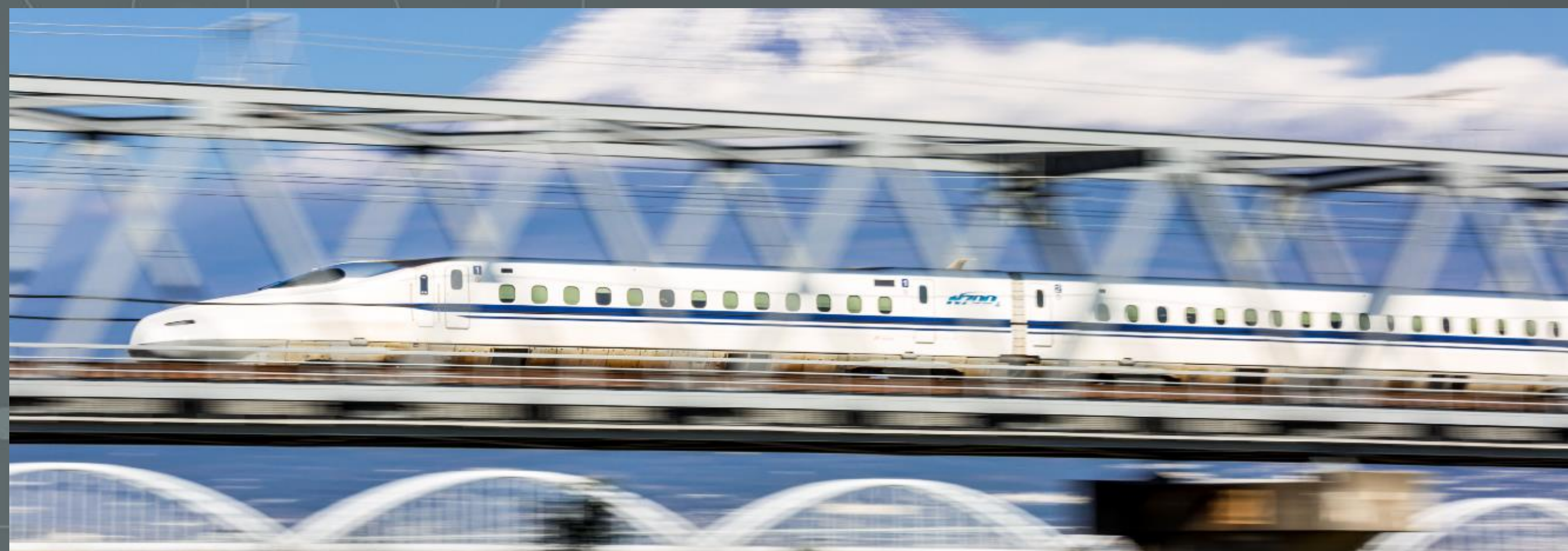


INTERFACES AND INTERACTION BETWEEN INFRASTRUCTURE SUBSYSTEM AND ROLLING STOCK

Rail System Department



Agenda

Day 1



Train-Track Interaction

Day 1. 17th September 2025

08:00-13:00 Technical visit

The visit will be to multiple-gauge S&C (Loja), a track-gauge changer as well as the track maintenance facilities (Antequera).

13:00-14:30 Lunch

Joint TTI & TEG coordination lunch, focused on collaboration and synergy opportunities.

14:30-15:00 Point 1. Welcome remarks and general information

1.1 UIC TTI chairman welcome and ADIF welcome

Anup Chalisey and ADIF will open the meeting.

1.2 Short round table

Short introduction from the attendants to the meeting.

1.3 General remarks and UIC news

Rosa Casquero and Jorge Suárez. General information on the meeting and UIC.

15:00-15:45 Point 2. Key invited session

TTI sector - looking forward. Anup Chalisey. RSSB

Flying ballast. Miguel Rodríguez. ADIF

15:45-16:00 Coffee break

Agenda

Day 1



Train-Track Interaction

16:00-18:00 Point 3. SubWGs parallel invited sessions

SWG Pantograph-Catenary

1. *Pantograph testing for simulation models.* Manuel Tur. Polimi-UPV-Huddersfield
2. *Investigate pantograph-catenary interaction issues in neutral zones.* Mehdi Dib. RAIL ELECT Spa - Groupe GCF(SNTF)
3. *Current Developments in Rigid Catenary–Pantograph Wear Reduction: Insights from the University of Málaga.* Vid Bacic. Universidad de Málaga.

