XX. EUROPEAN TRANSPORT CONGRESS - GYŐR

Introducing artificial intelligence in air traffic control

ROLAND GURÁLY

SLOT CONSULTING/CORVINUS UNIVERSITY OF BUDAPEST (PHD STUDENT)

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Content

AI in general

Air Traffic Control

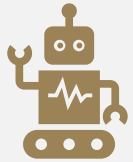
AISA project

Lessons learnt

Introduction – AI in general

Acceleration of technological development

Automation is everywhere



Emergence of artificial intelligence

AI vs traditional automation

	Uncertainty	Creativity
Traditional automation	NO	NO
Human being	YES	YES
Artificial intelligence	YES, but decreasing	YES, and increasing

Source: own work in AISA D2.2

Core AI domains

Reasoning	data transformation into knowledge
Planning	designing organised set of actions
Learning	Machine learning (ML): capability of the systems to automatically learn
Communication	Natural Language Processing: to identify, process, understand and/or generate information
Perception	computer vision and audio processing: ability of the system to become aware of their environment through the senses

Source: own creation on the basis of AI watch

Transversal AI domains

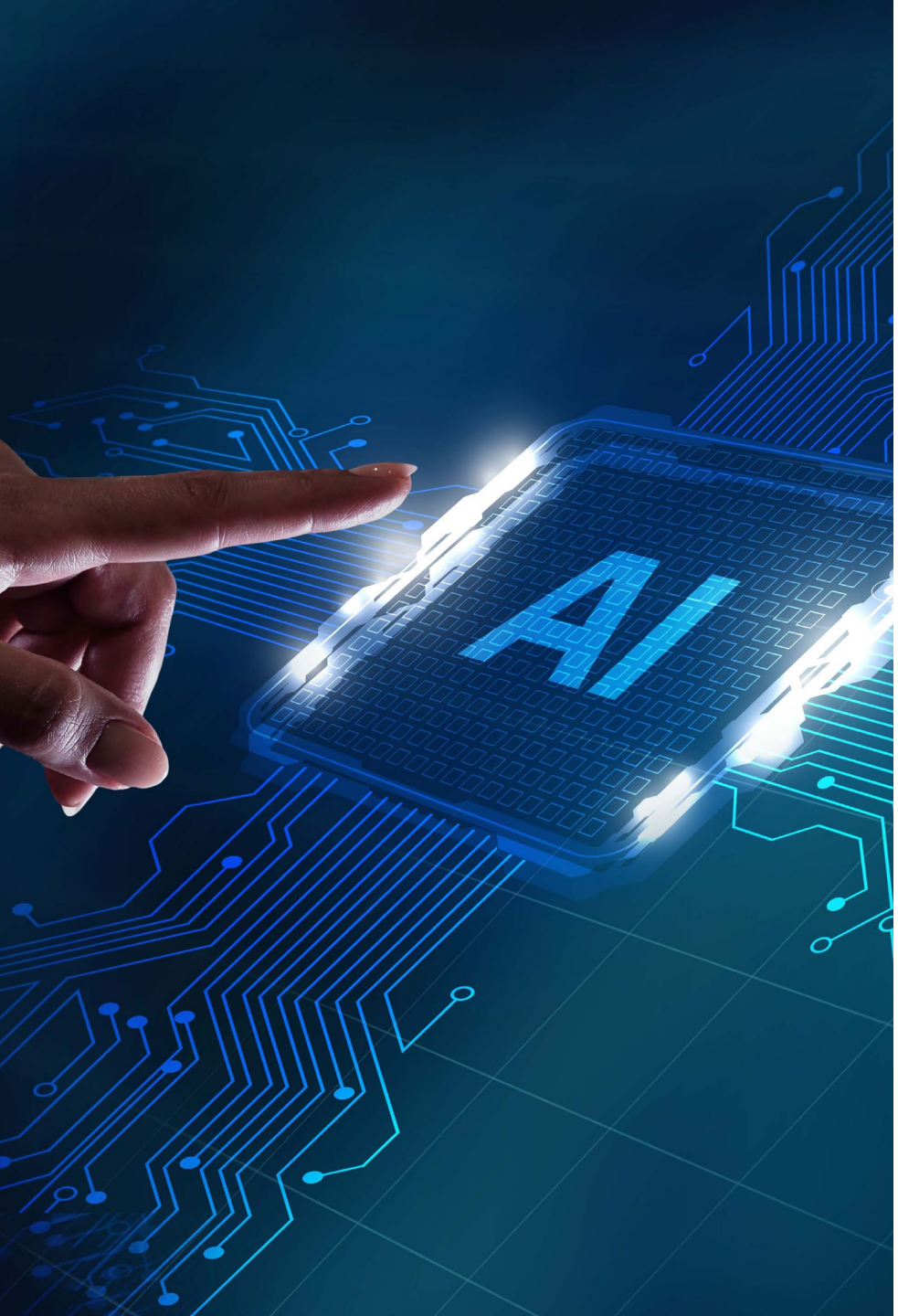
Integration and Interaction	combining the core domains with different characteristics (autonomy, cooperation, integration, etc.)
Services	usually cloud platforms - off the shelf products
Ethics and Philosophy	significant impact on human and society: solutions should be compliant with ethical principles and applicable regulations

