

SARIL – Sustainability And Resilience for Infrastructure and Logistics networks

Launch 01.06.2023



Mission complete 31.05.2026



SARIL

Sustainability And Resilience for Infrastructure and Logistics networks



Stakeholder
engagement



SARIL
toolkit

Impact
&
Demonstration

Recommendations



The SARIL Vision

A system is resilient and sustainable, if it uses minimal resources to withstand and recover from disruptions

SARIL aims to:

improve decision making in transport and logistics systems

- in the face of disruptions
- by combining resilience and sustainability.

give recommendations for logistics operators and authorities regarding

- disruption handling and
- green business models



Together for sustainable resilience in logistics

		Company
		University
		Research organization
		European Technology Platform
		
		
		



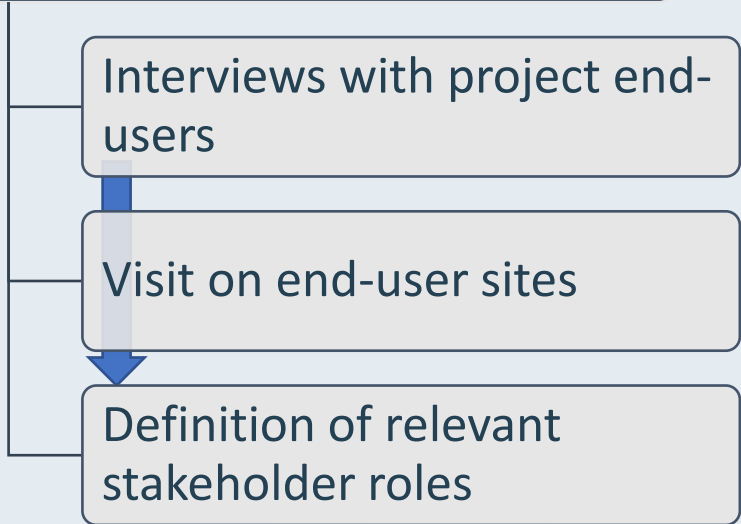
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- Research & Innovation Action
- Grant agreement ID: 101103978
- Total budget: 3.98 MEuro

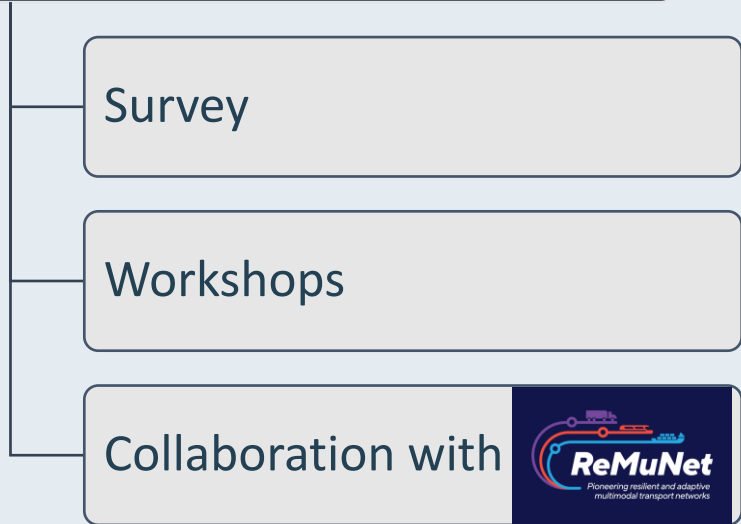


Intensive Exchange with Stakeholders

Within the project:



Outside of the project:



R1

Develop and maintain transport infrastructure

R2

Configure transport and logistics networks

R3

Manage transport and logistics operations



Workshops support all developments in SARIL

Sprint/Fall 2024: Scenario Workshops

Regional: Italy, June 2024



Cross-border: Spain, October 2024



European: Poland, September 2024



Discussion of future Images: Levels of knowledge and preparedness combined with levels of cost and delays

Spring 2025: 2 Pathway Workshops (online)

Joint Platform

Sustainability

Clear call for interoperable, user-friendly tools, combining real-time operations and planning analytics

Technical solutions of the project need to be integratable into transport management systems in use.

Data sharing and availability is key for disruption handling.

Sustainability is only/mainly considered in ,good weather' conditions.

The Three SAIRL Scenarios



Regional scenario

- Small-scale
- Flooding + data unavailability



National scenario

- Medium-scale
- Wildfires



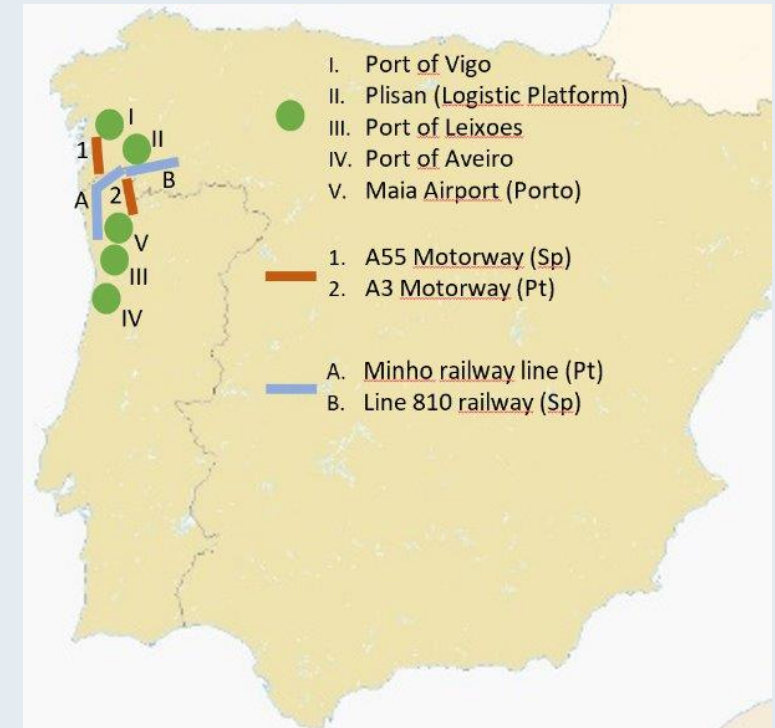
European scenario

- Large-scale
- Pandemic and War



Iberian Peninsula

This medium-scale scenario investigates the prediction of fire risk and the potential impacts on logistics and transport processes.