SWG Railway Dynamics and Gauges

Data-oriented

From Track to Tool: Turning Data into Compatibility Decisions. Amine Chakir SNCF

InterActive Pads for monitoring the interaction Wheel-Rail. Miguel del Sol. Universidad de Granada.

Extension of Rail Replacement Cycle Using Rail Health Index Reflecting Onboard Train Data (Axle Box Acceleration Measurement etc). Mitsuru Hosoda. UIC-RTRI

AI-Enhanced Condition Monitoring of Railway Infrastructure Using Onboard and Wayside Systems. Diogo Ribeiro. ISEP

Track component-oriented

Reduction of rapid variations in track stiffness around e.g. bridges and tunnels. Björn Paulsson Chalmers University of Technology.

Fatigue resistance required for rail fastening systems considering the occurrence tendency of lateral forces at curved sections of narrow gauge track. Tadashi Deshimaru. RTRI.

A new calculation framework for railway track designers and maintainers to better understand and estimate service loads. Yann Bezin. University of Huddersfield.

The dynamic amplification of railway loads in the design of under-track structures. Andrea Latorre. RFI.

20:00 Social Dinner

Self-paid. Málaga beach.

The dinner will take place on 17 September at 20:00 at Chiringuito La Campana (Málaga).

📍 Location: <https://maps.app.goo.gl/aFD5Wc4MvgJ6YLu2A>

Agenda

Day 2



Train-Track Interaction

Day 2. 18th September 2025

09:00-10:45 Point 4. Workshop on TTI strategy

Parallel working sessions on the different TTI SubWGs

Identifying key topics and building the Mission and Vision.

SWG Railway Dynamics and Gauges.

SWG Pantograph-Catenary.

General session to exchange each SubWG's conclusions.

10:45-11:00 Coffee break

11:00-11:30 Point 5. Opt-In 2026

Reminder and preparation of proposed opt-in projects for 2026.

11:30-12:00 Point 6. Ongoing projects update

The status of ongoing projects will be briefly presented.

- P384/ HARMO-TRACK project, which aims to harmonise data formats and thresholds for track geometry and dynamic measurements.
- P652/ CROSS-T project aimed at ensuring safe train operations when crossing in mixed traffic lines.
- P653/ AERONOISE project, which focuses on developing an improved noise emission measurement method for high-speed trains.
- P703/ DYNMEASURE project, which aims to identify the right framework for application of the various measuring systems trackside and on-board.
- P849 / CONFORCES project, which aim to validation of measurements of the Wheel-rail contact forces through instrumental wheelsets for UIC Leaflet 518 homologation purposes.

12:00-12:20 Point 7. Migration plan

Follow-up and decision on revision of leaflets and IRS.

12:20-12:45 Point 8. AOB and Next Meeting dates

- Next meeting.

12:45-13:00 Final remarks and closure

Anup Chalisey, Chairman for the TTI Sector.

13:00-14:00 Lunch

Lunch at the Málaga TechPark.

