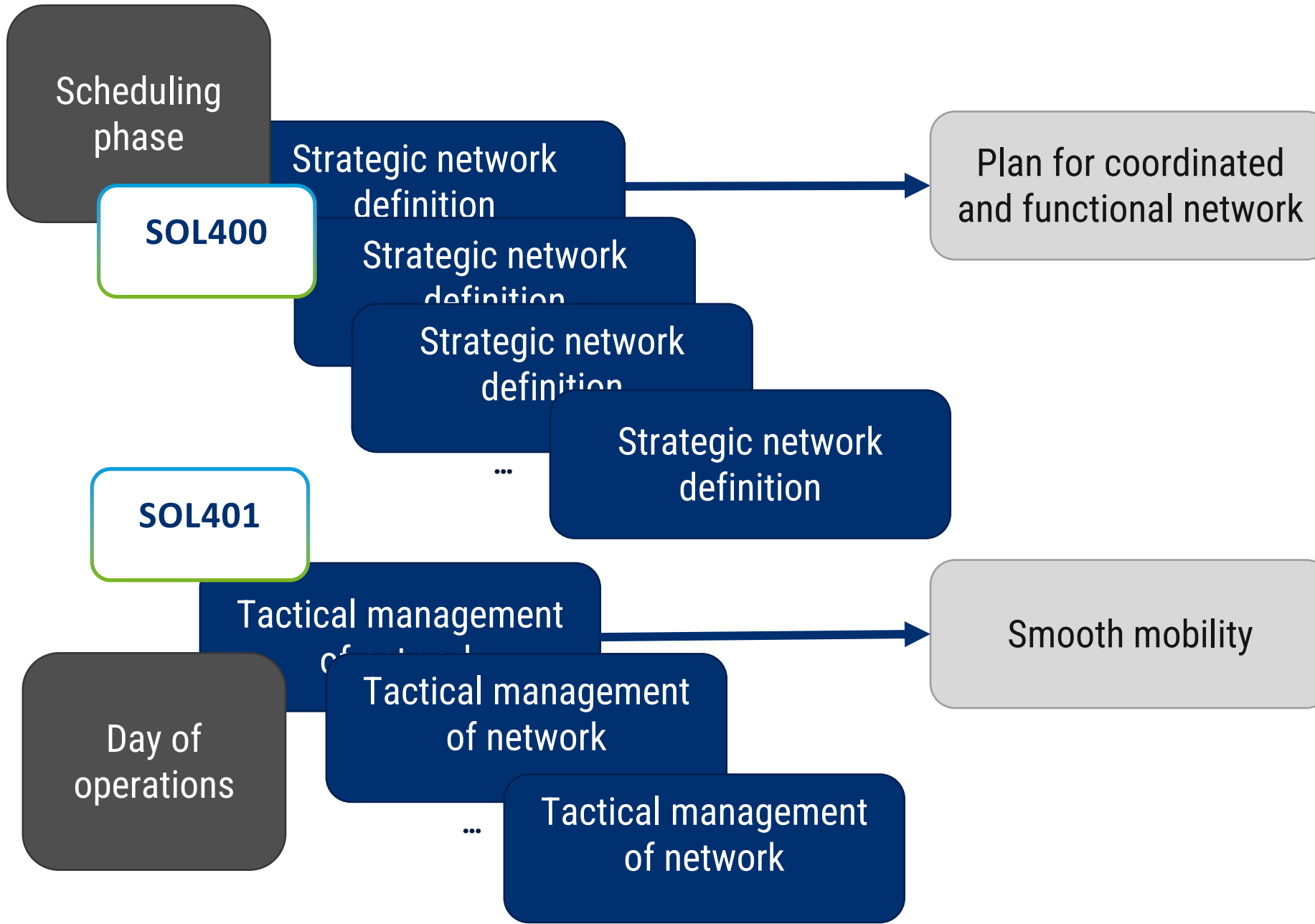


MultiModX

MultiModX: Tools for evaluating and optimising air-rail networks

Passenger-centric digital airport and multimodality
24 February 2026

Modelling multimodal networks



Need for an **evaluation framework and tools**

SOL399



UNIVERSITY OF
WESTMINSTER



NOMMON



- **Solution 399 – Multimodal Performance Evaluation** measures door-to-door passenger outcomes using a structured catalogue of passenger-centric indicators, extending existing aviation performance frameworks to multimodal journeys and providing open-source tools for evaluating multimodal networks.
- **Solution 400 – Multimodal Schedule Design** improves planned connectivity by optimizing air and rail timetables within operational constraints, increasing feasible connections and reducing transfer times.
- **Solution 401 – Multimodal Disruption Management** protects passengers during disruptions through coordinated, cross-modal recovery strategies that minimise stranded passenger numbers and preserve journey continuity.

■ **Solution 400 – Multimodal Schedule Design**

- Modest air–rail timetable adjustments (± 10 –20 minutes) significantly improve connectivity at multimodal hubs:
 - Door-to-door travel times were reduced by up to 20%
 - Number of feasible connecting itineraries increased by 5–7%

■ **Solution 401 – Multimodal Disruption Management**

- Coordinated air–rail disruption management reduced:
 - Stranded passengers by 17%
 - Average journey times by 20%
 - Service delays by up to 50%

Multimodal Performance Framework

Multimodal Performance Framework

- Digital catalogue of indicators

- Passenger-centric
- Open

- KPAs and example indicators

- **Operational Efficiency**

- Pax processing time
- Total journey time
- Buffers in itineraries
- Missed connections
- ...