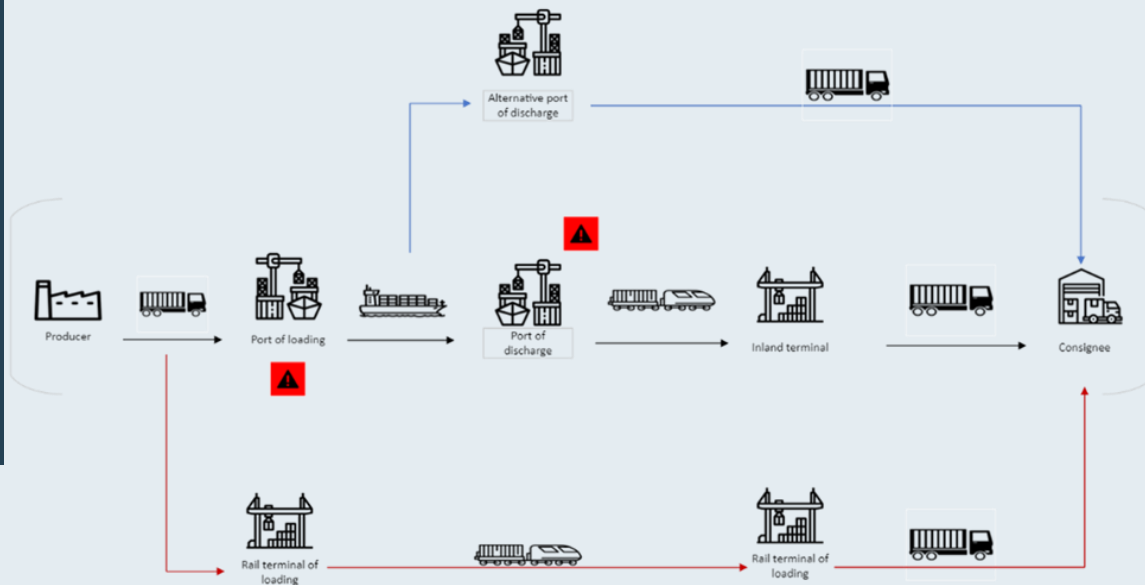
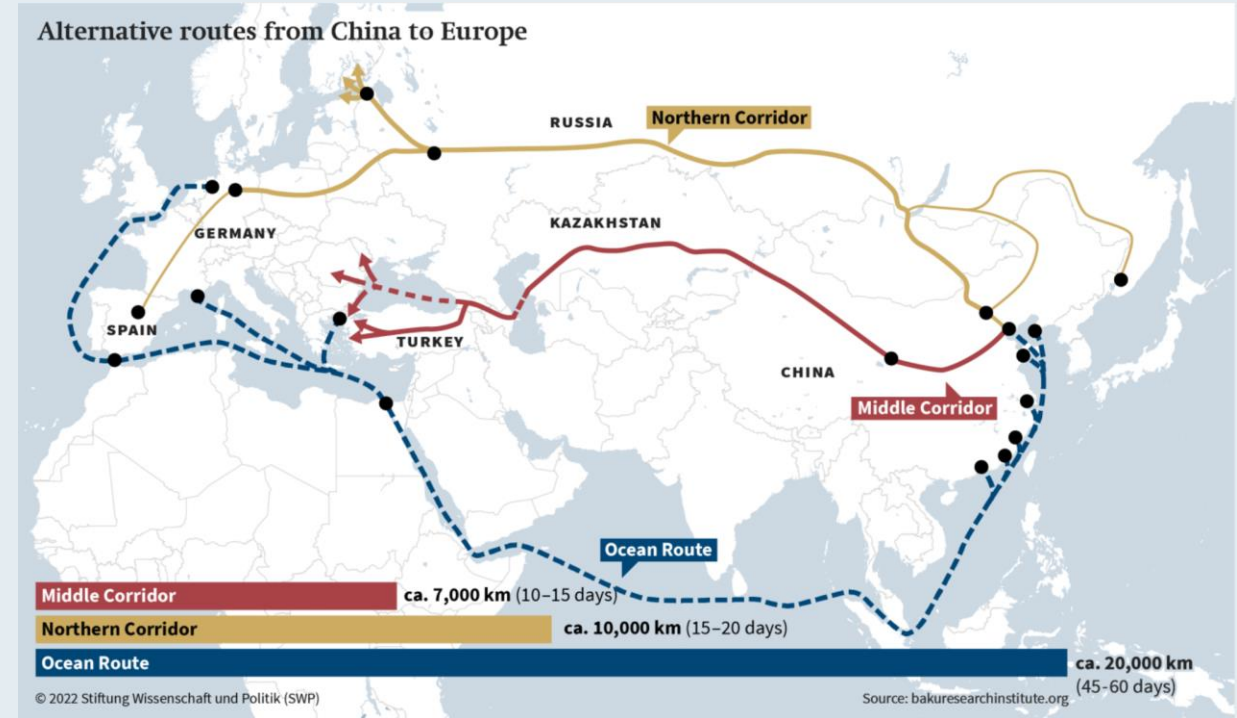


All Scenarios



Transport through Europe from ASIA

This large-scale scenario considers disruptions caused by events such as a pandemic and war and their impact on the European transport network.



All Scenarios



The SARIL Toolkit



Tool Architecture



Transport simulations – ASTROIT

Scour monitoring for Decision Support – SURGE

Route Attributes – SINTEF Energy Module

Natural hazard maps - GEODIS

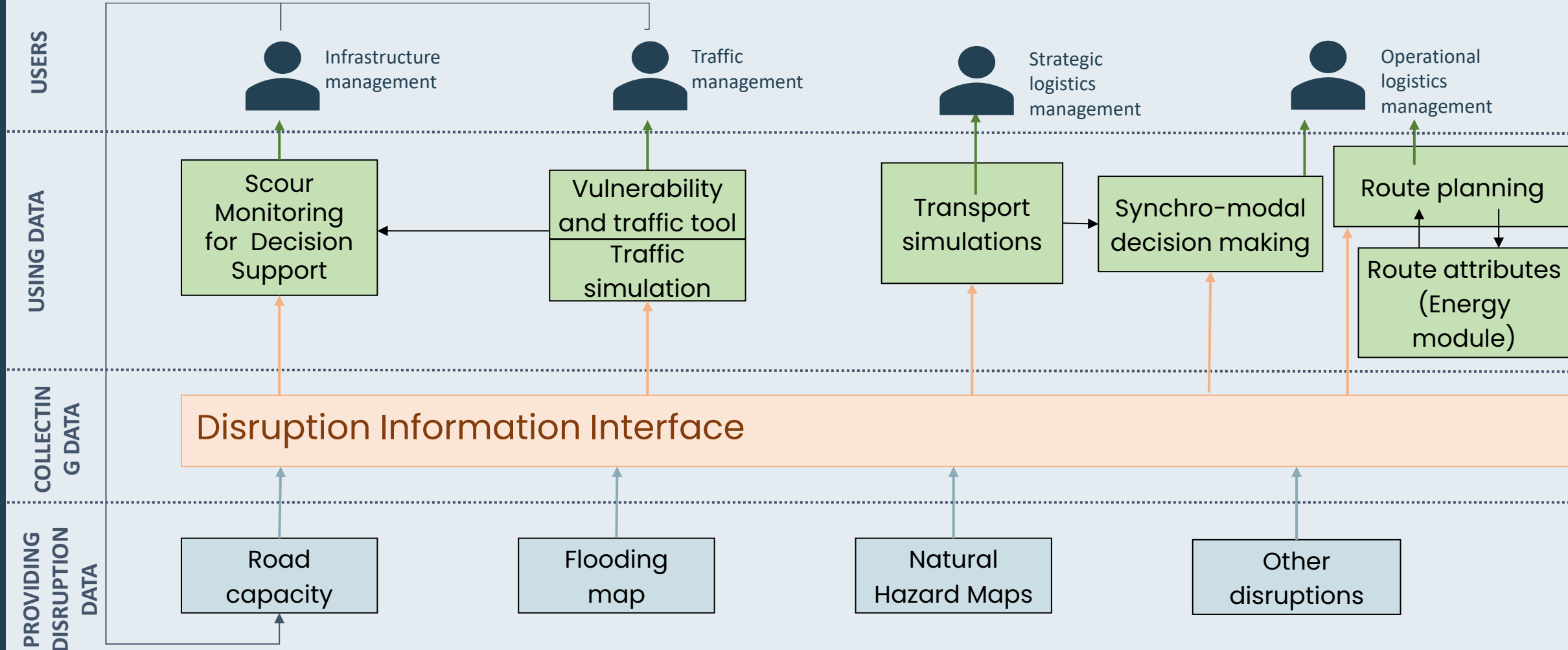
Vulnerability and Traffic Model tool

Traffic simulation - TSIDE

Disruption Information Interface – LOGIS



SARIL Tool Architecture



All Tools



ASTROIT

Agent-based SimulaTion for Resilience Of Intermodal Transportation



Solution description

ASTROIT is a customizable simulation tool designed to model cargo transport as an agent-based system.