Source: own creation on the basis of AI watch

Guidelines for trustworthy AI

- human agency and oversight
- technical robustness and safety
- privacy and data governance
- transparency, diversity
- non-discrimination and fairness
- societal and environmental wellbeing
- accountability

Source: HIGH-LEVEL EXPERT GROUP ON ARTIFICIAL INTELLIGENCE



Issues with AI

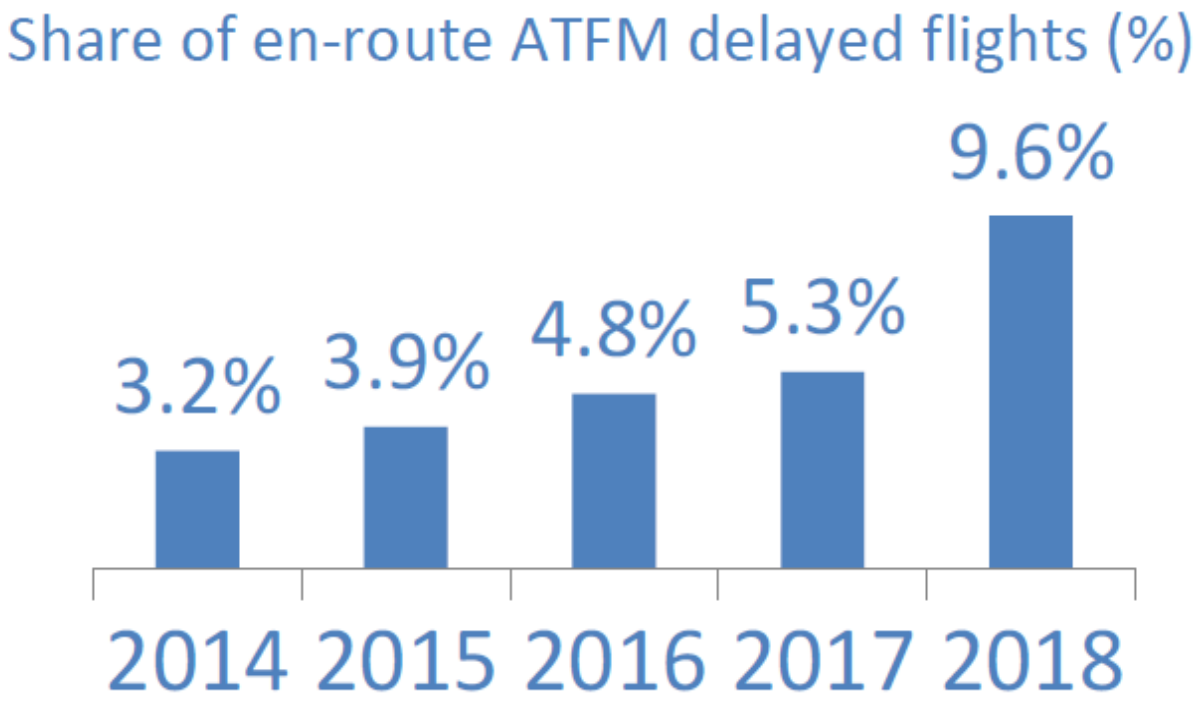
- new technology
- boundaries are unknown (yet)
- ethical concerns
- regulations are in progress
- standardization is lagging behind

