alice | Alliance for Logistics Innovation through Collaboration in Europe

Resilience and Intermodality.

- SARIL and ReMuNet key results and innovations.
  - Resilient transport network Programme and TRA
    - Plenary, Strategic Session, Special Session and Final SARIL and ReMuNet
    - ALICE Booth at TRA

SARIL and ReMuNet key results and innovations.

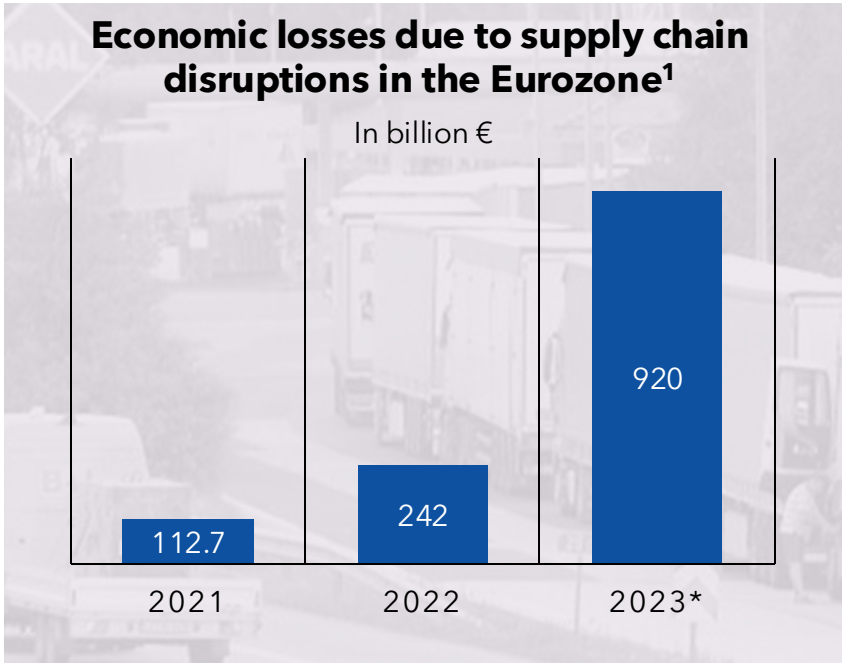
SARIL – Sustainability And Resilience for Infrastructure and Logistics Networks

SARIL addresses resilience at infrastructure and network level, integrating sustainability aspects int resilience framework. The project develops methods and tools to understand how freight transport networks behave under disruption and how they can recover while minimising environmental impacts.

ReMuNet – Resilient Multimodal Freight Transport Network

ReMuNet focuses on operational resilience in multimodal corridors, with an emphasis on real-time response and digital innovation. Inspired by Physical Internet principles, ReMuNet enables adaptive and synchromodal relay transport across rail, road, and inland waterways.

Supply chain disruptions have devastating effects on European economy



Supply chains need to become more resilient!

1) Accenture (2022)

ReMuNet aims to increase both resilience and sustainability of European freight transport

ReMuNet
Pioneering resilient and adaptive multimodal transport networks

Intermodal & International

- Road
- Rail
- Inland Waterways

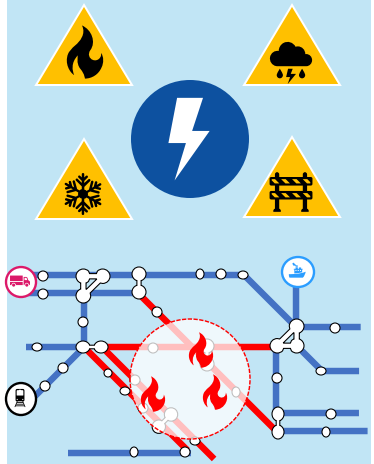
Project Volume: 4 Mio. €

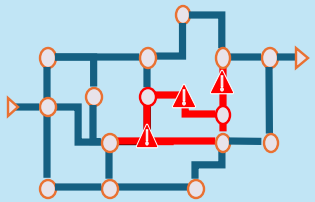
Duration: 07/23-06/26

ReMuNet
Pioneering resilient and adaptive multimodal transport networks

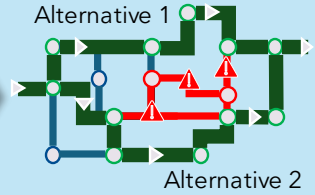
Funded by the European Union

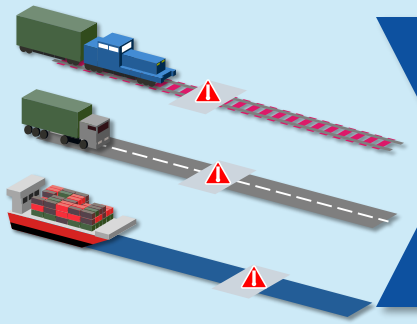
Understand disruptions and their impact



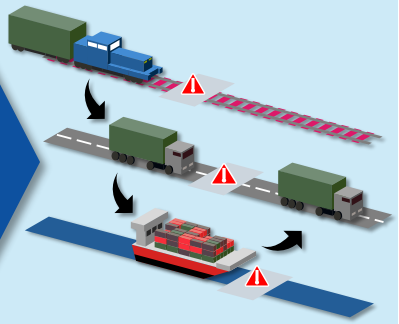


Identify alternative routes





Orchestrate freight transports on a digital platform to bypass disruptions and increase resilience



fir an der RWTH Aachen
WHITE
MANSIO truck meets truck
CONTARGO trimodal network
VDV Die Verkehrsunternehmen
SGKV
HAFEN WIEN
4FLOW Your supply chain solution
Fraunhofer AUSTRIA
HANKEN
4PL Intermodal
PTV GROUP
UIRR
vedia
INFORM
SCHACHINGER LOGISTIK
FMI
RØDE KORS
CargoBeamer
Kouvola Innovation
UNION INTERNATIONALE POUR LE TRANSPORT COMBINÉ RAIL-ROUTE
alice Alliance for Logistics Innovation through Collaboration in Europe
TRANSPOREON transforming transportation
Huoltovarmuuskeskus
Försörjningsberedskapscentralen
National Emergency Supply Agency

