Summary of the 2021 “FLY AI webinars”

Introduction

AI is already transforming the world and has enormous potential to help the aviation industry build back better, more sustainably and more resiliently. The FLY AI webinar series, which EUROCONTROL organised on behalf of the European Aviation High-Level Group on Artificial intelligence (AI), is a first step towards building an AI community of practice for aviation.

The seven FLY AI webinars illustrated on the basis of many use cases the rapid uptake of AI in aviation, provided insights into the European regulatory and standardisation framework under development in AI for aviation, and highlighted key areas of future work, notably research and innovation and infrastructure.

Webinar summaries

Disclaimer: *Answers given on the spur of the moment during a webinar may not reflect the official position of any organisation or person.*

WEBINAR 1: Partnering for AI in aviation

Webinar objective

The first FLY AI webinar focused on the first recommendation of the FLY AI Group: the need for partnering to ensure a successful and rapid uptake of AI across key aviation sectors.

For this, four practical initiatives were highlighted:

The FLY AI Report
by Paul Bosman, EUROCONTROL, who was also the moderator of the webinar

Use of AI at Amsterdam airport, supporting the many airport actors
by Floris Hoogenboom, Schiphol Group

Examples of **industry and regulator collaboration** to help accelerate the deployment of safe AI-based products
by Baptiste Lefebvre, Thales, and Guillaume Soudain, EASA

The European AI-on-demand platform project, which offers several opportunities to accelerate knowledge and give access to the European AI community for all sectors including aviation
by Violette Lepercq, Thales/AI4EU project manager

Key takeaways

AI is a game changer for aviation but comes with new challenges. Appropriate partnering should be explored and used to its full extent, as it is a key asset for success.

All aviation areas are concerned (aircraft/ATM/airports/drones, etc.).

There are many ways to partner, for example with your regulator, other industries, your competitors, your customers, or your business partners.

Partnering in AI can really help expand your business, increase your know-how in AI, deliver AI's expected benefits, and help overcome AI's new challenges when it comes to the certification of safety-critical systems and operations.

Partnering is also about allowing small projects to kick off and to expand more rapidly.

Experience and lessons learned could be shared in the aviation community, for example how specific measures for personal data protection were put in place.

Alignment of AI industrial and regulatory roadmaps is essential for successful and rapid deployment of industrial products.

Cooperation on the development of standards and regulation is a must, as there is competition for the products.

The AI4EU platform is to help, liaising with the European AI community and acquiring a deeper understanding of AI challenges and evolutions.

References

FLY AI report : https://www.eurocontrol.int/publication/fly-ai-report
AI4EU – AI on Demand platform: https://www.ai4europe.eu/
EASA Artificial Intelligence Roadmap: https://www.easa.europa.eu/newsroom-and-events/news/easa-artificial-intelligence-roadmap-10-published

Q&A session

Q1 – "What does Europe do regarding China and US race?"

The newspapers often have us believe that Europe has lost the race for AI in the world and that China or the US are going to be the winners, that they are going to dominate us, etc., but what we have seen (not only from the FLY AI webinars presentations) is that we do not think this is necessary the truth. We have our own destiny in our hands and we have many tools and ways to work together to really move the topic forward. Maybe the only limitation is the one we have put in our own heads. The AI4EU platform is a really excellent initiative and I invite all of you to register for that platform and to see what we can learn from one another and how we can all better cooperate together.

Q2 – "How do the people react to the continuous recording? How are you managing the privacy issues?"

Schiphol basically had two phases. At the start of this project, the camera feeds blurred people and that is a sort of a post-processing step which you need to basically trust. Now, the new cameras are installed at such a height and the cameras have such low resolution that it is simply impossible to recognise any faces from those camera images. We never get any data which might cause privacy concerns and we also try to make sure that everybody on the platform is aware of that fact. We do take precautions to make sure that this is covered, and we have discussions with the unions and staff associations concerning this type of topic.

Q3 – "How many cameras do you need per stand to implement different models for the different weather conditions?"

We have seen snow, rain, everything. We have one common model and we try to share it across ramps. We keep on improving that model by having it run on those ramps, improving on those moments where we were wrong. We try to fix problems using sampling, making sure that all weather conditions are taken into consideration (e.g. snow, rain, etc.). Drops on the camera affect predictions. The role of the data scientist comes into play, as you need to be smart about how to train those models in order to be able to deal with this kind of situation.

Q4 – "How easy is it for you to recruit AI specialist?"

If you look at the market where we are recruiting, which is basically Europe, it's rather easy and that's absolutely not because we probably have the best pay or whatever, but we have a very interesting case and that means that you have a lot of data sources from the cameras, the radar, the passenger flow. The nice thing about AI in an airport is that you also see your models take effect and you can walk through the terminal and basically see what's happening with your predictions. It really helps us sell this in terms of recruiting. It is not only about the pure job content itself but about the situation. Moreover, the aviation domain remains glamorous, even if things are a bit more difficult in these times of COVID.

Q5 – "How many AI related certification applications are you receiving nowadays and do you see any acceleration or is it still very silent?"

Applications are confidential, so EASA cannot give any details, but it has already received half a dozen applications, and indeed the number is increasing. And this does not take into account applications made at national level (e.g. by ANSPs to their NSAs). Under the pressure of the drone market and urban air mobility, EASA is engaging in a number of promising innovation contracts, preparing the floor for concrete applications for certification or approval projects, also in more traditional areas like commercial industry.

Q6 – "On the AI4EU platform do you see other domains struggling with the certification of AI products and services and are there any best practices lessons learned that you that you can share with us?"

The AI4EU project is not focused on certification but on the notion of the trustworthiness of AI, and will address a lot of sectors. AI4EU is working on the identification of procedures and design methodology, ensuring human centricity.

Q7 – "How far are you willing to partner with your competitors and how do you see this evolving over time?"

We compete on products and innovation, but not in the way we certify things. In aviation, we have quite lengthy experience of partnership in the certification development process, and it is almost always built together with other industrial partners. But of course, there is competition for the product and this may indeed be a challenge in discussions, because in order to make progress you have to discuss use cases and it is not always so easy to share use cases when we are in the early stages of the development of new technology. The tricky point is probably the use cases, but we still are able to share some use cases.

Q8 – "Are you planning to work with other airports and would you be willing to share your models or do you think your models are very specific to the Schiphol airport environment?"