Questions on progress with AI

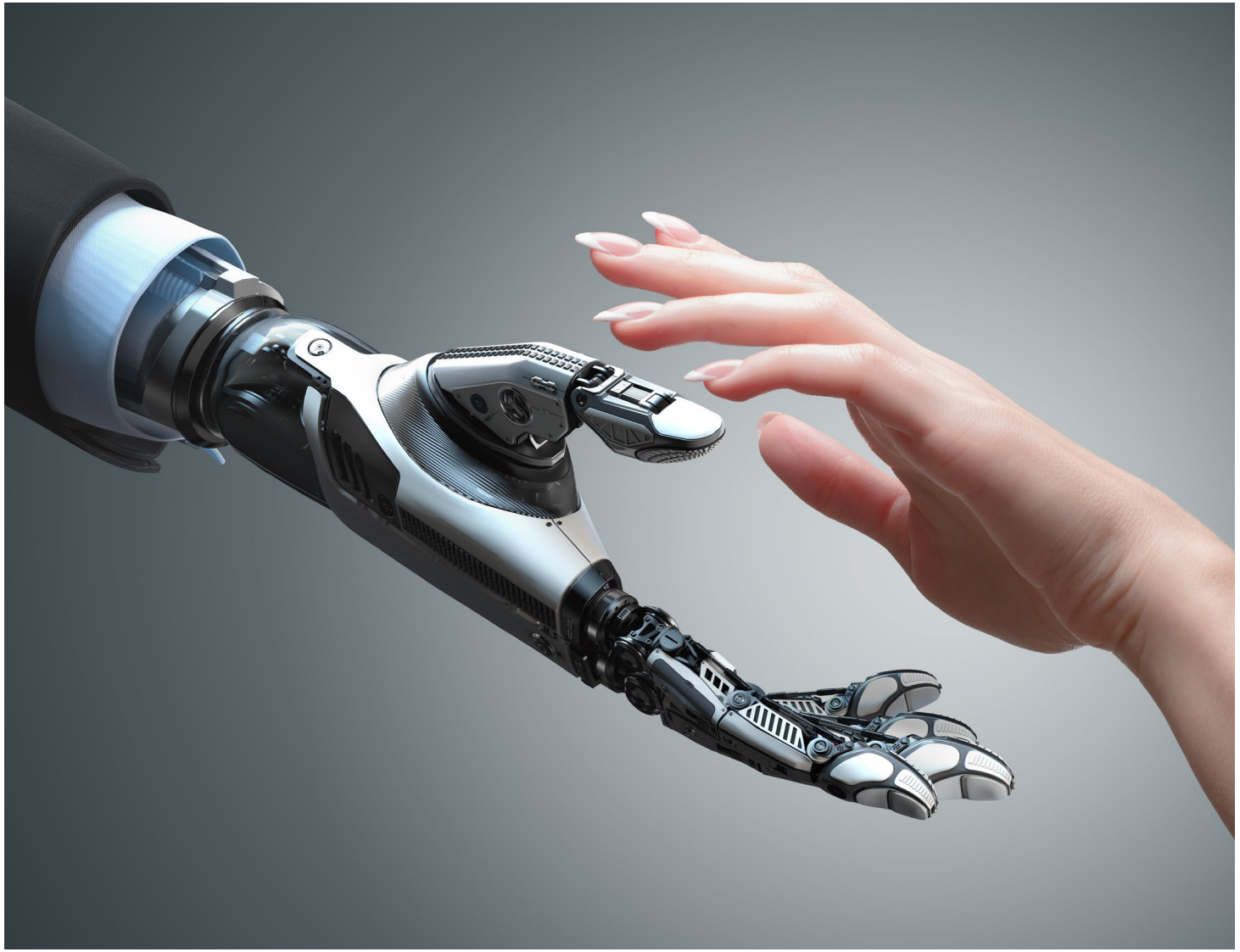
Will artificial intelligence be used in primary systems in safety critical industries?

If yes, what are the main steps to be taken?

Air traffic control – capacity problems



Source: EUROCONTROL



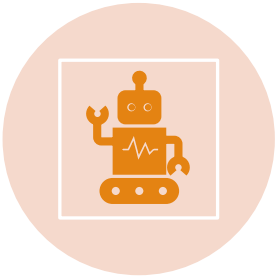
Automation is needed

SESAR: new solutions should provide substantial and verifiable performance benefits but maintain the safety level

AI is already in used in ATC, BUT: not in primary activities

Challenge: how to make human and machine cooperate efficiently?