- **Interoperability**

- Modal share
- Infrastructure connectivity
- ...

- **Flexibility**

- Diversity of destinations
- ...

- **Cost-Efficiency**

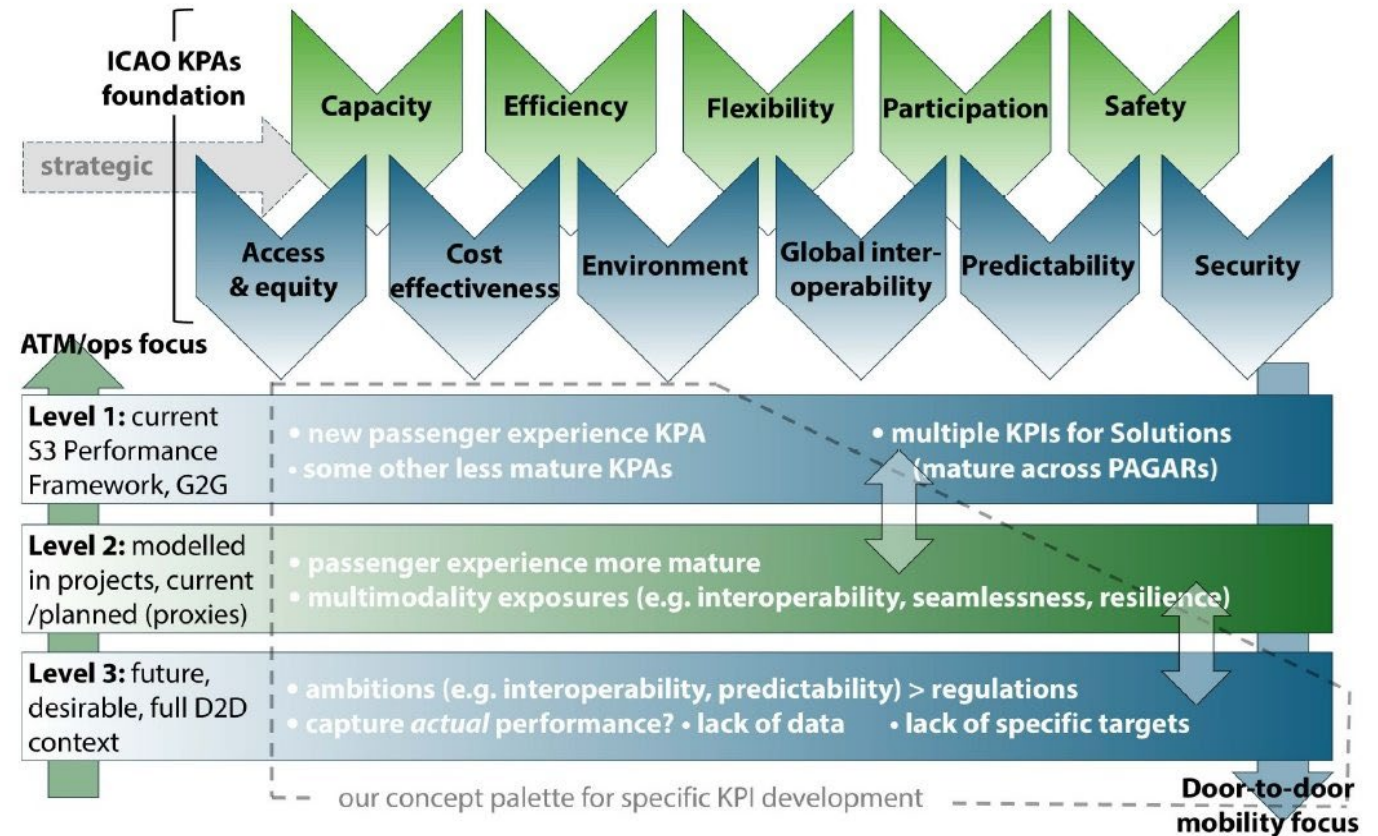
- Load factors
- ...

- **Capacity**

- Demand served
- Catchment area
- ...

