Haiku

REPORT

1st HAIKU Dissemination Event

JUNE **26**th **- 27**th 2023

AI IN AVIATION
NAVIGATING THE HYPE

Funded by Horizon Europe R&I Program.

AI in Future Aviation
HAIKU offers a peek through the looking glass...

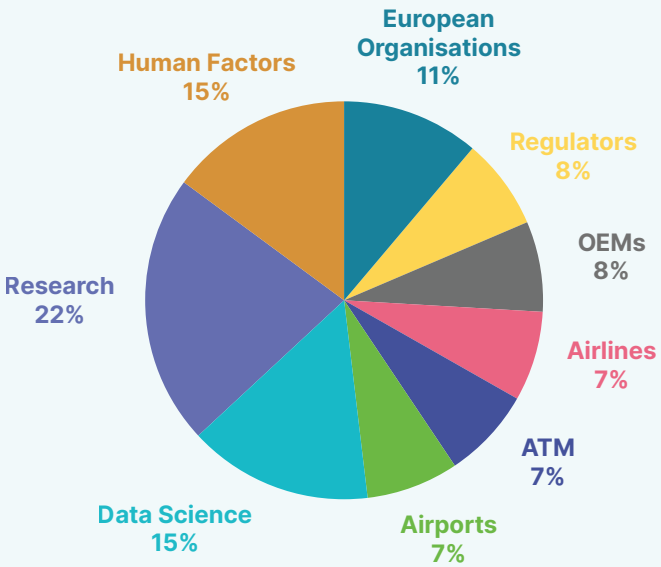
Introduction

During two summery June days in Brussels, **27 organisations** from **14 countries** gathered in EUROCONTROL HQ to explore **the future of Artificial Intelligence (AI) in aviation.**

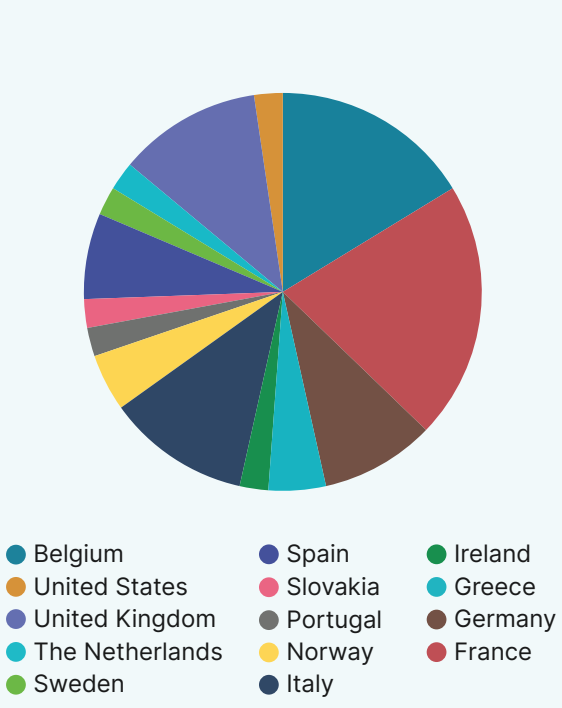
Day 1

The event – organised by the EU-funded project HAIKU – was opened by **Vladimir Cid-Bourrie (European Commission)** and aimed to cut through the 'hype' about AI, and develop a realistic vision of AI-supported applications for aviation in the 2030+ timeframe. HAIKU's mission is to see how AI can support and enhance aviation workers' future roles, rather than outright replace them or render their jobs mundane and uninteresting. The HAIKU coordinator **Simone Pozzi (Deep Blue)** made it clear from the outset that the only way to really do this is to explore AI possibilities in real aviation tasks, and this became a recurrent theme during the two days. HAIKU's focus goes beyond today's Machine Learning (ML) approaches, which give human operators better information and solutions, to next generation Intelligent Assistants that will be able to carry out complex tasks and interact with human operators.

Attendees



Origin of participants



Vanessa Arrigoni

Roberto Venditti (Deep Blue)

Vanessa Arrigoni and **Roberto Venditti (Deep Blue)** presented HAIKU's vision of society and transportation in 2050, with a strong focus on Urban Air Mobility (UAM) and the need to move (by 2050) **from segregated to integrated air traffic management**, as well as on **multi-modal transport**. The **ten key challenges** required to get there were discussed, and **John Hird (EUROCONTROL)** added an eleventh, namely the need to develop a **security culture across the industry**.