The objectives of the AISA project



Exploration of the effects of human-machine distributed situational awareness

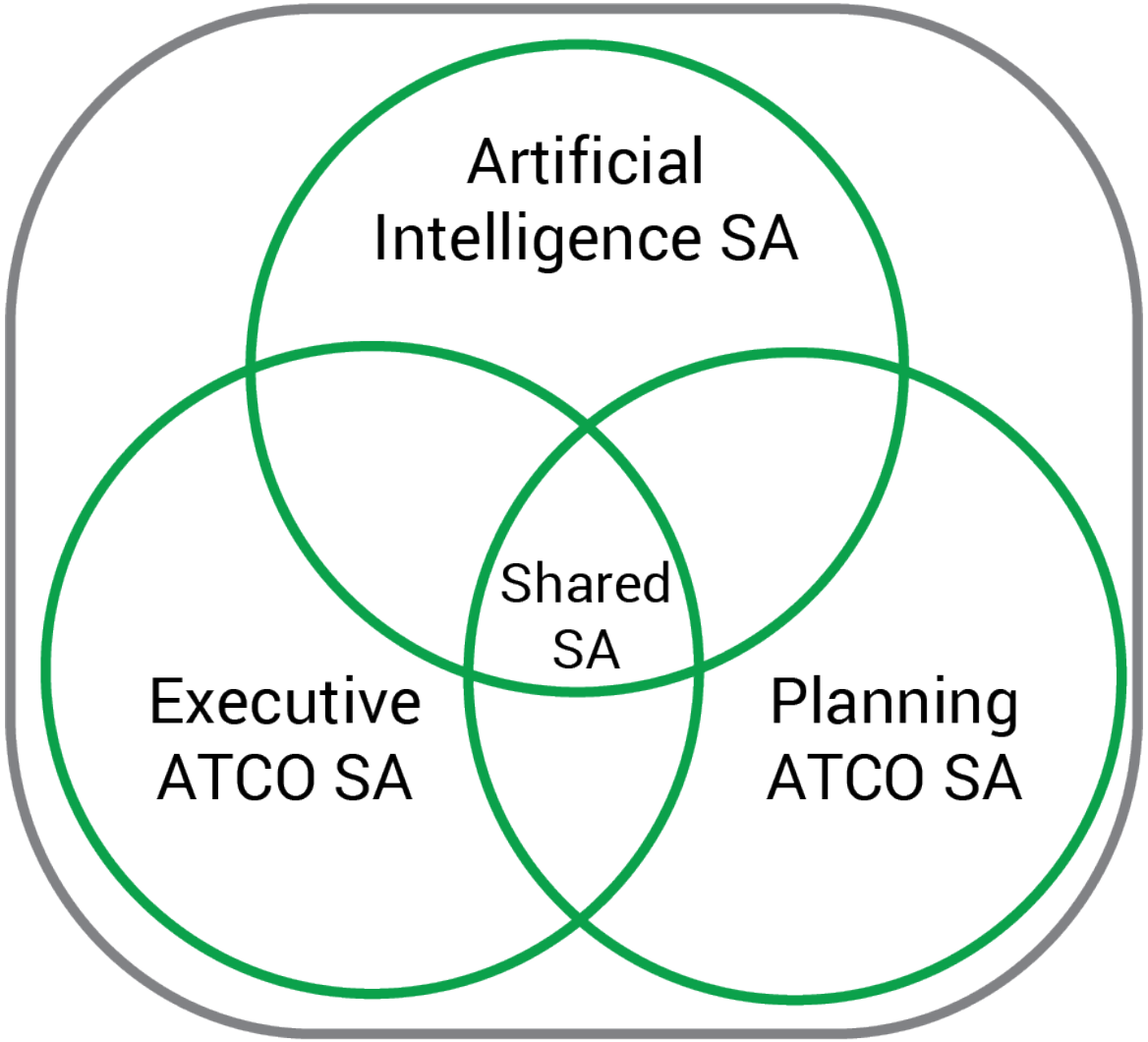
Search for opportunities for automation of monitoring tasks in en-route operations