- **Environment**

- **Predictability**



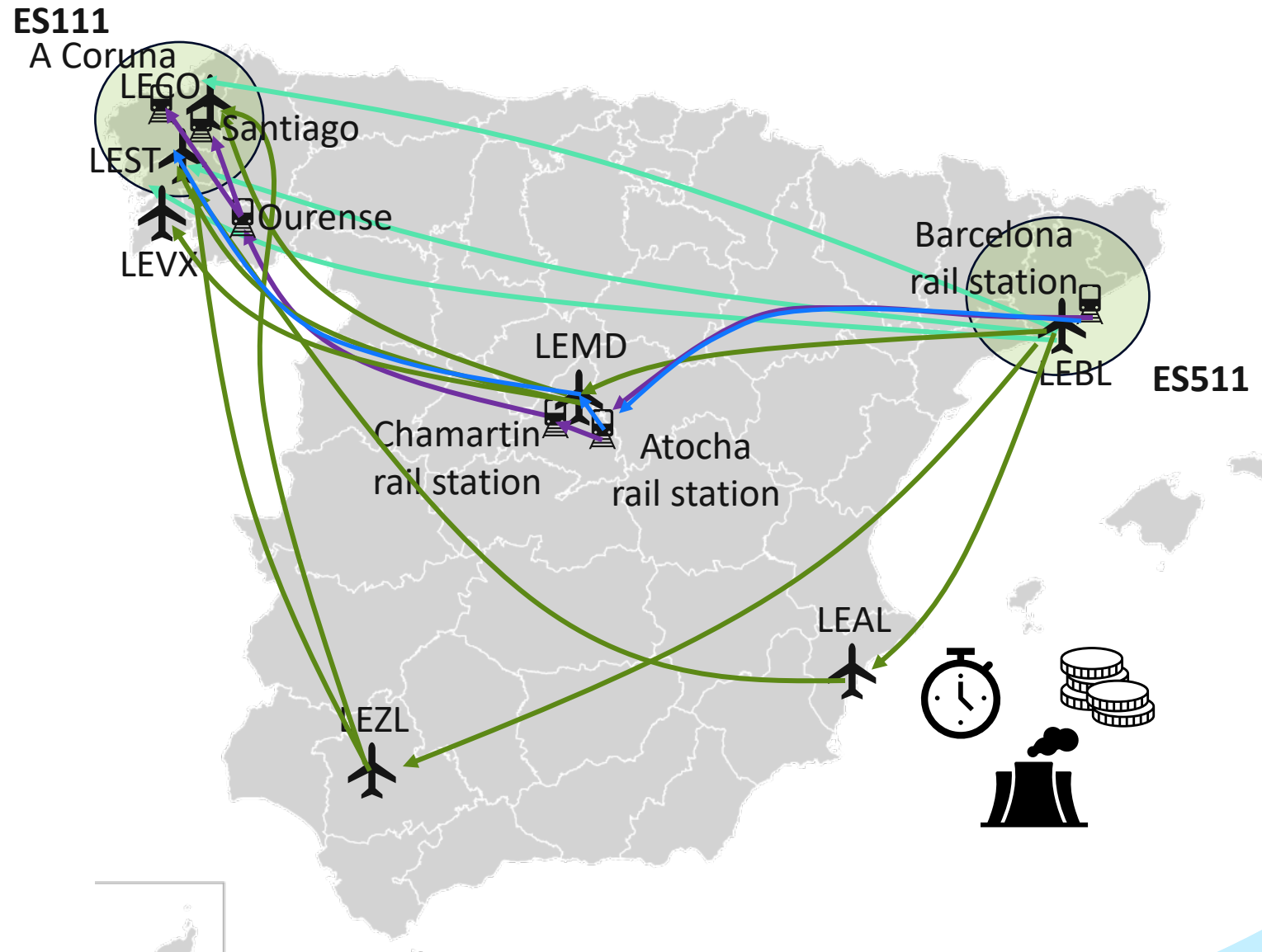
Open Multimodal Evaluation Tools

Evaluation of planned networks

Strategic Evaluation of Networks

Evaluate mobility from a
passenger-centric perspective

Path finding algorithms



Strategic Evaluation of Networks

Clusters: [2 air, 1 multimodal 1 rail]
(13 itineraries)

Evaluate mobility from a
passenger-centric perspective

Demand distribution
(pax preferences)



Demand per cluster

Pax flows
disaggregation
(pax itineraries)

