# WP2 AI for Safety and Automation
# General Recommendations

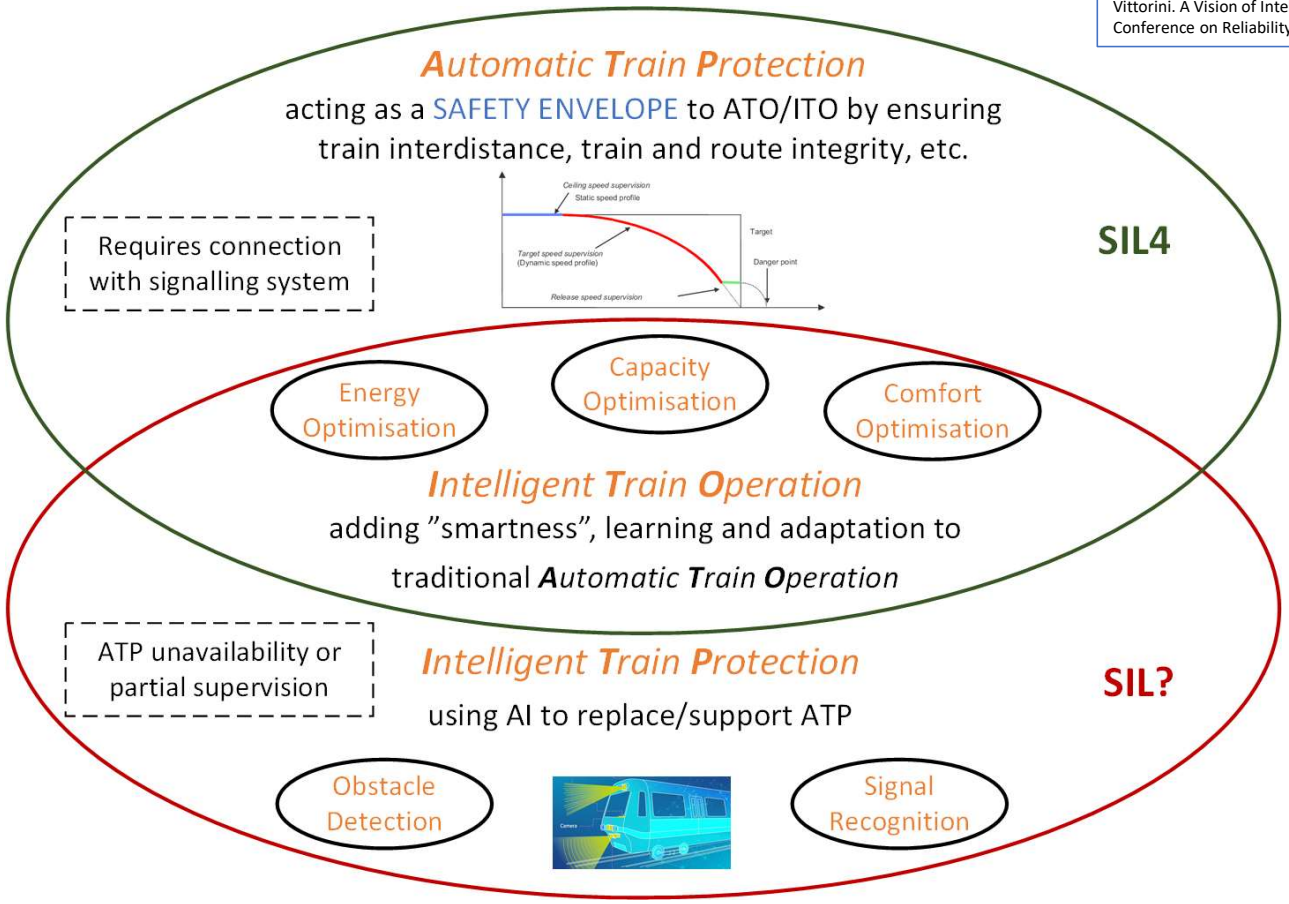
**Francesco Flammini**

# From automation to autonomy in railways

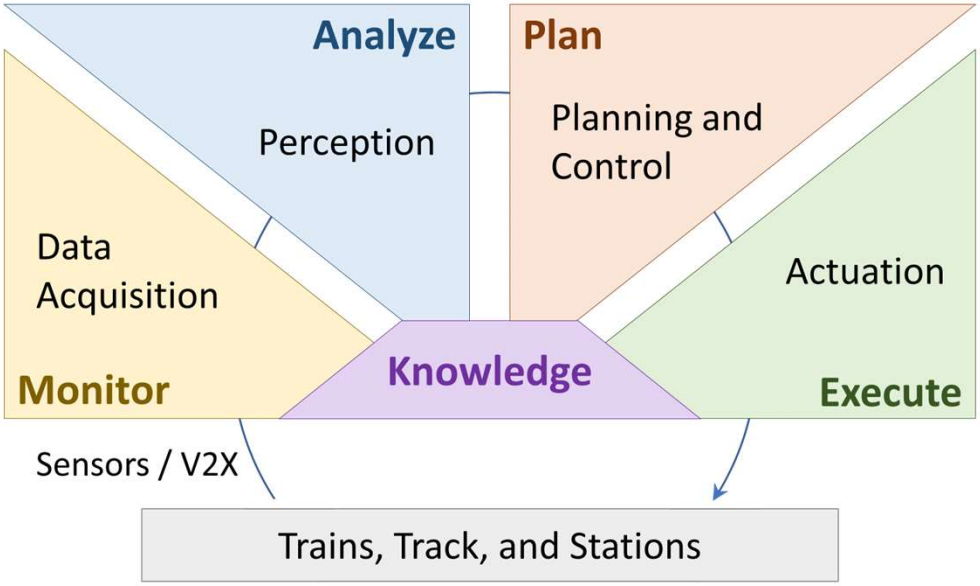
| | |
|---|---|
| **GoA 0** | Train operations are manually supervised by the driver, no automation. |
| **GoA 1** | Train operations are manually supervised by the driver supported by ATP. |
| **GoA 2** | Semi-automatic train operation. ATO and ATP systems automatically manage train operations and protection while supervised by the driver. |