ReMuNet pursues a multi-stage approach to increase multimodal freight transport resilience

ReMuNet
Pioneering resilient and adaptive multimodal transport networks

Understanding
of multimodal transport networks and description of the effects of disruptive events

Calculation
of multimodal transport route options in the face of disruptive events

Enabling
of collaborative synchromodal freight transport

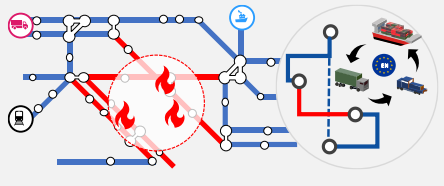
Piloting & Improvement
system-optimising transport and route allocation

European transport networks

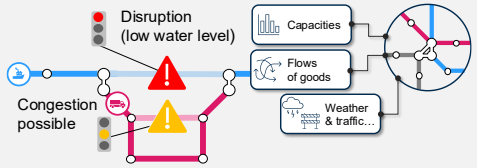
Reference Model & Algorithm

Platform Development & Application

WP 1
Developing European multimodal transport ontology & classifying disruptive events and their impact on transport networks

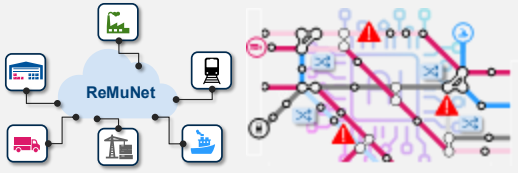


WP 2
Creating reference infrastructure network and routing algorithm focusing on European multimodal transport corridors



WP 3
Designing collaborative platform with high operational interconnectivity for event-based synchromodal relay transport

WP 4
Modelling self-learning transport corridors to increase resilience and reduce emissions



WP 5
Piloting event-based multimodal relay transport in
North Sea - Baltic and
Rhine - Danube corridors

WP 6
Dissemination and joint activities

ReMuNet WP3: Expected future results

ReMuNet
Pioneering resilient and adaptive multimodal transport networks

Data and platform governance

Methods

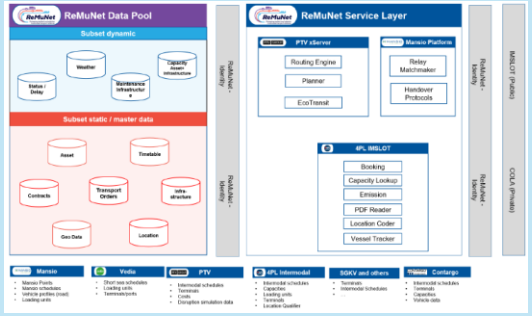
- Data collection & research
- Framework for data exchange
- Governance conceptualization

Results

I. Derivation of a data management plan

II. Conceptualization of a unified data pool for the ReMuNet platform

III. Data and platform governance



Ecosystem and business model design

Methods

- Literature review, stakeholder workshops and interviews
- specific focus on the TEN-T Rhine-Danube and North Sea-Baltic corridors

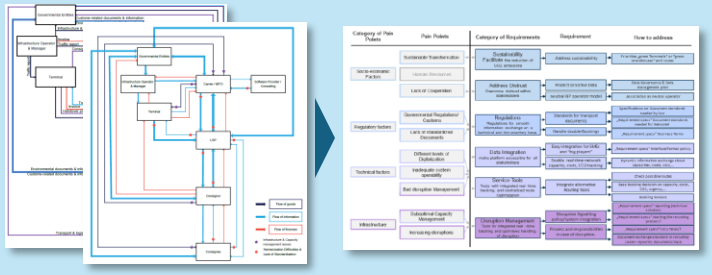
Results

I. Value stream map of current ecosystem

II. Requirement list for service concepts and technical development

III. Platform operator model, defined services and sustainable business models for key actors

IV. Fit4ReMuNet transformation methodology for SMEs



Technical platform development

Methods

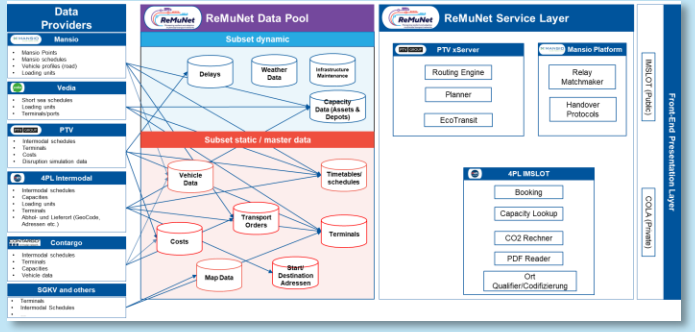
- Interface development via API or SFTP
- Data Space connector
- UI & UX Design

Results

I. Develop collaborative platform backend and design interfaces for data and stakeholder integration

II. Design user-friendly web-based frontend (white label and standard)

III. Data Space integration to MDS or other



ReMuNet WP 4 & 5: Expected future results

ReMuNet
Pioneering resilient and adaptive multimodal transport networks

Modelling **self-learning transport corridors** to increase resilience and reduce emissions

Methods

- Agent-based Reinforcement Learning optimization
- Transfer of reference model into simulation models for the reference transport corridors
- Integration of data, sources and options via data interfaces
- Validation by scenario analysis

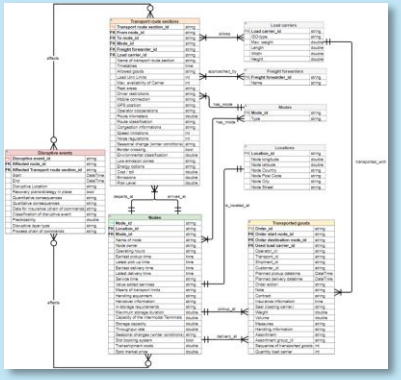
Results

I. Efficient simulation environment for Reinforcement Learning

II. Optimization goal functions of multimodal transport networks

III. Agent-based Reinforcement Learning optimization

IV. Validate and evaluate



Piloting event-based multimodal relay transport in North Sea - Baltic and Rhine - Danube corridors