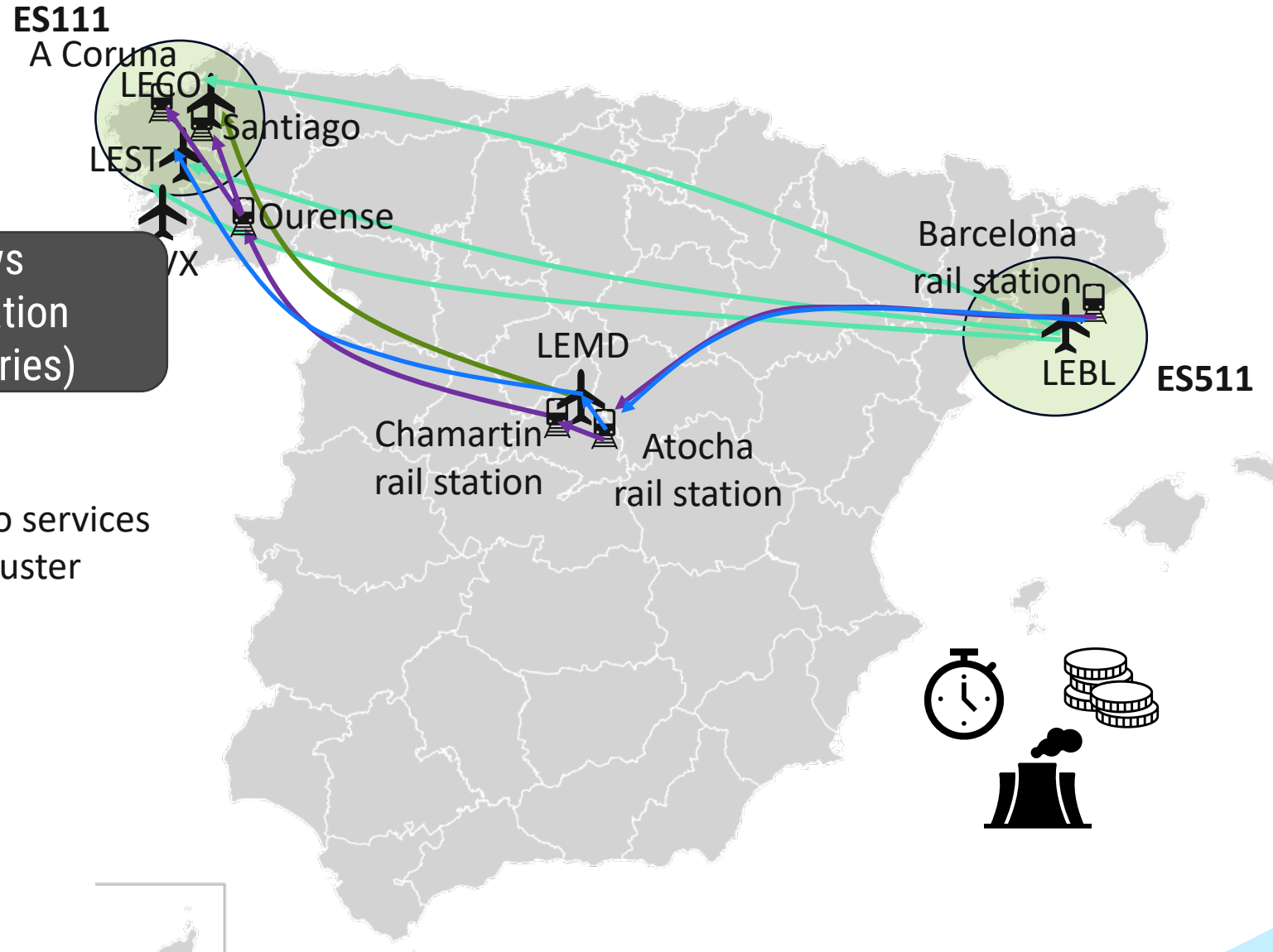


Passengers to services
within cluster

Metrics computation



Region, infrastructure,
operator, etc.



Strategic Evaluation of Networks

Evaluate mobility from a
passenger-centric perspective

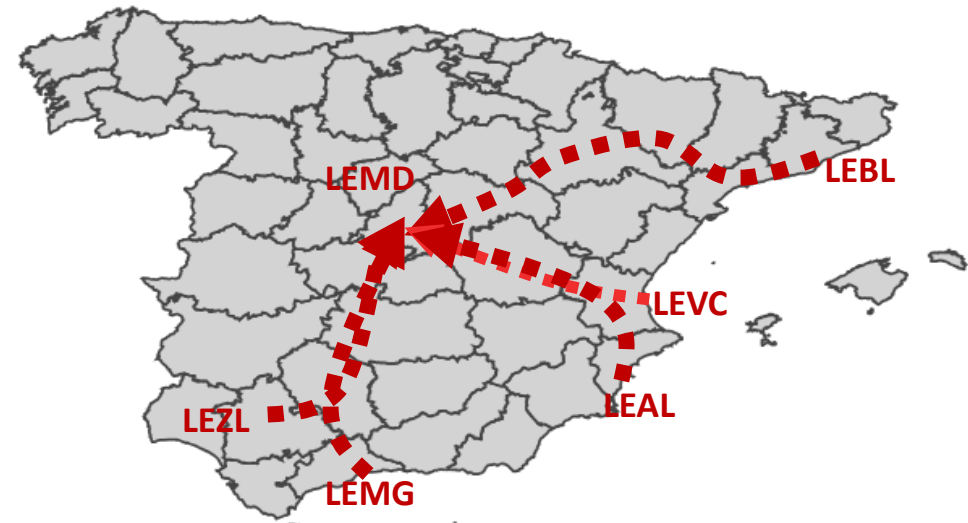
- Considers
 - New schedules
 - Policies
 - Changes in infrastructure
 - ...

SOL400

Example of strategic evaluations

■ Policy-packages

ID	Policy Package	Individual policies definition
PP00	Reference (no particular policies)	• No integrated tickets (buffers in multimodal MCTs)
PP10	Multimodality incentivised	• Fully integrated (respecting alliances) • CO₂ tax applied to emissions
PP20	Multimodality enforced	• Fully integrated (respecting alliances) • CO₂ tax applied to emissions • Short-haul flight ban if rail available between regions $\leq 2h30$