POINT 1. WELCOME REMARKS AND GENERAL INFORMATION

OPENING AND WELCOME FROM THE CHAIRMEN



Anup Chalisey

TTI Chairman

Head of Infrastructure at RSSB



David Villalmanzo

Infraestructure Chairman

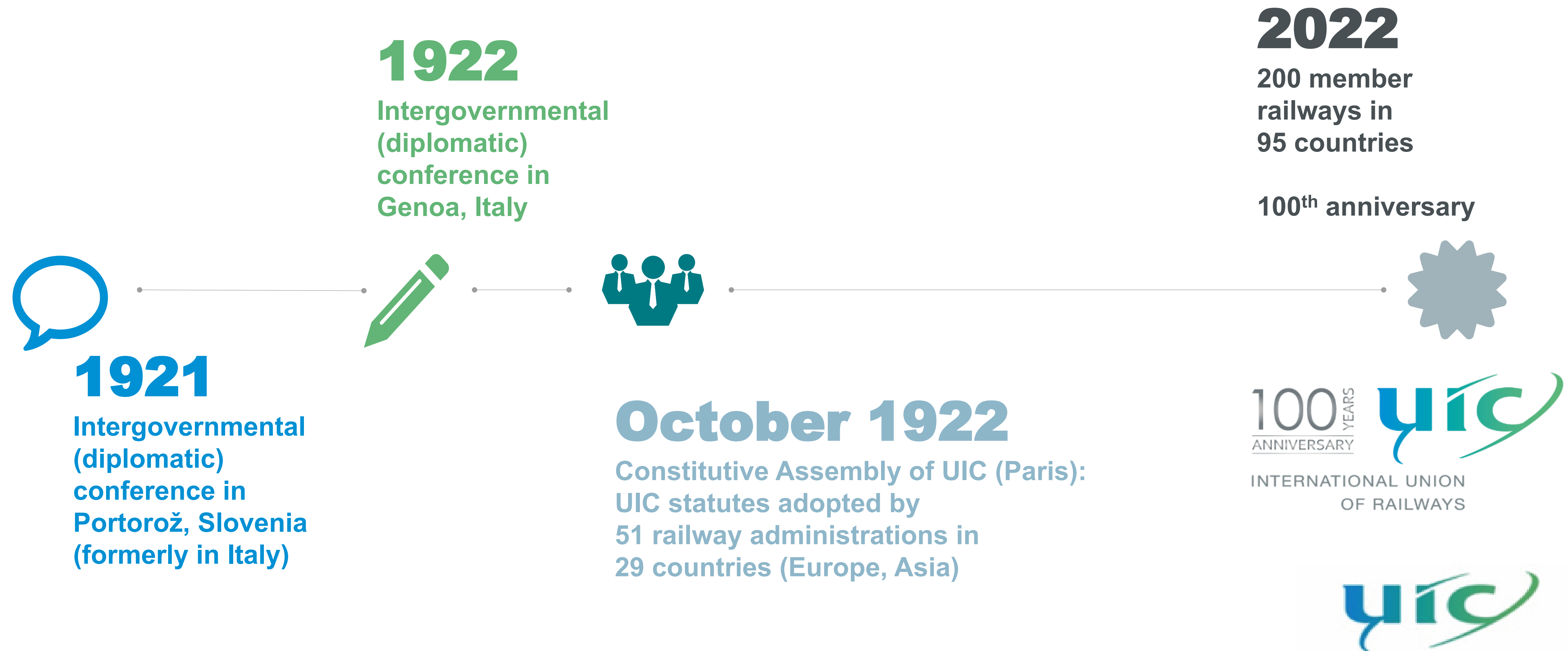
