FUTURE SKY SAFETY

A RESEARCH PROGRAMME OF THE FUTURE SKY JOINT RESEARCH INITIATIVE

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SUMMARY

Future Sky Safety is the framework programme promoted by the Association of European Research Establishments in Aeronautics (EREA) to support the improvement of Aviation Safety. It is part of Future Sky, an ambitious EREA initiative intending to address the main challenges for Aviation aiming to achieve a European transport system that is resilient, resource-efficient, climate- and environmentally-friendly, safe and seamless and to maintain the EU leading position in the Aviation sector for the benefit of all citizens, the economy and society.

Since its inception in 2013, the main activities in this program have focussed on the development and execution of the largest safety research project in H2020, which is also called Future Sky Safety (phase 1). This project ended in June 2019.

The H2020 project has addressed several key safety research priorities. While the research on some topics is thus completed, others will require further effort in the EREA Future Sky Safety programme. In additional, several important topics previously identified within the EREA Future Sky Safety programme were not covered in the current H2020 project, and dedicated R&TD projects will be needed to address these topics. Topics include, among others, next generation flight envelope protection, human-automation interaction, and protection from weather hazards.

Moreover, new challenges have emerged since 2013, such as the need to bring the full potential of advanced analytics to flight data, demographic trends and their consequences for training the workforce, the safety consequences of higher traffic volumes such as the risk of mass diversions, the insertion of new type of vehicles and more.

At a program level, important lessons have been learned while conducting the current H2020 Future Sky Safety program, and these lessons need to be translated into the way the EREA safety research initiatives will be organized in the coming years.

More recently, both as part of the initiatives taken under the Future Sky Safety program and also at the initiative of EASA in view of the extension of the remit of EASA under its new Basic Regulation, EREA and EASA are engaging in closer coordination with regard to aviation safety research. In addition, the already extensive network of stakeholders of Future Sky Safety can be strengthened further with, among others, NGO's, associations (such as those specialized in education), and the regulatory community.

All of these factors, including safety research topics yet to be addressed, emerging safety risks requiring analysis and research, implementing the lessons learned from the H2020 program, and working in closer coordination with EASA call for a next phase of the EREA Future Sky Safety programme.

In a nutshell, Future Sky Safety programme will address new safety research priorities, in much closer coordination with EASA, and as part of an extended network of research partners and stakeholders, with the purpose of further improving the safety of aviation in Europe and beyond.

LEGACY

Launched in 2013, Future Sky Safety is a cutting-edge Future Sky programme that inspired the European Commission and eventually led to one of the largest EU-funded programmes in aviation safety research ever. The EU-funded Future Sky Safety program consisted of two main pillars, one for safety research coordination and one for conducting specific safety research. The first pillar was coordinating the vast amount of air-transport safety research and innovation happening across the EREA research establishments. It has not only created – for the first time ever – a detailed mapping of the institutionally funded safety research projects within EREA, but it has also allowed the implementation of a range of new cooperations among institutes and the development of a common EREA safety research agenda. In the second pillar, the leading European researchers inside and outside of the EREA community took on key safety challenges together, developing collaborative R&TD projects. This second pillar of the program, inspired on the goals of Challenge Four of Flight Path 2050 and the Europa Aviation Safety Program (EASP) as well as the leading causes of accidents, consisted of a set of projects addressing specific safety topics:

- Runway excursion accidents
- Total system risk assessment
- Safety culture and organizational risk
- Human performance in the cockpit
- The risk of fire, smoke & fumes

A key element of the program is that it brought together a vast group of 33 partners including the EREA institutes, and also the main European industries, the leading universities involved in safety research and education and many other key stakeholders and researchers such a EUROCONTROL, airlines, regulators and SME's.

As the EC-funded Future Sky Safety program has of course not been able to address all safety priorities, as lessons have been learned in the EC-funded program, as new safety priorities have emerged since 2013, and in view of the closer coordination with EASA, it is time for a next generation Future Sky Safety initiative – which is the topic of this whitepaper.

CHALLENGES

COORDINATION

To face the formidable safety research challenges still before us, it remains essential to bring together the scarce resources for safety research at a European level.

It is a fact that the Future Sky Safety program has made great strides in safety research coordination and important results have been achieved. For example, there is now a thorough insight in the volume, nature, priorities and gaps in the safety research carried out by the EREA institutes and these insights are now – also for the first time – available for stakeholders like EASA and European policymakers. In addition, more cooperative research initiatives in safety have been initiated among the EREA institutes as well as some personnel mobility. Further building blocks for coordination are made available by other projects, such as OPTICS. Moreover, coordination between EREA and EASA, as leaders in public sector safety research, is certainly improving, also as a result of Future Sky Safety.