Example of strategic evaluations

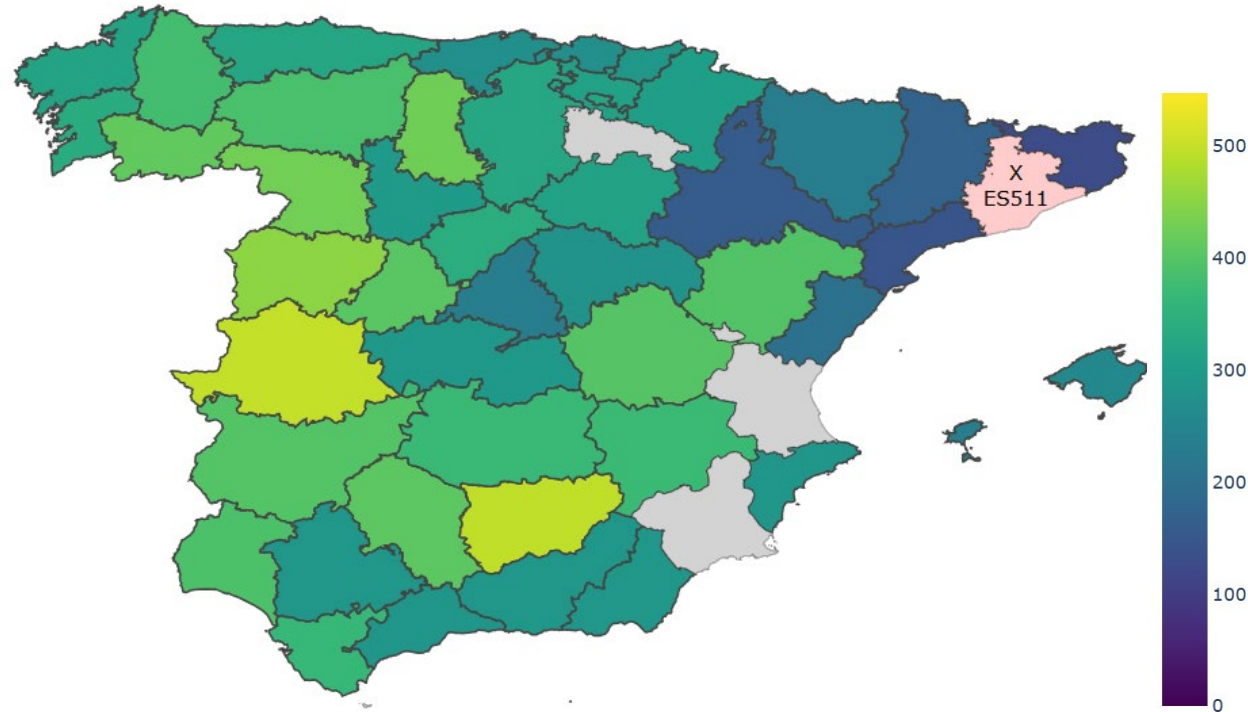
Demand satisfied and mode usage

- 81% demand satisfied
- 70% average load factor

	PP00 – Baseline	PP10 – Incentivised	PP20 – Enforced (flight-ban)
Rail	72.1%	71.9%	74.1%
Air	26.3%	26.0%	23.8%
Multimodal	1.6%	2.0%	2.1%

Example of strategic evaluations

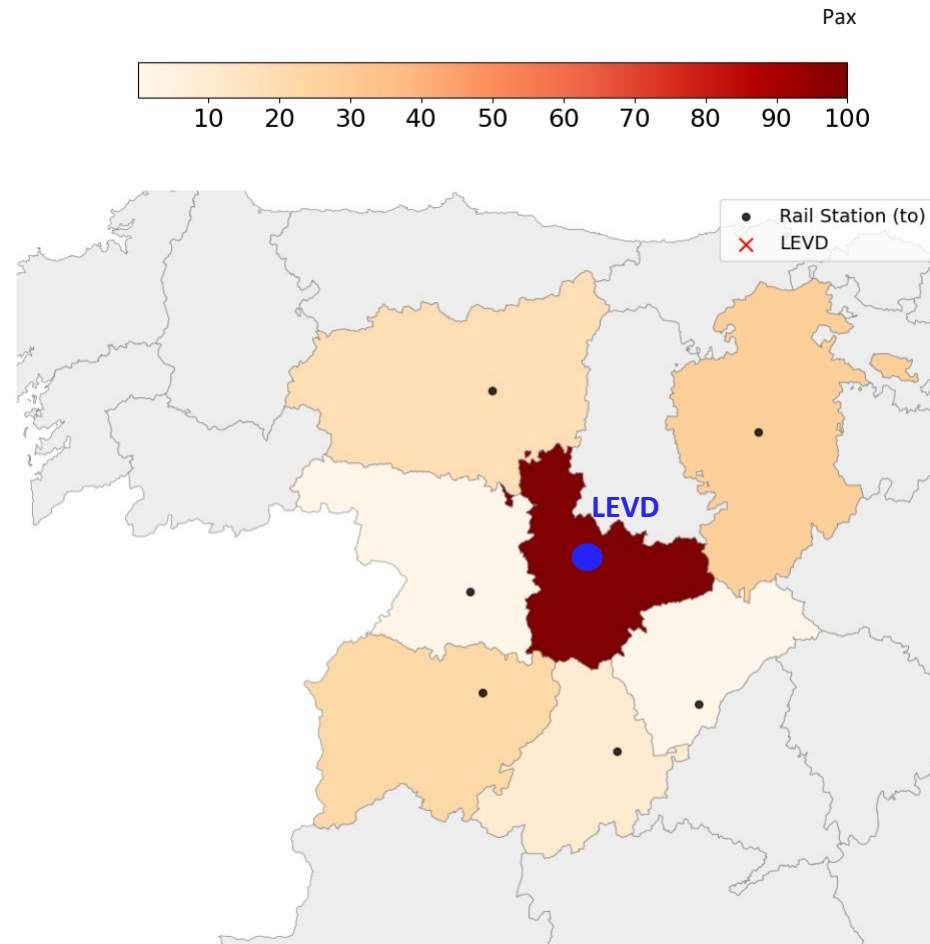
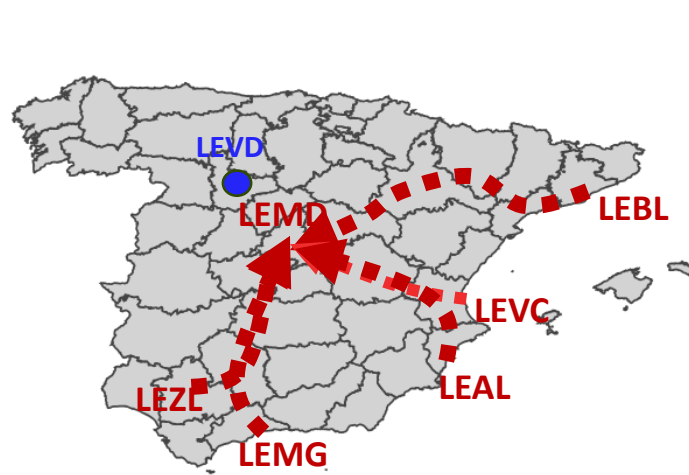
Total mobility time