General Manager Strategic Partnerships and
Coordination at ADIF

Short Round table



UIC RSF General Information & News from UIC

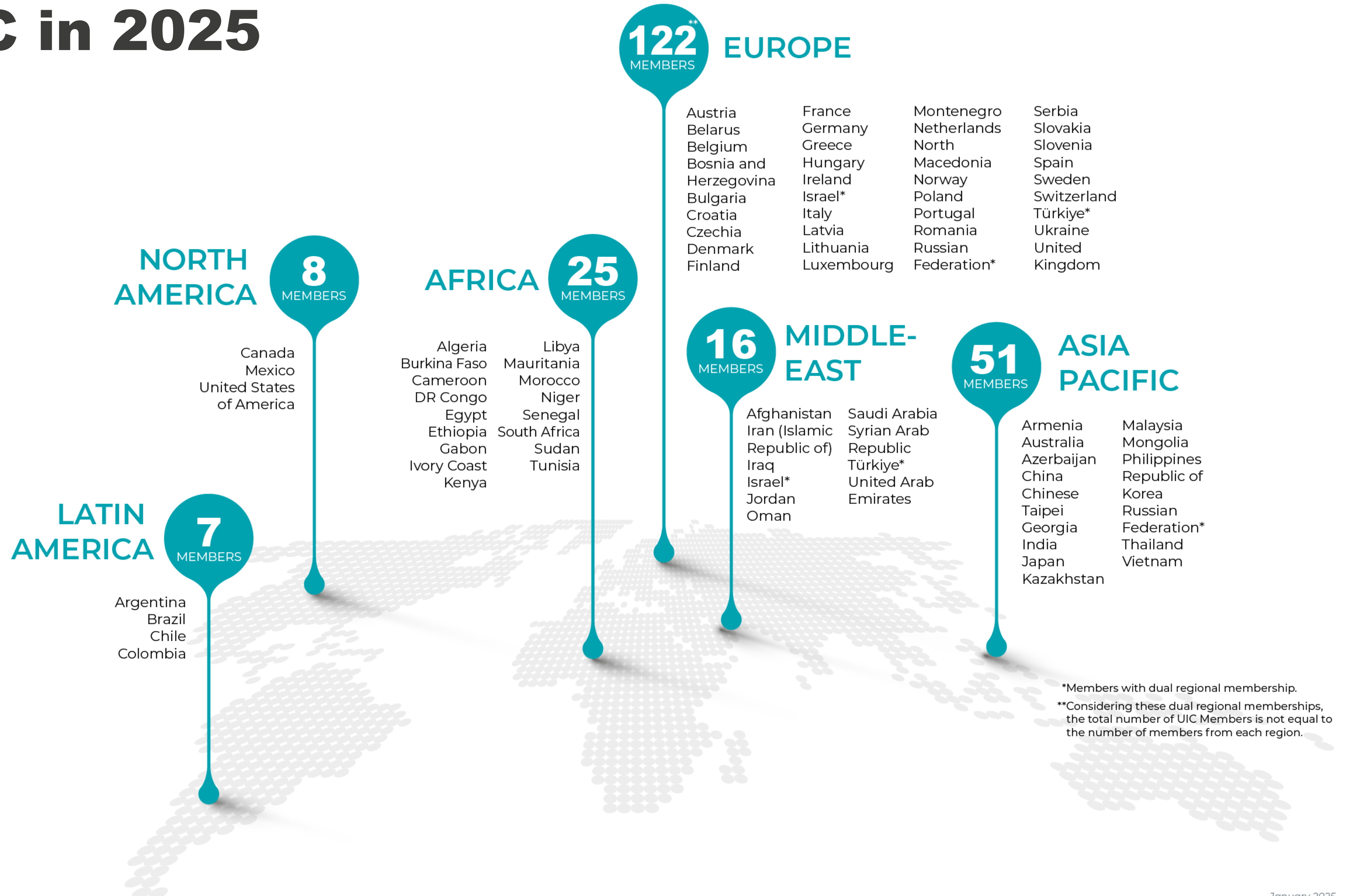
UIC: a long history of serving member railways and facilitating international railway cooperation



