Navigating the future AI skyscape

The three types of AI

Artificial Intelligence refers to machines that can carry out cognitive tasks – perception, calculation, reasoning – at least as well as, if not better than humans. Modern AI is achieving remarkable results mostly thanks to its learning capability, processing vast amounts of data in no time. AI has been around for some time in aviation, in the form of **Machine Learning** (ML), where AI algorithms analyse large data sets to help us optimise landing rates, detect adverse weather patterns that might cause re-routing, reduce fuel usage, etc. ML gives our controllers, pilots, and operational planners better information and tools. This level of AI is not so different from today's advanced automation.

Generative AI, including Large Language Models (LLMs) are 'trained' on very large datasets (e.g. the entire worldwide web). LLMs such as ChatGPT are both powerful and creative, and can answer any question we care to pose. However, the answer may not be correct, as they try to give you what you want, including fabricating answers and evidence if necessary. They can also even deceive you to achieve the goals you set them. Yet Generative AI is seen as potentially transformative of human work, and investment in this area is simply off the scale at the moment.

The third type of AI, called **Artificial General Intelligence** or AGI, does not exist yet, and could out-think humans at every level. AGI is the reason for various open letters by eminent scientists, AI thought leaders and business leaders, urging caution and worrying about an 'extinction-level threat' by such systems, should they ever come into existence. AGI could be decades away, or tomorrow. No one really knows.

Why 85% of AI projects fail...

There is no doubt that AI can be harnessed in aviation to increase productivity, reduce climate impact, and enhance safety, but it is not a 'plug-in-and-play' system. Typically, only 15% of AI projects succeed; due to three main reasons:

Barry Kirwan
Eurocontrol

Simone Pozzi
Deep Blue

Miguel Villegas Sánchez
Skyway

- A lack of high-quality data (many organisations think they have this, then find out that it's not enough).
- Business leaders lack an understanding of the data science and technological skills necessary to sustain operational applications of AI.
- A failure to develop the 'social capital' required, leading to operational users rejecting the AI tool.

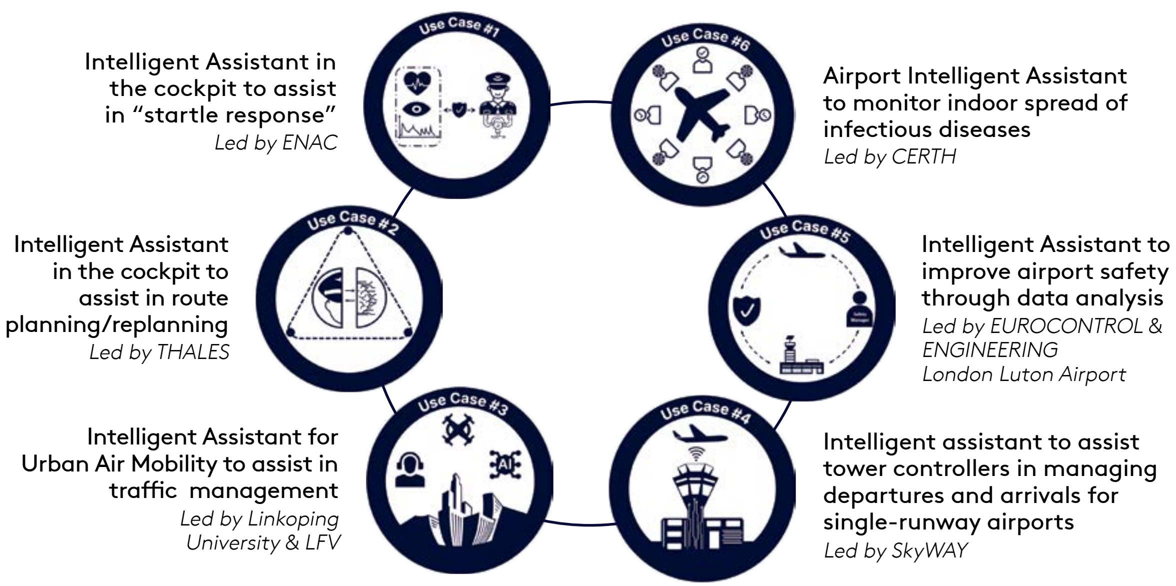
The rest of this article focuses on this third aspect – how to ensure user acceptance via the application of Human Factors to ensure high performance Human-AI Teaming.

What does Human-AI Teaming look like?

First, it needs to be said that an AI cannot think like we do, does not have feelings or a sense of self, and so cannot be considered a true 'team member'. Nevertheless, it can carry out tasks and (if programmed to do so) can act autonomously, and negotiate with its human counter-parts. For this reason it can be useful to talk of Human-AI Teaming. An ongoing European project called HAIKU is exploring Human-AI Teaming solutions, via six use cases shown in the figure below. These range from cockpit support in case of emergencies, to supporting tower controllers in optimising single runway airport throughput, as further elaborated in the inset.

What the Regulators have to say about AI in aviation

The EU Act on AI is the first regulation on AI of its kind, encompassing all industries and walks of life. It has implications for aviation, as a safety critical industry. In particular, and for all industries, any use by AI systems of personal data – biometric, facial images, emotional recognition – is generally banned by 2025, though exceptions may be possible. Additionally, the (human) user must always know if they are dealing with an AI (e.g. a chatbot).