10 future challenges for aviation

A MAINTAIN **HIGH LEVEL SAFETY STANDARDS**

B MAINTAIN A **STRONG SAFETY CULTURE**

C ENABLING **ADAPTIVE REGULATION**

D ENABLING THE SHIFT **FROM SEGREGATION TO INTEGRATION**

E MINIMISE **CARBON FOOTPRINT**

F PRODUCE **SUSTAINABLE FUEL SOURCES**

G BE CAPABLE OF ADAPTING TO **EXTREME WEATHER EVENTS**

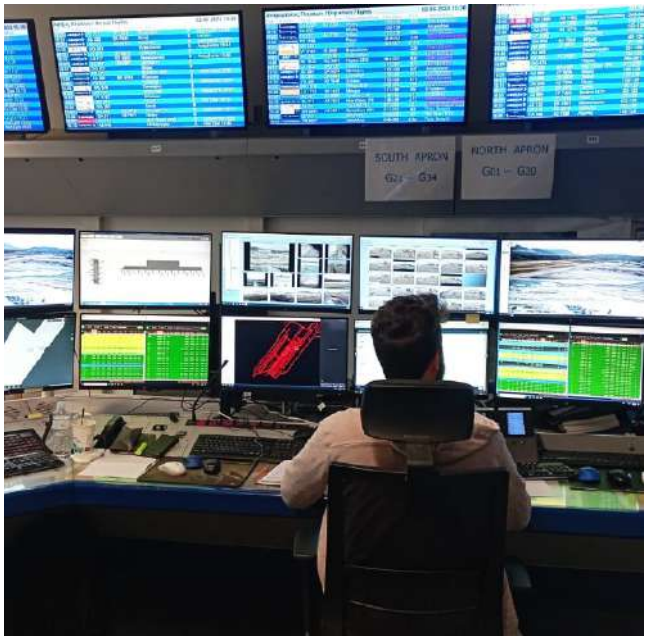
H ENABLING THE SHIFT TOWARDS **MULTIMODAL TRANSPORT SYSTEM**

I **INTEGRATE SYSTEMS**

J ENSURING **CYBER-RESILIENCE**

Alessandro Prister (SESAR JU)

Alessandro Prister (SESAR JU) gave an excellent **overview of a dozen AI exploratory projects past and present**, singling out two new projects, DARWIN and JARVIS, as ones to watch. Alessandro also gave a link to a White Paper on AI research in ATM based on the projects AISA, ARTIMATION, MAHALO, SAFEOPS and TAPAS, with a specific focus on explainability, as well as a video highlighting early results and insights.



Ricardo Reis (Embraer)

Ricardo Reis (Embraer) offered aircraft manufacturer **Embraer's vision of Human-AI Teaming (HAT)**, including the core elements of their design philosophy, which has a ***human-centric*** focus, meaning the **interfaces** (including digital assistants) should be **easy to learn and use**, with the **human remaining in control**.

The design must also be **safe** and **ethical**, yielding total system performance. Human AI Teaming suggests that the digital assistant must be able to decode contextual cues in order to frame the aircraft and cockpit situation and adapt to the flight crew's intentions, goals and likely behaviour. Overall, this points to the need for a **new human-centred, collaborative AI concept**.

Along this journey we will need **new metrics**, **new HAT techniques** and **requirements, new risk** (and cyber-risk) **analysis approaches**, and **new V&V** (validation and verification) **frameworks**, all the while watching for emerging unknowns/surprises – AI 'black swans'. Overall, there will need to be **strong governance of (AI) learning systems**, as is being discussed more generally in society.

Rob Stallard (UK CAAi)