It is essentially one of the goals to also scale this to other airports, and the Schiphol group is of course more than just Amsterdam airport. We have a pilot with those models running at Eindhoven airport, which is a regional airport here in the Netherlands. It is definitely part of the vision to also see how we can expand this across the group and maybe beyond.

Q9 – "Everybody is happy to consume the data of others but is much more hesitant to share data themselves. How do you look at that at Schiphol?"

Data sharing from a technical perspective is not always needed to collaborate in AI. There is a sort of dichotomy between the traditional AI-based methods of forecasting and the AI-based computer vision methods. The first type of method is often very much bound to a specific situation at a specific airport and hence does not scale well. Also, data sharing is usually contrary to privacy regulations, with those camera images, and even though we might be open to it, it is just very difficult to share data.

Q10 – "What could the AI community do for you? What would really be of help? What would you appreciate to get in your mailbox in terms of presentations etc?"

We are already receiving a lot, as shown on the slides. There is a constant exchange through working groups and research groups, and through projects like innovation projects. As a regulator, we have more of a duty to create the framework. We will be working on top-level objectives to be achieved in order to strive for and make possible the approval capabilities, but obviously the means of compliance themselves will come from the operational floor and clearly from our stakeholders, and that is where every day I am pleased to receive emails with research papers and new considerations on whatever methodology could be applied.

It is a constant exchange, and that is why partnership is so important.

Q11 – "We need to certify AI models that are in constant technological evolution (ML or self-learning model). How do you see the role of the regulator with the speed of technology, which is only increasing? How do you see that from a regulator perspective, from a standardization perspective?"

The first step is the focus we have placed on the roadmap and the guidance. It is more on the side of safety-relevant/safety-critical applications. There is a common agreement to focus on very important assumptions, which are freezing models only, and not allowing continuous online learning, because it is too complex, not only from a technical perspective but also from a certification framework perspective. However, we will be dealing simultaneously with a lot more applications in parallel, ones which are maybe less safety-critical/safety-relevant using this type of techniques of continuous learning and really pushing barriers. We are ready to engage a little earlier than we may have foreseen.

Q12 – "Will the COVID crisis impact on the validity of the roadmap? how are you tackling that?"

Despite the crisis, we cannot stop the pace of innovation, so we have managed at least to secure the resources and to progress roughly on time for the first guidance on AI, and we will in any case benefit from all the consultations, even the public consultation.

Q13 – "AI explainability is very important. In our world, we are working a lot with operational people with pilots with air traffic controllers with flow managers etc. We really need to make sure that we have them on board when we are starting to provide systems that are augmenting assisting their work. Does any of you have a good example on how to deal with explainability? "

It is of course inherent in the methods we use that they really focus on prediction quality. We always try to have a gradual roll-out into these kinds of black-box methods. What we have also seen is that it is sometimes good to take a step back and not go for deep-learning approaches but approaches where you really control a lot of structure in your models. We have a model which predicts passenger flows through the terminal, which is just a very simple linear model. It allows us to explain, on the basis of flights which come in and on the basis of aggregates which we make, why that model is outputting certain predictions. This has two benefits: it allows us to sell it and to build trust.

COVID invalidated many models we had before, but because we have such a structure in those models, we understand them so well and can also deal with this situation. We can adapt those models on the basis of our knowledge, so it is also a sort of a design choice in some sense with AI whether you should go for a complex model or whether you might also solve it with something which is actually simpler but gets the job done.

Explainability is a very important topic which is discussed within the various working groups. There are debates about it, because they are diverging views. I do not see explainability as a necessary objective for all applications, or at least we must really agree on what it means. For example, if you use neural networks to perform computer vision and detect an aircraft in an image, you do not necessarily need to understand why the neural network detected the item in the image, because it is basically a sum of weights and non-linear operations which is calculated in a large bunch of neurons. There is no explainability possible for why the neural network outputs this decision. You need to have a good human-machine interface to enable the user to use the device properly. You may need to highlight the item which is identified and enable the operator to use the system.

It is not necessarily useful to require full explainability, but we must analyse on the case-by-case basis what needs to be explained and why it needs to be explained, and the final objective is not to explain but to enable the operator to safely operate the system.

EASA is looking at this from a different angle, trying to create this framework. Explainability is a key building block of the AI trustworthiness concept in the EASA roadmap. EASA believes that although AI models might not be always fully explainable, there is an objective to ensure that the end-user gets the right information at the right time from an AI-based system. And it is confirmed that the learning assurance framework is probably a part of the explainability itself.

The AI4EU platform is also focusing on explainable AI. There are research activities on this topic. There is a simple guide regarding all the work that the a4u consortium has been doing for the last two years on this theme at https://www.ai4europe.eu/research/simple-guide-explainable-ai.

Q14 – "Is the AI4EU platform really geared towards accelerating the deployment of AI applications?"

One of the main ambitions of AI4EU is to bridge the gap between research and industry. We do not want to focus just on research, so we are offering our users not only a collaborative environment but also an experiment environment and a prototyping environment. Users can train models and deploy these models within their own products. This is the main objective. However, we launched the platform only a year ago, and we have still many things to do before we achieve this objective, and we expect to fulfil this ambition with the support of the upcoming ICT 49 projects. This should greatly reinforce the service layer of the platform.

Q15 – "Is AI4EU going into competition with API managers such as mulesoft .. etc? These COTS products are available on the market. How do you position yourself towards this type of products and services?"

AI4EU proposes a European alternative for working with AI, in order to innovate through AI and to allow non-tech SMEs to make the most of these new technologies.

Q16 "What are the top things to do on the AI4EU platform to really make sure that we get this European success?"

The main priority, which already constitutes ongoing work, is to shift from a closed development model to an open distributed development model. Once this new open-source model is operational, it will allow European projects and organisations to integrate their own services and their own features directly into the platform. It will allow the platform to be sustainable.

Q17 – "When can we foresee artificial intelligence in automated tools taking over the controllers for safety critical tasks?"

Taking over means replacing, so in accordance with the roadmap which we published in 2019 (although it might be affected by COVID) we envisage that this will happen in 2030, or at least that is our aspirational goal, but a lot can happen before 2030. It may be later or earlier. It may be possible or impossible. No one can answer that question today.

AI developments are currently focused on pilot assistance on the airborne side, and probably on controller assistants on the ground side.

Q18 – "Do you see in your experiences other safety critical tasks that could be taken over by AI applications?"