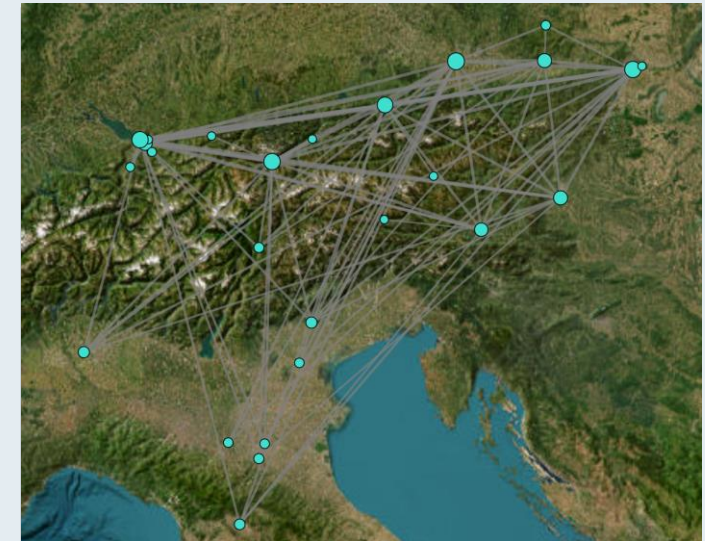
Each cargo unit (agent) autonomously selects the most optimal route from origin to destination based on user-defined cost minimization preferences (e.g., operational cost per km, CO₂ emissions per km, and travel time).



Benefits

- **Vehicle Customization:** Vehicles differ by type, capacity, speed, CO₂ 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



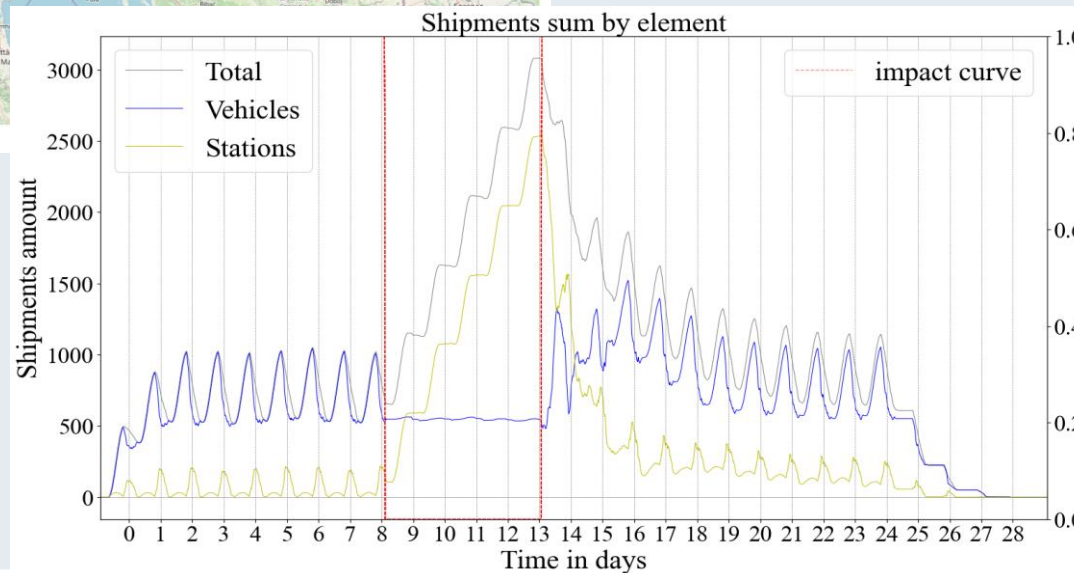
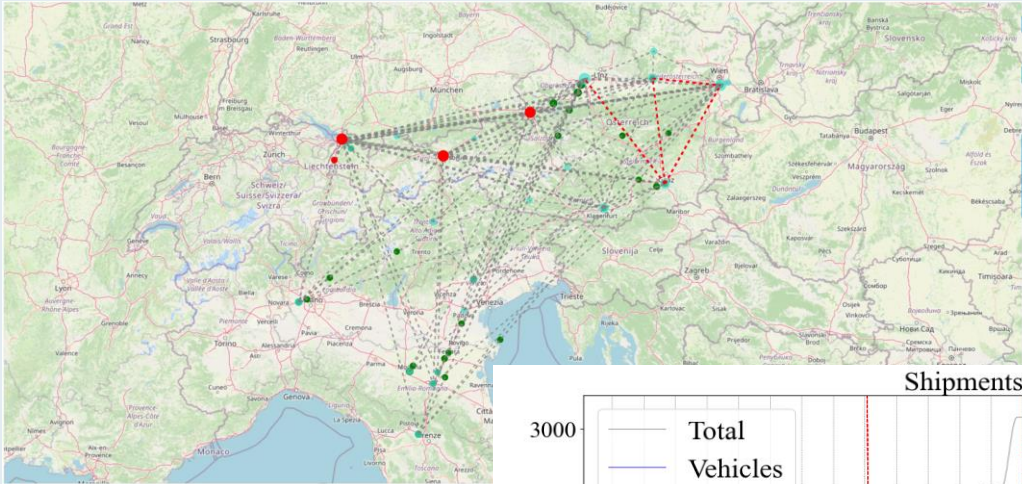
Technology readiness level : 6
Implementation stage :

All Tools



ASTROIT

Agent-based SimulaTion for Resilience Of Intermodal Transportation



Would you like to know more?
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All Tools



Disruption Information Interface



Solution description

This tool acts as an integration component for disruption and hazard information in multimodal transport networks, covering road, rail, and sea.

It integrates multiple data sources and prepares analysed and forecast-enriched disruption information for interactive exploration and use by transport management and decision-support tools.



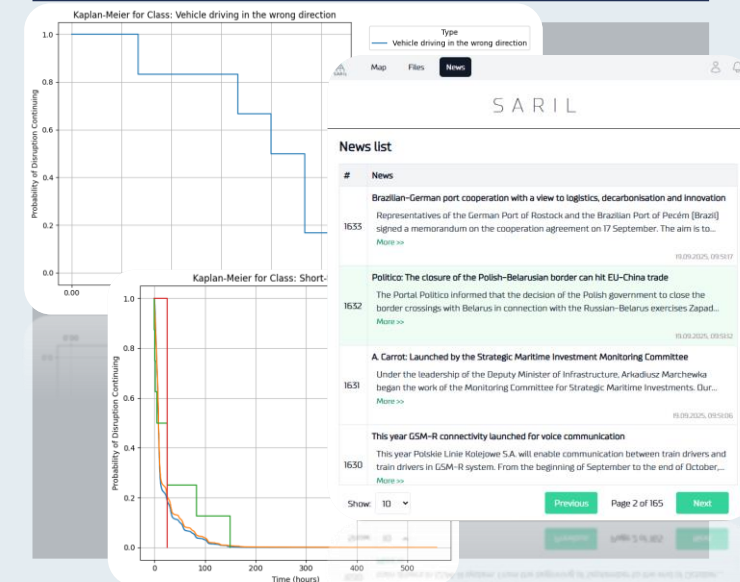
Benefits

- **Situational Awareness:** Aggregates real-time disruption signals from governmental and industry data sources to provide a coherent, multimodal picture of ongoing events, with personalised AI-based noise filtering that reduces operator cognitive load.
- **Operational Readiness:** Built on a scalable, containerised architecture with geospatial and logging capabilities to support continuous operation and integration with other transport management tools.
- **Predictive Disruption Enrichment:** Enriches raw disruption information with temporal insights, including estimated disruption duration derived from AI-based Survival Analysis.
- **Decision Support Across Time Horizons:** Supports both short-term operational responses and longer-term strategic planning by combining real-time disruption monitoring with historical analysis and forecasting capabilities.

