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From research to deployment | Exploitation, Impact and Legacy



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From research results to project legacy

This session connects three complementary angles that intersect. Together, they give direction to further work and to future projects.

◆ 1. Exploitation

Who can use NEXUS results and what value they generate after the project.

€ 2. Cost-benefit analysis

How the value of higher levels of automation can be framed from a business-case perspective.

↗ 3. Acceleration

How operator priorities can become more concrete and actionable innovation and investment pathways.

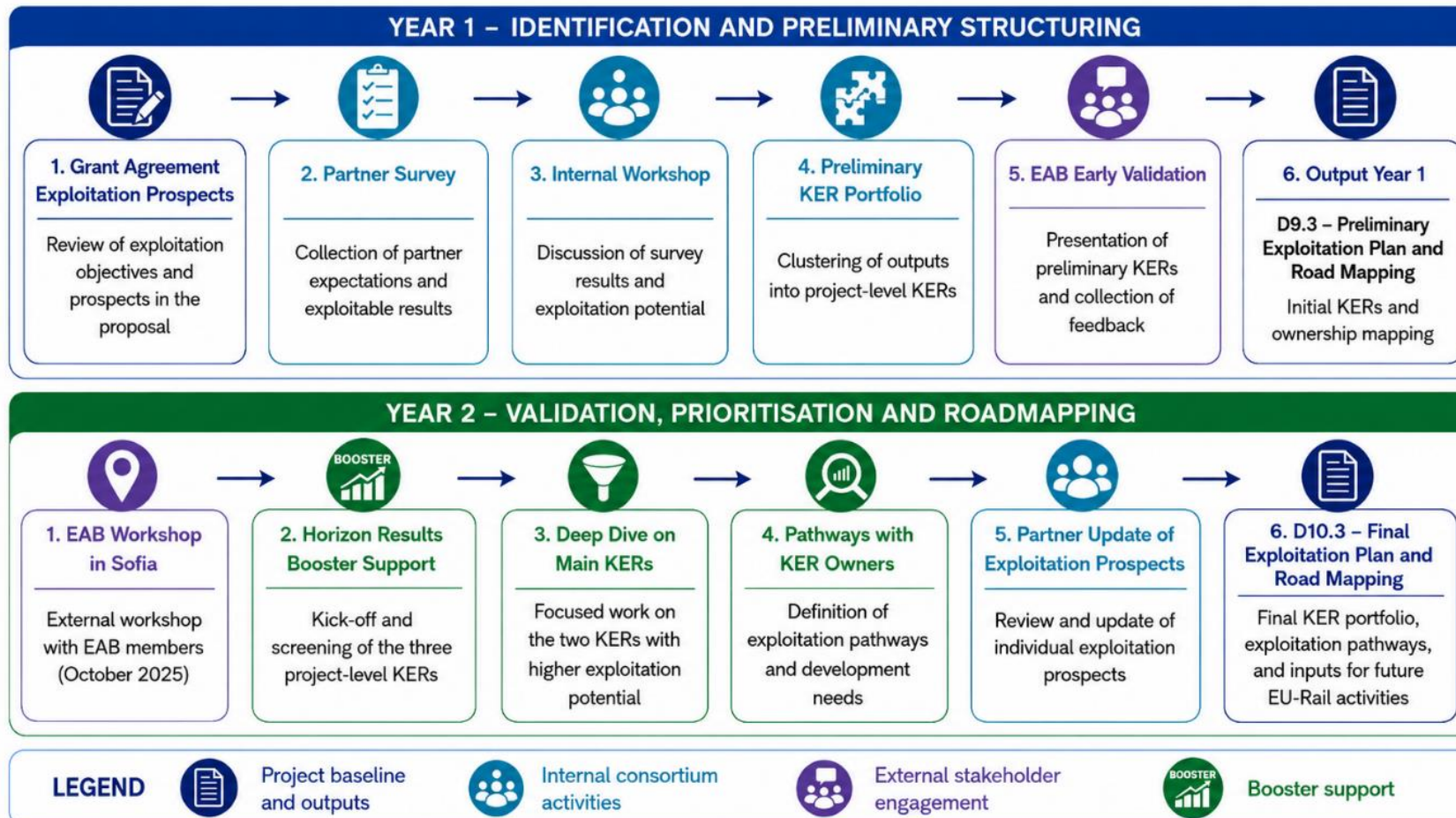


01

Exploitation

From identification to consolidation

The final exploitation plan moves from an initial list of opportunities to a refined portfolio of partner-level pathways and project-level KERs.