What we see are many critical operational tasks, which might of course in turn lead to safety hazards. What we are striving for is a human-in-the-loop AI. Take gate planning for example. It is not safety-critical, but it has a ripple effect throughout the whole day, so you want to get it right. We are investigating whether we can add support, not necessarily taking over the role of a planner but enhancing the views he/she has of the airport, with AI coming up with proactive suggestions. We do see opportunities, and the developments in research especially focus a great deal on reinforcement learning for example. We do not feel comfortable enough yet to take these people out of the loop, because they have a lot of experience and they can serve as a sort of a validator, which in turn also allows us to build that AI capability together with them.

Q19 – "What would be your advice to our audience if they want to get on with partnering on artificial intelligence? What should they start doing first?"

Connect to the AI4EU platform and collaborate with the 4000+ members, enrich the platform, and enrich your capabilities.

Come to EASA with any relevant use case which you want to share and use. This will contribute to developing our guidance further. Also join EUROCAE 114/ SAE 34 to help also to mature lower-level standards on how to certify AI.

Think about how an AI model would change your business, reflecting on what your business need is, and what is your business need which needs filling?

Join forces on the processes and tools, and compete on the products.

WEBINAR 2: Research and innovation in AI in aviation

Webinar objective

The Single European Sky ATM Research programme (SESAR) has developed a portfolio of research and innovation projects pushing the boundaries of this technology and addressing the recommendations of the FLY AI report. The second webinar, moderated by the SESAR Joint Undertaking, explored "Research and innovation in AI for aviation" in Europe and beyond, and new opportunities in the framework of SESAR 3.

A number of AI R&I use cases in aviation were presented:

- **in the defence domain**, by GMV – with a focus on the development of high-performance and highly autonomous aircraft. Details were provided on the EDA Safeterm project;
- **in the avionics domain**, by Honeywell, highlighting key developments in product support, anomaly detection, pilot assistance, health and performance optimisation, and autonomy. Details were provided on a visual landing system based on AI (Daedalean);
- **in ATM**, by LFV, with a focus on their automatic planner project, stressing a number of key AI challenges to get there;
- **also in ATM,** with a special focus on ATC speech recognition projects by DLR;
- **still in ATM, but looking outside Europe, i.e. Singapore**, with airside optimisation, runway capacity optimisation, human hybrid learning for conflict detection and resolution, and digital towers, also highlighting a number of key ATM challenges with AI, such as trust in the AI/ML system, ATM system integration problems, safety verification and validation and post-accident audit mechanisms.

Key takeaways

- The progress made in the fields of machine learning and AI has opened the door to a myriad of applications in ATM.

- Many tasks in aviation, which can only be performed by humans today, have the potential to be performed collaboratively by hybrid human-machine teams, allowing higher performance levels.

- AI-powered systems are being integrated into the cockpit and into systems on the ground, which is redefining the principles of pilot/ATC interactions.

References

SESAR AI: https://www.sesarju.eu/ai
SJU SRIA: https://www.sesarju.eu/node/3697

Q&A session

Q1 – "Can you please elaborate on the risk of the AI module learning the wrong sub optimal controler behaviour, controller action as they are now but not how they are supposed to be?"

There is a need to de-bias the data and machine-learning techniques in order to allow us to identify the noise or the outliers. There is a need to establish an envelope or a set of boundaries. The techniques for deriving the data and learning normal behaviour from the data might be useful. With the availability of more controller action training data, the outliers or the noise should be suppressed. If not enough data are available, there is certainly a challenge, but as more data are available, the law of averages will kick in and we will be able to see normalised behaviour.

Q2 – "Should we teach the algorithm how the human behaves, or should we leave the algorithm to generate solutions based on the rules of separation?"

We are touching here on interesting topics, such as trustworthiness and the machine generating quite weird patterns, which are not necessarily understood by the human being.

Q3 – "Will AI allow a new eVTOL aircraft to operate autonomously in controlled airspace especially in urban areas? Will AI allow for new eVTOL operations and control of airspace?"

There will be a stepped approach to achieve this. A number of challenges need to be addressed before we achieve autonomous aircraft operation. These include data-related challenges such as being able to understand how we got to the answer, being able to trust whether we can, and having confidence that the digital pilot is making the right decisions using factors which work not just 95% but 99.999% of the time. This is what the intended function requires. We also need public acceptance of these autonomous vehicles. Indeed, there is a lot of activity going on in other industries, such as the car industry, with semi-autonomous vehicles which are promising to save lives. So, by seeing a sort of autonomy all around us, that will also help. Then there is the HMI perspective. As we move to autonomous vehicles, the pilot will not disappear from step one, and we need appropriate HMIs.

There is the promise that AI may allow autonomous eVTOL operations, but this is going to be a stepped approach. We will see vetoes. We will be starting with a pilot in the loop, with those on the ground. Then we will move to simplified operations with new HMIs, where the machine will be doing more, and eventually we will get to autonomous operations, assuming that there is justification from a business standpoint. Indeed, to get to that stage, we will need to be able to demonstrate economically viable and competitive urban mobility.

Q4 – "In this new virtualized, interconnected, highly automated environment what are the boundaries/the limits we should put on AI so that we can maintain control?"

First, this depends on the application or on whether you are just using artificial intelligence. AI should not be confused with autonomous systems. If you are using artificial intelligence for speech recognition for example, then it is just a support tool. The human still has to decide. If the understanding of the machine is better than that of the human, then why not use it. Artificial intelligence is just a technique: it still has nothing to do with autonomous systems.

Now if you are talking about autonomous systems based on AI, then we could think of setting boundaries for the output of AI, so that it does not go beyond any kind of safety margins. This could be hard-coded in the system. This is just one possibility, but the possibilities will always depend on the application.

Q5 – "How can we make sure that we can enrich this ecosystem of data? did you face any data issue for your experiments? Is there a need for standardised data?"

One main problem with ML is that if you fix a problem in Malmö, it is still valid for Sweden but you know that you have to work it out for another country. When AI/ML is applied in the context of enhanced air traffic management to ensure safe separation, there are always going to be rules and nuances for the variations in airspace and type of airspeed.

Actually, the fundamental difference between the machine learning approach and the classical symbolic AI approach is the move away from having a general purpose with machines which can do everything. Machine learning algorithms are very specific, applied to very specific problems, and trained on a specific data train on a very specific sector for example. They give very good results but have machine learning which can recognise that everything written will be very challenging. That is why we are focusing on personalised tools for air traffic controllers, which are trained by themselves and by their activities or resolutions.