- Case studies
- Testing of reference and simulation models in the real-world PoC/pilots
- Development of roadmaps for various development paths

I. Create PoC for synchromodal relay transport in the face of disruptive events

II. Social Use Case: Using multimodal transport network to deliver auxiliary supplies to Ukraine

III. Ecological Use Case: Exploring possibilities for the integration of transport vehicles with alternative drive

IV. Develop roadmaps and strategies for the expansion of the ReMuNet to further transport corridors

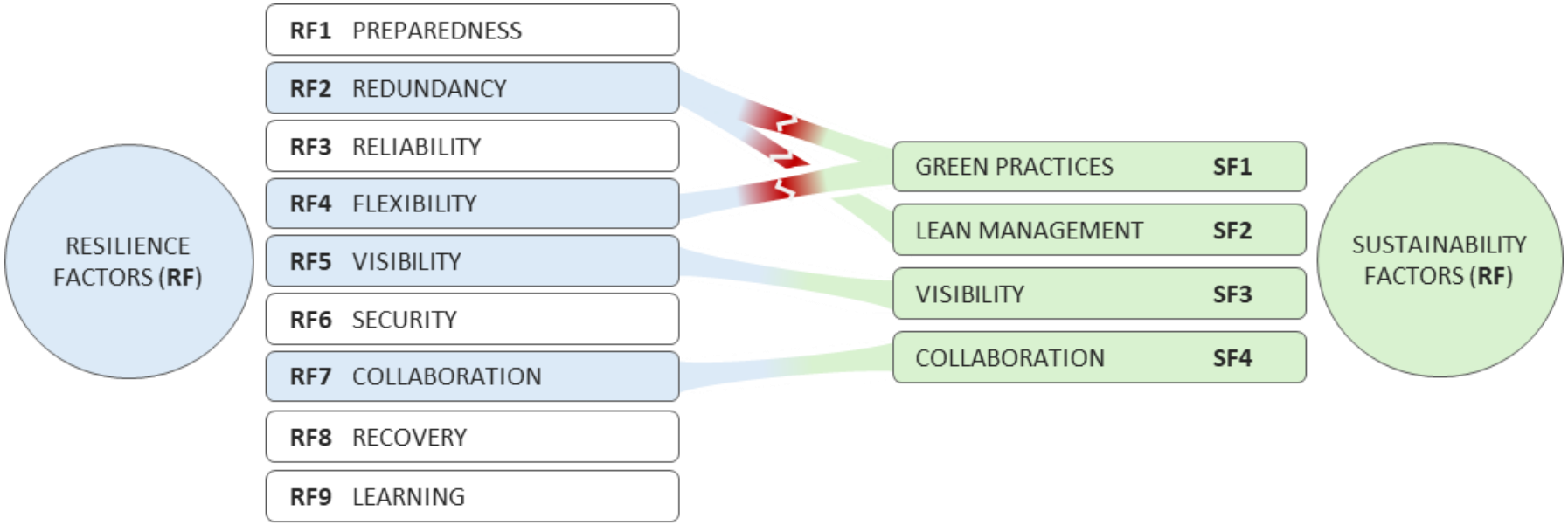
Green Resilience Methodology

European scenario
- Large-scale
- Pandemic and War

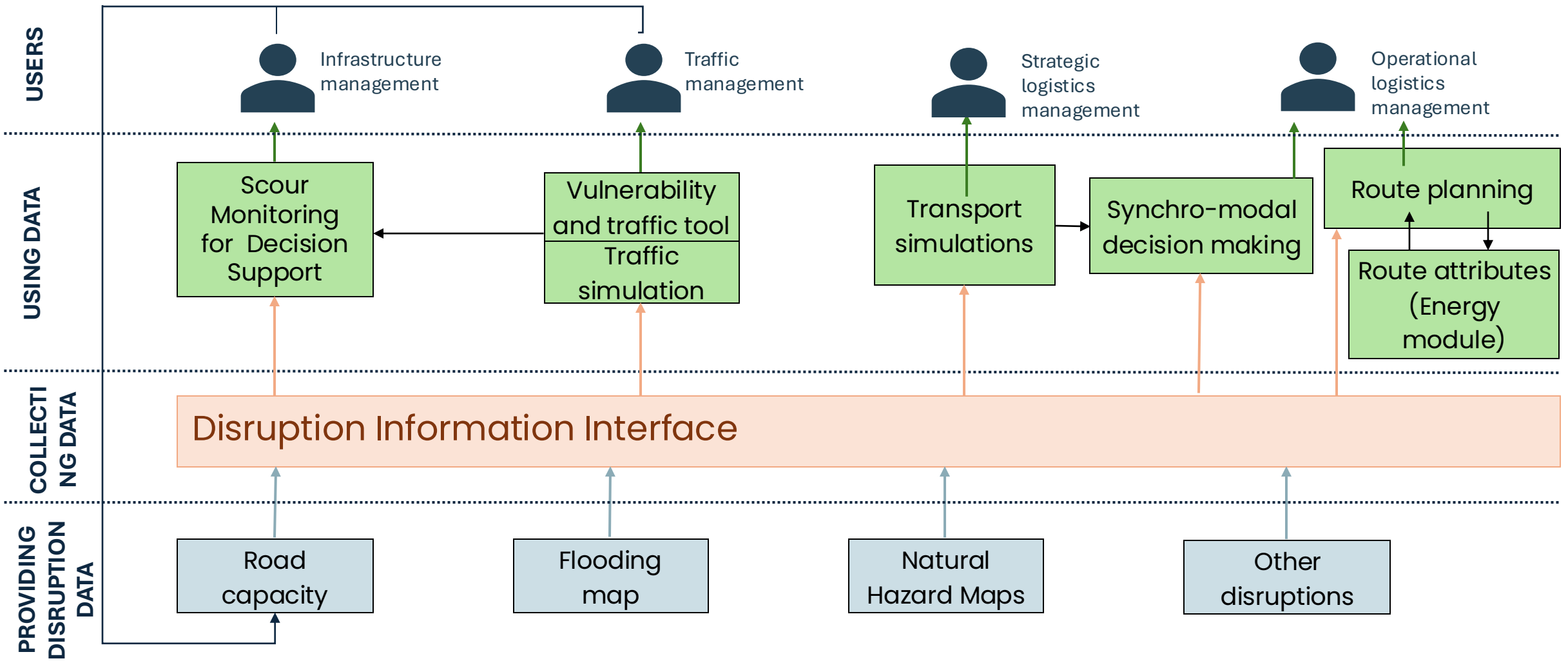
Regional scenario
- Small-scale
- Flooding + data unavailability