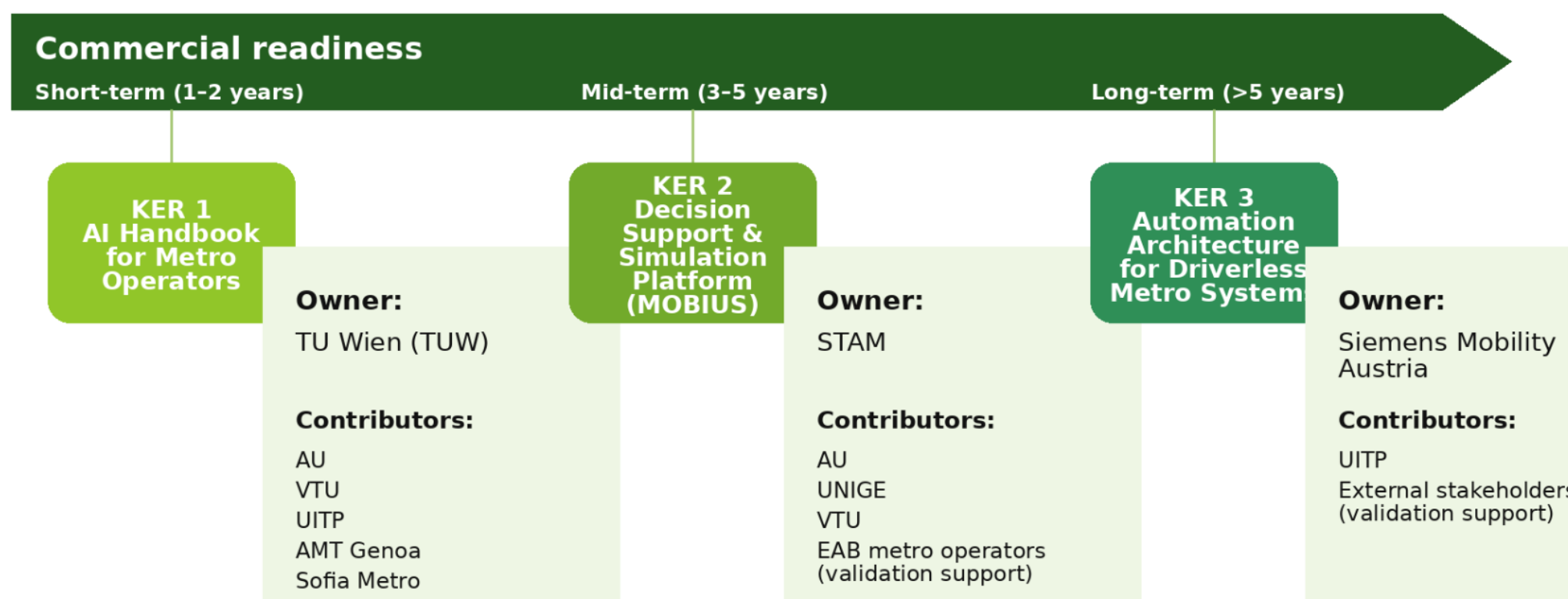


✓ **Main work**
From broad exploitation intentions towards user segmentation, value proposition, service categories and roadmaps.

Booster contribution
Entry-level diagnosis, Go-to-Market support, communication support and audiovisual support.

★ **Output**
A final exploitation plan that connects technical results, partner interests and recommendations for future Europe's Rail activities.