Technology readiness level : **6**
Implementation stage : **Tests**

Main beneficiaries:

Carriers, LSPs, Infrastructure managers, Public Authorities



All Tools



Disruption Information Interface

Disruptions occurring in selected area

14.05.2025, 12:16:22	Sanctions over Belarus	War	certain
14.05.2025, 12:16:29	War on Ukrain	War	certain
14.05.2025, 12:16:34	Sanctions over Russia	War	certain
14.05.2025, 12:56:12	Stike in Port	Strike	certain
14.05.2025, 12:58:28	Congestion in port	Congestion in port	certain
15.05.2025, 07:04:01	Levelled fire hazard for Portugal based on Natural Hazard maps tool	Fire	high
15.05.2025, 07:04:01	Levelled fire hazard for Portugal based on Natural Hazard maps tool	Fire	very high
15.05.2025, 08:02:54	Levelled fire hazard for Galitia based on Natural Hazard maps tool	Fire	high
15.05.2025, 08:02:54	Levelled fire hazard for Galitia based on Natural Hazard maps tool	Fire	very high

Map Legend:

- Sanctions over Russia: Start date: 14.05.2025, 12:16:54; End date: N/A
- Sanctions over Belarus: Start date: 14.05.2025, 12:16:22; End date: N/A
- War on Ukrain: Start date: 14.05.2025, 12:16:29; End date: N/A
- Stike in Port: Start date: 14.05.2025, 12:56:12; End date: 15.06.2025, 10:25:01
- Congestion in Port: Start date: 14.05.2025, 12:58:28; End date: N/A
- Levelled fire hazard for Portugal based on Natural Hazard maps tool: Start date: 15.05.2025, 08:02:54; End date: N/A
- Levelled fire hazard for Galitia based on Natural Hazard maps tool: Start date: 15.05.2025, 07:04:01; End date: N/A

Map Callouts:

- Traffic Jam on I-95** - Heavy congestion due to an earlier incident. Traffic moving at 10 mph.
- Bridge Closure on 5th Ave** - Structural maintenance is in progress; detours available via Elm Street.
- Train Crossing Delays** - A malfunctioning railway signal is causing frequent traffic stops.
- Strong container throughput drives Port of Antwerp-Bruges growth despite challenging market conditions** - Positive trend in container throughput continues...
- Protest Blocking Downtown Roads** - Demonstrators have occupied Main Square; police redirecting traffic.
- HHLA presents hydrogen projects at Hydrogen Technology Expo Europe** - Hamburger Hafen und Logistik AG (HHLA) presented its hydrogen projects...

Would you like to know more?
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All Tools



SINTEF Energy Module



Solution description

The Energy Modules performs calculations of energy consumption in the transport sector (road, rail, air, and water). Specific to road/rail transport, the model calculates energy usage and emissions by simulating a given vehicle driving a given route based on the 3-D geometry of the route and vehicle characteristics.

The tool uses a speed model influenced by speed limits, lanes, curvature, and vehicle details. Route options are 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.

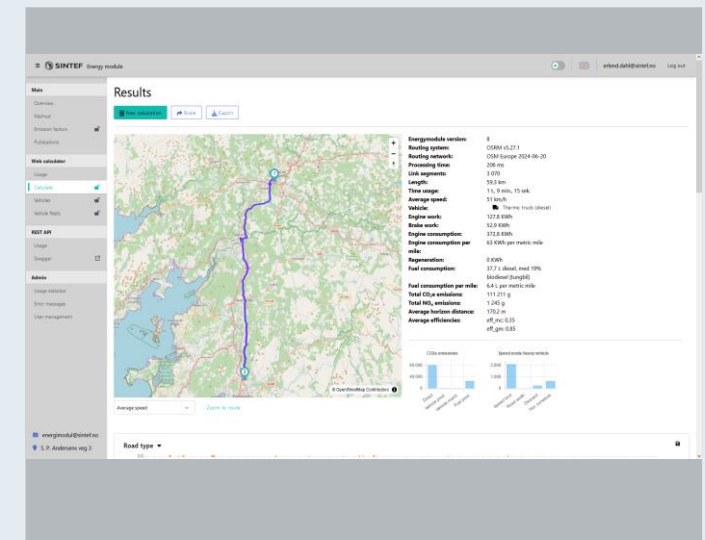


Benefits

- **Accurate Environmental Impact Analysis:** Provides precise estimates of energy consumption and emissions (CO₂, NO_x), 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 beneficiaries:

- Carriers
- LSPs

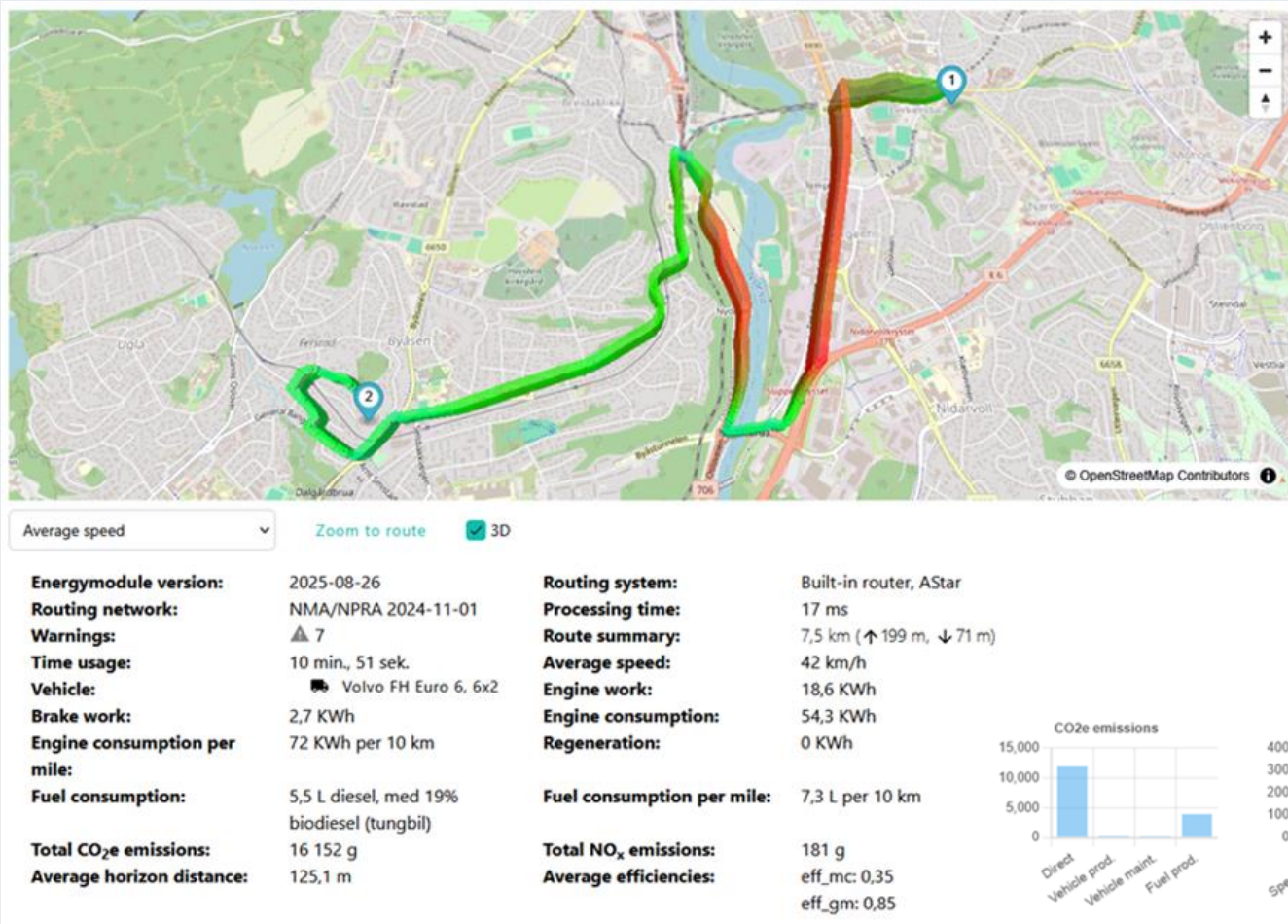


Technology readiness level : 6
Implementation stage :

All Tools



SINTEF Energy Module



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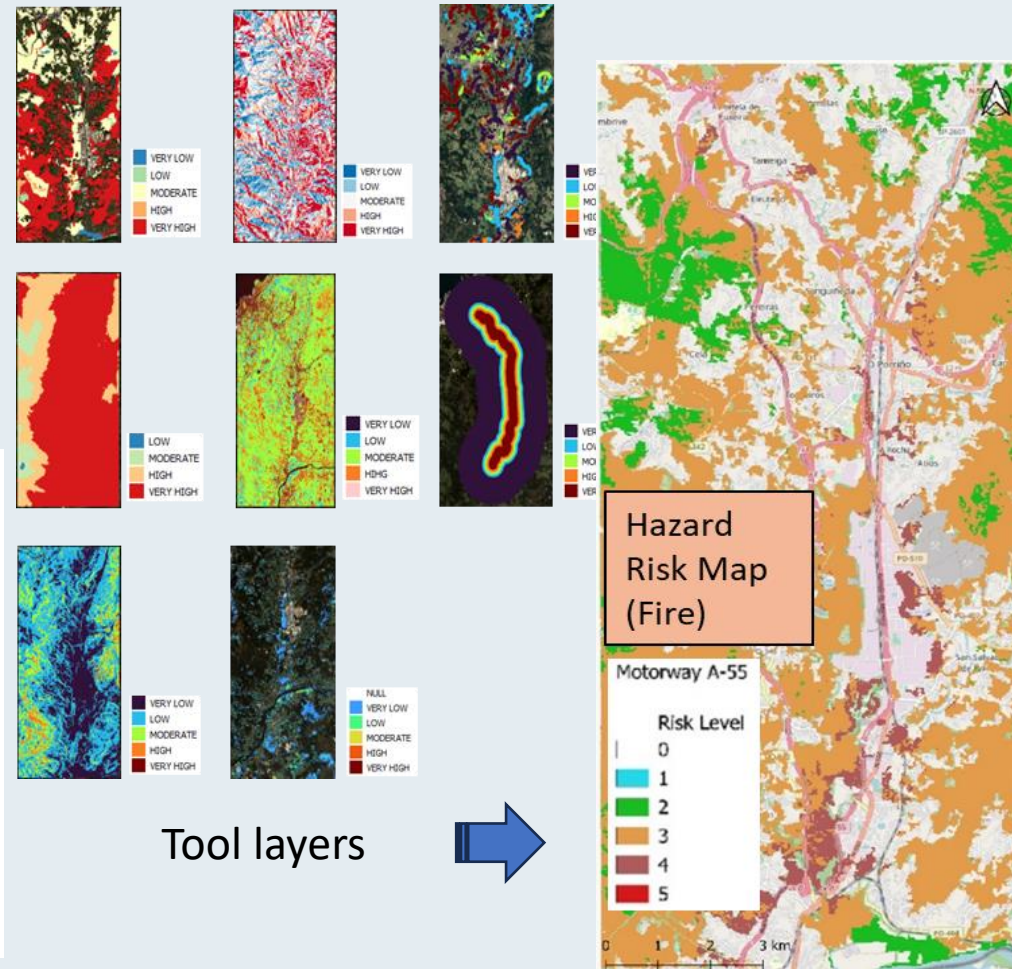
<https://www.sintef.no/en/>

All Tools



Natural Hazard Risk Map (Fire)

- Forest fire risk prediction
- Ignition point on a map
- Simulate disruption scenarios
- Other weather alerts (Rain and Wind)



A-55 Motorway (Sp)

Risk Map

**Would you like to know more?
Take contact :**

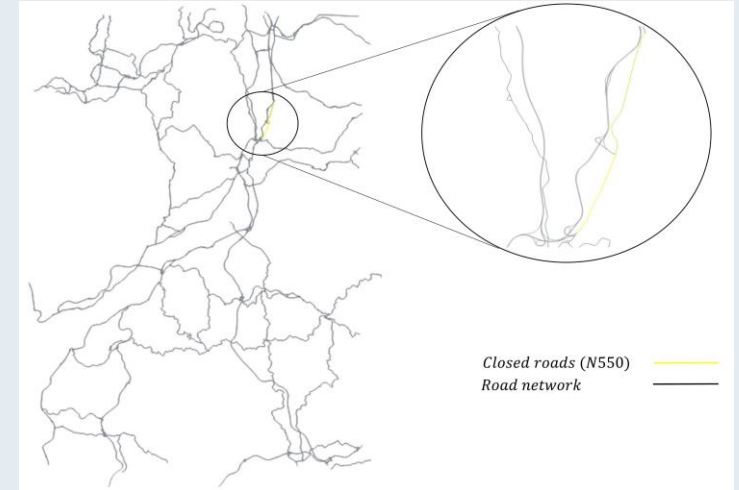
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Traffic simulation - TSIDE


- Impact of disruptions on traffic scenarios
- Vary the initial traffic distribution