UIC in figures



UIC in 2025



UIC's mission

Promoting the development of rail transport globally to respond to challenges in respect of mobility and sustainable development

KEY ACTIVITIES

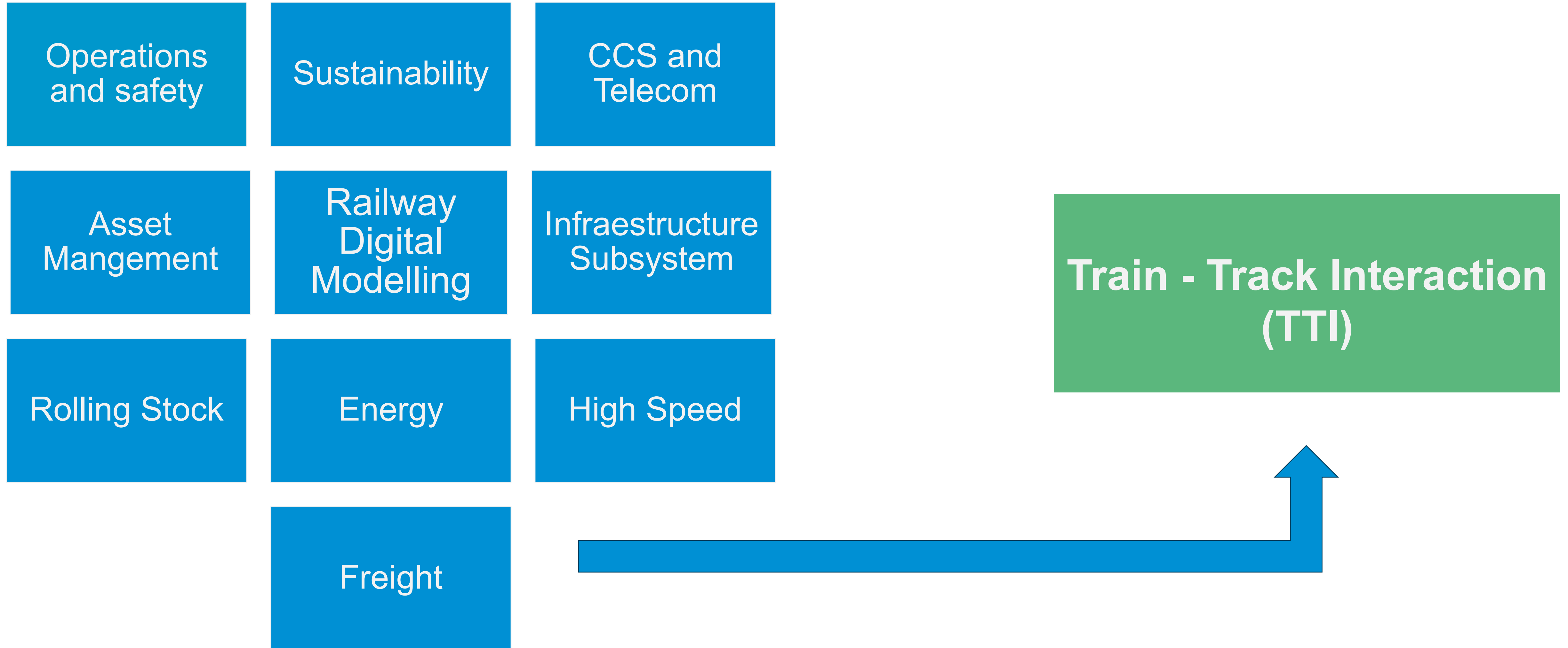
INNOVATION

SPECIFICATIONS

DISSEMINATION

STRATEGIC ADVICE

Technical Sectors of the UIC



Interfaces and Interaction between Infrastructure Subsystem and Rolling Stock (TTI)