Most importantly are that LLMs should not be used in safety critical areas of aviation, due to the risk of wrong outputs or fictitious answers (often called hallucinations). The EU Act on AI aims to maintain human agency, keeping the human in control. This is achieved by a general rule that **AIs in safety critical industries must have human oversight.** This includes designing appropriate interfaces, to monitor the AI operations. Human oversight is intended as a safeguard against risks to health, safety or fundamental rights.

EASA has outlined six Human AI Teaming categories that range from cognitive assistants performing routine tasks, to AIs capable of taking control in cockpit emergencies, to systems either run by the AI with human intervention only when required, e.g. future urban traffic management systems (drones and sky-taxis), to fully autonomous AI systems with no human intervention possible. In order to certify AI systems in these categories, **EASA has developed detailed requirements** in several areas, including **Human Factors, Explainability** (the ability of the AI to explain why it is doing what it is doing) and **Ethics.**

How to realise the 'social capital' of future AI systems

A primary consideration is whether current end-users are involved in the development of the Human-AI Teaming system. Such involvement is called **Human Centred Design**, and helps ensure that the final system deployed is fit for purpose, won't 'surprise' the users at critical moments, and will be sufficiently 'trained' to deliver smooth operational system performance. Another key success factor for Human-AI Teaming systems is ensuring **'shared situation awareness'**, via effective user-AI interface design and user-tested 'explainability'

(XAI). These measures keep the human team and the AI 'on the same page'.

The HAIKU project is developing an **AI Requirements APP** merging the EASA guidance, key elements from the EU Act on AI, and best practice Human Factors guidance from SESAR as well as other industries, to assist organisations developing, integrating or deploying AI system elements into operational aviation settings. A Safety approach is also being developed, as well as a Liability 'App'. HAIKU is therefore developing a suite of tools to optimise Human-AI Teaming systems in future aviation scenarios. The toolset is being tested and refined on the six HAIKU use cases and will be ready for general use by 2025.

The Undiscovered Country...

AI continues to evolve rapidly. For example, ChatGPT4.0 is far more powerful and impressive than ChatGPT3.5, and new LLMs are springing up in various quarters. Many CEOs are being urged to 'get on the bandwagon', but given the actual success rate of AI development projects, there is room for caution, and in particular deciding what kinds of AI their business really needs. The EU Act on AI also mandates (two years from now) that high risk industries utilising AI will need to have the following in place: AI risk management processes, data governance, evidence of human oversight, cybersecurity processes and safeguards, and a specific reporting system of events linked to AI usage. To this can be added the need to update Just Culture policies in aviation organisations (with suitable protections for the human end users), for incidents involving Human-AI Teaming combinations.

On the positive side...

Machine Learning in aviation has already shown its worth, and there are plenty of areas where AI could make a positive difference. What would be useful is a strategic roadmap laying out what is needed where and by when, and the steps to get there safely. Such a roadmap, particularly if collaborative, can firstly share-and-prepare relevant high quality datasets required to fuel AI systems. Second, it can ensure sufficient investment in social capital across the full AI development life cycle, for instance by focusing on designing the human role in a way that is effective and desirable. Third, it can be under-pinned by sufficient 'AI literacy' to show that aviation as a collective industry is embarking on its own AI journey as with any other – via planning, forethought, validation and viable safeguards.

In the global AI race we are witnessing today, where many are trying to run before they can walk, such a measured approach would be welcome.

In summary, AI is already here and likely to become increasingly integrated into aviation systems. A key component will be the 'social capital' needed to ensure safe and sustainable introduction of new AI systems. The Human Factors approach outlined can deliver assurance in this area, while ensuring alignment with EU and EASA requirements. This approach is being tailored and tested right now, and will be available to aviation partners in 2025.

Skyway and AI

At Skyway, we are leading Use Case Number 4 within the European HAIKU project (https://haikuproject.eu), which aims to develop an Intelligent Assistant to support air traffic controllers in sequencing arrivals and departures at single-runway airports.

This assistant, known as ISA (Intelligent Sequence Assistant), is being tested in a simulator that replicates Alicante-Elche Airport. Its goal is to offer the controller an orderly sequence of arrivals and departures, taking into consideration:

- Real-time analysis of data for all traffic intending to use the runway (positions, speeds, EOBT/CTOT, etc.).
- Algorithms (ML) to learn average runway occupancy times and taxi times to/from parking stands.
- Application of regulations (SERA) and local procedures (AIP, Letter of Agreement, etc.) with a direct impact on aircraft prioritization, wake turbulence separation, separation between consecutive departures, etc.

All this information is processed and handled in real time, to be displayed in a Human-Machine Interface (HMI) that replicates the real operational working position, adding new layers of information grouped into 4 levels of detail, for different roles (controllers, tower supervisors, etc).

The ultimate goal is to develop a prototype assistant that supports and improves air traffic controllers' decision-making, as early trials suggest that ISA could help reduce controller mental workload in high capacity conditions and increase operational efficiency.

In summary, at Skyway, as a pioneering company, we feel obligated to continue researching how new technologies can help us achieve **a safer and more efficient air traffic management system.**

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