| **GoA 3** | Driverless train operation with on-board staff handling possible emergencies. |
| **GoA 4** | Unattended train operation, neither the driver nor the staff are required. |

# Intelligent Train Control

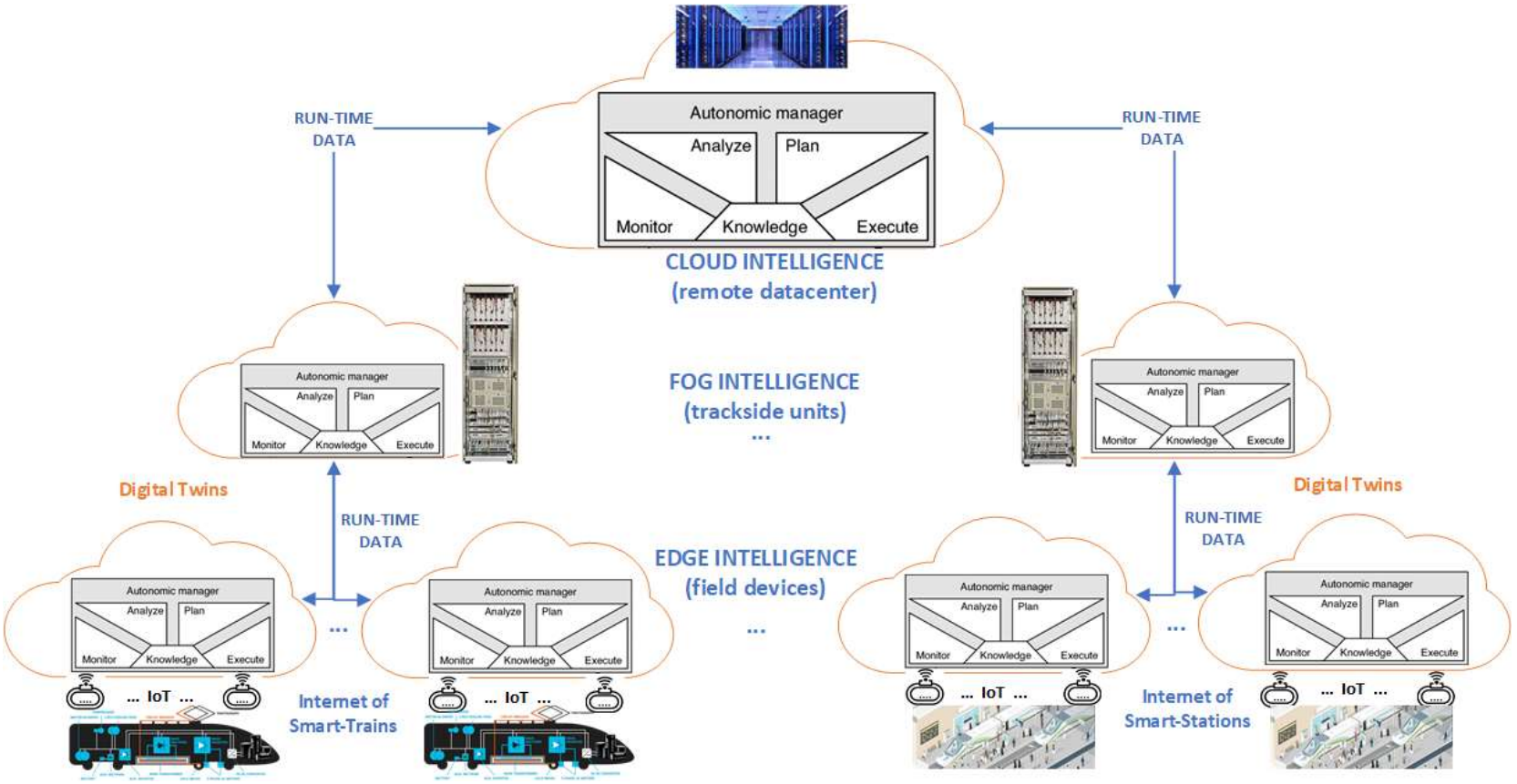
Francesco Flammini, Lorenzo De Donato, Alessandro Fantechi, Valeria Vittorini. A Vision of Intelligent Train Control. Proc. 4th International Conference on Reliability, Safety and Security of Railway Systems (RSSRail'22).