Disruption scenario: N550 closure



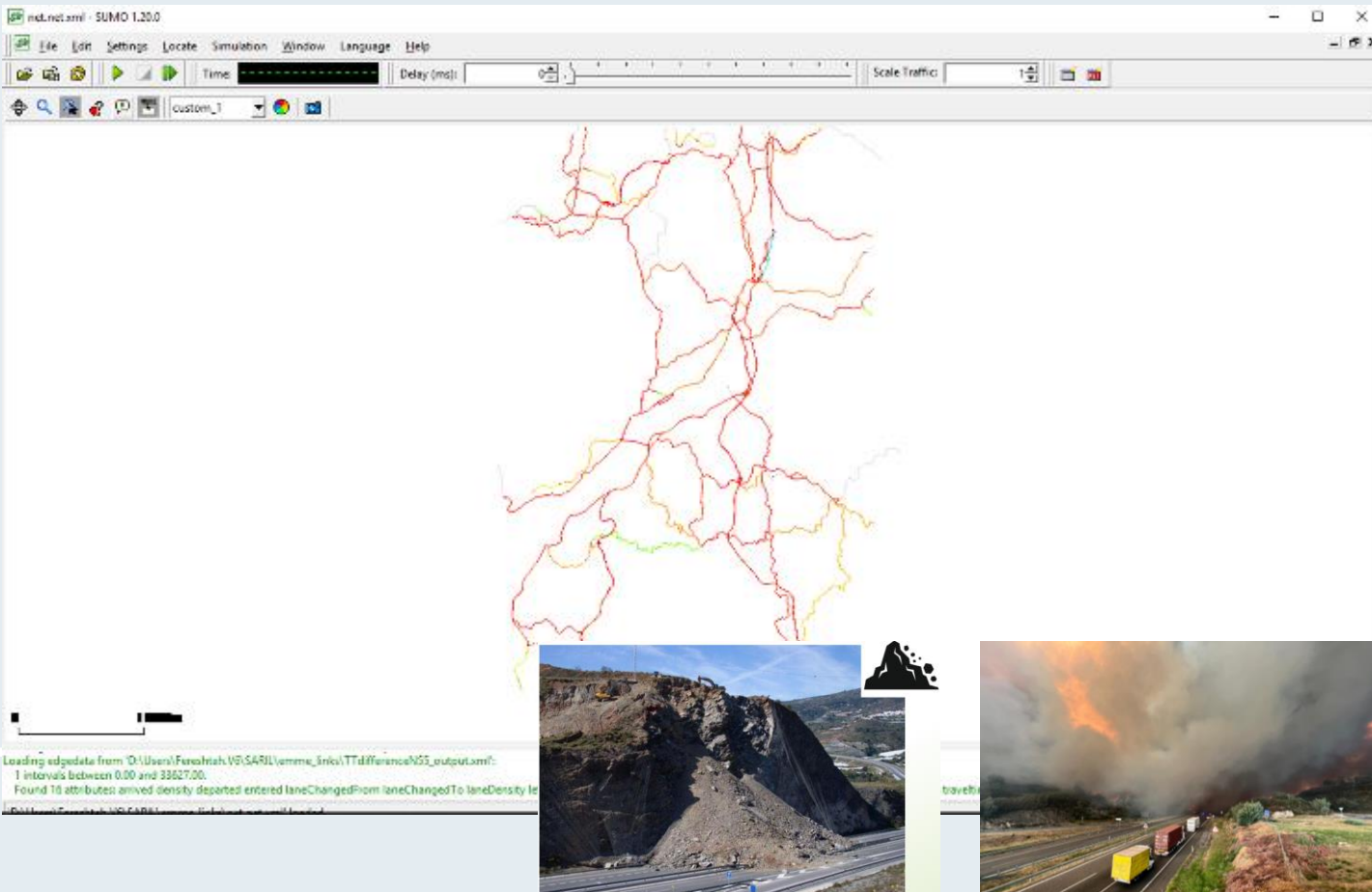
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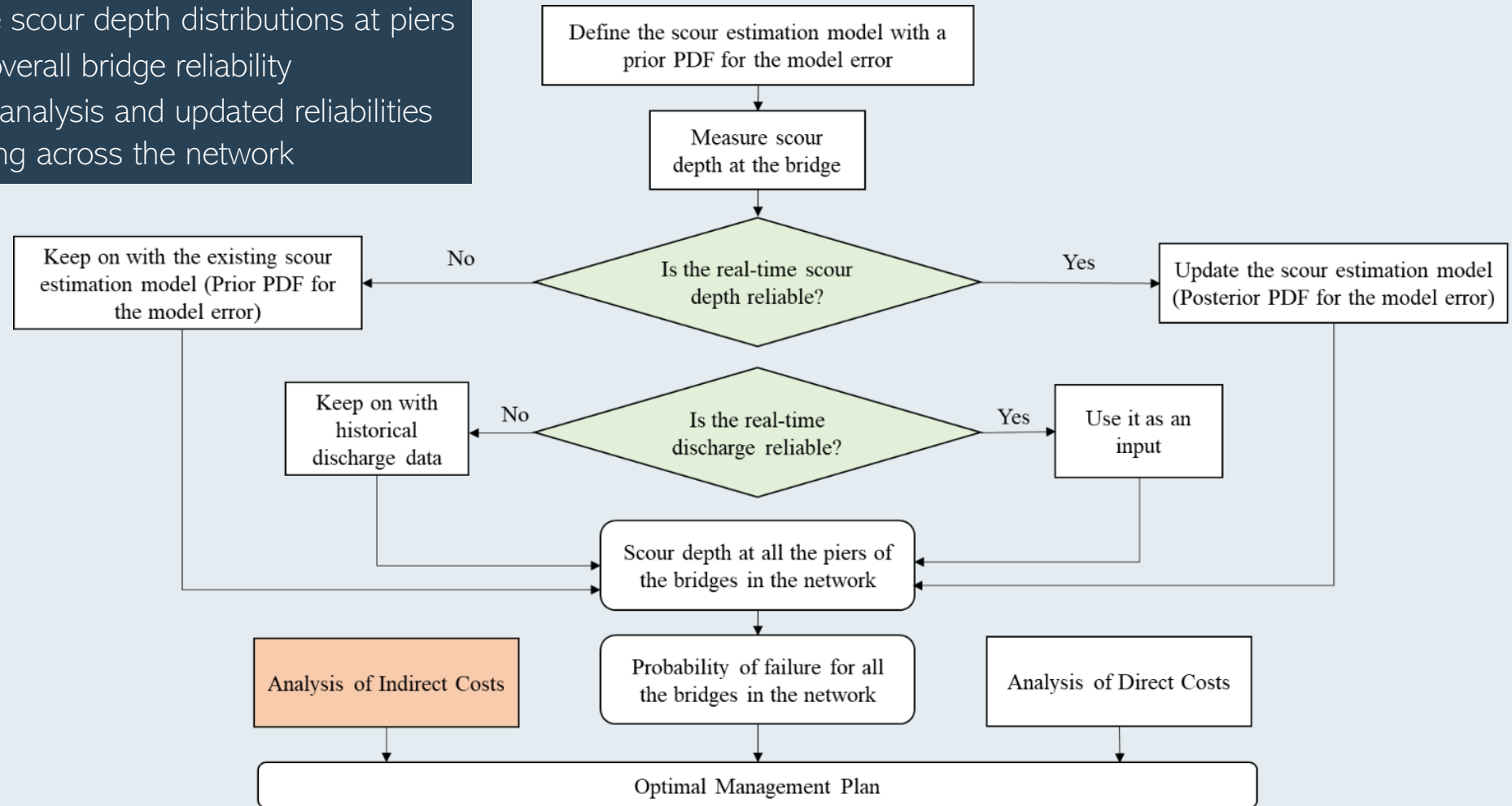


All Tools

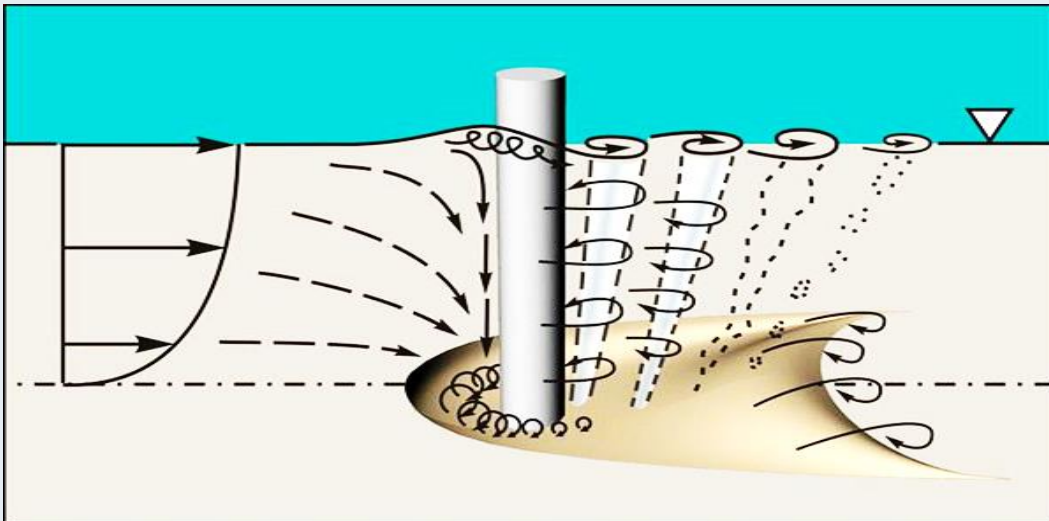


Scour Monitoring for Decision Support

- Scour as a critical driver of bridge failure during floods
- Bayesian Network to update scour depth distributions at piers
- Assessment of impacts on overall bridge reliability
- Integration of consequence analysis and updated reliabilities for risk-based decision-making across the network