National scenario
- Medium-scale
- Wildfires

Green Resilience Methodology



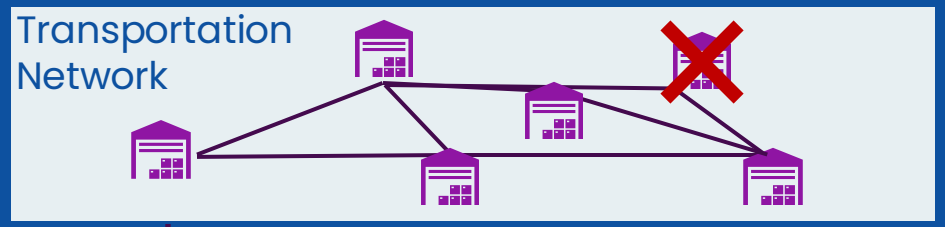
SARIL Toolkit



Synchromodal Decision Making

SARIL Toolkit

Strategic logistics management



Disruption Scenarios

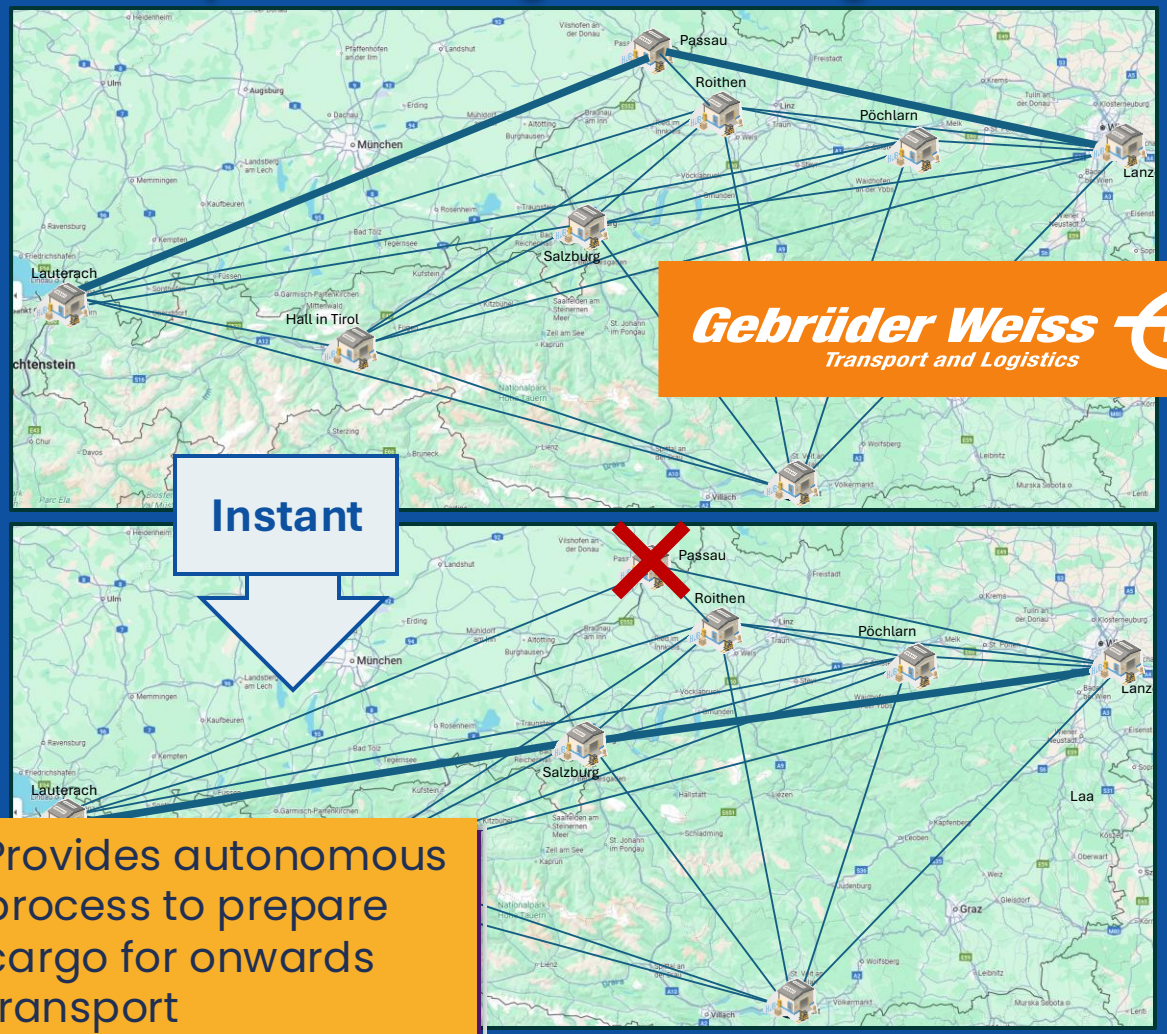
Transport Simulation