Three project-level Key Exploitable Results



KER 1 | AI Handbook

A practical guidance and training resource for responsible AI adoption in metro contexts.

KER 2 | MOBIUS

A simulation tool for scenario testing, passenger-flow analysis and KPI-based decision-making.

KER 3 | Automation architecture

Open, modular and scalable automation systems for driverless metro.

KER 1 Roadmap and Future Development Plan

AI Handbook for Metro Operators



Lead owner: TU Wien (TUW)

Supporting partners: AU, VTU, UITP, AMT Genoa, Sofia Metro



Post-project priorities

1



Validate with operators

2



Develop exploitation package

3



Strengthen IP & governance

4



Refine value proposition

5



Establish update mechanism

KER 2 Roadmap and Future Development Plan

Decision Support and Simulation Platform for Metro Operations (MOBIUS)



Lead owner: STAM

Supporting partners: AU, UNIGE, VTU

Validation support: EAB metro operators

1



CONSOLIDATE

Short term

2



VALIDATE

Short term

3



PILOT & PACKAGE

Short to medium term

4



DEPLOY, UPDATE & SCALE

Medium to long term



Objectives

- Stabilise MOBIUS prototype
- Integrate optimisation engine
- Prepare documentation and data templates

- Test relevance with metro operators
- Check usability and data requirements
- Gather structured end-user feedback

- Refine value proposition and positioning
- Prepare pilot deployments
- Define service and delivery model

- Launch pilots and build market traction
- Improve platform with user feedback
- Scale towards a maintained metro decision-support tool



Key outputs

- Proof-of-concept version
- Use case set and KPI framework
- User guide and data input templates

- PoC access for EAB operators
- Validation feedback and lessons learned
- Refined functionalities and KPIs

- Pilot concept and deployment package
- SaaS + consultancy model
- Target segments and pricing logic

- Pilot results and case evidence
- Updated platform and new modules
- Commercial roadmap and scale-up basis



Key actions

- Finalise platform architecture
- Document scenarios, inputs and outputs
- Prepare onboarding materials

- Grant controlled access to MOBIUS
- Run feedback sessions with EAB operators
- Consolidate validation results

- Benchmark against alternative tools
- Define implementation and support offer
- Clarify IP, access rights and governance

- Deliver pilots and training/support
- Integrate lessons from operators and data
- Plan AI integration and update cycle

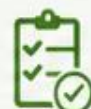
Post-project priorities

1



Proof of concept with EAB operators

2



Pilot validation

3



Develop business model

4



Clarify IP & data governance

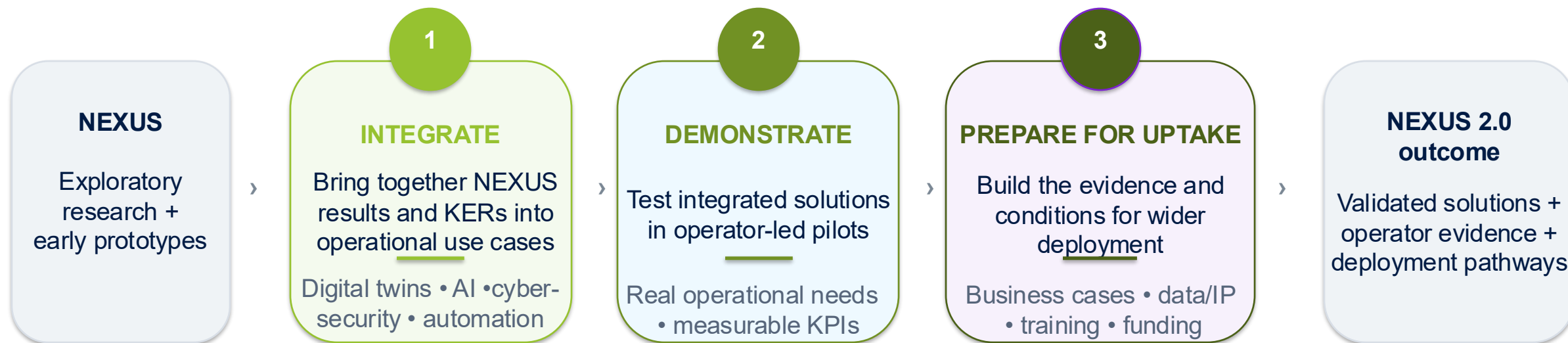
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Update and scale MOBIUS

What could a NEXUS 2.0 look like?