Identifying the data needed by air traffic controller

Finding methods for adaptation to changes of the environment

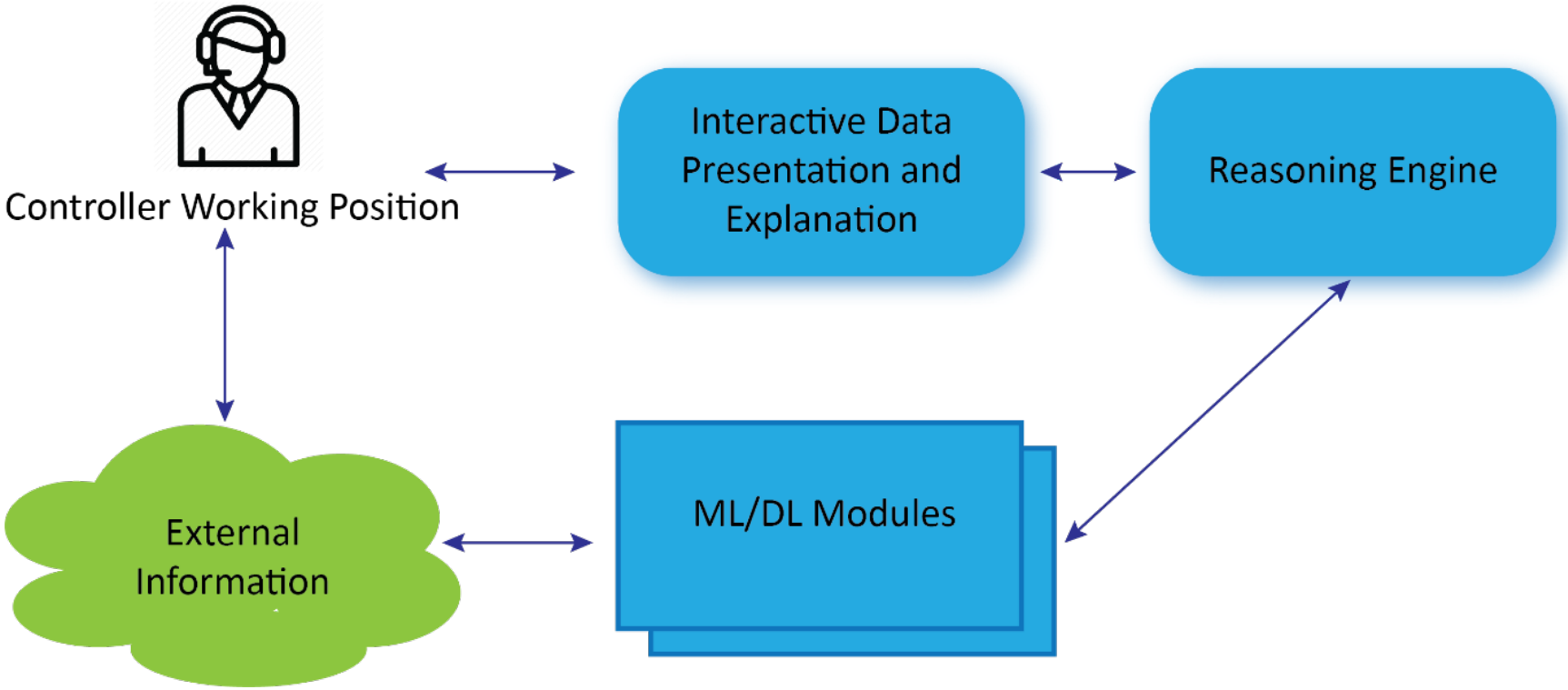
AISA: AI Situational Awareness Foundation for Advancing Automation is a SESAR ER project, 892618

Aim: Team Situational Awareness



Future Vision

own drawing on the basis of the AISA concept



The main conceptual elements

own drawing on the basis of the AISA concept

Gradual implementation approach

AI	ATCO	PROBABILITY
Support	Apply	High
Propose	Approve	Low
Apply	Monitor	Unlikely

The forecasted roles of human and AI at particular tasks by 2035

Source: own work in AISA D2.2

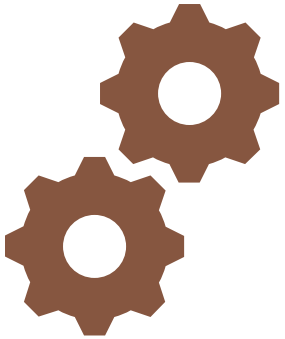
AI	ATCO	PROBABILITY
Support	Apply	High
Propose	Approve	Medium
Apply	Monitor	Low