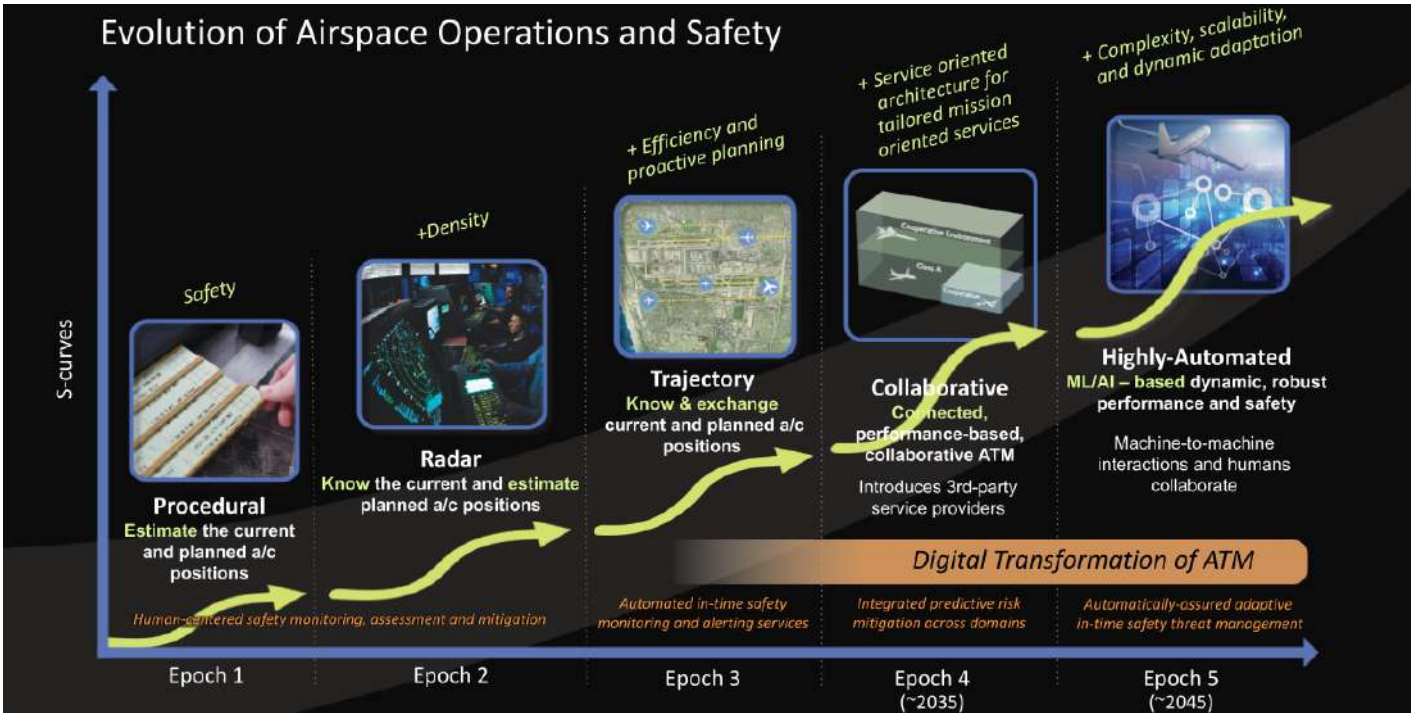
The focus on governance neatly segued into a presentation by **Rob Stallard (UK CAAi)** on **AI & Regulatory challenges**, from the basic lack of a firm definition of what is and is not AI, to the diversity of new entrants into aviation, and to the increasingly important and complex challenge of cyber-security. Since any regulator must balance removing obstacles to innovation with ensuring safety and security, and since much of the new 'tech' capability is coming from outside aviation, there will be a **need for international and cross-industry cooperation on AI regulation**.

Parimal Kopardekar (NASA)

Parimal Kopardekar (NASA) presented on a **framework for responsible AI in air traffic management (ATM)**, wherein by 2045 ATM will have shifted from being human-centric, with little collaboration between users and third parties, to an **'Unmanned Aircraft System Traffic Management'** inspired system arrangement, in which the automation is at the epicentre of information integration and addresses off-nominal situations, and where various users collaborate for efficiency. In automation terminology, **ATM becomes a 'Management by Exception' activity**.

To get to this level of AI/Automation support, Parimal suggested the need for **'visibility in learning'**, in order to uncover potential problems or 'surprises' (so-called edge or corner cases where the AI does something unexpected / undesired).

This is particularly the case with decisions that are irreversible, tactical or could impact operational safety. The point that was discussed most after the presentation was **NASA's concept of an independent *safety monitor***: a non-human layer of automation that is deterministic and focused on safety. The idea is that if the 'normally used' AI begins to 'misbehave' or take too long, the safety monitor will kick in and take over. The safety monitor is therefore a system-level 'digital twin' running in the background, and there is already a precedent for this type of system: TCAS.