Take the most promising results closer to operational validation and deployment



What changes in NEXUS 2.0

- Stronger focus on pre-deployment and operational validation
- More explicit connection between technical maturity and investment readiness
- Closer involvement of metro operators, cities and public transport authorities



02

Business cases

Evidence base for the business case

- The business cases assessed whether higher levels of automation in Genoa and Sofia could generate sufficient benefits to justify the investment
- Evidence on the costs and benefits of upgrading existing metro systems is limited, particularly for brownfield automation
- To fill this evidence gap, a UITP survey was launched.
- UITP survey results were integrated into the CBA to establish upper and lower-bound estimates for costs and benefits.
- The limited number of survey responses is acknowledged in the deliverable, and the findings should be considered indicative.

Survey covers 10 metro systems across Europe, representing a wide range of network sizes



10

metro systems



11

responses

Geographic coverage

	Southern Europe	5
	Western / Central Europe	3
	Northern Europe	2
	Eastern Europe	1

Metro systems cover a wide range of annual ridership



30 million
passengers/year



900+ million
passengers/year



To carry out the CBA, we used a simplified Five Case Model, which cover 5 different domains:

Strategic Case

Assessed the rationale for transitioning the Genoa and Sofia metro systems towards GoA4, considering operational needs, opportunities, challenges and alignment with future mobility objectives.

Economic Case

Compared the Baseline and GoA4 scenarios, estimating investment and operational costs alongside potential benefits for passengers, society and the environment. UITP survey findings informed the cost and benefit assumptions.

Financial Case

Evaluated the financial implications for each metro, including investment needs, operating costs, revenues and potential funding strategies.

Commercial Case

Examined procurement approaches and key commercial considerations, including systems integration, supplier interfaces, and long-term performance.

Management Case

Considered how the transition could be governed and implemented, including risk management, organisational readiness, operational preparation and project evaluation.

Five Case Model: Economic & Financial

Overall findings

- The CBA found a positive economic case for GoA4 in both Genoa and Sofia, with estimated benefits exceeding costs.
- Potential benefits include lower operating costs, increased metro ridership, but mostly concern social benefits such as travel-time savings, and reduced congestion, accidents and air pollution – rather than direct financial gains for the metro operator.

Genoa

Financial BCR



Economic BCR



Sofia

Financial BCR



Economic BCR





03

Acceleration

Why acceleration support was needed?

TRL Early maturity

Several results are still at exploratory or intermediate maturity and cannot yet be treated as deployment-ready solutions.

⚙️ Operator fit

Implementation depends on real operational needs, legacy systems, governance, procurement and public-authority priorities.

€ Funding readiness

Future funding requires a convincing intervention logic, expected results, partnerships and evidence of additionality.



💡 Acceleration support translated project findings into practical pathways for Metro Genoa and Metro Sofia, identifying:

- which innovation areas can be taken forward,
- under what conditions,
- by which actors,
- and through which possible funding or financing routes.



Focus groups

Genoa and Sofia discussions on 10-year visions, demand drivers, innovation needs and funding experience.

Backcasting

Consortium exercise linking operator ambitions with NEXUS innovations and maturity levels.

Prioritisation

Operators assessed four candidate areas and selected one priority pathway each.

Funding case

Preparation gaps, partnership needs and indicative funding routes were analysed.

From operator needs to candidate innovation pathways

Prioritised for acceleration

1 Predictive maintenance for rolling stock and infrastructure

Main value

Improve service reliability through earlier fault detection and smarter maintenance planning.