Total mobility time from
ES511 to NUTS3 regions for
PP00

Example of strategic evaluations

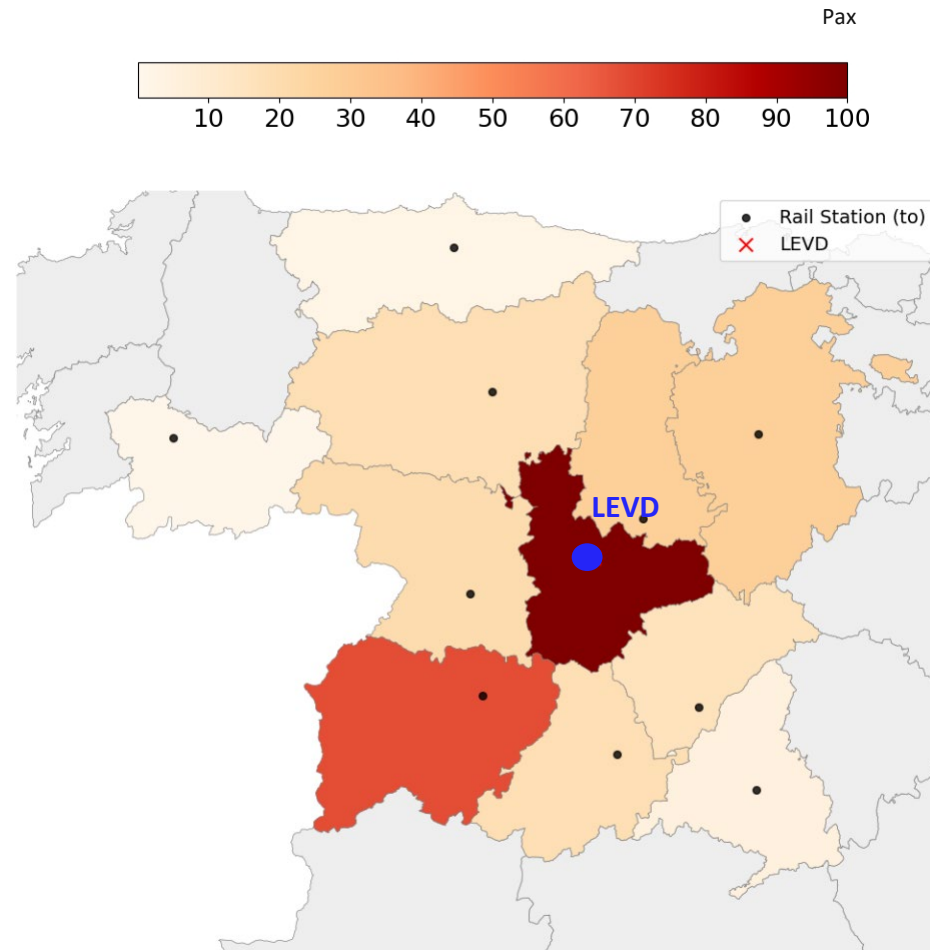
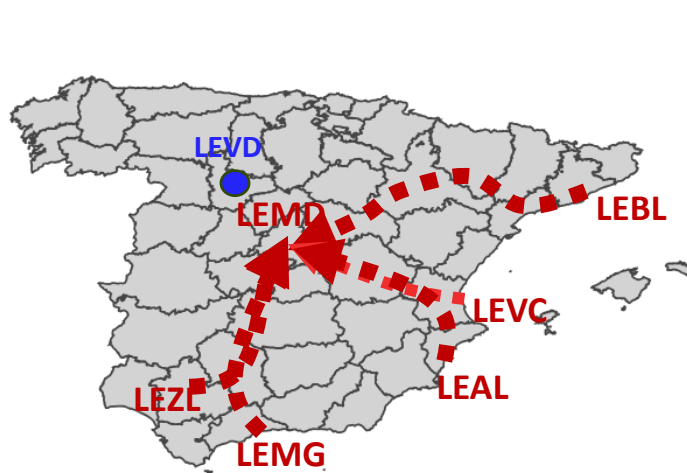
Infrastructure connectivity