ASTROIT

Best alternative routes

- Adapt decision rules to avoid disruptions

Operational logistics management



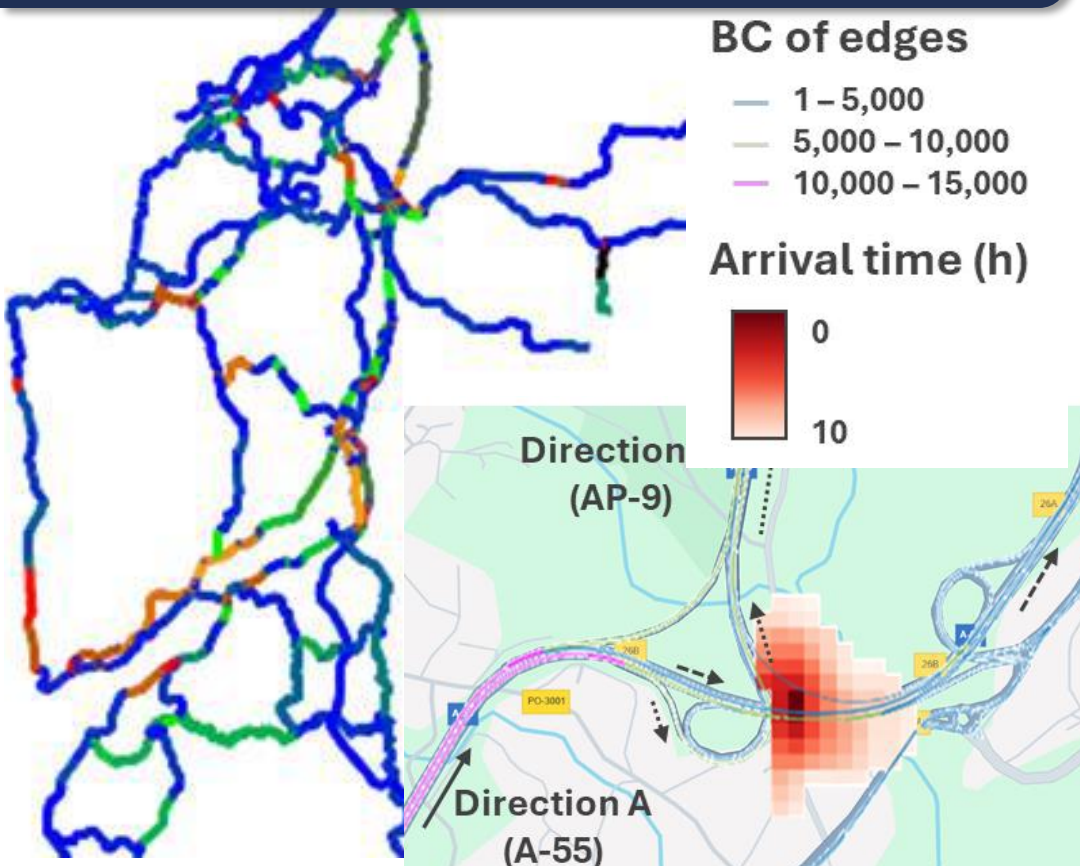
Gebrüder Weiss
Transport and Logistics

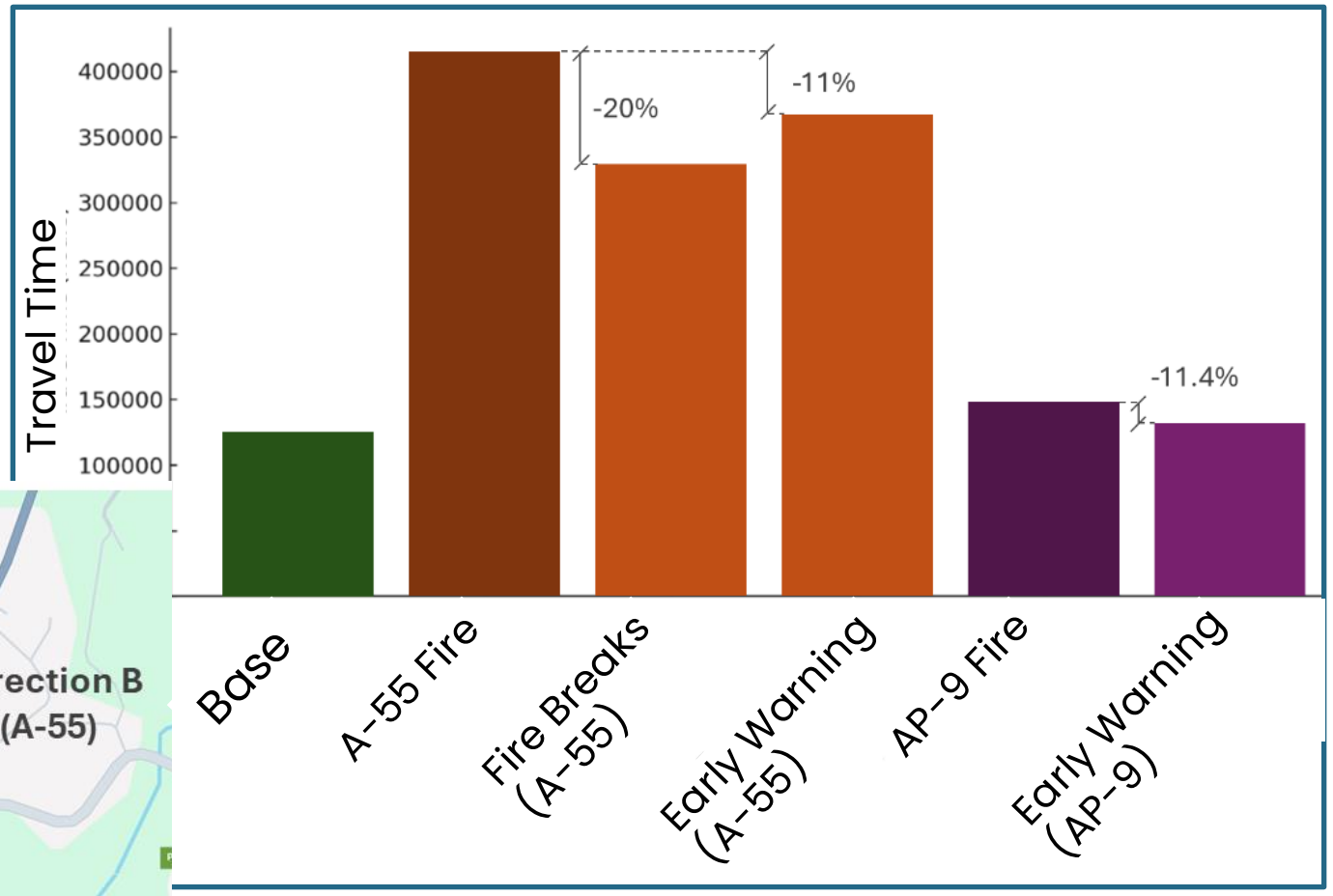
- Provides autonomous process to prepare cargo for onwards transport