Illustrative interventions

- Condition monitoring of high-value components
- Depot-based visual/ultrasonic scanning
- AI-supported diagnostics
- Integration with maintenance planning and asset management

Relevant NEXUS links

WP3 requirements and operational needs; WP6 AI and data-driven diagnostics.

2 Integrated passenger information, accessibility and journey guidance system

Main value

Improve the passenger journey through clearer, more accessible and multimodal information.

Illustrative interventions

- Real-time multimodal information
- Disruption and crowding messages
- Car/door guidance; accessibility and acoustic wayfinding
- Integration with existing passenger information systems

Relevant NEXUS links

WP3 user needs; WP4 passenger and station modelling; WP6 data integration and analytics.

3 Automation-readiness and future control systems upgrade package

Main value

Prepare metro systems for future automation and stronger operational control in a staged way.

Illustrative interventions

- Migration-pathway assessment
- Signalling / CBTC / control-centre integration
- Digital twins and simulation
- Wireless communication; cybersecurity and maintainability assessment

Relevant NEXUS links

WP4 simulation; WP5 future train-control architecture; WP6 cybersecurity and digital tools.

4 Passenger-flow analytics and dynamic capacity management platform

Main value

Support better capacity management and more responsive operations under changing demand.

Illustrative interventions

- Passenger-flow monitoring
- Crowding prediction
- Integration of ticketing and counting data
- Operational dashboards; scenario testing for service planning

Relevant NEXUS links

WP4 network and station simulation; WP6 AI, analytics and forecasting.



GENOA

Passenger-flow analytics and dynamic capacity management



SOFIA

Integrated passenger information, accessibility and journey guidance

Genoa pilot intervention logic

Passenger-flow analytics and dynamic capacity management



To improve the use of available metro capacity through integrated passenger-flow monitoring and analytics, supporting service planning, station management, security and passenger comfort



S01. Understand passenger flows and crowding patterns at key stations



S02. Support operational decisions through integrated analytics and dashboards



S03. Validate a scalable pilot for wider deployment and future funding



01. Data collection
Cameras, sensors, passenger-counting data and operational data.



02. Analytics platform
Crowding detection, demand patterns, forecasting and alerts.



03. Operational dashboards
Support to the control centre, service planning and station management.



04. Pilot implementation
De Ferrari, Brignole and Principe.



05. Evaluation and scale-up
Performance indicators, technical assessment and extension potential



Preparation

Technical assessment, system architecture, data integration, GDPR and cybersecurity



Pilot

Testing at three stations, operational use, alerts, dashboards and passenger-flow monitoring



Scale-up

Validated model for broader deployment and future investment



Improved evidence for capacity use and station management



Better service planning, passenger comfort and security.



Validated pathway for replication and future funding.



Indicative funding pathway



Initial fit: EIT Urban Mobility



Possible longer-term routes: ECF or CEF-T

! Operational problem

Growing and unbalanced demand; sensitivity to passenger volumes at key stations.