Egress PP00

Example of strategic evaluations

Infrastructure connectivity



Egress PP20

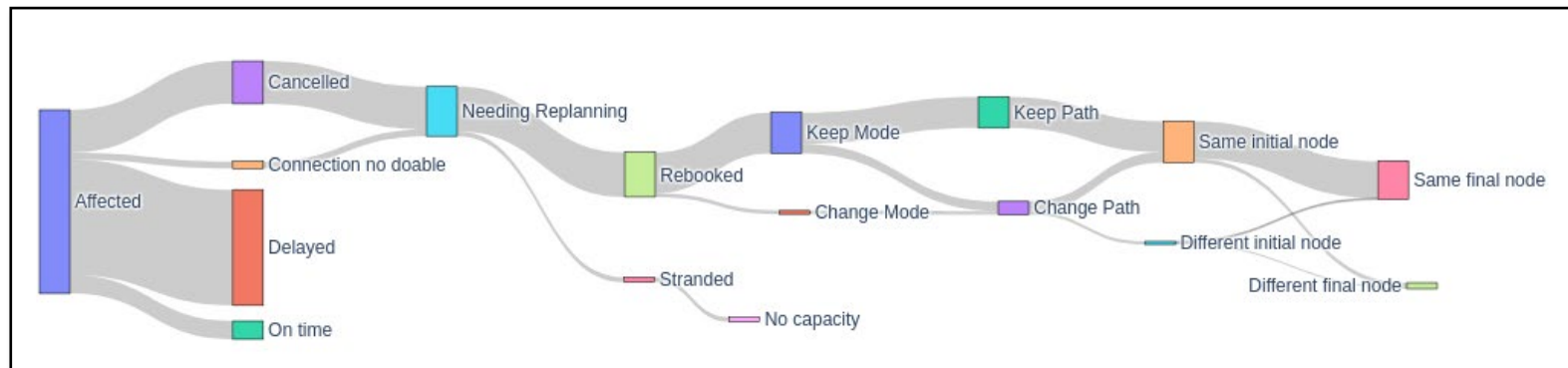
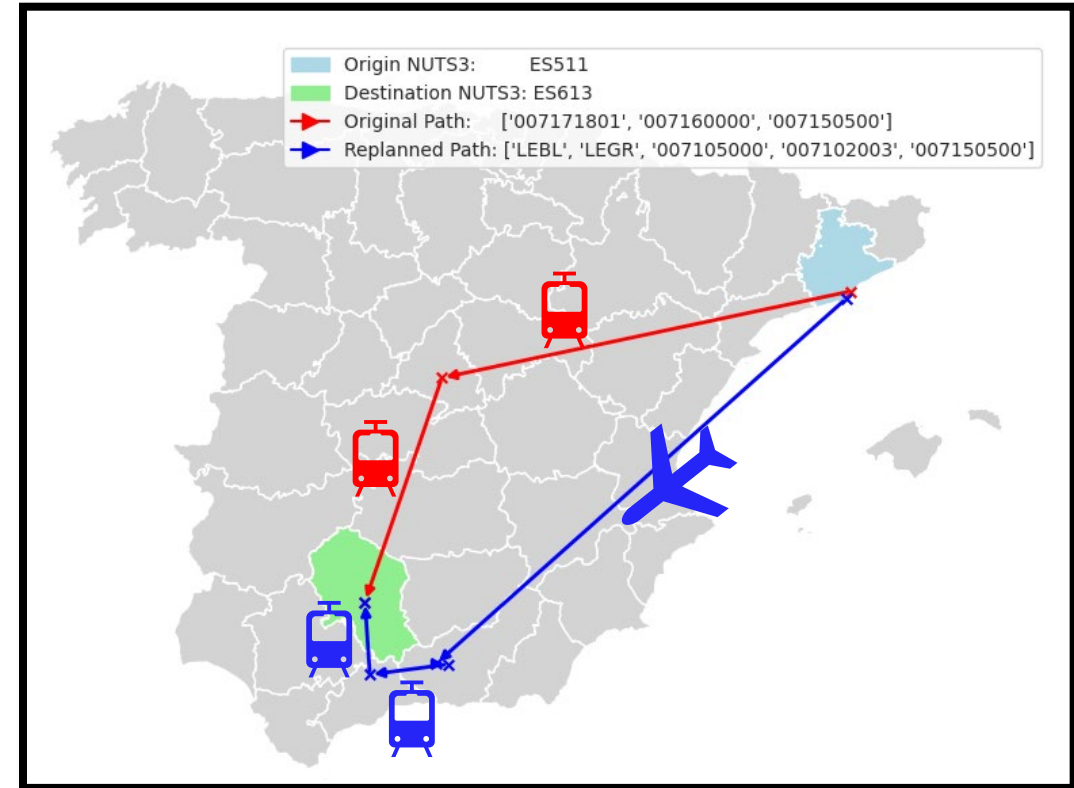
Evaluation of replanned networks (under disruptions)

Evaluation of replanned networks (under disruptions)

Multinetwork support each other

- Update network
(delays, cancellation, additional services)
- Assess passengers impacted
(delayed/stranded) and replanning alternatives for them.