Q6 – "There are many innovations ongoing; some of which are really supported by SESAR, the industry or research labs. How could the research stakeholders and ecosystem fast track these types of innovations in the future?"

Fast-tracking AI innovations is one of the ideas which we have with the set-up of the future SESAR programme. We want to create the right platform, so that we can work together on such topics.

Q7 – "What about the use of AI in our domain and the impact it could have in terms of safety?"

One of the elements on which we need to move forward when we progress towards implementing AI solutions in air traffic management is to enhance safety. From the examples which have been mentioned in this Webinar 2 on R&I, we can see that there is a potential to improve the way in which we currently deal with the traffic, and to improve the solutions which we provide to the pilot and the controller. We can demonstrate that there is a safety benefit in aviation. Many other applications may probably be useful at a later stage. However, let us start with that. With the introduction of AI vision at the airport, we see immediate additional benefit in all sorts of weather conditions for instance. Such assistants could improve the way in which we ensure safety at an airfield. Other elements are that we must also team up to work on data. This substantial effort must be brought into the work we do. The accessibility of data and the way we can support the work of the industry scientists or researchers in the domain are some of the challenges which we foresee in the future programme. That is why it is very important that we have EUROCONTROL as a founding member of the future activities. It will help bring network data which can be used to carry out those research activities. On the basis of a very simple calculation of the amount of traffic we had in Europe in 2019 multiplied by an average of two to three hours of flight for each flight, we quickly reach something like 30 million hours of recordings. We have those recordings because they are necessary for safety purposes, so let's try to start to tap into that and to use it for the purpose of research first of all. Then, once we have demonstrated through research that we have additional safety benefits, we can on to the operational environment.

WEBINAR 3: AI in ATM: Enablers and use cases

Webinar objective

The availability of huge volumes of data, coupled with the growth of highly effective and efficient computing power, allows the widespread use of artificial intelligence (AI) in air traffic management and related fields.

In this third webinar, we looked specifically at how AI can increase the efficiency of air navigation service provider services through a variety of new tools and systems.

An impressive panel of international AI experts from the aviation industry explored the great potential which AI offers to ATM operations and discussed how we can bring AI into air traffic control systems, looking at safety, trustworthiness and certification questions. Several use cases were showcased where machine-learning has been successfully implemented in ATM.

Key takeaways

- AI is one of the seven technologies which the CANSO Strategic Technology Workgroup (STW) has identified as having a significant impact on ATM.
- The STWG White Paper on AI will soon be made available.
- Key enablers are infrastructures for data, explainability, certification, safety, and human-machine collaboration.
- Common data infrastructures are essential to ensure data availability, accessibility, interoperability, traceability and reliability.
- EUROCAE WG-114 will establish common standards, guidance material and any related documents required to support the development and certification/approval of aeronautical-safety-related products based on AI-technology.
- Potential solutions to address the specificities of AI safety demonstration have been identified.
- AI can complement and augment human capabilities, but will not replace the human in the ATM domain.
- AI use cases have been applied in the area of air traffic safety management and risk analysis to assess key performance indicators, risk metrics, event categorisation and anomaly detection.
- Increased automation through conflict-resolution advisories using AI has also been demonstrated as a promising use case.
- Voice and speech recognition supported by AI can also increase ATM operator effectiveness (i.e. command and control), safety (i.e. attention trigger or conformance monitoring) and digitalisation through automated system responses

References

CANSO White Paper on AI: https://canso.org/publication/emerging-technologies-for-future-skies-artificial-intelligence/

Q&A session

Q1 – "Who should take the lead for research on AI applications (ANSP, Industry, Academia …)?"

All three must work hand in hand. Industry is working on many use cases, but we have seen many unanswered questions. Academia can certainly bring real help on these tough questions.

Additionally, one of the objectives of the FLY AI is to create a community of practitioners. Only together, especially in ATM, by sharing what we have learned can we accelerate AI uptake in aviation.

Q2 – "Is there a standard cycle, one can follow or refer to on moving AI from research to operations? What is the work of EUROCAE in this regard?"

The standard will give MoCs on how use cases in AI defined and implemented by industry or ANSPs can work properly. The various questions you need to answer going into implementation towards a real product are very much related to data. What is new here with neural networks is the importance of data for the specification of the algorithm. First of all, in the implementation process, you need to follow a very strict path to check the properties of the data collected. Also, at system level, you need to pay attention to how you introduce this data. Other questions when you follow this path are related to checking whether a minimum viable product (MVP) can be put into practice or are related to the robustness of the ML model and hence to the verification requirements. The first question is how variable is the model with respect to the underlying training data sets? How many of its characteristics will vary depending on the way it was trained? How robust will the model be over time once in production? The variability between its inputs is related to the small variation in the input, which can lead to unexpected behaviour of the model's output. The standard will give guidance on how to detect adversarial attacks or unintended output from a neural network. You can check that you include in the training methodology some methods to improve robustness. In the process and the standard, you should be able to define safety mitigation. This is a long process taking place at EUROCAE, but an essential one in the uptake of AI in aviation.

The certification and standards will provide some guidance. However, the amount of work for the full cycle will depend on the application area. For safety critical application …

It is important to understand the use case in the overall business process. We need from the beginning to understand which information you need.

Q3 – "Will AI increase or decrease ATC workload? What would be the role of the controller in the entire control loop? How far in terms of automation can we go with AI?"

As regards the example of conflict resolution, what AI can bring is to speed up computation for resolution purposes. It also offers the possibility to take into consideration controller experience and many more alternative solutions. It can also have other objectives in increasing global optimisation, such as the

environment, noise or airport and sector capacity. AI is not intended to replace controllers but to reduce the time they spend on routine tasks in order to allow them to focus on more critical situations. Controllers will have more time to react and to contribute more effectively.

To integrate the advisor into a safe architecture is the main reason we are contributing to the standard. We do not know what the exact trade-off between the controller and the machine will be. Collaboration with the machine still requires some refinements in user sessions.

We need to understand the functional system. It has not yet been decided what the role of the controller will be. We do not know today what the role of the controller will be. This remains to be shaped.

Q4 – "What about safe transition of the human machine system to degraded modes? How can the human recover from degraded modes if AI is having safety issues or limitations?"

One aspect is that the AI or the ML component should also be able to handle abnormal and non-nominal situations. Another important aspect is integrity, so the system should let the controller know if there is a degradation in its performance. This needs to be carefully assessed during the safety assessment before implementation to see how the model will interact with the human and what procedures are required for safe handling of the degraded mode.