© Pilot concept

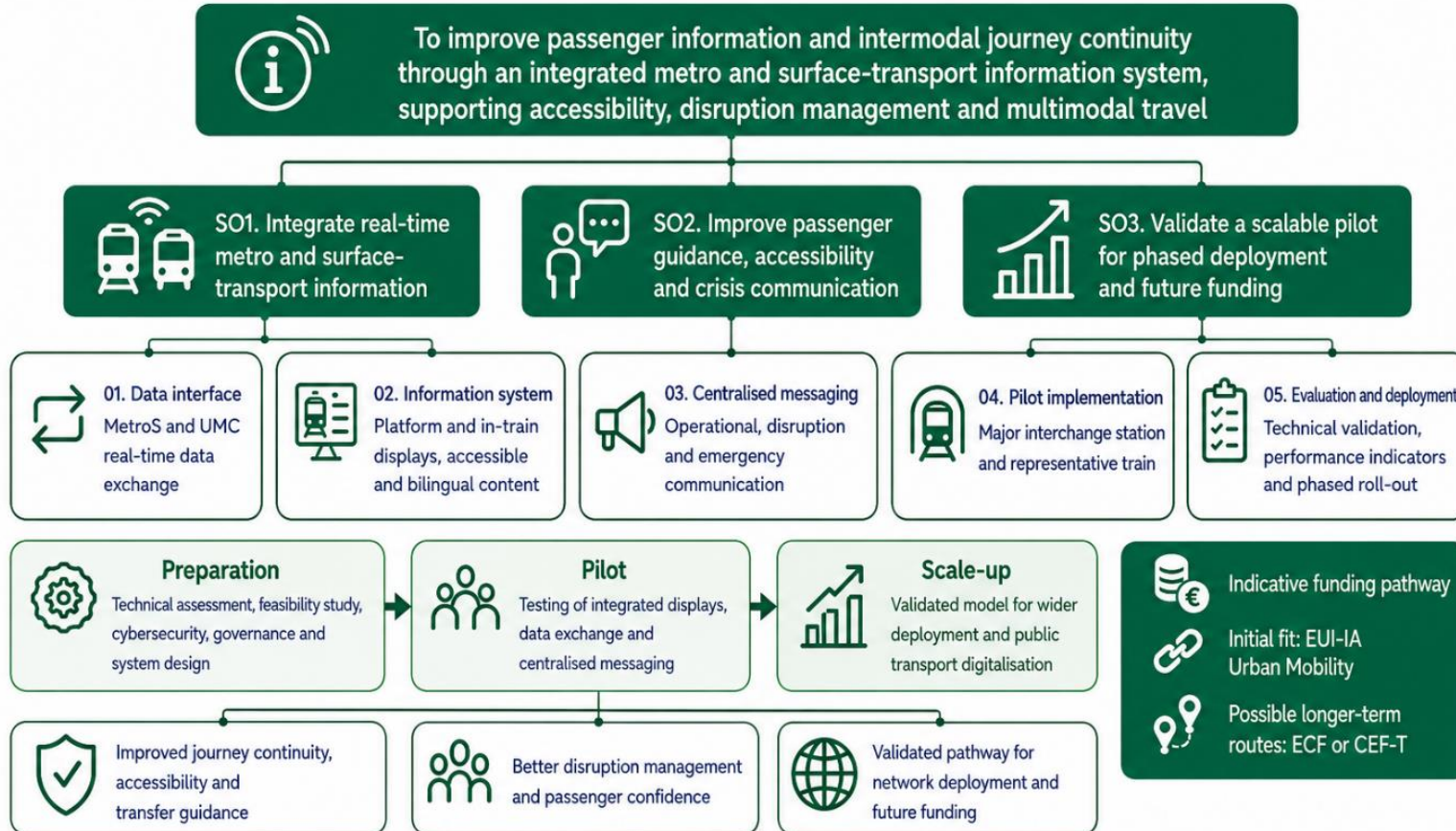
Initial testing at De Ferrari, Brignole and Principe, linking data collection, analytics and operational dashboards.

€ Funding logic

Initial fit: EIT Urban Mobility; possible longer-term routes: ECF or CEF-T.

Sofia pilot intervention logic

Integrated passenger information, accessibility and journey guidance



! Operational problem

Need for better real-time information across metro and surface transport, to respond better to disruptions and transfers.

© Pilot concept

Data exchange with UMC, platform and in-train displays, centralised messaging and accessible bilingual content.

€ Funding logic

Initial fit: EUI-IA Urban Mobility; possible longer-term routes: ECF or CEF-T.

TRA workshop

Expert sense-check with operators, supplier and sectoral actors

Takeaways from the TRA workshop

- Metros are safety-critical, and therefore risk-sensitive. New solutions need strong evidence before they can enter daily operations.
- The main barrier is often not the technology itself. Validation, certification, legacy-system integration, cybersecurity, procurement and proving ROI are crucial.
- There is still a gap between pilot and deployment. Operators may be able to fund studies or demonstrations, but struggle to secure the larger investment needed for implementation and scale-up.