➤ **SWG Aerodynamic and Acoustics**

➤ **SWG Railway Dynamics & Gauges**

➤ **SWG Pantograph-Catenary**

➤ **Innovative Transport**



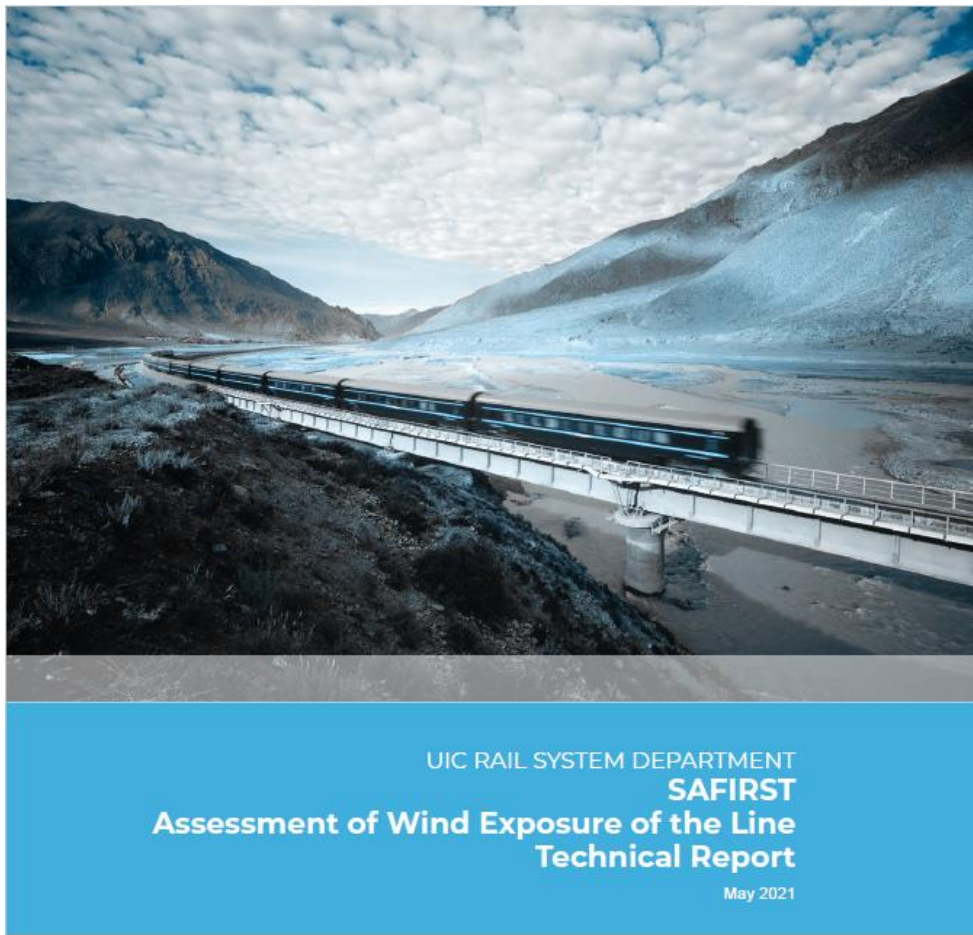
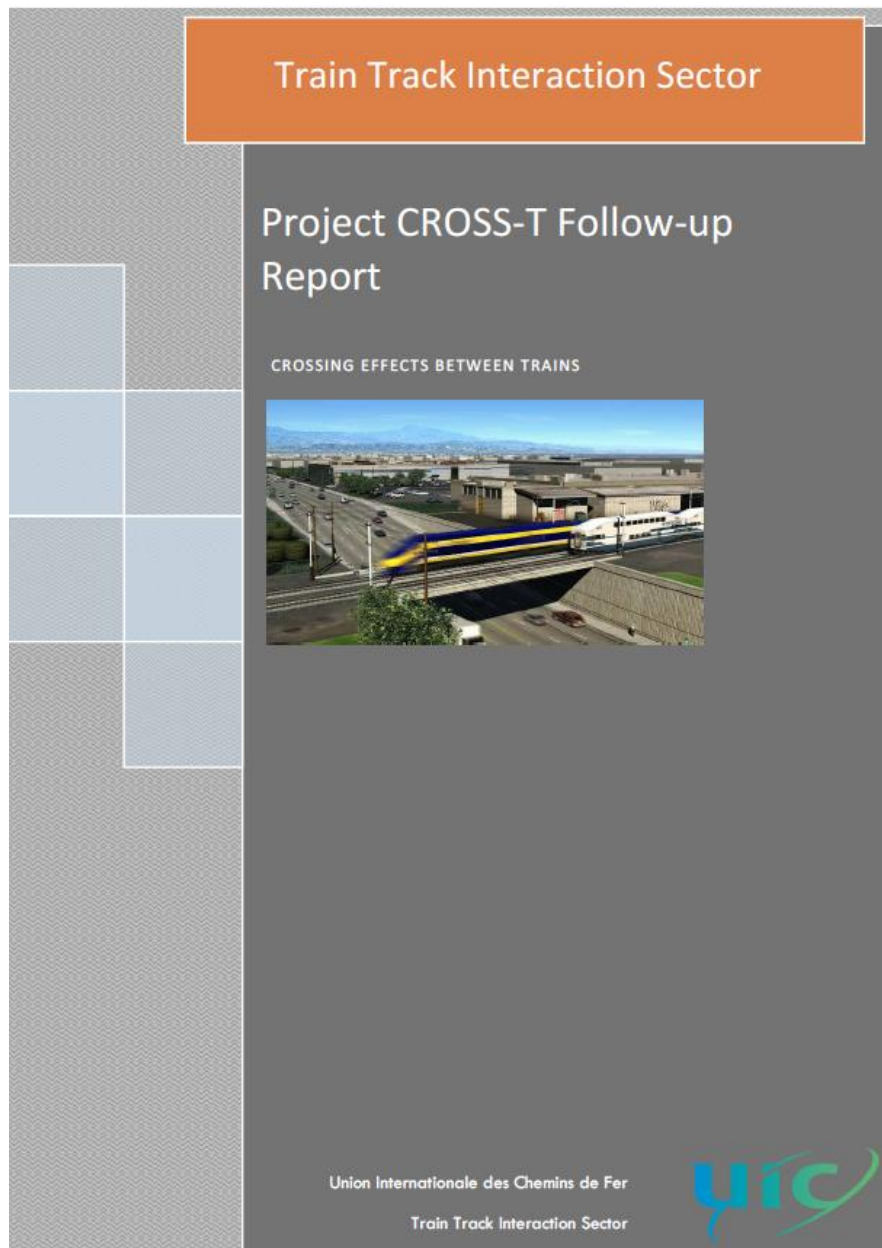
Interfaces and Interaction between Infrastructure Subsystem and Rolling Stock (TTI)

TTI is the UIC's reference forum for studying the **interaction between trains and infrastructure**, balancing performance, safety and sustainability, and providing railway managers with **updated standards, guidelines and knowledge** to achieve a more efficient and interoperable railway system.

Main objectives

- ✓ Improve the **operational, economic, and environmental efficiency** of the railway system.
- ✓ Ensure **safety** and strengthen **international interoperability**.
- ✓ Identify and anticipate the **impact of changes** in any of the subsystems (infrastructure, rolling stock, operations, environment, regulations).

