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OPTICS² Main Findings

Final Safety and Security integrated recommendations

OPTICS² assessed the progress of European Aviation Safety and Security Research and Innovation (R&I) towards the goals of Flightpath 2050. As a result, OPTICS² has provided recommendations to help steer EU Aviation Safety and Security R&I in the right direction, even when there are unexpected events such as the arrival of new disruptive technologies, or global pandemics such as COVID-19.

OPTICS² reviewed the state-of-the-art in European Aviation Safety and Security R&I annually from 2018 to 2021, via a core team of experts from across the entire aviation spectrum assessing more than six hundred European and nationally funded projects, including major programmes such as Horizon 2020, CleanSky and SESAR. OPTICS2 reports to both the European Commission and ACARE, summarising the status of each safety and security 'Action Area' (as identified in ACARE Strategic research and Innovation Agenda, the SRIA), identifying the main performers, gaps and obstacles in the research landscape, along with strategic recommendations and priorities.

The backbone of OPTICS2 is the ten Action Areas, derived by ACARE WG4 (Safety & Security):

Weighing up both the research gaps and the positive advances obtained in the pursuit of the ACARE SRIA goals, several research priorities emerge, which are formulated in the document as a top six for safety, a top six for security, and a series of cross-cutting research priorities for both research domains.

THE TOP

Safety Research

PRIORITIES

1

[METHODOLOGY]

Safety risk modelling will need to raise its game to determine how the aerial systems can share the airspace safely, by using **multi-actor risk modelling** to inform the development of an all-inclusive CONOPS (Concept of Operations).

2

[RESILIENCE]

Research is needed on new ways of organizing the increasingly complex transport system comprising ultra-efficient commercial vehicles, via **new ways of communication, information sharing, interaction and collaborative decision-making**, to ensure the system is more resilient against emerging and sustained hazards such as the **COVID-19 pandemic.**

FP2050 Safety Goals

Less than one accident per ten million commercial aircraft flights.

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

Manned and unmanned vehicles operate safely in the same airspace.

3

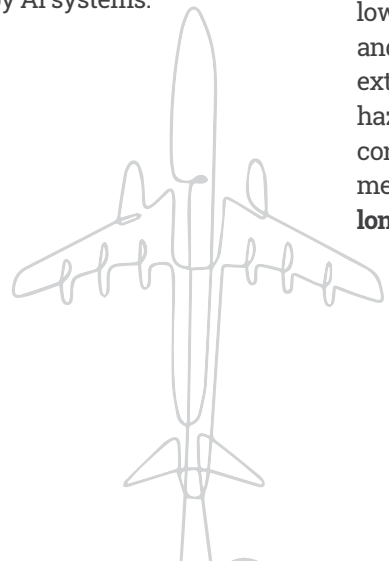
[PEOPLE]

The **future aviation workforce** will be different from today, with more automation, more distributed teams, and new roles and ways of working such as smart working and remote control. To select and train this workforce we need to understand how work is really done today, across all aviation sectors, via **'open-book' task analysis**, as well as developing an approach to **wellbeing** that ensures aviation continues to deliver high levels of performance and remains an attractive sector in which to work.

4

[AI-ASSISTANT]

Finding **the right Human-AI** partnerships will be key to future aviation safety. The **Intelligent Assistant (IA) in the cockpit and on the ground** will be the crucial stepping stone toward fuller Artificial Intelligence (AI) by 2050. Research is urgently needed to determine how humans and IAs can work together productively (e.g. IAs handling repetitive tasks in ATC) and safely (e.g. IAs assisting pilots during flight upsets or 'startle events'), including human supervision and recovery in case of 'aberrant behaviour' by AI systems.



5

[CLIMATE]

Research needs to consolidate the safety of **'all-weather operations'** (e.g. clear air turbulence, low visibility conditions and thunderstorms), and extend the types of weather hazards or external hazards considered (e.g. extreme meteorological events, **long-term climate change**).

6

[AIRCRAFT]

Survivability of aircraft needs to be drastically improved. Already identified as a priority for **rotor vehicles and small GA aircraft,** this also needs to be extended to cover new aerial vehicles such as **personal vehicles and sky taxis** which could jeopardize, in new ways, the on-ground population safety.

THE TOP

Security Research

PRIORITIES

1

[PEOPLE]

Research is required to develop an **Aviation-Wide Security Culture**. This includes validated and mature training material to provide baseline knowledge and awareness for all personnel, and customised training for specialists.

2

[METHODOLOGY]

As yet, there is no common or compatible Teachnical **Security Baseline and Risk Assessment.** This is required to build confidence between stakeholders, avoid weak links **across the aviation segments**, and facilitate the progression towards higher levels of intermodal transport security.

3

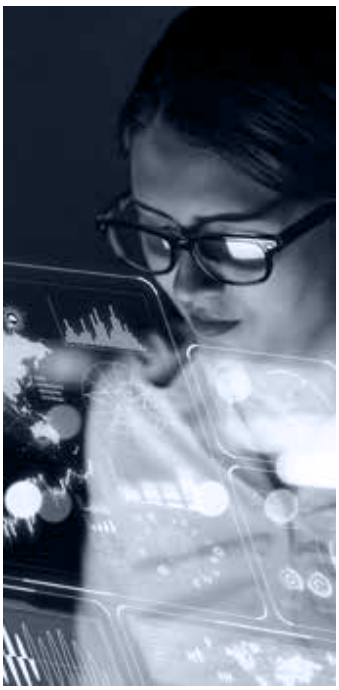
[LEGAL]

A **common framework** is required to address **legal, ethical and societal** concerns (e.g. over data privacy protection, privacy-preserving data processing on the Cloud and respecting passenger rights and culture at worldwide level) that otherwise may prevent the deployment of novel technical and procedural solutions to improve security, nullifying the effort invested.

