

AI Situational Awareness Foundation for Advancing Automation



The AISA project explored the effects of human-machine distributed situational awareness and the opportunities for automation of monitoring tasks in en-route operation.

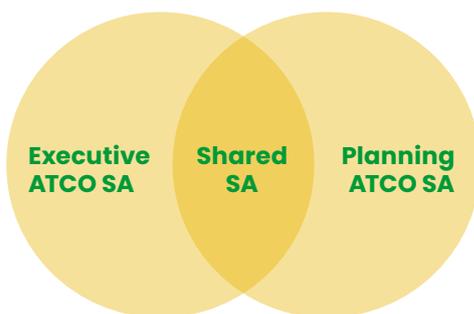
The main objectives:

AISA (AI Situational Awareness Foundation for Advancing Automation) was a SESAR Exploratory Research project investigating how to increase automation in air traffic management. The project explored domain-specific application of transparent and generalizable artificial intelligence methods. The solution proposed by AISA aims at enabling human-machine collaboration in air traffic control environment by introducing shared situational awareness, and it lays a foundation for implementation of further machine learning based automation.

The main novelty of the future AISA-like solution:

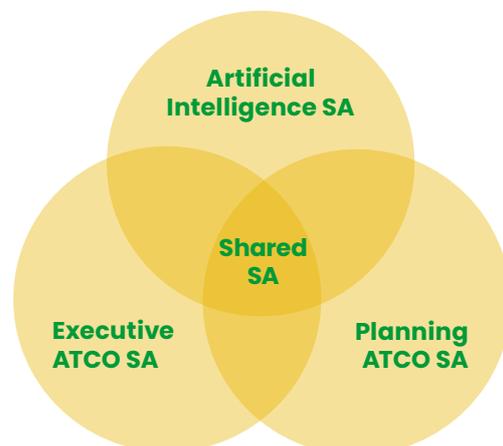
The project explored how artificial intelligence will be able to share the same situational awareness as air traffic controllers have. In this manner the machine and the human will jointly form a team situational awareness.

Current Team SA



Current Situation

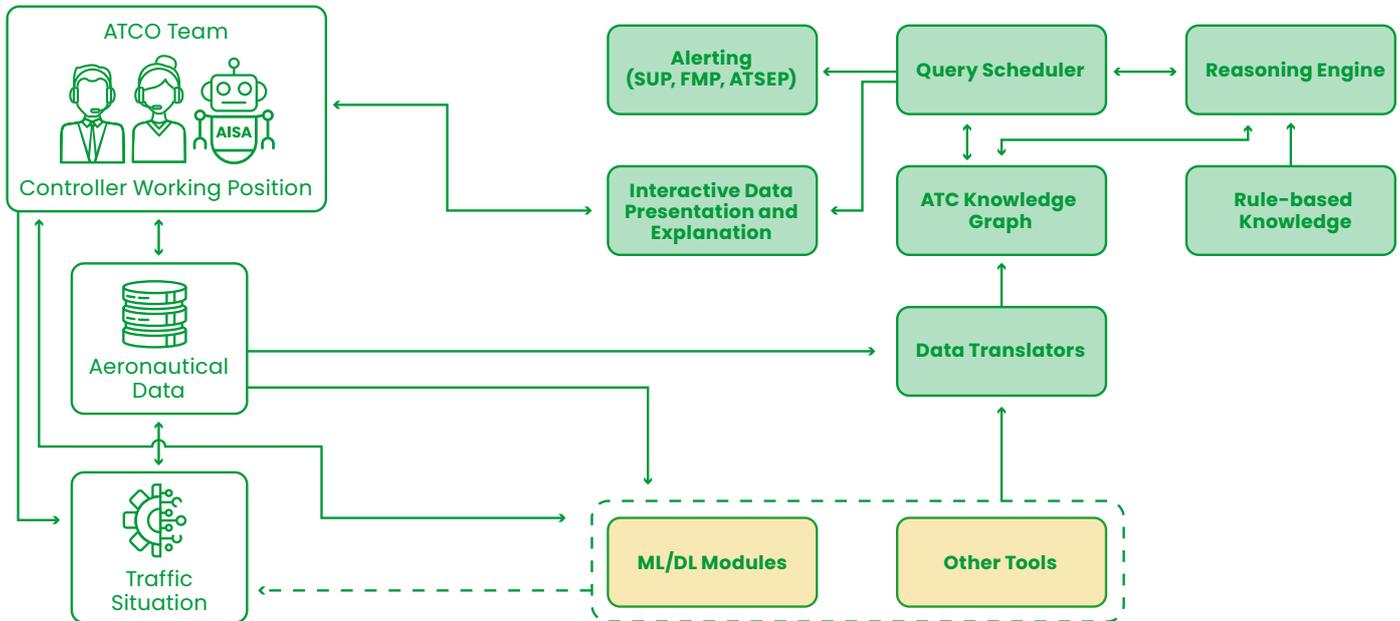
New Team SA



Future Vision



The Artificial Situational Awareness system developed by the project collects high-integrity information (using aeronautical information exchange models) to create a knowledge graph describing the traffic situation on a sector level. In addition to factual knowledge, a knowledge-based system manages and executes rule-based knowledge, defined and executed on top of the factual knowledge via a reasoning engine. The knowledge-graph is integrated with multiple machine-learning (ML) modules which enable the assessment of probabilistic events (e.g. aircraft trajectory prediction or conflict detection). By combining the reasoning engine with machine-learning, the system assesses complex interactions between objects, draws conclusions, explains the reasoning behind those conclusions, and predicts future system states.



Results of the experiments

Human-in-the-loop simulations were conducted in Zurich in the facilities of Skyguide with the involvement of licensed air traffic controllers with two main goals. First, to compare the human and artificial situational awareness, and second to assess the feasibility of integrating artificial situational awareness into human-machine team situation awareness. The experiments showed that the artificial situational awareness system is comparable to human situational awareness despite using only elementary HMI. Data from the first human-in-the-loop simulation was used to understand the human behaviours and performance, and during the second simulation the accuracy of machine situation awareness was assessed quantitatively as well as subjectively by air traffic controllers. The final results of the experiments indicated that 80% of the monitoring tasks selected, as the most primary and useful ones in the AISA Concept of Operations, were successfully automated. There is a need for considerable further research to build shared team situation awareness between the system and the air traffic controllers, but the future is promising!

Benefits provided by the future AISA-like system:

- enabling more efficient human-machine collaboration,
- automation of monitoring tasks,
- additional safety layer for exhaustive and uninterrupted monitoring of air traffic,
- supporting the introduction of machine learning automation systems.

Project partners:

- Faculty of Transport and Traffic Sciences at University of Zagreb
- Johannes Kepler University Linz / Institute of Business Informatics
- Skyguide Swiss Air Navigation Services Ltd
- Slot Consulting Ltd.
- Technische Universität Braunschweig, Institute of Flight Guidance
- Universidad Politécnica de Madrid
- Zurich University of Applied Sciences (ZHAW), School of Engineering