One of the characteristics of the AI system is to provide answers and the capacity to know if it is functioning in the nominal regime. The AI system should accompanied by a safety envelope to address degraded modes if the answer is not in the range expected for the function concerned.

In the system currently implemented, we have advisory increased awareness: you provide more precise information to the ATCO, and in this case, you can set the limit, and different probability information about the measures which are provided. In case of advisories, we keep the human in the loop, so it is also for the user to decide whether or not to accept the advice if it does not seem normal. Overall, there is also a system aspect, as the AI module is embedded in a safety architecture which manages degraded modes.

Just as in any software system, you need to know what the trigger point is, where the system enters a degraded mode, and you must take over. This depends on the application area, but we need to provide some kind of independent monitoring. The AI should provide some self-reporting of its performance. It has to be monitored by an independent system to continuously probe the AI. If this determines that it is falling below a certain threshold, then it is time to trigger. The implementation might be different, but it must provide some kind of independent monitoring.

Q5 – "In case of AI driven machine, is the human the risk?"

We highlighted this point in the white paper. For near-term applications, we do not envisage AI fully replacing the human. It is going to be a collaborative environment in which the human is still there. The

critical decision-making will still need to be supplemented by the human. There will be no room for AI to simply upgrade by itself. The technology will certainly at some time be mature enough to allow it to take over from the human, but that is for the future.

Q6 – "When using speech recognition for command and control was there a concept to segregate the vocal intervention to manage the traffic from those to command and control the system?"

For command and control, we are concentrating on how to integrate it into the overall interface of workflows. Command and control are sometimes quite difficult to integrate, because speech control has some impact because you are also using the voice for communication with the pilot. Consequently, the concept of speech recognition is more one of assistance, taking the voice, taking command of what you are saying to the controller and then doing something with it in the user interface. The concept of control and command as we know it in the flight deck/aircraft or in car navigation is a concept which is not applicable to ATM.

WEBINAR 4: EASA AI Trustworthiness Guidance: paving the way to safety-related AI certification

Webinar objective

Artificial intelligence (AI) is a key driver for any digital journey. When applied to the aviation domain, it comes with challenges as regards the trustworthiness of its applications, challenges which need to be addressed before an AI-based system can be certified or approved.

In this webinar, we will be looking specifically at what EASA is working on when it comes to AI, highlighting the timeline and principles of the EASA AI Roadmap and detailing the key elements of the first release of the AI trustworthiness guidance document.

An impressive panel of AI experts will show how these guidelines have already been implemented for some specific aviation use cases, with a view to further operational deployments. Participants will also learn more about the progress made in AI standardisation.

Key takeaways

- The EASA Concept Paper (first usable guidance for Level 1 machine learning applications) proposes a framework structuring the way AI systems should be designed for the aviation domain.
- Collaboration between EASA, standardisation groups (such as EUROCAE with WG114) and industry, with operational use cases, is a must for converging on the certifiability of AI applications in the aviation domain.

- Collaboration with industry and other operational stakeholders has been a win-win experience: 1) The specific use cases from different aviation domains have been instrumental in maturing the development of the "AI trustworthiness building blocks", and 2) the Concept Paper supported accelerated operational implementation.

References

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EUROCAEWG114/SAE G34: ER 22 Statement of concern: https://eshop.eurocae.net/eurocae-documents-and-reports/er-022/

Q&A session

Q1 – "It is essential to have a tight link between the regulator and the standardisation body work together. We have seen the importance of the use cases to develop the theory. What are the relationships between the standard and the use cases?"

More than 50 uses cases have been collected. Several of these were selected for each aviation segment in order to ensure complete representativeness of the practical use cases. Such complete representativeness is critical in order to ensure that there are no gaps in the standard and that the methods developed at each level of the standard are complete. The use cases are also very important in order to ensure the development of a unified taxonomy and to help understand the concept, and to identify all relevant existing standards and their current gaps in the context of AI. They also help a seamless flow of information between all groups involved in the various stages of the development of the standard. They are key, as they need to cover every concern, so that there is no gap in the specifications.

Q2 – "How human oversight will work with self-learning or reinforcement technics?"

We need to think about self-learning, but full human oversight will remain the rule until we can rely on something different. This should be addressed at level 3. It will be for the future. Working on a level 3B case, human oversight was ensured during the development of the application. The model was then frozen and used as is in the application, so not in a self-learning environment.

Q3 – "What are the lessons you learned when applying the W shape approach?""

We learned to use it to enhance or identify design weaknesses. The approach helped us spend more time on the specificities of ML, where we need to spend more time compared with the standard ML process, which is too data-centric. The approach helped demonstrate that the completeness and representativeness of the data sets was sufficient and to point out the weaknesses of the model. We spent more time increasing its robustness than we would have done otherwise.

Q4 – "Is there a cooperation with the FAA and EASA on AI?"

There is a long history of cooperation between EASA and the FAA. EASA is also cooperating with the FAA on AI. This is currently happening primarily through EUROCAE/SAE standardisation work. Even more

cooperation is expected in the future. The Concept Paper is not only the basis for EASA industrial partners but supports the discussion on AI with EASA's authority partners.

Q5 – "Inside the safety the process where do you ensure that the model is not hackable, leads to abnormal behaviours or unusual modified inputs?"

Along with the safety assessment, we have also been addressing security. The security measures will depend a lot on how you will deploy your system. When integrated into the NM system, there is already protection through the NM system's cybersecurity barriers. However, if your model is proposed as an API or on the cloud, you need to demonstrate that the security protection is in place. So yes, it is part of the process.

Q6 – "Does the panel envisage full autonomous pilotless aircraft/flight and if yes at which time horizon?"

In the Roadmap, we captured an industry perspective with a 2035 time horizon for autonomous aircraft. This perspective is constantly evolving, and in this context please note that EASA's task is not to look for benefits of removing the pilot. However, there is a trend in the industry, and EASA is here to support it. In this context, EASA's role is to ensure that flights remain as safe as they are today.

Q7 – "In the examples mentioned in the guidelines the design assurance levels are not discussed. Is there a reason for that?"

There is a major reason for that: EASA is not at the stage of development of the guidance at which we are creating definitive means of compliance (MoCs). However, EASA has, as a first step, proposed proportionality by levels (1A versus 1B) in section D. Proportionality for the criticality of the application will come later, once we are more advanced on the objectives and MoCs.

Q8 – "Where does the predictive maintenance sit in your guidance?"