4

[DESIGN]

Research is required on how to achieve **Security Resilience in Design**, including aspects such as software and maintenance, covering the entire lifecycle phase from concept design through to deployment, operation and decommissioning and covering the various aspects of the **supply chains** which can become mission critical as recent events have shown.



5

[INCIDENTS]

Research is needed to develop more effective and coordinated tools for **real-time security incident management**, including spill-over effects into other transport modes and coordinated multi-modal transport attacks. A **horizon scanning and threat intelligence capability** is required to anticipate the longer-term threats likely to emerge.

6

[RESEARCH]

Global aviation security should be a first class **research target** since most projects address the reaction towards a particular incident or threat, or address security as a secondary or indirect objective. This can be brought about by having **more aviation projects** (including Horizon Europe Cluster 5 and the aviation Joint Undertaking projects) **focus on development and operational aviation security as a main line of their research**. This will help convince stakeholders to **share security practices** and operations.

FP2050 Security Goals

Boarding and security checks allow seamless security for global travel. Passengers and cargo pass through security screening without intrusion.

Air vehicles are resilient by design to aerial and ground security threats.

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

CONCLUSIONS

Cross-cutting research priorities

1 [AIR TRAFFIC DIVERSITY & COMPLEXITY]

Assure the safety and security of the future aviation 'skyscape', addressing the full future complexity of current and novel manned and unmanned vehicles, including drone fleets, personal vehicles and sky-taxis, as well as operations in Higher Airspace, including solar planes, supersonic and hypersonic aircrafts, and new sustainable aviation fuels and aircraft configurations for Clean Aviation.

2 [BIOLOGY]

A strategic and collaborative approach for controlling the spread of biological threats through the international air transport system needs to be researched and supported by policy/regulation, to counter the effects illustrated by the COVID-19 pandemic.

3 [SHARING]

When it comes to safety and security intelligence and data analytics, cooperation matters. There is still insufficient sharing of data between the various stakeholders. Research is needed to determine how best to enable multiple actors to share their data confidentially, enabling benchmarking and insights that will lead to safer and more operations and designs of aircraft, airports and air traffic systems. Such a data-sharing and safety-security learning platform must also include new entrants (drones, sky taxis, etc.).

4 [NEW DEVICES]

Research is needed on the adoption of electronic devices with increasing automation capabilities and interactive modes into the cockpit and potential for security compromise (e.g. tablets, electronic flight bags, etc.). This research needs to encompass conventional airliners as well as GA aircraft and new vehicles (personal aerial vehicles, sky taxis, etc.).

5 [BIG DATA]

The 'promise' of Big Data and Machine Learning has yet to deliver in aviation safety and security. Research is needed on which related use-cases should be prioritised by advanced analytics and data-mining, providing compelling demonstrations of the utility of the approach for safety and security, as well as guidance on how to install data-driven safety analytic processes into aviation businesses. This is particularly challenging for all current Machine-Learning approaches as safety and security incidents are rare and we want them to stay so.

6 [CERTIFICATION]

Research is needed to develop more agile and less fragmented certification methods (which are still fit-for-purpose) such as virtual certification, to maximise the implementation of safe and secure innovations in the aviation sector by means of model-based tools and the adoption of shared and robust validation approaches, including Industry 4.0 technologies and new aerial systems.

7 [SOVEREIGNTY]

As demonstrated by the supply chain issues during the COVID-19 crisis and the Huawei 5G security risks, a strategic assessment needs to be conducted on future ATS operational safety and security requirements to determine if there are critical technologies requiring European Technological sovereignty, which need to be supported through European research.

8 [MULTI-MODAL]

As transport modes are increasingly integrated, a more strategic and collaborative capability-driven process for security and safety is required, backed by regulation and policy to provide a safe, secure and resilient transport system through improved integration of systems and procedures across the four transport modes.

CONCLUSIONS

Use of OPTICS² Recommendations

The list of research priorities, as well as the status of progress achieved so far along the ACARE SRIA goals prepared by OPTICS represent a key input to the work of the ACARE dedicated working group for aviation safety and security domains (WG4).

With the new ACARE Vision domain structure (see below), Safety and Security apply primarily to domains 1, 2, and 3. A series of exchanges between the ACARE WG4 and the team in charge of the ACARE 'New Vision' will assess how best to integrate these research and cross-cutting priorities into the ACARE WG4 work programme and the SRIA.

ACARE 'New Vision' for Strategic Research and Innovation (under development)	**Domain 1: Vehicle (Technologies, Demonstration, ...)**
	Domain 2: The Air Transport System
	Domain 3: Digitization for Greening
	Domain 4: Measures and Impact
	Domain 5: Support and facilitation of implementation

Conclusions

OPTICS2, via its in-depth and broad-spectrum approach to the analysis of European aviation safety and security research, has been able to highlight where future research needs to focus in order to deliver a safe and secure aviation evolution towards 2050. It is hoped that these future research 'destinations' may help inform major European aviation research frameworks such as Horizon Europe, CleanSky and SESAR, as well as national research programmes, leading to the delivery of a safe, secure and sustainable world-leading aviation transport system.

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Consortium

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