

#	Title	Short description
WE-01*	Icing hazard	Characterisation of phenomena and analysis of impact/mitigation for safety (ice crystal icing or super-cooled large droplet icing) in order to participate in the development of means of compliance with the new ice protection regulation
IN-16	Ice crystal detection	Ice crystal icing phenomenon is still posing a severe threat to high altitude flying, in particular to new engine designs. Pilots have little or no means to detect and/or avoid it, especially at night. A research is proposed in order to better detect the presence of ice crystal icing and to develop an equipment suitable to detect such a phenomenon
LOC-06	Fuel icing	The engine exposure to continuous fuel icing threat (saturated fuel + 200 ppm free water) can potentially affect the engine operation. It is now known that the ice concentration (specified in the Accepted Means of Compliance) is not the only pertinent parameter (ice particle size and structure have an influence on engine system operation) The proposed research aims to characterise and reproduce test conditions more representative of the fuel icing threat generated by the aircraft system at the inlet of the engine

\* WE: Weather

## 5 Security

Security measures are meant to ensure the safety of flights and service / business continuity in the presence of acts of unlawful interferences. The needs to have secure systems, processes and procedures for the protection and responses to threats as well as enabling effective risk management are becoming more acute.

#	Title	Short description
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SEC-01*	Tamper-resistant Aircraft Localisation	Ensure a fail-safe localisation of an aircraft whatever the outcome of an abnormal situation and covering aircraft tracking, autonomous distress tracking and automatic deployable flight recorder
SEC-05	Cybersecurity: common aeronautical vulnerabilities database	Collection of vulnerabilities in aviation systems and security attributes impacts analysis
SEC-06	Composition of secure systems	Develop tools and methods for the assessment of the effects on security properties when adding or modifying a subcomponent in a complex architecture
SEC-07	Cyber Security – Vulnerabilities vs Complexity	Evaluation of safety implication of cyber security threats and mitigation measures

\* SEC: Security

## 6 Environmental Protection Standards

The relevance of environmental protection matters to the aviation sector has increased significantly. This holds for both noise and emissions. In view of the environmental challenges that face the aviation system, a comprehensive approach using all options to mitigate the negative environmental impact of aviation and promoting any positive impacts is needed in Europe and globally. In this respect one important cornerstone is environmental protection research.

#	Title	Short description
ENV-02*	Aviation Emissions Support	Obtain high quality technical expert support on standardisation issues
ENV-04	Development of Particulate Matter (PM) regulations and guidelines	Acquire high quality PM data, analysis, modelling and expert support for regulatory action
ENV-06	Market-based Measures (ETS and CORSIA) – ecoImpact II	Extend and update of existing capabilities for assessment of Market-based measures notably to cater for new traffic data and forecasts, handling of novel scenarios and measures, ensuring their fitness-for-purpose and credibility for supporting critical policy-making both at European (EC, Member States) and international (ICAO) level.

\* ENV: Environmental Protection

## 7 New Operations / Processes / Products

### 7.1 RPAS (remotely piloted aircraft systems)

The EASA “Drone Collision Task Force”, in response to the increasing perceived risk of collision between Unmanned Air Systems (UAS) and manned aircraft, recommended research actions and published a risk assessment.

#	Title	Short description
RP-03*	Vulnerability of manned aircraft to drone strike	The Project assesses the collision threat posed by drones to manned aircraft and validates its results by means of a complete set of activities including modelling and impact tests

\*RP: Remote Piloted

## 7.2 Novel technologies assessment

New technologies are fast developing, which has impacts on aeronautical products (e.g. new aircraft designs), new means to process and convey information, new operational procedures or new training methods. While most of the technological developments are impacting external stakeholders, some will also impact the way EASA is conducting its activities (e.g. use of virtual reality for training, use artificial intelligence for regulatory analysis). A specific area of research should therefore consider these developments focusing on making best and safe use of the latest developments.

#	Title	Short description
IN-29	Risk modelling tools specifically designed for novel technologies	New technologies emerge at an accelerated pace, challenging the established conventions. We will need to answer the question "is this safe?". A bespoke, risk modelling tool, that is not entirely technology specific should help EASA to answer such a question.
IN-30	Machine learning	In order to qualify machine learning in sensitive applications (example the one involving decision making processes) there is a need to get visibility on the neuronal network functioning. The study should explore all tools the regulatory authority should have to ensure the integrity of the process.

## 7.3 Flight data monitoring

Research is needed to assess the safety and operational benefit of new emerging Flight data monitoring technologies, such as transmitting flight recorder data continuously or upon detection of an emergency situation.

#	Title	Short description
IN-04	Quick recovery of flight data recordings	Assess means to recover flight recorder data quickly after an accident for the purpose of faster corrective actions, their limitations as well as the related challenges for standardisation and deployment.

## 8 Health

Considering public interest in health issues related to flying, it is necessary to further investigate factors that might have an impact on human health.

#	Title	Short description
HE-01*	Research study on cabin air quality	Investigation of the quality level of the air inside the cabin of large transport aeroplanes and its health implication. The work aims at demonstrating, on the basis of a sound scientific process, whether potential health implications may result from the quality of the air on board commercially operated large transport aeroplanes.

\*HE: Health

## 9 Other

#	Title	Short description
IN-15	Toxicity of failing non-rechargeable lithium batteries	Non-rechargeable lithium batteries are more and more present in the occupied compartment. Type Certificate Holders/applicants information on this aspect is very limited since basic knowledge is missing about the toxicity of burning "small" non-rechargeable lithium batteries.
FIR-02*	Fire risks with large Personal Electronic	Characterise fire risk (propagation, detection, suppression) for large PED transported in aircraft cargo compartment (checked luggage).

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	Devices (PED) in checked luggage	
AW-05	Halon Replacement	Investigate Halon replacement including aircraft system integration level feasibility for engine/nacelle/auxiliary power unit fire extinguishing system due to banning by regulation the installation of 'halon firex' system on aircraft

\*FIR: Fire and Cabin Safety