Scour Monitoring for Decision Support



**Would you like to know more?
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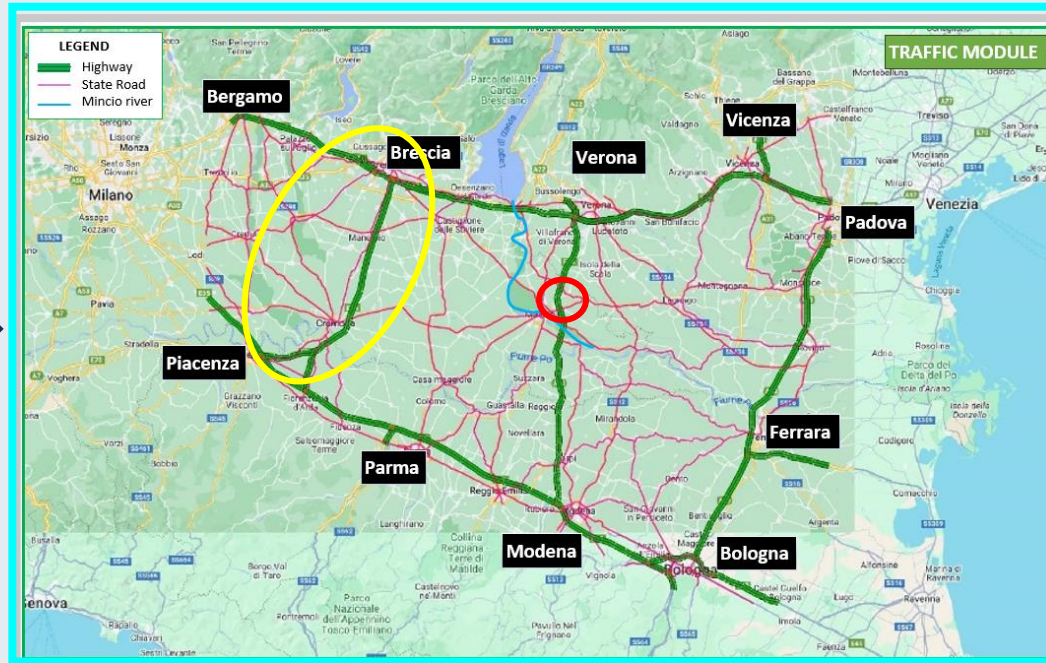
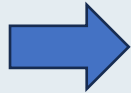
All Tools



Vulnerability and Traffic tool

- Resilience assessment of traffic networks
- Consider disruptive events and reduced capacities

System Characterization
Asset description
Hazard characterization
Vulnerability Analysis
Consequence Analysis
Disruption Analysis
Risk Analysis
Transport and Traffic Modelling
Impact Assessment
Resilience Assessment



Would you like to know more?
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Resilience assessment at the **asset** level, **route** and **network** level

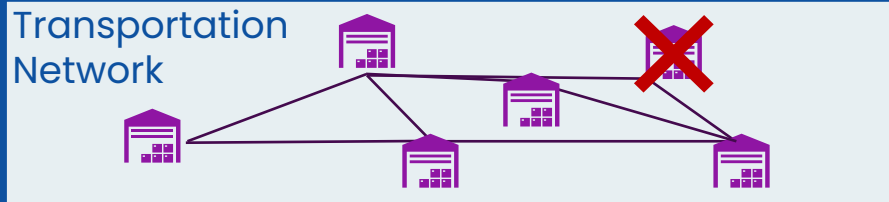
All Tools



Synchromodal Decision Making

SARIL Toolkit

Strategic logistics management



Disruption Scenarios

Transport Simulation



Best alternative routes

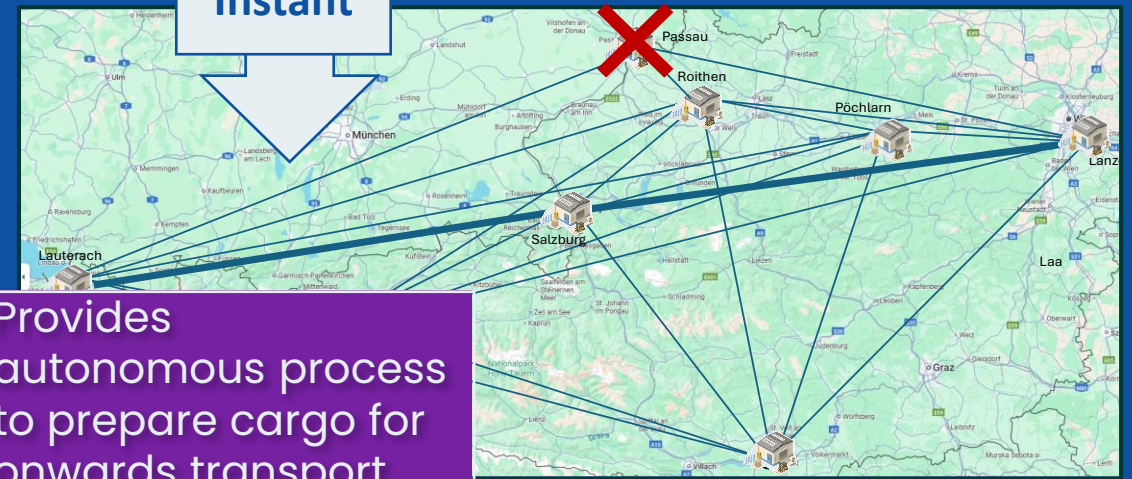
- Adapt decision rules to avoid disruptions