Day 2

Paula Lopez-Catala (Innaxis)

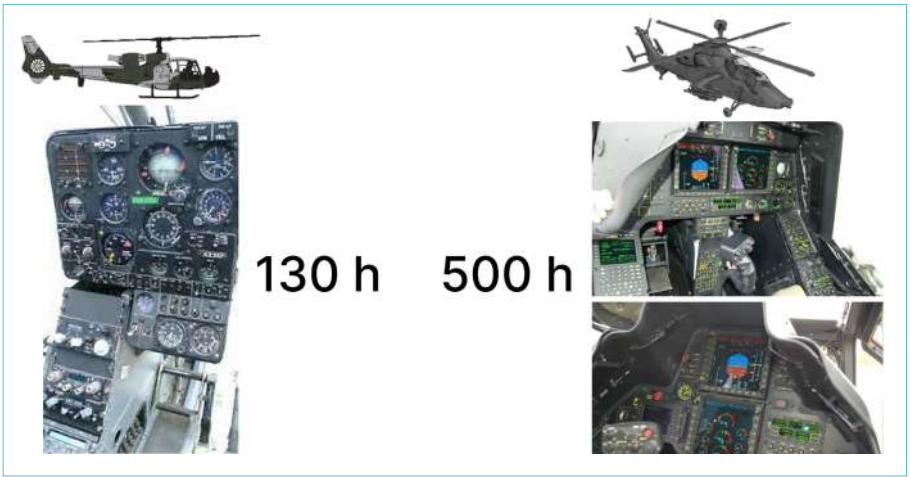
Lukas Beller (TUM)

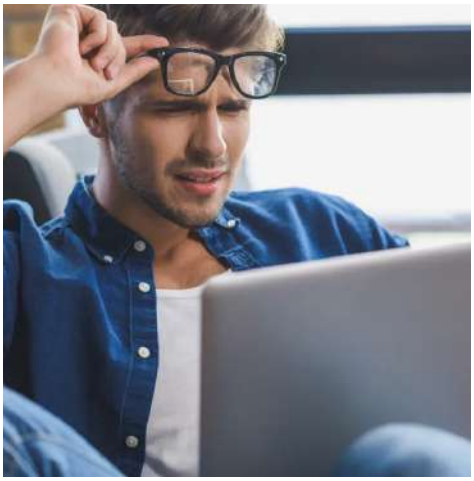
Paula Lopez-Catala (Innaxis) continued the focus on ATM's future development, usefully presenting **several scales of 'levels of automation / AI'** including EASA's current classification from Assistance, to Teaming, to Advanced. Much of today's AI in aviation is thought to be 1A to 2A, while the HAIKU and SAFETEAM use cases range from 1B to 3A. Paula's presentation, and her SAFETEAM colleague's **Lukas Beller's (TUM)** on **AI support for unstabilised approaches**, focused on specific tasks and tools to help aviation workers in managing challenging events.

Level 1 AI: assistance to human	Level 2 AI: human-AI teaming	Level 3 AI: advanced automation
Level 1A: Human augmentation **Level 1B:** Human cognitive assistance in decision-making and action selection	**Level 2A:** Human and AI-based system cooperation **Level 2B:** Human and AI-based system collaboration	**Level 3A:** The AI-based system performs decisions and actions that are overridable by the human **Level 3B:** The AI-based system performs non-overridable decisions and actions (e.g. to support safety upon loss of human oversight)

Sylvain Hourlier (Thales)