MIXMOVE

Forest Fires: Evaluate Mitigation Measures

Fire risk + Network Analysis -> Choice of Test case





Agent-based SimulaTion for Resilience Of Intermodal Transportation (ASTROIT)

ASTROIT

SARIL

Solution description

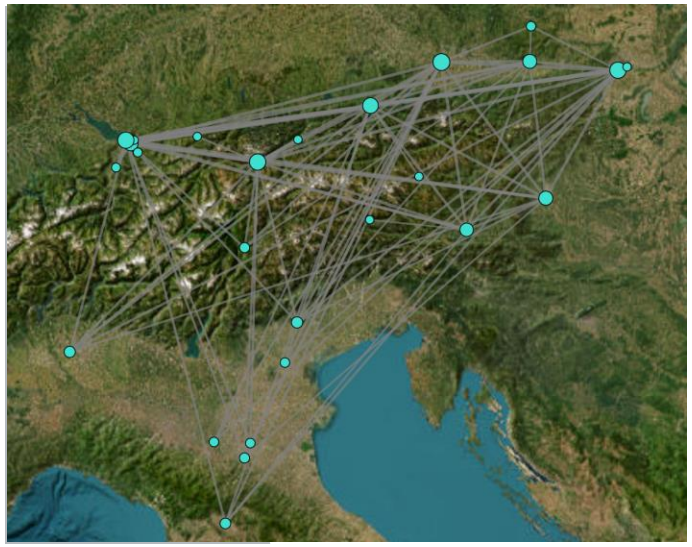
ASTROIT is a customizable simulation tool designed to model cargo transport as an agent-based system. Each cargo unit (agent) autonomously selects the most optimal route from origin to destination based on user-defined cost minimization preferences (e.g., operational cost per km, CO_2 emissions per km, and travel time).

Benefits

- **Vehicle Customization:** Vehicles differ by type, capacity, speed, CO_2 emissions, and operational costs. They operate on specific, scheduled routes suitable for their type.
- **Dynamic Disruption Handling**: Network disruptions lower the performance of nodes/edges, increasing delays or causing total failure. Agents recalculate routes after a set reaction time.
- **Congestion Management**: Overloaded nodes trigger the spawning of additional vehicles on connecting routes to relieve congestion. These auxiliary vehicles are removed once normal conditions resume.
- **Full Customization:** Users can configure the network layout, vehicle characteristics, route schedules, and disruption scenarios at both node and edge levels.

Main beneficiary:

Carriers, LSPs, Infrastructure managers



Technology readiness level : *6*
Implementation stage :
Pilot

Disruption Information Interface

Disruption Information Interface

SARIL

Solution description

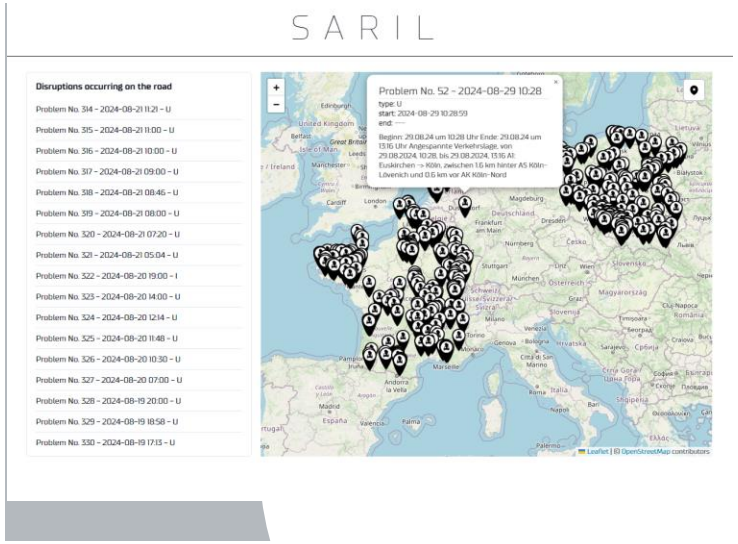
This tool is designed to collect and disseminate information about transport disruptions across three modes: road, rail, and sea. It serves as an integration layer between various data sources and other transport management tools.

Benefits

- **Data Collection:** Gathers real-time disruption information from government APIs and industry platforms used by partners, via both active scraping and passive API submission.
- **Infrastructure & Storage:** Built with Python 3.11, Docker, PostgreSQL with PostGIS, and Elasticsearch for scalable deployment and robust data logging.
- **Disruption Insights:** Delivers detailed reports including location, timing, impact type, affected infrastructure, and predictive insights (e.g., estimated disruption end time via AI-based Survival Analysis).

Main beneficiary:

Carriers, LSPs, Infrastructure managers, Public Authorities



Technology readiness level : *6*
Implementation stage :
Pilot

Energy Module

Energy Module

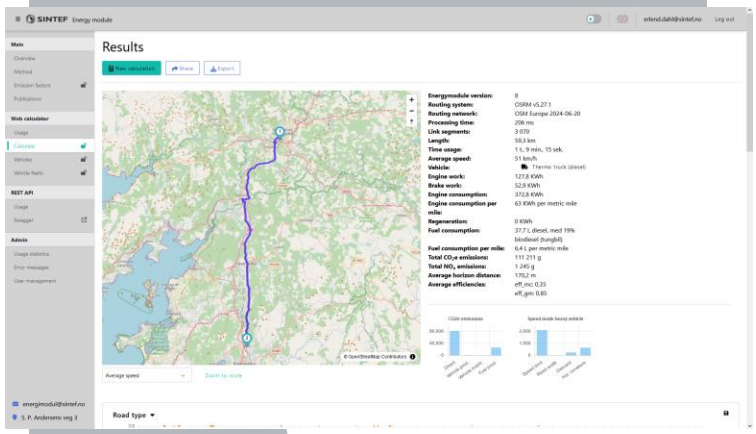
Solution description

The Energy Module is designed to estimate travel time, energy or fuel consumption, and emissions (CO_2 and NOx) based on road infrastructure and vehicle characteristics. Users can input data either manually or via an API. The tool uses a speed model influenced by infrastructure features like speed limits, lanes, curvature, and vehicle details. Route options include user-defined paths or automatic shortest-path calculations. Results can be accessed through a web interface or a REST API, both requiring an API key from SINTEF for access.