Yet, coordination – while improving – is still in its infancy, and much remains to be improved. Much deeper coordination and cooperation, both between the EREA institutes themselves, between EREA and EASA and

with various other stakeholder as well as the academia, is necessary. EREA, as an independent and not-for-profit organization will be able to play a linking role between the actors involved, including academia and industry.

In the US, the FAA is not only the regulatory agency but also the safety research agency (along with NASA and its centres) including long-term joint programming. The European Commission, EASA, EUROCONTROL together with EREA and the national centres could articulate a similar role. This could lead not only to more efficiency within the EU (less duplication, less costs, less gaps), but also to jointly strengthen EU Member States stakeholders' position internationally:

- for competition, when negotiating new global safety regulations / standards (e.g. at UN's ICAO), especially regarding new products, processes and services;
- for cooperation, when engaging in research with third countries.

Hence, safety research coordination will have to remain a key activity for the Future Sky Safety program – together with its partners.

SAFETY PERFORMANCE

While the level of safety performance of air transport is already very high, the need of keeping up with traffic growth to prevent an increase in the number of accidents means that new safety enhancements must be continuously be developed. As the air transport system is already a highly optimized system, particularly in safety, this presents a serious challenge. Attaining a detailed understanding of safety performance in day-to-day operations is an essential instrument in identifying opportunities for further risk reduction and to be able to develop effective risk mitigations. Very significant developments, both in the availability and sharing of data and in progress in the techniques to use that data, are creating great potential, for example to put tools in the hands of smaller organizations that could previously simply not afford such tools. At the same time, there are major challenges in dealing with the avalanche of data on a daily basis, keeping operational personnel informed, identifying and implementing operationally useful big data techniques, etc.

DEMOGRAPHICS

The workforce is changing. Due to the continuing growth of the industry, and the fact that a significant portion of the current workforce – both in flight operations and in maintenance & engineering – is retiring or will retire in the next decade so that the challenge of recruiting, training and retaining new pilots and engineers is formidable. For example, between 470,000 (Airbus estimate) and 750,000 (Boeing estimate) new pilots will be needed until 2035, an unprecedented number. As a consequence, new generations of young people will enter the workforce bringing different skill sets, different life experiences and different expectations of their professional work environment. At the same time new ways of training and new training technologies such as virtual and augmented reality are rapidly maturing in terms of affordability, capability, and ease of access. The innovations needed will create challenges in the regulatory domain as well, both at the level of regulations and in oversight.

CLIMATE CHANGE

Climate change is changing the likelihood and magnitude of (extreme) weather events. Atmospheric phenomena have an important impact on aviation safety as weather hazards (poor visibility, icing, lightning, wind & turbulence) are still an important risk category. Furthermore, new regulation have been issued and still quite some effort is needed to properly define standards and make available tools and facilities as means of

compliance to comply with these new regulations. While very significant work has been done in this domain over the last decade, important challenges remain or are emerging, which require focussed R&TD activities.

TRANSVERSAL CHALLENGES

Developments in Aviation Energy, Security, Circular Aviation and Urban Air Mobility may bring about safety challenges as well. New risks may be introduced, safety regulations or safety standards may be non-existent or insufficient, novel safety analysis processes and techniques may be needed, new safety data may be needed, etc. But the reverse is true as well; developments in safety may affect for example Circular Aviation or Security. Since Aviation Energy, Security, Circular Aviation and Urban Air Mobility and safety are addressed in separate Future Sky themes, it is yet to be determined how the transversal (safety) challenges will be addressed

FUTURE SKY SAFETY – ACTION LINES

In accordance with the approach taken in the first Future Sky Safety Program the organization of safety research topics adopted across the industry (Operational Issues, Systemic Issues and Emerging Issues) is followed as much as possible to provide a common language, to enable cooperation and also to facilitate coordination with EASA. In Future Sky Safety, the organization of the safety research topics to be addressed in the next decade is into the same three main categories, albeit with a slight difference to allow a deeper focus on the technology aspects and human performance aspects:

MITIGATING RISK FOR SPECIFIC ACCIDENT CATEGORIES

- Decreasing accident risk by developing new and more efficient safety interventions, both at the technology level, the operations level and the human operator level, specifically for the main accident categories Aircraft Upset/Loss of Control and Runway Excursion. Interventions shall include advanced flight envelope protection and improved protection against external hazards including adverse weather hazards (poor visibility, icing, lightning, wind & turbulence);
- Improving passenger and crew survivability by improving vehicle resilience for impacts (birds, drones, ground and water impacts), and by the development of cabin environment technologies and airframe technologies to deal with on-board hazards such as fire.

