



Horizon 2020
European Union Funding
for Research & Innovation

Roadmaps for Artificial Intelligence integration in the rail Sector

PROJECT MID-TERM WORKSHOP

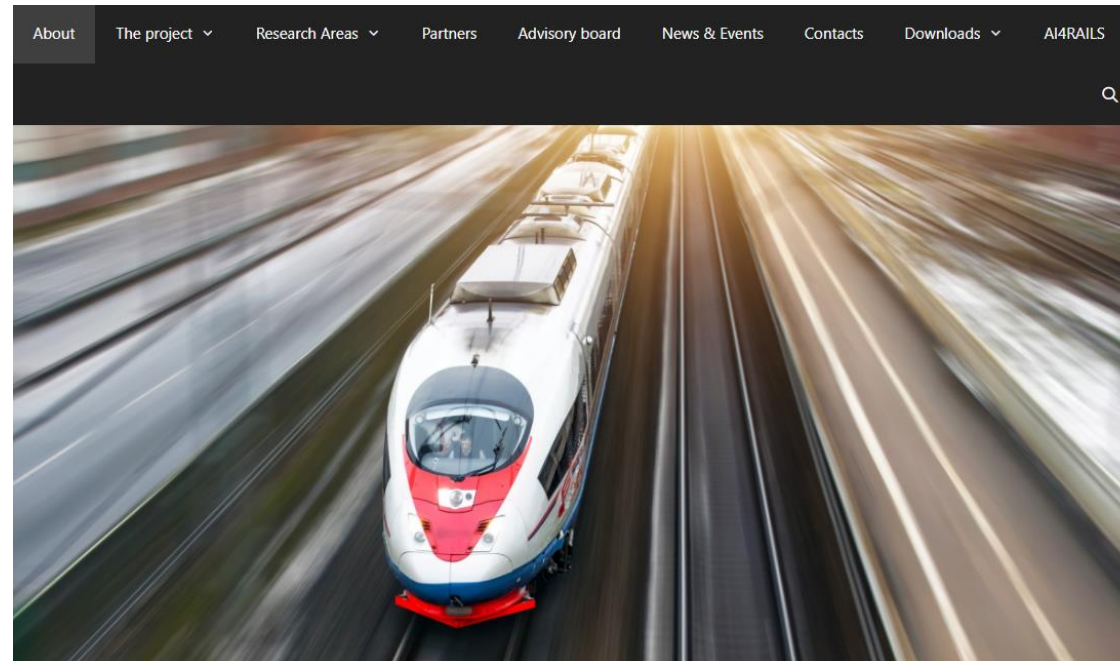
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RAILS

Roadmaps for AI integration in the rail Sector

<https://rails-project.eu/>



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 881782. The content of this document reflects only the author's view – the Joint Undertaking is not responsible for any use that may be made of the information it contains. The users use the information at their sole risk and liability.

Partners

ID	NAME	COUNTRY
1 CINI	CONSORZIO INTERUNIVERSITARIO NAZIONALE PER L'INFORMATICA (CINI) (Coordinator)	IT
2 UNIVLEEDS	UNIVERSITY OF LEEDS	UK
3 LNU	LINNAEUS UNIVERSITY	LNU
4 TU DELFT	DELFT UNIVERSITY OF TECHNOLOGY	NL



- ✓ CINI is a CONSORTIUM of Italian Universities founded in 1989
- ✓ Educational non-profit organization under the supervision of the competent Italian Ministry for University and Research
- ✓ **44 public Italian universities**, more than 1300 professors and researchers
- ✓ **10 Laboratories** (e.g., AI and Intelligent Systems, Big Data, Cybersecurity, Embedded Systemes & Smart Manufacturing, Smart Cities & Communities...)
- ✓ Its aim is to foster the cooperation of Italian computer scientists and engineers in nationwide and international projects
- ✓ Research in the fields of Computer Engineering, Computer Science, and Information Technologies
- ✓ CINI participates in RAILS mainly through the **CINI ITEM Laboratory**

University of Leeds

- ✓ University of Leeds is acclaimed world-wide for the quality of its teaching and research, and has been frequently ranked within the top 100 universities worldwide.
 - Leeds hosts over 32,000 students from 141 countries attached to 560 different undergraduate and 300 postgraduate degree programmes.
 - Under Horizon 2020 Leeds is currently coordinating 71 H2020 projects and is a partner in a further 60 successful projects.
- ✓ Institute for Transport Studies (ITS) at University of Leeds is the largest academic research groups in the transport field in the UK
 - Ranked 4th in the 2017 Shanghai Ranking on the subject of Transportation Science & Technology
 - ITS has participated in a large number of projects funded under H2020, as well as many projects funded by the rail industry and UK governments.