Benefits

- **Accurate Environmental Impact Analysis:** Provides precise estimates of energy consumption and emissions (CO_2, NOx), supporting greener transport planning.
- **Customizable and Flexible Routing:** Users can define routes manually or let the tool calculate the most efficient path based on infrastructure data.
- **Detailed Infrastructure Insight:** Considers road features (e.g., lanes, speed limits, tolls) to improve accuracy in route performance evaluation.
- **Interoperability via API**: Easily integrates with other models or systems through a REST API, enabling seamless data exchange
- **Decision Support**: Assists policymakers, transport planners, and logistics operators in making data-driven, sustainable decisions.

Main beneficiary:
Carriers, LSPs



Technology readiness level : ***5***
Implementation stage :
Pilot

Multimodal transport platforms federation and orchestration

Multimodal transport platforms

Solution description

ReMuNet is building a collaborative digital infrastructure that connects key actors in the logistics ecosystem—forwarders, operators, infrastructure managers, and also researchers and service providers.

Key components:

- Interfaces for master & transaction data exchange (booking, infrastructure, transport, emissions, loading status)
- Support for both API and SFTP, tailored to client capabilities (e.g., SMEs with/without TMS)
- Query-based data delivery: ReMuNet responds to specific info needs (e.g., capacity, weather, emissions)

A modern XXP protocol (Extensible Exchange Protocol) underpins secure and decentralized communication. ReMuNet acts as an authentication broker, enabling peer-to-peer data exchange as the system scales.

Benefits

- **Interoperability & Scalability:** Supports both direct and decentralized data exchange. Compatible with existing systems and future growth via Open Logistics Foundation. Works across diverse stakeholder IT capabilities
- **Security & Compliance**: Cybersecurity by design: firewalls, access controls, encryption, virus scanning. GDPR-compliant data handling. Authentication brokering ensures secure, trusted information flows
- **Smart Logistics Integration**: Real-time and static data exchange on booking, traffic, emissions, capacity. Enables coordinated decision-making across modes and stakeholders. Reduces latency and overhead in multimodal transport planning

Main beneficiary:
Forwarders, operators, infrastructure managers, researchers and service providers

Technology readiness level : *7*
Implementation stage :
Pilot

Routing algorithm enabling synchromodal transport chains

Routing algorithm

ReMuNet
Pioneering resilient and adaptive multimodal transport networks

Solution description

ReMuNet's High-Performance Routing Algorithm enables synchromodal door-to-door transport chains across Europe by integrating road, rail, inland waterway, and sea modes.

Key features include:

- Multimodal route optimization with real-time updates
- Simulation of disruptions (e.g., strikes, weather, infrastructure failures)
- Dynamic rerouting and cost-emission trade-offs
- Integration with timetable and relay transport data
- AI-based trailer swap coordination (MANSIO)

The system uses advanced graph models, Dijkstra's variants, and precomputed routing networks (HPR) to deliver fast, accurate, and scalable routing results.

Benefits

- **Logistics Efficiency:** Combines road + intermodal legs optimally. Reduces empty runs through relay transport. Enables door-to-door routing with intermediate transshipment.
- **Sustainability**: Supports modal shift to greener transport (rail, inland waterway). Reduces CO_2 emissions through optimized routing and e-truck integration.
- **Resilience & Agility**: Real-time disruption management (events, delays, restrictions). Provides alternative routing within seconds .
- **Cost Optimization:** Considers tolls, fuel, service fees, emissions, and time. Offers Pareto-optimal route sets (best cost vs. time balance).
- **Interoperability:** Web service / API access. Ready for integration with TMS and planning systems.

Main beneficiary:
LSPs, Freight Forwarders & Shippers, Intermodal Operators & Carriers

Technology readiness level : ***7***
Implementation stage :
Pilot

Unified data pool for resilient transport and logistics

Unified data pool

ReMuNet
Pioneering resilient and adaptive multimodal transport networks

Solution description

- A standardized data model that maps the structure, processes, and disruptions in multimodal transport networks.
- Integrates road, rail, inland waterway, and maritime transport within a unified relational database framework.
- Defines core entities: Transported Goods, Transport Nodes, Transport Route Sections, and Disruptive Events.
- Captures both static and dynamic operational data to support planning, tracking, and response.
- Developed collaboratively with stakeholders to ensure practical usability and cross-corridor transferability.

Benefits

- **Standardization and Interoperability:** Enables harmonized data exchange and interpretation across operators, systems, and borders.
- **Operational Efficiency**: Supports detailed planning and coordination through comprehensive transport and infrastructure attributes.
- **Resilience and Disruption Management**: Incorporates disruption modelling for proactive response strategies and network recovery.
- **Scalability and Adaptability:** Designed to be easily extended or adjusted for new corridors, data sources, and operational requirements.
- **Strategic Decision Support:** Enables analysis of routing, emissions, capacity, and risk using structured, high-quality data.
- **Compliance and Transparency:** Aligns with TEN-T and EU regulatory frameworks, enhancing traceability and reporting.