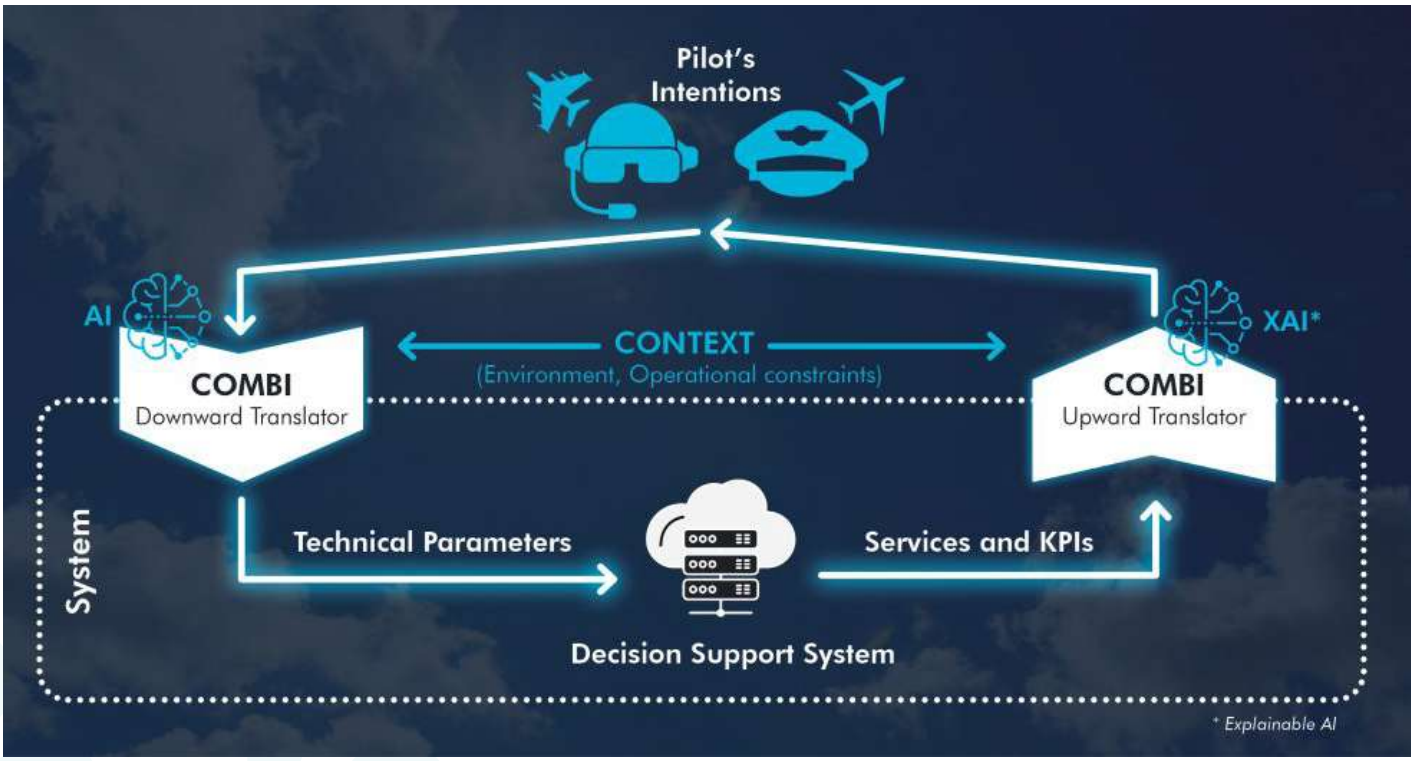
Sylvain Hourlier (Thales) showed how complex current automation is, giving the everyday example of the smartphone, where most people only know and utilise a fraction of their phone's capability. This is known as **'hidden complexity'**. He gave an aviation example where required training time has dramatically increased to knowledgeably operate the system. In everyday life we may resort to searching on YouTube or Google to find a video telling us what to do, but this will not work in many aviation scenarios which are safety and time critical. The problem, Sylvain suggests, comes down to a communication conundrum: *The operator doesn't know what the system is doing, and the system can't figure out what the operator wants...*





He suggests that no HMI is designed to resolve this situation. Sylvain also showed that even Chat-GPT is not very helpful, as it will give you a list of things you could do, but not tell you what to actually do in your specific situation. Instead, he suggested, what is needed is an ***interpreter***, and Thales are working on a system called **COMBI (Bi-directional Communicator)**.

Ensuing discussion considered that the 'interpreter' function might offer a solution to the foreseen explainability problem that not all AI suggestions will be explainable, especially with complex systems and solutions. In principle the COMBI approach could apply to all 4 aviation domains: cockpit, ATM, UTM and airport.



To change the pace on Day 2, two workshops were held where participants were given 1 million euros each (not real money!) to sponsor their choice of **19 potential future AI R&D projects**, to decide which were the most important.

This proved to be an energetic exercise!

1. Considering the AI projects

2. Place your bets!

3. And the winner is...!

The 4 winners

The four 'winners' were as follows:

COCKPIT – HAIKU USE CASE 2
A Digital Assistant in the cockpit to assist with Route Planning / Re-planning

ATM
An AI-powered Airport Awareness System

UATM – HAIKU USE CASE 3
A Digital Assistant for Urban Air Mobility Coordinator

AIRPORT – HAIKU USE CASE 5
An AI-based 'safety overwatch' system for managing day-to-day risks

An overview on the four winning concepts is available in the Annex. More detail on this exercise will be reported on the HAIKU website in due course, as the exercise also served as a prioritisation of stakeholder AI interests in the four aviation domains.