Linnaeus University (LNU)



- ✓ Linnaeus University is a modern university in southeastern Sweden with a strong international profile.
 - ✓ 1,600 international students every year and 750 partner universities in more than 60 countries.
 - ✓ One of Sweden's larger universities, with over 31,000 students and 2,000 employees.
- ✓ The Department of Computer Science and Media Technology has about 80 faculty members, who have conducted research in major areas of computer science such as software engineering, embedded systems, adaptive systems and networks, artificial intelligence and machine learning, etc.
- ✓ Recently, several new professors and researchers have joined the department with a strong expertise on cyber-physical systems security, computer dependability, model-driven and formal engineering methods. They also have specific expertise on smart-grid and transportation systems.

Delft University of Technology

- ✓ Founded in 1842
- ✓ Over 20,000 students and 2,500 staff members divided over eight faculties
- ✓ QS World University Rankings 2018:
 - ✓ Overall: 54th
 - ✓ Civil Engineering: 4th.
- ✓ Transportation Science & Technology (in the Shanghai Global Ranking 2018): 3rd

RAILS Key Objectives

1. Identification of the potential of AI for railways
2. Adherence to current work in railways innovation
3. Recognition of required innovation shifts
4. Development of methodological and experimental proof-of-concepts
5. Development of Benchmarks, Models and Simulations
6. Transition pathways toward the rail system scenario
7. Involvement of relevant rail stakeholders
8. Training of young researchers and promotion of research networks on AI in railways

Advisory Board

European Union Agency for Railways (ERA)

Hitachi Rail STS

First Rail

Netherlands Railways

ProRAIL

Aitek S.p.A.