SYSTEMIC RISK REDUCTION

- Finding new ways to significantly strengthen the effectiveness and efficiency of Safety Management, including Integrated Risk Management, the development of organizational design guidelines and the development of new and effective and (cross-organizational) safety culture interventions;
- Enhancing the effectiveness of aviation sector specific Safety Oversight and performance-based regulation;
- Further enhancing the role of the Human Operator by developing more advanced methods & techniques for Human Performance Management and crew interaction in highly automated environments, and by strengthening European capabilities in the field of Evidence-Based Training, advanced flight simulation - including virtual flight simulation and blended learning;

- Strengthening the capabilities in Europe to manage risk by developing and applying advanced tools and techniques such as data analytics and dynamic risk modelling;
- Use flight & occurrence data as well as the collective knowledge of aviation professionals to detect the emergence of new risks in the air transport system – such as mass diversion, to assess their potential impact and to investigate potential interventions;
- The improvement of maintenance safety across the full vehicle and ATS life cycle.

EMERGING RISK

- Developing methods to ensure the safety performance of new entrants in the air transport system such as personal aircraft as well as that of new technologies such as Artificial Intelligence or hybrid/electric propulsion. This shall include new approaches & tools for certification such as digital twins and virtual certification, and also verification and validation (safety assurance) for intelligent systems.

ORGANISATIONAL REMARKS

EREA has led a large set of research initiatives for safety under the EC H2020 framework program. The network of Future Sky Safety is already quite well developed – about 50% of the effort in the H2020 projects led by EREA was conducted by non-EREA partners, with a strong representation of the industry, academia, and other stakeholders. Further improvements in coordinating internally within EREA and externally with other stakeholders are feasible.

WHAT WE HAVE LEARNED

As we have learned from the first generation of Future Sky Safety, several enhancements are proposed to further strengthen the effectiveness and impact of the program.

- The next generation Future Sky Safety programme will retain the approach based on multiple topic-specific projects as experience in Future Sky Safety has proven that addressing the safety research challenges through various separate topic specific projects works well (and early experience in the sister programme Quiet Air Transport showed that addressing all the challenges through a single project was not working well). We have however also learned that it is difficult to combine these projects into an integrated program, the main reason being that specialists and stakeholders interested in one project will in most cases not be interested in the other project, even though both projects pursue safety objectives. This is mainly because specialists are organized by scientific/technical/operational discipline and not by objective. For this reason, the organization of the Future Sky Safety programme will be amended as follows:
  - As previously, there will be two pillars, one dedicated to coordination and the other one dedicated to research on specific safety topics.
  - Integrating the two pillars or integrating the projects within the research pillar into a single common programme will no longer be pursued.

  - The coordination activities will of course also take into account the work going on in the specific research pillar.
  - The coordination pillar shall develop closer ties with other initiatives pursuing or facilitating coordination such as the OPTICS (II) project.

- In view of the expected stronger presence of EASA in European safety research and the growing mutual interest in coordination between EREA and EASA, coordination with EASA will be further expanded and formalized to the extent necessary and feasible.
- The range of partners in Future Sky Safety is already quite complete. This being said, the range of partners to be involved can be further extended. Strengthening partnerships is foreseen with:
  - EU Policy-makers,
  - European bodies,
  - European Aeronautics Science Network (EASN),
  - Societies and NGOs involved dedicated to aviation safety,
  - Joint Undertakings or Joint Research Initiatives,
  - Similar eligible entities from non-EU countries.

Through Future Sky Safety, EREA intends to articulate, together with relevant partners, shared views to pave the way for common projects. Further to the challenges introduced above, these projects may target the priorities detailed hereafter. The institutional framework in which these priorities should be addressed is H2020 in the short term but an important step will be to maintain the safety R&TD priorities in Horizon Europe.

TOWARD AN ENLARGED AUDIENCE

The first Future Sky Safety program was quite successful in bringing together all European aeronautical research establishments with the leading academia, the main European aviation industries and a number of other leading stakeholders (airlines, regulators, EUROCONTROL) in aviation safety research. Further steps are still possible and will be taken towards EASA (already underway) and the wider regulatory community, and the wider operational community (airlines, airports, ANSPs, Maintenance organizations). Furthermore, outreach to industry associations and Safety relevant NGO's such as A4E, ACI, EUROCAE, IATA, ECA, and others will be pursued. Moreover, as safety is a global challenge, outreach beyond Europe (IFAR, FSF) will be considered.

TRAINING & EDUCATIONAL ACTIONS

The European Aviation Science Network (EASN) is an official partner of the EREA, specialized in education. While several universities play an important role in the current Future Sky Safety program, no activities have been coordinated with the EASN, at least on safety. It is therefore suggested to start engaging a common approach on this topic in the prospect of raising awareness of teachers and lecturers from Universities and Engineering schools and to be more attractive for young professionals. It is noteworthy that this kind of educational actions, once well-defined and duly introduced, may also be supported by the European Commission.