MIXMOVE

Operational logistics management



Instant

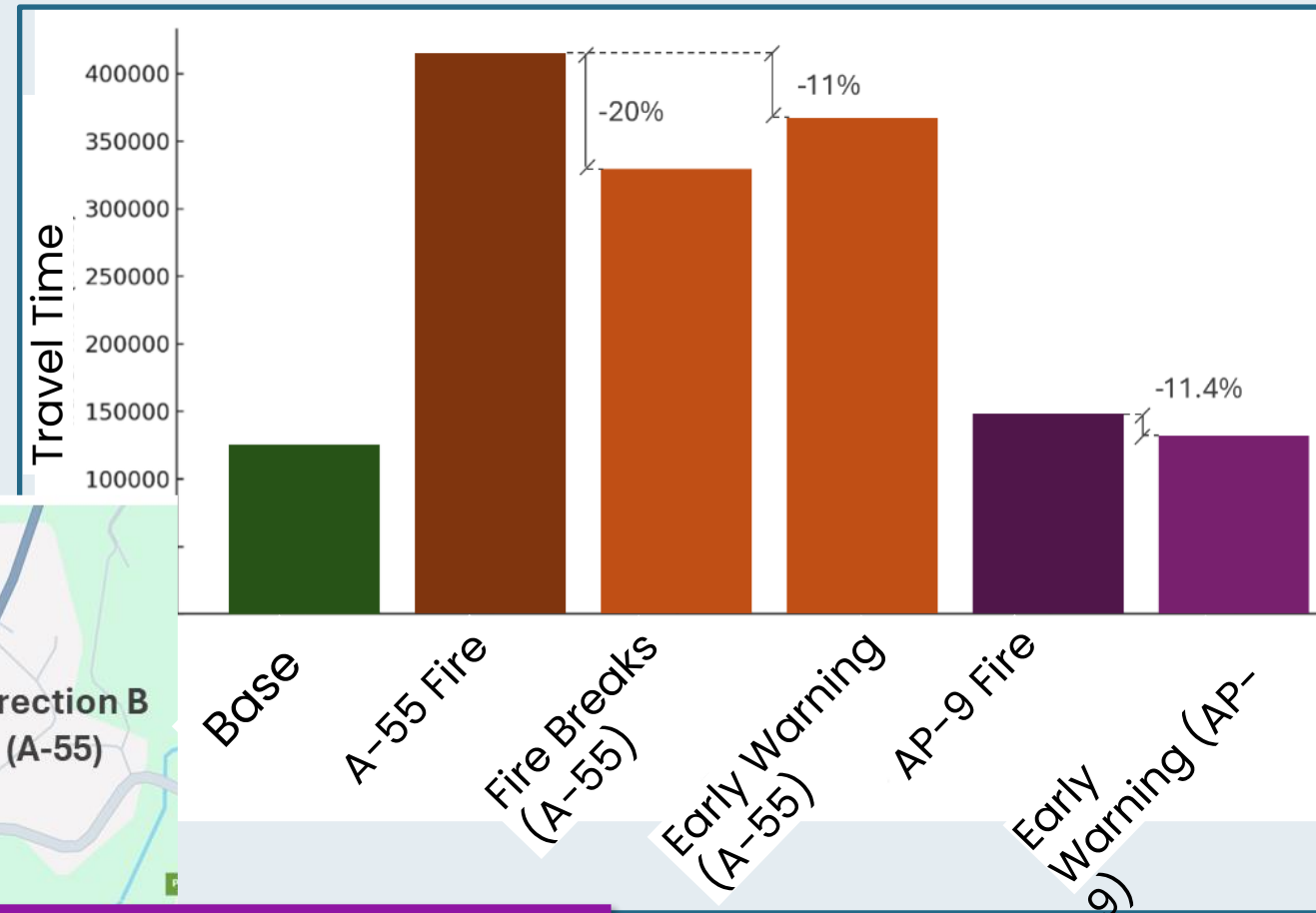
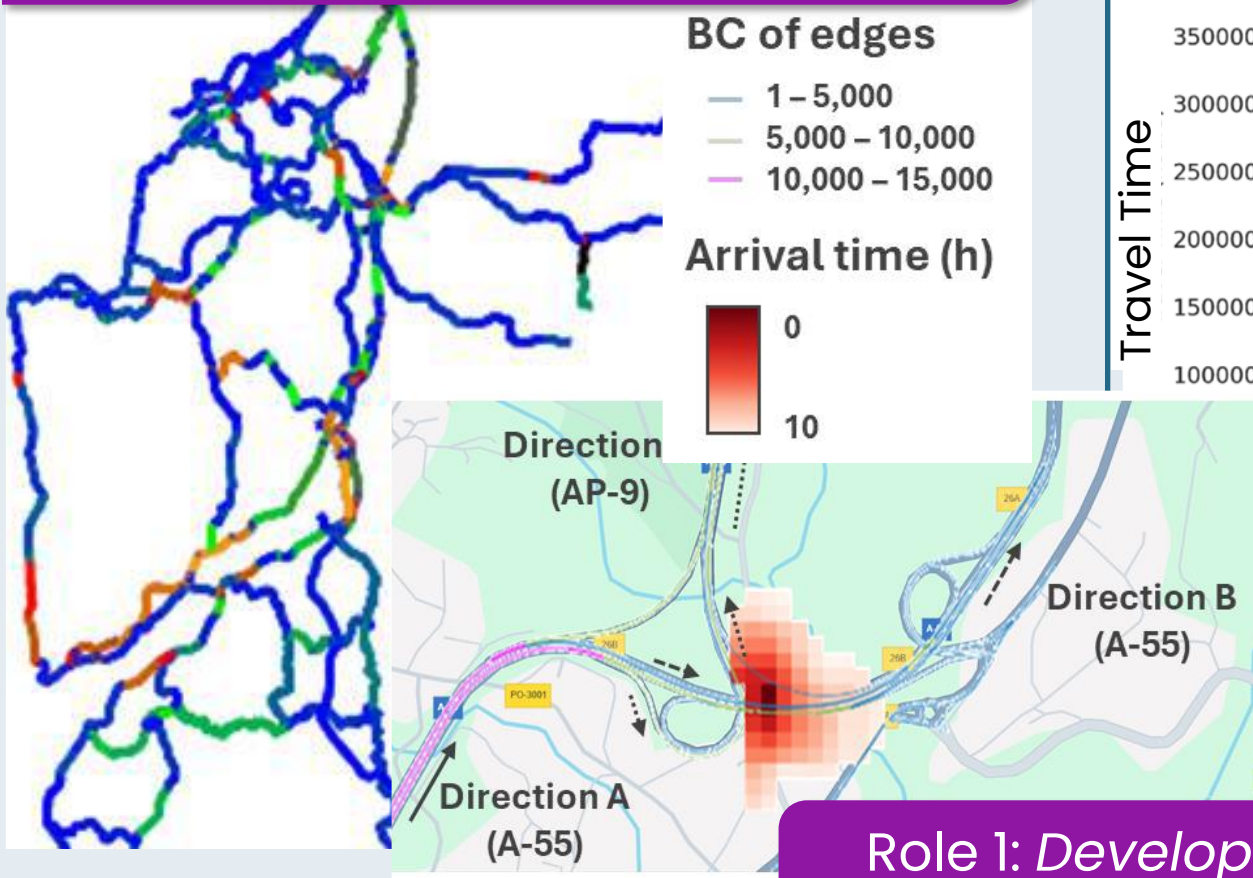


- Provides autonomous process to prepare cargo for onwards transport



Forest Fires: Evaluate Mitigation Measures

Fire risk + Network Analysis
 -> Choice of Test case



Role 1: *Develop and maintain transport infrastructure*



Recommendations

Role 1

- Implementation of ongoing monitoring
- Hazard Forecast (Wildfires, Flooding)
- Scenario simulations to design green, resilient infrastructure networks (cascading effects)

Role 2

- Evaluate network vulnerabilities (Simulate disruptions)
- Investigation of alternative, multi-modal transport chains
- Assess env. performance of routing options
- KPIs for resilience and sustainability

Role 3

- Real time monitoring of disruptions and infrastructure status
- Dynamic decision making for rerouting and mode switching
- Environmental performance of routing choices





The presented work was performed in context of the Horizon Europe project SARIL which is funded by the European Union under grant agreement ID 101103978. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Climate, Infrastructure and Environment Executive Agency. Neither the European Union nor the granting authority can be held responsible for them. More information on the project can be found under <https://saril-project.eu>. Except where otherwise specified, all document contents are: “©SARIL Project - All rights reserved”. Reproduction is not authorised without prior written agreement.

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