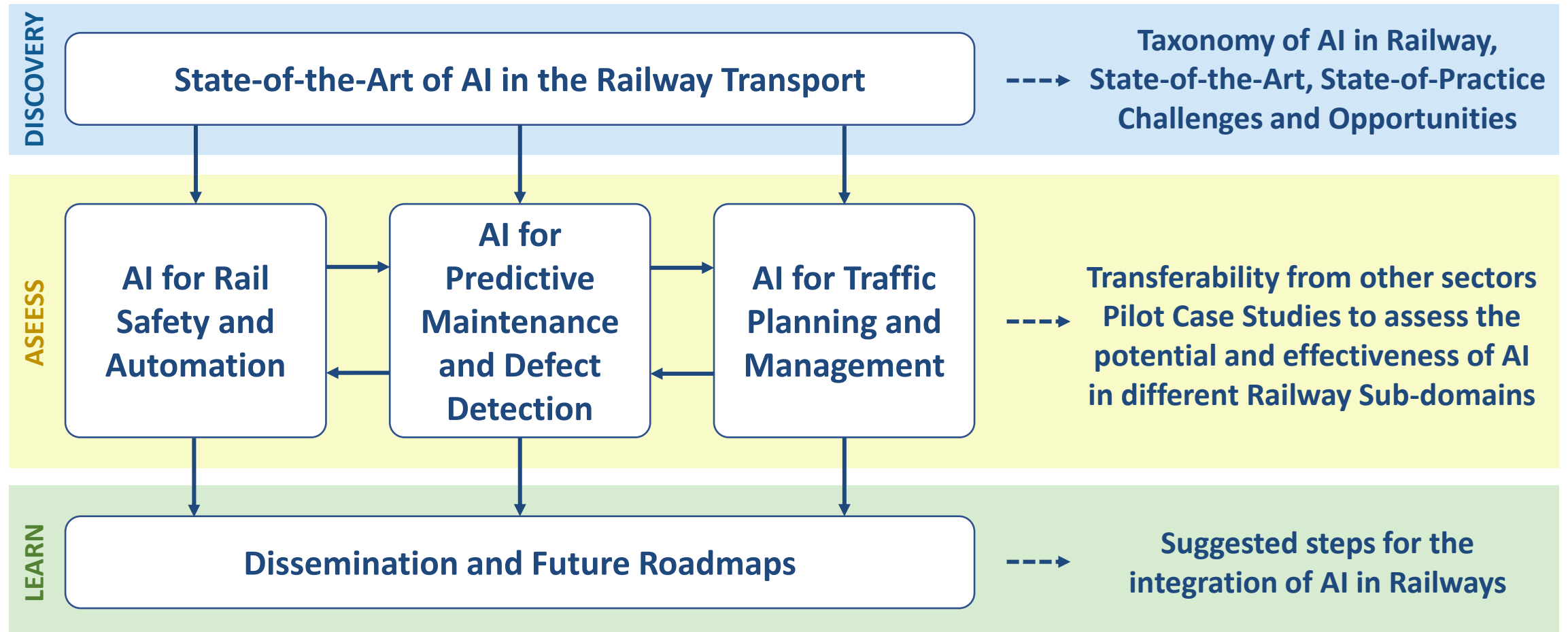
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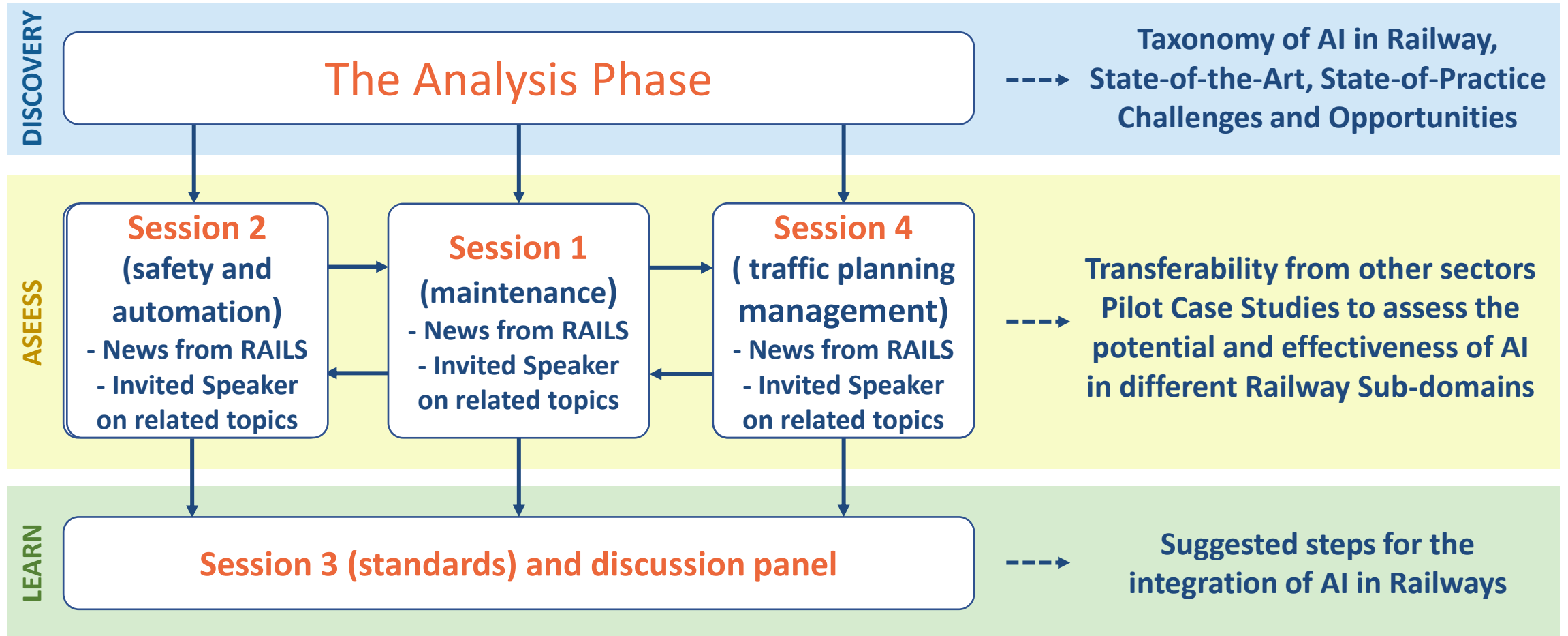
Nexttechnologies Ltd.