Interfaces and Interaction between Infrastructure Subsystem and Rolling Stock (TTI)



INTERNATIONAL RAILWAY SOLUTION **IRS 70729**
1st edition, 2019-10

Prevention and Mitigation of Derailment (PMD)

INTERNATIONAL RAILWAY SOLUTION **IRS 50505x1 - Ed. 1**
1st edition: January 2021

Railway transport stock
Rolling stock construction gauge



LINK: <https://shop.uic.org/en/>



Interfaces and Interaction between Infrastructure Subsystem and Rolling Stock (TTI)



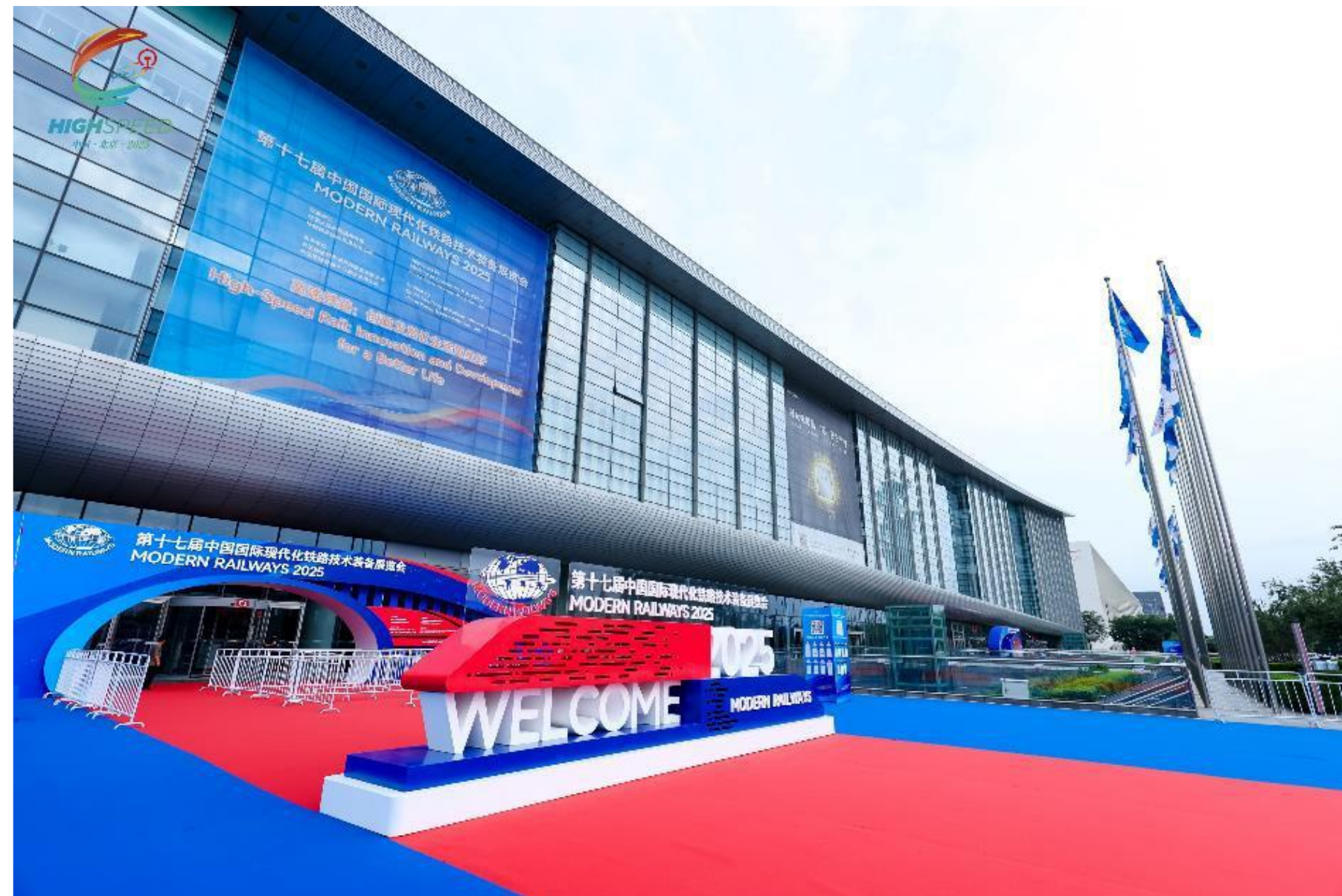
IWRN15

15th International Workshop on Railway Noise
15-19 September 2025 - Isla de la Toja, Spain

Interfaces and Interaction between Infrastructure Subsystem and Rolling Stock (TTI)

WCHSR 2025 – Introduction

From 10 to 12 July 2025, Beijing hosted the **12th UIC World Congress on High-Speed Rail**, bringing together over **2,000 participants** from more than **60 countries** - organised in collaboration with **China State Railway Group (CR)** and the **China Academy of Railway Sciences (CARS)**.