The guidance is considering maintenance. Several use cases deal with maintenance, so maintenance is part of the scope.

WEBINAR 5: Data Sharing for AI in aviation

Webinar objective

"Data is the new oil", "the more data the better" – these are just some of the slogans associated with the rise of artificial intelligence (AI). Indeed, a lot of the recent AI breakthroughs are based on machine learning and deep learning, which rely on large amounts of data for analytics at scale and to train an algorithm to carry out a specific task such as classifying an object in an image.

This webinar highlighted how data sharing is allowing the development of new data analytics and AI capabilities for aviation and presented some of the challenges we are facing in terms of regulation, data collection, data governance, data quality, and also in terms of building trust between competitive actors. Presenters represented Airbus, EUROCONTROL, EASA and IATA.

Key takeaways

- AI is already creating value for aviation – there are many examples of existing and future AI applications, e.g. improving operations for A380s, improving aviation operations, and developing more autonomous aircraft.

- Access to data is key if we want to unleash AI's full potential for aviation. EUROCONTROL is providing an R&D archive with information from 14 million flights which is free to access for R&D purposes. Collaborative walled gardens are being developed and used, i.e. Airbus Skywise and EASA d4S.

- Some best practices on data sharing identified through this work are as follows:
- Share analysis rather than bulk data, as data usage is very specific.
- Using a common language is essential (single ontology), SWIM for example in ATM.
- Standardise the report request and response process in order to facilitate the fast increase of access requests.
- The Data4Safety (d4S) proof of concept gathers expert knowledge, including flight data, traffic data, safety reports and weather data, resulting in a "big data" pool of knowledge. Collaborative aviation experts and data analysts are working within the analysis platform to provide metrics, studies, benchmarking, and discoveries.
- Quality, security, and governance of data are a must when sharing data, as well as building trust among competitive actors.
- The European Data Strategy and the White Paper on Artificial Intelligence are the first pillars of the new digital strategy by the Commission. The European strategy for data aims to create a single market for data, which will guarantee Europe's global competitiveness and data sovereignty.
- It is built on four key instruments: 1) The Data Governance Act (November 2020); 2) the Digital Markets Act (December 2020), 3) the high-value data sets implementing act (due Q3 2021), 4) the Data Act (Q4 2021), and is complemented by the Artificial Intelligence Act.

- The common European data spaces, one of them is mobility, will ensure that more data become available for use in the economy and society, while keeping companies and individuals who generate the data under control.

- The European Commission has developed new rules on data governance, which facilitate data sharing across the EU and between sectors in order to create wealth for society, increase control and trust of both citizens and companies regarding their data, and offer an alternative European model to the data handling practice of major tech platforms.

- IATA data exchange programs provide data governance, data management and collaborative applications. AI is used to help airlines with strategic decision-making. Input includes levels of demand, customer digital experience measurements, network planning, predictive maintenance and people services. The output is improved safety, operational efficiency and sustainability.

References

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EUROCONTROL R&D data archive: https://www.eurocontrol.int/dashboard/rnd-data-archive

Q&A session

Q1 – "Building trust in data sharing is paramount. What measure can we take in order to protect the data especially in ATM? How to avoid data being misused while sharing the data across various organizations, misuse in terms of security?"

Security and trust are paramount. We have a whole data flow and we have data suppliers, and we try to maintain their trust, otherwise our flow is cut off and then we cannot deliver the applications. There is a separation of the data into different levels of security and needs. There is a big difference between the historical data which you find in the R&D data archive and the live data which is available in the in the B2B feed for example, and the processes involved in getting access to those are also very different. The level of authentication needed to get such access is different. It is a little like the whole safety innovation, which is a layered approach where you have several different safety nets. With data security, we have several different layers of security to protect the data. In the past, it was easier to keep the doors closed than to let some out. There is a balance to be drawn between safeguarding and giving access to valuable data sets. It is all about a layered process.

Q2 – "What about safety in data sharing?"

We have a set of transversal mechanisms to create this trust, and to create the data protection which we apply to any type of data as well as for any organisation and aviation professional. However, to focus on ATM, the key principle of the data for safety approach, as for the other family of organisations, is to ensure that the ATM community is involved at governance level and at technical level. This is required in order to ensure that the purposes for which we use this data and the way we approach analytics outputting makes sense from ATM's perspective. In this process, we must not jeopardise the data, organisations or aviation professionals. The ATM actor's involvement is an essential enabler for data sharing, at least in the data for safety part, which is a systemic post-processing programme.

One of the major problems of data sharing, as in other data spaces such as for example health data spaces, is the protection of people's privacy. The point to be addressed is how to protect privacy when sharing data. This is not possible as soon as data is shared, as you lose full control of the data. To overcome this problem, we would need to create a link between the data users and the data provider which authenticates the identity of the data user for the data provider and establishes a contract between the data user and the data provider. The contract needs to ensure that the data will be used to serve the purpose which the data user requires. This does not make us flexible in the use of data sets which a company or a data provider has. It limits the use of those data to specific requirements in specific cases. A possible technological alternative is not to move the data but to run the algorithm on the premises of the data holder. By distributed training, you can train the data to develop your algorithms whilst maintaining full confidentiality of the data and ensuring that the data is used for its intended purpose.

Trust is essential, but how can this be ensured? If I know the person, or if I provide the data to a given organisation, misuse of the data, thereby breaching the contract, will become a problem for the reputation of that person or organisation. The EC is looking into this and to put in place appropriate mitigations. For example, the data spaces need to be put in place to create such an environment of trust.

Q3 – "Can we really trace the way the data is used?"

With some technologies called data lineage, there is the possibility to have a really full view of who has accessed which data, who has processed which algorithm, and which data and what results were obtained. This was not the focus of the webinar, but there are certainly many technologies which enable the various safety and security approaches to be reinforced.

Q4 – "Is there an intention to use the speech to text capability"?

This is indeed the case. The intention is to provide in real time a transcript of the conversation to the pilot, so that the pilot can cross-check what has been said and can potentially respond, also taking into the account the information of the text transcript.

Q5 – "Do you intend to share these ATC speeches annotated you are going to collect?"

The answer is yes, but not necessarily free of charge. Sharing does not necessarily mean that sharing comes for free. A lot of what we are doing in preparing the data sets (collecting, string annotating, etc.) costs money, so sometimes there will also be cost for obtaining access to the data.

What we will certainly be releasing free of charge is a standard for the annotation, so that more people can really annotate speech data which is used for ATC, in such a way that sharing is made possible for everyone.