The MathWorks

RAILS Structure



Today's Event



MID-TERM Project Picture



4 EU Partners
10 AB Members
2 Ph.D. Students

Activities



AI4RAILS
(RAILS supported
Workshop Series)



1 AB Meeting



1 Survey



KoM meeting
Mid-Term WS



Papers and Articles

- ✓ Roadmaps for AI Integration in the Rail Sector – RAILS (ERCIM News 121)
- ✓ "Low-Power Wide-Area Networks in Intelligent Transportation: Review and Opportunities for Smart-Railways (IEEE ITSC 2020)
- ✓ **A Systematic Review of Artificial Intelligence Public Datasets for Railway Applications (MDPI Infrastructures)**
- ✓ Software Verification and Validation of Safe Autonomous Cars: A Systematic Literature Review (IEEE Access)
- ✓ Artificial Intelligence in Railway Transport: Taxonomy, Regulations and Applications (IEEE Trans. on Int. Trans. Systems, 2021 - Early Access)
- ✓ A Vision of Intelligent Train Control (Accepted at RSSRail 2022)
- ✓ Trustworthy AI for safe autonomy of smart railways: directions and lessons learnt from other sectors (Accepted at WCRR 2022)



DISCOVERY

WP1



ASSESS

WP2,3,4



LEARN

WP5



WP6



Talks and
Presentations



Organized WS

IEEE ITCS 2020

DisCoRail 2021

INFORMS 2021

InnoRail 2021

AI4RAILS 2020
co-located with EDCC2020

AI4RAILS 2021
co-located with EURO2021

Upcoming

RSSRail 2022

WRCC 2022

Planned

AI4RAILS 2022
co-located with EDCC22
Zaragoza (Spain)
12 September 2022



Deliverables accepted and published

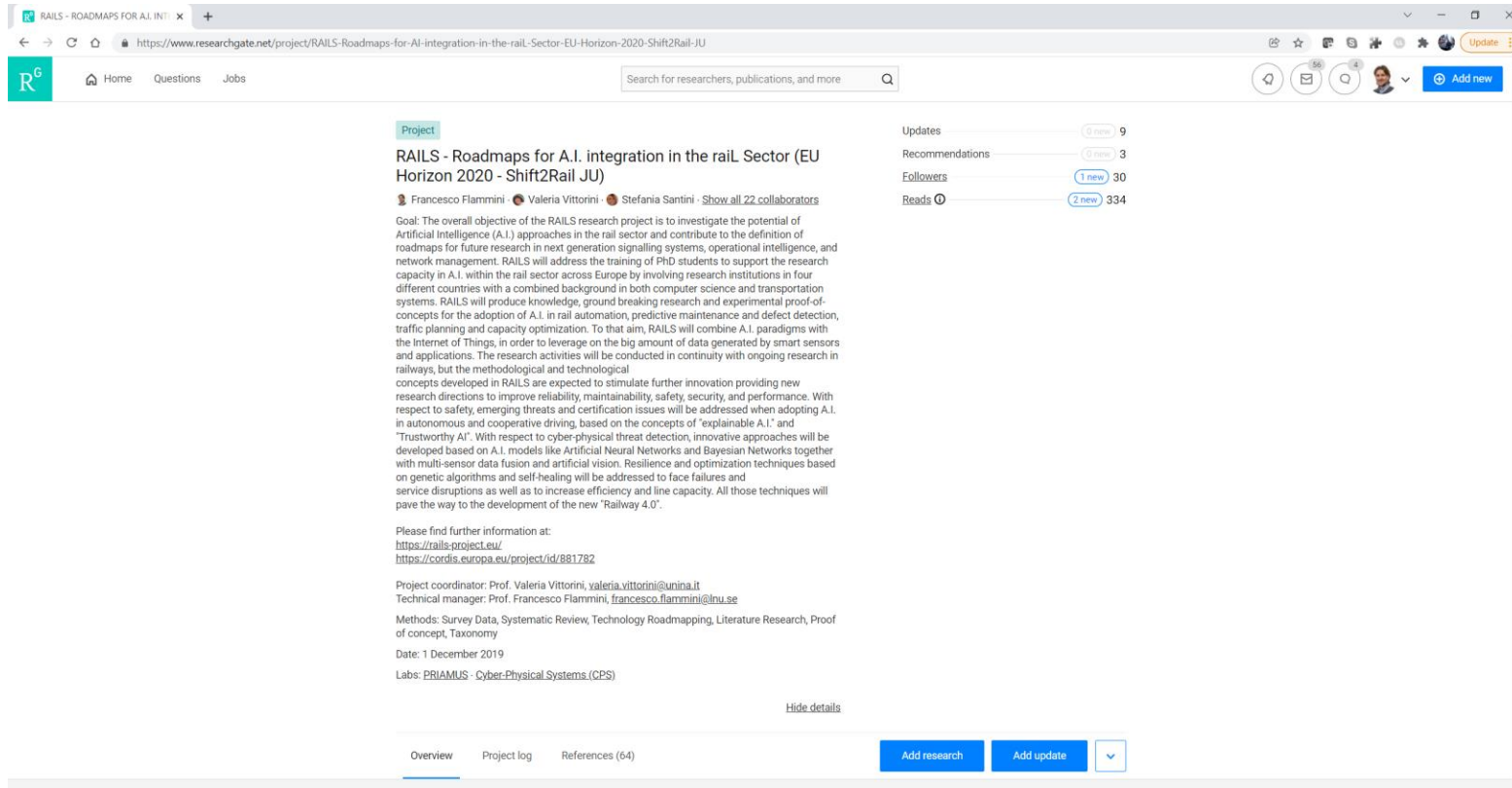