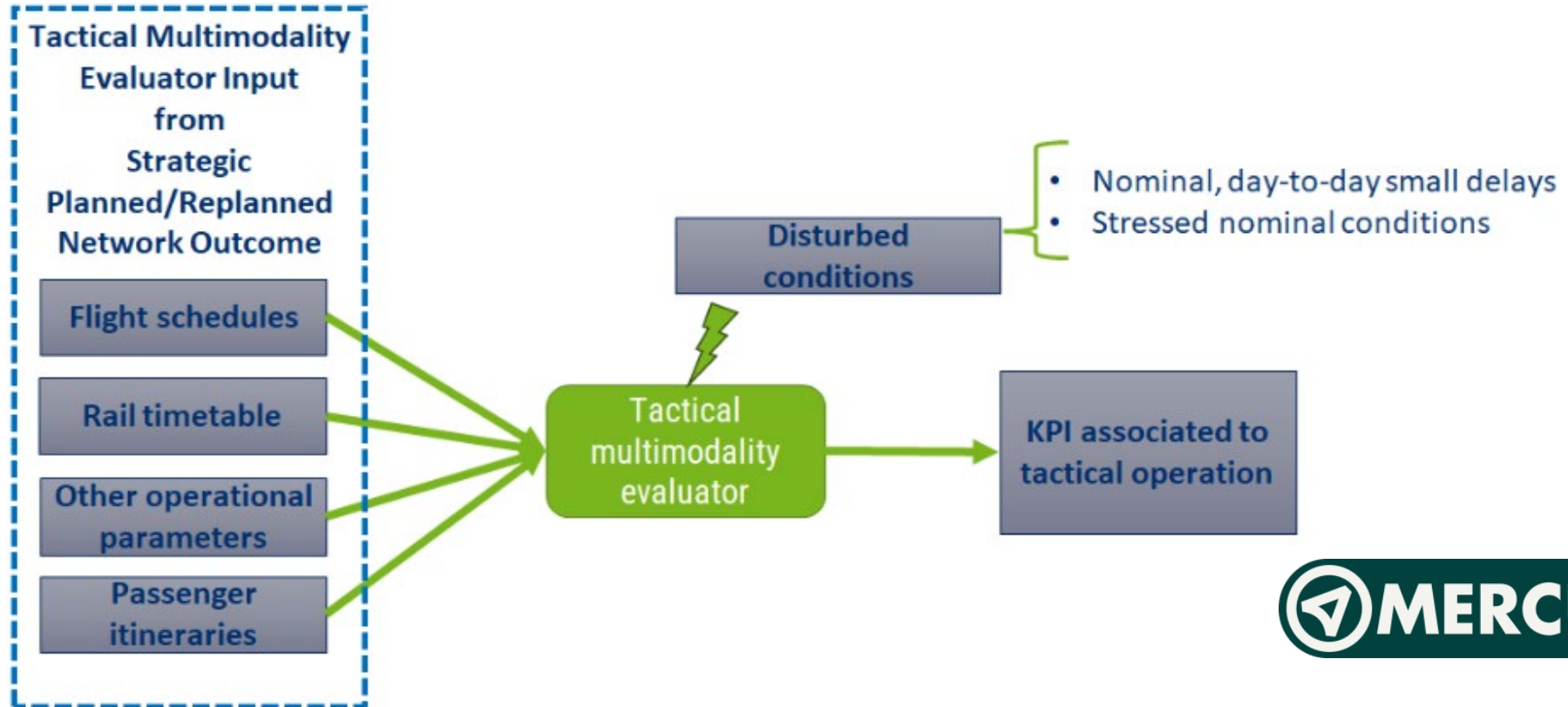
SOL401



Tactical Multimodal Evaluation

Description

Tactical Multimodal Evaluator



Fast-track to process passengers arriving at airport → impact on multimodal missed connections

Conclusions

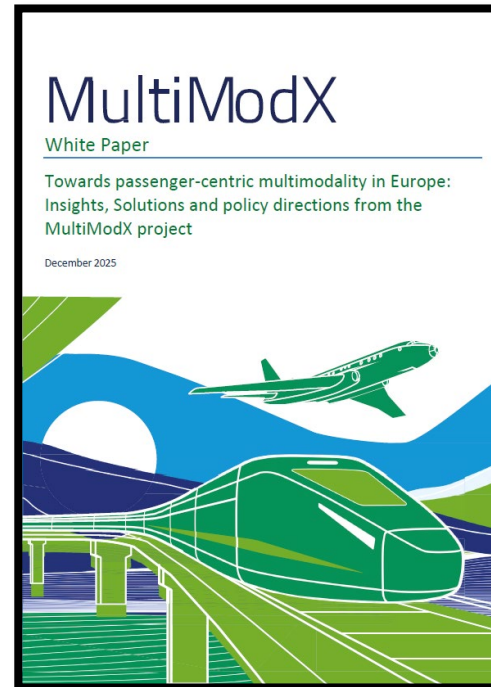
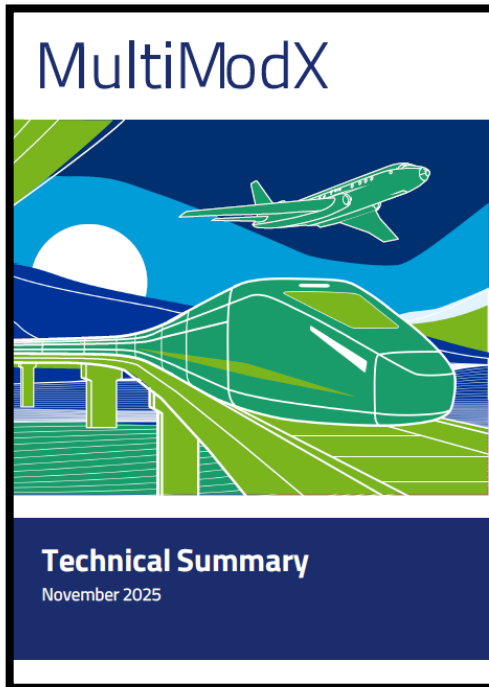
Conclusions

- MultiModX provides
 - Multimodality performance framework (passenger-centric focus)
 - Strategic (planning) Multimodal Evaluator
 - Tactical (day of operations) Multimodal Evaluator
 - Multimodal scheduler (SOL400)
 - Network replanner considering disruptions (SOL401)

MultiModX



<https://multimodx.eu/>



[https://github.com/
UoW-ATM/MultiModX](https://github.com/UoW-ATM/MultiModX)

MultiModX

Thank you!