# MAPE-K Loop for Intelligent Train Control

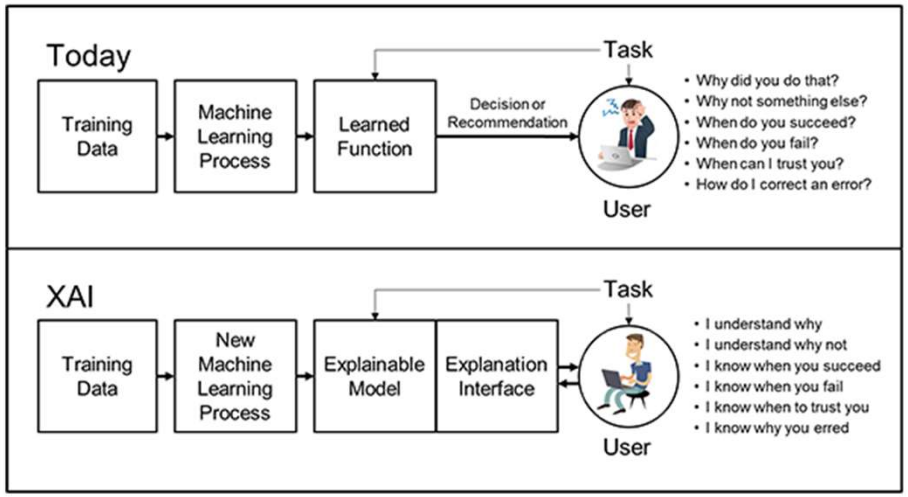


# Levels of intelligence: reference architecture



# Mixed-Reality Simulators

# Explainability challenges






https://www.darpa.mil/program/explainable-artificial-intelligence

# Summary of key technical recommendations

- Work on **common dataset generation and sharing** to train and/or benchmark novel data-driven technologies, as well as data augmentation, automatic labelling, and new paradigms as **deep transfer learning** to support domain adaptation
- Combine **Cognitive Digital Twins**, autonomic computing through self-adaptation (**MAPE-K**) and distributed levels of intelligence (**edge-fog-cloud**) to enable on-line predictive analyses and pro-active safety
- Develop **mixed-reality simulators** to improve effectiveness and efficiency of AI testing
- Research on **trustworthy artificial intelligence** (e.g., robustness through ML redundancy and diversity, transparency and explainability to manage ethical and legal implications, etc.) as a key paradigm to enable autonomous train operation

# Thank you for your attention!

RAILS
Roadmaps for AI Integration in raiL Sector