(<https://rails-project.eu/downloads/deliverables/>)

- D1.1: Definition of a reference taxonomy of AI in railways
- D1.2: Summary of existing relevant projects and state-of-the-art of AI application in railways
- D1.3: Application Areas (including guidelines, survey results, and recommendations)
- D2.1, D3.1, and D4.1 which are "Reports on case studies and analysis of transferability from other sectors" in the context of WP2, WP3, and WP4 respectively

To follow the project and get updates:

<https://rails-project.eu/>

<https://www.researchgate.net/project/RAILS-Roadmaps-for-AI-integration-in-the-rail-Sector-EU-Horizon-2020-Shift2Rail-JU>



The screenshot shows the ResearchGate project page for "RAILS - Roadmaps for A.I. integration in the rail Sector (EU Horizon 2020 - Shift2Rail JU)". The page includes a search bar, navigation links (Home, Questions, Jobs), and a sidebar with statistics: Updates (9), Recommendations (3), Followers (30), and Reads (334). The main content area features the project title, a list of collaborators (Francesco Flammini, Valeria Vittorini, Stefania Santini), and a detailed description of the project's goals and methods. The project coordinator is Prof. Valeria Vittorini, and the technical manager is Prof. Francesco Flammini. The project was established on December 1, 2019, and is part of the PRIMUMUS - Cyber-Physical Systems (CPS) labs. At the bottom, there are tabs for Overview, Project log, and References (64), along with buttons to "Add research" and "Add update".