The forecasted roles of human and AI at particular tasks by 2050

Source: own work in AISA D2.2

First Tasks of AI in ATC systems

A, Relatively simple monitoring activities



B, Already automated

Examples

detection of incoming traffic

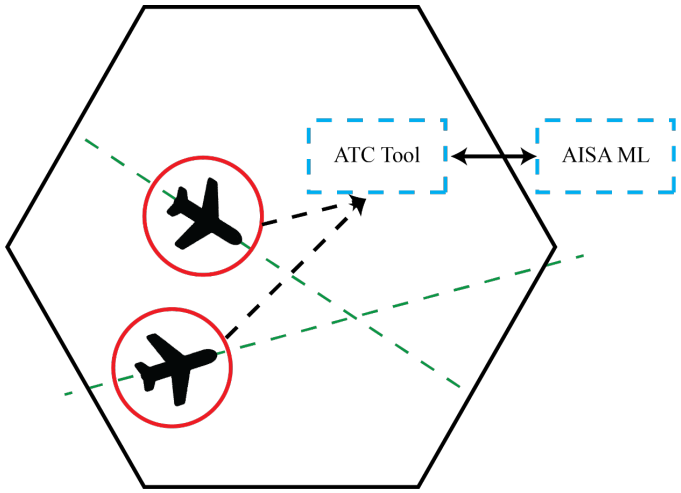
monitoring conformance of aircraft to the planned trajectory

identifying conflicts

monitoring adverse weather areas and restricted airspace

monitoring of the status and performance of ATC sub-systems

Examples of results - ML



Source: own drawing on the basis of Perez-Castan, A. et al, 2022

Focus: Situation of Interest (SI) prediction

Using classification, regression techniques

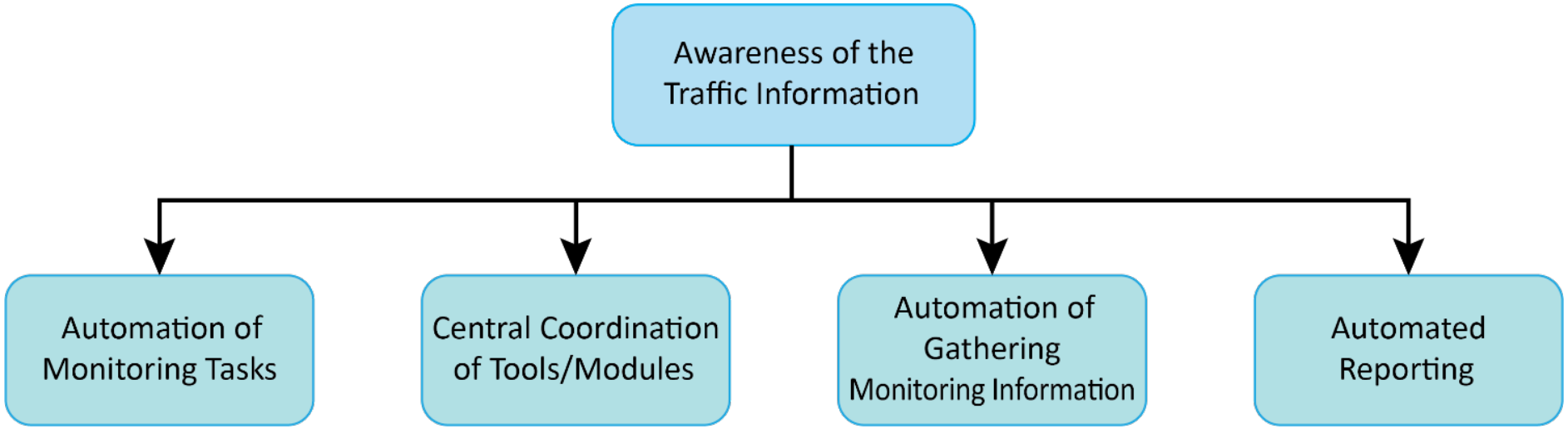
- updates the prediction in a certain period of time
- realises both the aircraft currently in the sector and the ones approaching it
- utilising historical 4DT (4D trajectory) data and the current ADS-B data (position, velocity, heading), makes prediction for each aircraft.
- supports the tactical ATCO in his/her airspace monitoring work

Promising results:

100% right: predicted minimal distance between pairs within 5 NM

97% right: predicted minimal distance between pairs 5 – 10 NM

Foreseen future benefits



own drawing on the basis of the AISA concept

Lessons learnt: Implementing AI in primary systems of safety critical industries

- Promising opportunities
- *BUT:*
- Essential: Safety, security and transparency
- Important: Establishment of shared situational awareness
- Gradual approach is needed: starting with simple tasks