BENCHMARKING

Review of direct EU R&I participation by operators and authorities

Takeaways from the benchmarking

- Metro-only operators tend to participate less in EU R&I projects.
- Size is not the decisive factor. Organisational capacity, a broader operational remit and accumulated project experience appear to matter at least as much.
- Funding experience is programme-specific. Being experienced in major infrastructure investment does not automatically mean being ready for collaborative R&I or innovation funding

Benchmarking of Access to Direct EU Funding by Transport Operators and Authorities

Operator / Authority	Country	Operational size	No. of funded projects	Direct EU contribution
1. METRO-ONLY SERVICES				
Metropolitan EAD / Sofia Metro	Bulgaria	Medium	2	€100,937.50
Metroselskabet / Copenhagen Metro	Denmark	Medium	1	€153,613.25
Metro de Madrid	Spain	Large	13	€2,132,638.80
Metropolitano de Lisboa	Portugal	Medium	2	€167,468.75
Metro do Porto	Portugal	Medium	0	€0.00
2. METRO AND OTHER PUBLIC TRANSPORT MODES				
DPP Prague	Czechia	Large	1	€148,500.00
AMT Genoa	Italy	Medium	6	€1,036,025.00
ATM Milan	Italy	Large	1	€140,875.00
3. SURFACE PUBLIC TRANSPORT SERVICES				
Movia	Denmark	Large	1	€99,008.25
EMT Madrid	Spain	Large	9	€2,698,888.75
MZA Warsaw	Poland	Large	3	€242,905.00
CARRIS Lisbon	Portugal	Medium	5	€906,412.50
4. MULTIMODAL PUBLIC TRANSPORT AND MOBILITY AUTHORITIES				
Sofia Urban Mobility Centre	Bulgaria	Large	4	€257,872.75
BKK Budapest	Hungary	Large	12	€1,555,231.75
5. PORTS AND PORT AUTHORITIES				
Port of Aalborg Logistics	Denmark	Medium	1	€411,000.00
Vordingborg Havn	Denmark	Small	1	€208,750.00
Port Authority of Vigo	Spain	Medium	3	€850,547.50
Port of Rijeka Authority	Croatia	Medium	1	€106,250.00
Port of Cork Company	Ireland	Medium	0	€0.00
Western Ligurian Sea Port Authority – Ports of Genoa and Savona	Italy	Large	2	€255,625.00
Port of Lisbon – APL	Portugal	Medium	1	€174,825.00

OPERATIONAL SIZE (badge)

● ○ ○ Small
● ● ○ Medium
● ● ● Large

DIRECT EU CONTRIBUTION (bar)

Bar lengths represent the relative level of direct EU contribution. The longest bar corresponds to the highest value in the table: €2,698,888.75.

Takeaways for operators, authorities and EU-level support

1 For metro operators

Start from operational needs and future priorities and define a staged investment pathway from pilot to scale-up, matching each stage with the appropriate funding and financing route.

2 For local authorities

Embed metro innovation in SUMP and investment plans; bundle measures into coherent multimodal portfolios (e.g CCC) for stronger TEN-T urban nodes.

3 Bridge innovation and deployment

Help operators overcome technical, financial and administrative barriers between pilots and large scale deployment. EU support should de-risk innovation and shorten the path from validated solutions to market uptake.

5 Capacity-building

Target small and medium-sized metro systems that lack dedicated innovation or EU funding teams (e.g. EIB-like TA for small and medium size ports).

6 Strengthen the metro R&I agenda

Consider a dedicated metro agenda within future EU rail innovation support. Increase the representation of metro operators in future rail R&I programming and deployment discussions.

EU-funded projects can act as accelerators when they shorten the path from validated solutions to market uptake.

The project comes to an end, it's impact endures!

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