Project

RAILS - Roadmaps for A.I. integration in the rail Sector (EU Horizon 2020 - Shift2Rail JU)

Francesco Flammini · Valeria Vittorini · Stefania Santini · [Show all 22 collaborators](#)

Goal: The overall objective of the RAILS research project is to investigate the potential of Artificial Intelligence (A.I.) approaches in the rail sector and contribute to the definition of roadmaps for future research in next generation signalling systems, operational intelligence, and network management. RAILS will address the training of PhD students to support the research capacity in A.I. within the rail sector across Europe by involving research institutions in four different countries with a combined background in both computer science and transportation systems. RAILS will produce knowledge, ground breaking research and experimental proof-of-concepts for the adoption of A.I. in rail automation, predictive maintenance and defect detection, traffic planning and capacity optimization. To that aim, RAILS will combine A.I. paradigms with the Internet of Things, in order to leverage on the big amount of data generated by smart sensors and applications. The research activities will be conducted in continuity with ongoing research in railways, but the methodological and technological concepts developed in RAILS are expected to stimulate further innovation providing new research directions to improve reliability, maintainability, safety, security, and performance. With respect to safety, emerging threats and certification issues will be addressed when adopting A.I. in autonomous and cooperative driving, based on the concepts of 'explainable A.I.' and 'Trustworthy AI'. With respect to cyber-physical threat detection, innovative approaches will be developed based on A.I. models like Artificial Neural Networks and Bayesian Networks together with multi-sensor data fusion and artificial vision. Resilience and optimization techniques based on genetic algorithms and self-healing will be addressed to face failures and service disruptions as well as to increase efficiency and line capacity. All those techniques will pave the way to the development of the new 'Railway 4.0'.

Please find further information at:
<https://rails-project.eu/>
<https://cordis.europa.eu/project/id/881782>

Project coordinator: Prof. Valeria Vittorini, valeria.vittorini@unina.it
Technical manager: Prof. Francesco Flammini, francesco.flammini@lnu.se

Methods: Survey Data, Systematic Review, Technology Roadmapping, Literature Research, Proof of concept, Taxonomy

Date: 1 December 2019

Labs: PRIMUMUS - Cyber-Physical Systems (CPS)

[Hide details](#)

[Overview](#) [Project log](#) [References \(64\)](#) [Add research](#) [Add update](#)

RAILS MID-TERM WORKSHOP

25 FEBRUARY 2022

Chair: Zhiyuan Lin (Univ. Leeds)

All times are CET

10.00 - 10.15	Opening and Welcome to attendees	Ronghui Liu (Univ. Leeds), Gorazd Marinic Shift2Rail IPX Programme Manager (EU-RAIL)
10.15 - 10.30	RAILS: A Mid-Term bird eye view	Valeria Vittorini RAILS Project Coordinator (CINI and Univ. Napoli Federico II)
10.30 - 10.50	AI in railways - analysis phase: main outcomes and their relevance for the next steps	Rob Goverde (TU Delft)
	Session 1: Smart maintenance	
10.50 - 11.10	Preliminary results and next steps	Lorenzo De Donato (Univ. Napoli Federico II)
11.10 - 11.30	New steps forward in railways smart maintenance	Carlo Crovetto (Hitachi Rail STS) IN2SMART2 project Coordinator, Marco Borinato (Hitachi Rail STS)
11.30 - 11.40	Break	
	Session 2: Trustworthy AI and autonomous trains	
11.40 - 12.00	Preliminary results and next steps	Francesco Flammini (Linnaeus Univ.)
12.00 - 12.20	AI: trustworthiness, safety and validation issues	Guo Zhou (Scania Group)
	Session 3: The need for standardization	
12.20 - 12.40	Ongoing standardization activities in the area of AI and Digital Twin	Denis Miglianico (Alstom Transport) CENELEC TC9X Secretary and IEC TC9 Secretary
12.40 - 13.00	The need for Standard XAI	Autilia Vitiello (Univ. Napoli Federico II) Chair of the IEEE P2976 - XAI Explainable AI Working Group
13.00 - 14.30	Lunch	
	Session 4: Traffic & passenger management	
14.30 - 14.50	Preliminary results and next steps	Ruifan Tang (Univ. Leeds)
14.50 - 15.10	Machine Learning for Crowd Behaviour Understanding in Public Spaces	He Wang (Univ. Leeds)
15.10 - 16.15	Panel – discussion about the challenges for a fast take-up of AI in railways	Moderators: Zhiyuan Lin (Univ. Leeds), and Francesco Flammini (Linnaeus Univ.)
16.15 - 16.20	Closing remarks and wrap-up	Valeria Vittorini (CINI and Univ. Napoli Federico II)

Thank you for your attention!