Captain Dougie Naismith (easyJet)

One of the last speakers was **Captain Dougie Naismith (easyJet)**, Base Captain at London Luton airport, who was asked to give some views from the cockpit. He cited a good number of **automation tools that worked very well** and were trusted by pilots all over the world. He then reviewed a number of **cases where the pilots had not followed the automation**, or had 'bet against it', preferring to follow their own intuition / experience, and suggested that this will be an issue for cockpit-based Intelligent Assistants. Following the presentation, there was much discussion on **Single Pilot Operations (SPO)** as well as whether the pilot will be able to take over when required if (s)he is only 'managing by exception,' and also whether being a pilot in the future would be as motivating as it is now.

Narek Minafskan (DFKI)

The final presentation by **Narek Minafskan (DFKI)** drew **contrasts between aviation and automotive use of AI**. In certain cars, AI is already driving the car, but the human driver needs to be there just in case… And as is well known, this does not always work, and fatal accidents have occurred. Clearly aviation cannot 'beta-test' AI systems in this way, and so must take a firmly conservative approach. **Pablo Perez-Illana (European Commission)** noted that there are significant automotive-AI projects and consortia, and that we should contact them to share ideas and what we are each learning.

This was a sound point on which to end the first HAIKU Dissemination Event, with two more to go before the end of the project in 2025. The next two will report progress made with the AIs in the six use cases, as well as what we've learned about Human-AI Teaming.

Annex

COCKPIT – HAIKU USE CASE 2
A Digital Assistant in the cockpit to assist with Route Planning / Re-planning

[1]Intelligent Assistant

The HAIKU UC2 IA[1] serves as a reliable guide for pilots, offering support when planning and replanning routes in face of unexpected situations. For instance, imagine a flight from Bordeaux to Munich delayed by 2 hours. Upon arrival above Lyon around 10 p.m., the snowstorm that was forecast turns out to be more severe than anticipated, and one by one, all the airports in Northeast Europe begin to close. A new route is needed. Options include continuing to Munich, landing in Zurich but unable to reach Munich, or landing in Lyon with a subsequent flight to Munich. Returning to Bordeaux is also feasible. The IA compares options, consults services, and prioritises based on the pilot's intentions, ensuring efficient decision-making.

ATM
An AI-powered Airport Awareness System

When managing the traffic in a control tower, any unexpected event can break the flow, forcing ATCOs to replan the entire sequence from scratch. The AAS would support the tower controller in monitoring and coordinating planned and unplanned airport activities on RWY, taxiway, and apron, alleviating his workload and ensuring smooth and safe operations. For instance, when a luggage cart falls off a truck and obstructs part of the apron, the AAS IA would promptly alert controllers of the obstacle's location and predict the time required to remove it. With the IA's recommended actions, controllers can quickly coordinate with ground personnel and adjust the sequence of aircraft based on the IA's suggestions.

UATM – HAIKU USE CASE 3
A Digital Assistant for Urban Air Mobility Coordinator

Envisaging high air traffic above cities in the near future, how to enable seamless cooperation across the UAM network? The Synchronair IA would be key to help, involving various stakeholders such as network managers, UAM coordinators, fleet managers, and individual operators. It would efficiently manage flight plans and trajectories, ensuring customer satisfaction while maintaining safe operations within capacity limits and restricted areas. During emergencies, like a building collapse requiring urgent medical assistance, the IA would promptly assign priority to the medical UAVs. It would automatically establish geofences, rerouting other drones to clear the way. Simultaneously, the IA would notify all UAM operators in the affected area, providing instructions and re-routing.

HOW IT WORKS

THE IA IN ACTION

AIRPORT – HAIKU USE CASE 5
An AI-based 'safety overwatch' system for managing day-to-day risks

The HAIKU UC5 IA, the Safety Watch IA, enhances safety measures by identifying potential risks and issuing alerts. In a scenario involving fog and temporary taxiway closures, the IA leverages historical data and recognises the increased likelihood of incorrect taxi routing and holdpoint breaches. It sends alerts to the tower and concerned airlines, prompting increased vigilance in following routing instructions Once conditions improve and risks subside, the IA cancels the alert, ensuring continuous monitoring of safety. Prevention at its finest!

HOW IT WORKS

THE IA IN ACTION

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