Main beneficiary:
Infrastructure Planners & Policy Makers, TMS/IT System Developers, Freight Operators

Technology readiness level : *6*
Implementation stage :
Pilot

Projects information

SARIL

MORE INFORMATION

Project website:

https://saril-project.eu/

Project LinkedIn:

www.linkedin.com/company/saril-project/

ReMuNet

Pioneering resilient and adaptive multimodal transport networks

Resilient transport network Programme and TRA

	DAY 02 19/05/2026 Tuesday	DAY 03 20/05/2026 Wednesday
09:00-10:00		Plenary Session 3. Resilience of transport systems
10:30-12:00		Strategic session 3.1 – Strategic imperatives for Europe's transport infrastructure in a changing hazards landscape
13:00-17:30		Final SARIL and ReMuNet
16:00-17:30	Special Session 3. Resilient freight transport and logistics networks vs decarbonization combined with a growing exposure to disruptions	

Resilient transport network Programme and TRA

DAY 02 19/05/2026 Tuesday

16:00-17:30

Special Session 3. Resilient freight transport and logistics networks vs decarbonization combined with a growing exposure to disruptions

Europe's freight transport system is facing a "perfect storm": the need for deep decarbonization combined with a growing exposure to disruptions. This session examines how resilience strategies and decarbonization pathways interact in practice, sometimes reinforcing each other and sometimes creating difficult trade-offs. A particular focus is placed on multimodal freight networks. Rail, inland waterways and short sea shipping are essential for sustainable transport, yet the operational complexity of multimodal systems makes them more vulnerable to disruptions, often driving operators and shippers back to road transport and undermining climate ambitions. By addressing affordability, service reliability, modal shift and climate resilient operations together, the session aims to highlight practical ways to balance decarbonization goals with resilient, competitive and disruption ready European freight networks.

Moderator:
Prof. Alan McKinnon, PhD, Professor Emeritus of Logistics, Kuehne Logistics University

Rapporteur:
Pablo Segura (ALICE)

Speakers:
Paola Chiarini (DG MOVE)
Sophie Punte (Life-Links)
Georgia Ayfantopoulou (CERTH)
Christine Roxanne Hung (SINTEF)
Ketki Kulkarni (Hanken)

Resilient transport network Programme and TRA

DAY 03 20/05/2026 Wednesday
09:00-10:00

Plenary Session 3. Resilience of transport systems

This session will address the challenges linked to the resilience of transport systems. Transport systems can be subject to perturbation and deterioration due to climate change shocks, longer-term climate stresses and other disruptive events. They can also experience digital-related incidents (e.g. cybersecurity). Preparing transport systems resilience and making sure that they can adapt to disruption is crucial to ensure continuity of transport services and safety of passengers. This session will aim to provide examples and initiatives highlighting innovative solutions to reduce negative impacts of disruptive events on transport systems.

The session aims to find answers to the following questions: how can we adapt our transportation infrastructure to the effects of climate change? What kind of adaptation strategies do we need to make the whole system resilient? What are the main barriers to achieve this? How multimodal transportation companies and shippers respond to transport disruptions?

Keynote speaker:

Prof. Alan McKinnon, PhD, Professor Emeritus of Logistics, Kuehne Logistics University

Panelists:

Margarida Marques, European Coordinator, European Coordinator of the TEN-T Rhine-Danube corridor
Uroš Salobir, MSc, Director of the Strategic Innovation Department, ELES, d.o.o.
Dr. Ivan Jimenez Aira, Executive President, Bilbao Port Authority
Dr. Claudia Elif Stutz, State Secretary, Federal Ministry of Transport (BMV) of the Federal Republic of Germany

Resilient transport network Programme and TRA

DAY 03 20/05/2026 Wednesday

10:30-12:00

Strategic session 3.1 – Strategic imperatives for Europe’s transport infrastructure in a changing hazards landscape

Transport infrastructure is vital for European society—essential for vibrant economy, territorial cohesion, and social well-being. Yet, this critical sector faces a growing array of hazards that negatively impact its reliability, safety, and long-term viability. From ageing assets and climate change risks to cyber threats and geopolitical tensions, the resilience of Europe's transport networks is under remarkable pressure.

Many infrastructure systems are approaching or have surpassed their intended lifespan. This issue is made worse by deferred maintenance and uncertainty about future funding, which together increase their vulnerability. At the same time, the increasing frequency of extreme weather events is projected to steadily continue exacerbating infrastructure-related damages. New strategic demands—such as enabling military functions and ensuring continuity during cyber or biological disruptions—further stretch the capacity of transport systems to adapt and respond.

This high-level session will explore Europe's readiness to face a multi-hazard environment and examine how resilience can be embedded across the full life cycle of transport infrastructure—from planning and design to operation, renovation and upgrade, considering needs for standardisation actions and adaptation measures. The session aims to bridge research and policy to co-develop strategic priorities for 2027–2030.

Moderator:

Beatriz Pastor Martinez (UCD)

Rapporteur:

Ciaran McNally (UCD)

Speakers:

David Batchelor (SESAR JU)

Francisco Esteban Leffler (PIANC)

Idriss Pagand (European Railway Agency)

Thierry Closset (European Defense Agency)

Ewa Ptaszynska (CINEA)


ReMuNet
Pioneering resilient and adaptive multimodal transport networks
SARIL
FINAL EVENT
Towards Resilient and Intelligent Multimodal Transport Networks
Co-organised by ReMuNet & SARIL Projects
TRA
BUDAPEST
18-21/05/26
20th May
13:00 PM
REGISTER NOW
www.etp-logistics.eu

Resilient transport network Programme and TRA

DAY 03 20/05/2026 Wednesday https://www.etp-logistics.eu/remunet-and-saril-final-event-at-tra-2026/
13:00-17:30

Final SARIL and ReMuNet event

13:00 – 13:10 | Welcome & Opening Remarks
13:10 – 14:00 | ReMuNet Project Presentation
14:00 – 15:00 | SARIL Project Presentation
15:00 – 15:15 | Coffee Break & Networking
15:15 – 16:00 | Panel Discussion
With Alan Mckinnon, Sophie Punte and ReMuNet and SARIL partners end users
16:00 – 16:45 | Interactive Q&A Session
With Alan Mckinnon, Sophie Punte and ReMuNet and SARIL partners end users
16:45 – 17:00 | Closing Remarks & Next Steps
17:00 – 17:30 | Informal Networking

Resilient transport network Programme and TRA

TRA 2026: ALICE Logistics Innovation Village

https://www.etp-logistics.eu/the-transport-research-arena-tra-2026/