Q6 – "Is the IATA data exchange platform(s) only open to airlines? Can an innovation research organization enter into collaboration with IATA on this platform?"

In general terms, (airline) data exchange programs are open to those that do the exchange. However, on the basis of data governance, IATA also has access rights to other stakeholders which can benefit from it. As long as the proprietary nature or sensitivity of some of the data fields are respected, IATA is always happy to have these discussions, especially with research organisations.

Q7 – "Is the European strategy for data ready to create an aircraft data standard that will enable airlines to share this data with its own partners and other non-OEM service provider?"

In terms of who owns the data, the data produced by an Airbus aircraft is not the property of Airbus but the property of the airline. Airbus does not prevent airlines from sharing their data with third parties other than Airbus. In Skywise, the airline decides whether or not to share the data with Airbus, for example to improve its operation. The airline is sometimes requested to share its data, notably to support investigations. Note that some airlines do not use Skywise, whereas others do. It is up to the airlines to make their own decision on whether or not they want to share their data, on the basis of a cost-benefit analysis which they carry out.

Furthermore, the Skywise ecosystem allows other partners and Airbus to develop services. It is organised as an app store, so that third party can develop applications for airlines, for example based on Skywise, without Airbus involvement in their developments.

Another aspect of data sharing currently being worked on by the EC concerns the sharing/using/owning of private data under special conditions. For example, if you buy a connected car, the manufacturer of the car will collect quite a lot of data from your car, hence private data but also data needed by the manufacturer to ensure that the car is working properly or to offer new services to its customers. What are your rights with regard to the data collected? This is something on which the EC is working and for which it is trying to find a solution which will make it possible again for this type of private data to be used under specific conditions, facilitating the development for example of new AI-based services.

Q8 – "Can you explain a bit more about vision-based navigation basically its architecture and certification procedure?"

Airbus has recently demonstrated autonomous landing vision based on an A350. The way it works is that the artificial intelligence part is used to detect the runway. The control of the aircraft does not at present use artificial intelligence. The AI capability is just about automating the perception task to localise the runway. In terms of certification, this is something on which we are working together with EASA and with the entire aviation sector. EUROCAE Working Group 114 is developing new standards for the certification of data-driven AI machine learning. Such developments raise new questions in terms of certification, and this is really an ongoing activity where we need to partner with the whole aviation ecosystem, and especially EASA. Webinar 4 provided more insight into the guidance which has just been issued by EASA. Note that EASA is working with other certification authorities, notably the FAA, on certification of AI on board aircraft.

Q9 – "What mechanism do we use to ensure trust in data transaction?"

What we have in fact found is that trust is affected by data quality. It is not really about trust in the accuracy of the radar data or of the flight plan data which you are provided with but about what happened to these data. Whether it is the pricing of the seats or whether it is the performance and the delay data, our experience is that by giving it back to people in the form of reports which they then use, it is in their interest to provide you with accurate data. They then use the results and you know that they are getting accurate reports out of it. So what matters is that you establish the circle "you give us the data and we give you value-added products which you can actively use". It is then in everybody's interest to provide high-quality accurate data. This is a valuable part of the trust and quality process.

A major component of data quality is related to the actual group. When we share/exchange data, the best checkers and validators are the participants who receive the information. They are perfectly capable of understanding discrepancies in things which make sense. It is the whole dynamic, the whole ecosystem, which self-regulates the data quality.

WEBINAR 6: Cyber for AI – AI for cyber

Webinar objective

Artificial intelligence (AI) and machine learning (ML) have a key role to play in mitigating the cyber-risk in aviation by identifying and responding to cybersecurity threats. However, AI can also be deployed for malicious intent, with hackers using the technology to commit larger-scale and more efficient attacks.

How is AI improving cybersecurity – and how can we use AI to counter AI-powered cyber-attacks?

This was the big question on the table for the sixth joint "FLY AI" webinar. We lined up a panel of AI experts from different aviation organisations, who helped us to build a clearer picture of how we can strengthen aviation's cyber-resilience using AI, and talked about the innovative AI/ML solutions which already exist to address cyber-threats, i.e. malware hunting and investigation in ATM, and insider threat protection and aviation document leaks.

Key takeaways

- We need to approach the topic together.
- We can see the benefits of AI for cyber-resilience, but we also see that access to data is important. Hence, we need to share either the data or the models, so that we can improve our cyber-resilience.
- AI is helping, but it is not a silver bullet, especially when you have a complex system with lots of data.
- We have clearly identified that we need to think about how to protect it, as otherwise it can be subject to cyber-attacks and misbehaviour.
- We are just at the beginning of the journey. The purpose was to open people's eyes, to make them understand that this is not a dream, that AI is out there, that we are using it, and that it is providing some benefits. Many more applications will come.

Q&A session

Q1 – "**How did you go about progressing the concept of the KTI in terms of staff confidentiality and staff association attitudes towards monitoring? What is the legal means of monitoring insiders, do you have an agreement with each worker? How do you assure security for the matching tables between clear names and pseudo-anonymised data?"**

AIRBUS has taken the GDPR at the concept level of the tool. While developing the concept of the tool, AIRBUS has been working closely with the data privacy department. Those constraints are therefore included by design in the tool. All the data are pseudo-anonymised, but not entirely, as in the event of problems, we need to be in contact with the persons concerned. No person, just the system, is looking at the data. No one has direct access to the information. They work only on aggregated data. Investigations can be carried out only by security staff. Recital 49 of the GDPR regulation allows cybersecurity incident investigations to be conducted.

Q2 – "How reliable the KTI has been proved so far?"

The KTI validation is currently still ongoing.

Q3 – "Are the concepts, already implemented as part of security management system of the company? Is that management system being supervised by a dedicated manager?"

All the data are pseudo-anonymised, not entirely, as in the event of problems, we need to be in contact with the persons concerned. No person, just the system, is looking at the data. No one has direct access to the information. They work only on aggregated data. Investigations can be carried out only by the security services. Recital 49 of the GDPR regulation allows cybersecurity incident investigations to be conducted.

Q4 – "What were the good and bad surprises during the development of the Thalès Cybels product? Is the product already in usage in ANSPs?"

It was a nice surprise to have data scientists and cybersecurity experts working together on the same project, and this produced very good results. Because we decided to go for a semi-supervised approach, we must also work with lots of end-users. This has significantly increased the learning curve. An unpleasant surprise and drawback of the semi-supervised approach is that it has proven to be much more complex than expected, owing to the integration of the feedback from end-users together with the need to develop specific end-user interfaces. For the application developed, further training cycles will be required for very specific systems.

WEBINAR 7: AI Training and Change Management in Aviation

Webinar objective

Our seventh webinar in the "FLY AI" series looked at how AI and machine learning (ML) are set to transform the way in which frontline actors such as air traffic controllers, air traffic safety electronics personnel, pilots and others will perform their daily tasks and carry out their roles in the future, with some tasks being fully automated or modified by AI/ML, and entirely new tasks and roles being introduced. The webinar focused on the following big question:

How will AI change the way air traffic controllers, pilots and other frontline actors do their jobs, and what will they need in terms of training and change management to be ready for a paradigm shift?

For this discussion, IFATCA and IFATSEA have put together a panel with AI expertise in key frontline roles, who identified the key points which need to be considered, as we prepare to embark on the transition to AI in aviation, and share their experiences and lessons learned from dealing with innovative AI/ML solutions in their business.

Key takeaways

- Technically better does not necessarily mean operationally better, the operator's involvement is crucial, and a stepped approach and communication are key to success.
- We need to learn what the system does, what are the failures, and how to deal with them.
- Increased automation will mean increased training time to allow basic skills to be practised.
- The controller does not have the systematic worry of change. In fact, MUAC's trajectory prediction was requested by the users.
- Rather than taking humans out of the loop, it would be safer to develop a system which assists humans.

Q&A session

Q1 – "Could you say something of the age group of OPS staff concerned? Were all age groups equally concerned with understanding what the AI does?"

At MUAC, the Ops Room is very receptive to change. This is already a good basis to start with. The Ops Room age pyramid is quite young. Recent new ab initio training will bring the average age even further

down. Acceptance of change is not, however, age-related. We cannot simply say that older controllers are more worried about taking on board innovations and that younger ones immediately embrace them. That is an incorrect perception. What MUAC has found is that it is extremely important to explain to people what it is that the system is doing. That is more to the point than the age of the controller.

Q2 – "Based on current experience have you noticed any improvement in trajectory prediction as based on ML principle, the system should improve its behaviour over time?"

If the system is designed optimally, then you do not need the machine to tell you what the system is doing. MUAC is in the process of redesigning the sector shapes. You do not need AI to do that. You can simply look at the traffic patterns. MUAC has an internal project called Maserati, which aims to redesign and realign the sectors. It should be noted that with the introduction of free route airspace, trajectory prediction has already much improved, and the next step is to ensure that the sectors boundaries are more aligned with where the aircraft are flying and to avoid small sectors corners.

Q3 – "Is there a source where more details (such as data and AI algorithm) of the models can be found?"

Some of the MUAC algorithms are already available on the EUROCONTROL website or in the August release of the Air traffic Management Journal. Many models are available in open source on the web (e.g. for optical analysis, voice recognition, etc.). However, using the model to the best effect or choosing the right model is often based on experience or trial and error. There is no certainty to it, but it is important to have the right data and the right place to work on it. A laboratory at Heathrow was used for that purpose. There is a need to have all operational data and the end-users. They do not need to be AI specialists. This approach gives you much more flexibility in terms of algorithms which are suitable.

Q4 – "Is there an estimated probability of the need to resort to a backout mechanism when using this AI Technique?"

No. However, there are back-up mechanisms in place. We can back out of the whole system and move back to the old model. The question is what the trigger for doing so would be. The system would have to be going wrong on a massive scale, but in that case how would ops recognise it. Again, it is the dashboard which would tell us that things are moving in the wrong direction for the flows, but really, as regards the tactical part itself, our options are either to switch back to the old system or to disable certain flows from the ML. MUAC cannot, however, think of a realistic case in which they would be able to pinpoint straight away which flow to disable. We are not looking at a completely autonomous system but at specific support in specific use cases, and by limiting that, the ability of the AI model is not stretched. The model does not learn on the job, so strange behaviour by the model is not happening.

Q5 – "How much is it possible to transfer operator expertise in handling system failures to automation through AI?"

We can put in layers of supervisory layers for AI, but if we take it like this, there will still be failures. Eventually, there will be an intervention point, and the problem is that the failure event will be very difficult to foresee, to predict what accident will happen, at what time and in what place.

Q6 – "How does your machine learn? How do you teach your AI algorithm to come up with such innovative skill-based finding when an incident may only happen once? (Example the Hudson River)."

We do not know the answer to this. At MUAC, it took a lot of time and effort to get people on board with this change. We also included the safety department for a safety assessment. It also took some time to convince our safety people, as AI introduces a level of unpredictability in the system. However, in MUAC's case, the only thing that can happen is that we end up with the wrong prediction. We are not introducing a new failure mode here. In MUAC's case, we have a system which is augmented by artificial intelligence, and AI is certainly not taking over.

Q7 – "In an environment of ML as human being will rely on machines' decision, how probable is the Pilot or ATCO will not be alerted to correct a potential mistake of AI? In other words, is there any study in progress aiming at ensuring the vigilance of ATCO, PILOT of ATSEP (as the case may be) so that they may intervene timely if the decision of computer is not the appropriate one?"

MUAC and Heathrow are not removing controllers from their role. The purpose of AI is to assist them in decision-making, and the level of automation is there to ensure that the controllers have output from the AI model. It is not an autonomous system. Controllers are very much in charge. For AI, the results depend on how the machine interprets, hence there is a certain degree of unpredictability in there. The likelihood that something strange will happen is not very great, and would probably involve incredible corruption, and we can always switch it off. For small things, there is the dashboard. The worst thing that can happen is that you have a wrong prediction. However, predictions before were not perfect, which was the reason for the introduction of AI. There are enough safety nets in place with humans in the loop to counteract any effect. Wrong predictions do not necessarily lead to incidents. We have not introduced a new failure case. Wrong predictions were there in the past. AI can bring small improvements but does not take the human away entirely.

Q8 – "How do you value the 4-eyes principle in the different AI ideas? Not only in case of incapacity of one pilot/ATCO but as an OPS safety contribution."

This is exactly how we operate in the cockpit today, except that we do not dedicate one pilot to a mode. In tower operations, controllers have different roles. The use of AI may lead to different modes of operation. Controllers at present tend to work in isolation, but having a team to support one another and deal with failures in a more cockpit-like way is an interesting point. Monitoring of the overall system is also an interesting option.