Interfaces and Interaction between Infrastructure Subsystem and Rolling Stock (TTI)



12th UIC WORLD CONGRESS ON HIGH-SPEED RAIL
8-11 July 2025 - Beijing, China


HIGHSPEED
中国 · 北京 · 2025

**Innovation and Development
for a Better Life**

**Resilience against
heavy rain and high
temperatures**

Addressing the impact of heavy rain and high
temperatures on railway infrastructure in the era of
climate change

Rosa Casquero
Head of Infrastructure, UIC, France
Session: 2.5 Infrastructure & Superstructure

The UIC RERA projects address the impact of heavy rain and high temperatures on railway infrastructure in the context of climate change.

Through frameworks for risk, vulnerability and adaptation planning, they provide scalable guidance for infrastructure managers. The goal is to strengthen resilience, integrate climate data into planning, and promote knowledge sharing across the railway sector.

Interfaces and Interaction between Infrastructure Subsystem and Rolling Stock (TTI)



12th UIC WORLD CONGRESS ON HIGH-SPEED RAIL
8-11 July 2025 - Beijing, China

HIGHSPEED
中国·北京·2025

UIC Aeronoise project

A simplified approach for measurement of aerodynamic noise emitted by high-speed trains

Jaume Solé-Bosquet
Chief Technical Engineer, SENER Mobility, Spain

Session 3.5 - Socio-Economics, Environment & Commercial

Innovation and Development for a Better Life

The Aeronoise project, led by UIC with partners such as HS2, SNCF, ADIF, Trafikverket, Banenor, and SZ, develops a simplified and cost-efficient methodology to measure aerodynamic noise from high-speed trains.

Focusing on upper train areas and pantograph noise, it enables quick and objective comparisons of emissions. Following validation campaigns in France and Spain, the project will deliver a new UIC IRS with the finalized methodology by 2026.

Interfaces and Interaction between Infrastructure Subsystem and Rolling Stock (TTI)



12th UIC WORLD CONGRESS ON HIGH-SPEED RAIL
8-11 July 2025 - Beijing, China

UIC *CONFORCES* project

Safety and Dynamic Performance Testing of
High-Speed Railway Vehicles Using
Instrumented Wheelsets

Luis Baeza
Full Professor at the University of Valencia



This study addresses the limitations of instrumented wheelsets used for UIC 518 homologation at very high speeds. While conventional methods assume a linear strain–force relationship and neglect dynamic effects, this simplification becomes questionable at commercial speeds of 350 km/h and above.

By employing advanced axisymmetric dynamic models that incorporate flexibility and inertial effects, the research demonstrates deviations of up to 10% between measured and actual forces, highlighting the need for more accurate methodologies in high-speed applications.

Interfaces and Interaction between Infrastructure Subsystem and Rolling Stock (TTI)



HIGHSPEED
中国·北京·2025

UIC
DYNMEASURE
project

Revolutionizing Rail Safety with Axle Load Monitoring Systems

Joaquin Botella
Sener Mobility, Spain

**Innovation and Development
for a Better Life**



This project investigates next-generation Axle Load Measurement Detectors (ALMDs) to improve rail safety and infrastructure protection.

AI- and data-driven systems enhance detection accuracy, reduce false alarms, and predict maintenance needs. Integrated with complementary monitoring tools, ALMDs provide a holistic safety framework, with case studies demonstrating benefits and recommendations to strengthen European regulations and global railway reliability.

Interfaces and Interaction between Infrastructure Subsystem and Rolling Stock (TTI)



15th International Workshop on Railway Noise
15-19 September 2025 - Isla de la Toja, Spain

Latest developments in the UIC Aeronoise project: a simplified methodology for measurement of aerodynamic noise emissions from high-speed trains

Jaume Sole¹, Gennaro Sica², Pierre Huguenet¹, Daniel Lurcock³, Baldrik Fauré⁴ and Rosa Casquero⁵

¹SENER Mobility SA.

E-mail: jaume.sole@mobility.sener

²HighSpeed 2 Ltd. London-UK ³ISVR, University of Southampton-UK

⁴SNCF, Saint Denis-France ⁵International Railways Union (UIC), Paris-France

The UIC Aeronoise Project aims to **simplify the measurement of aerodynamic noise from high-speed trains**, which becomes critical above 250 km/h and is difficult to mitigate with conventional barriers.

Using standard microphones and simple post-processing, the project enables objective assessment of noise emissions at different heights, overcoming the complexity and cost of traditional methods.

Interfaces and Interaction between Infrastructure Subsystem and Rolling Stock (TTI)

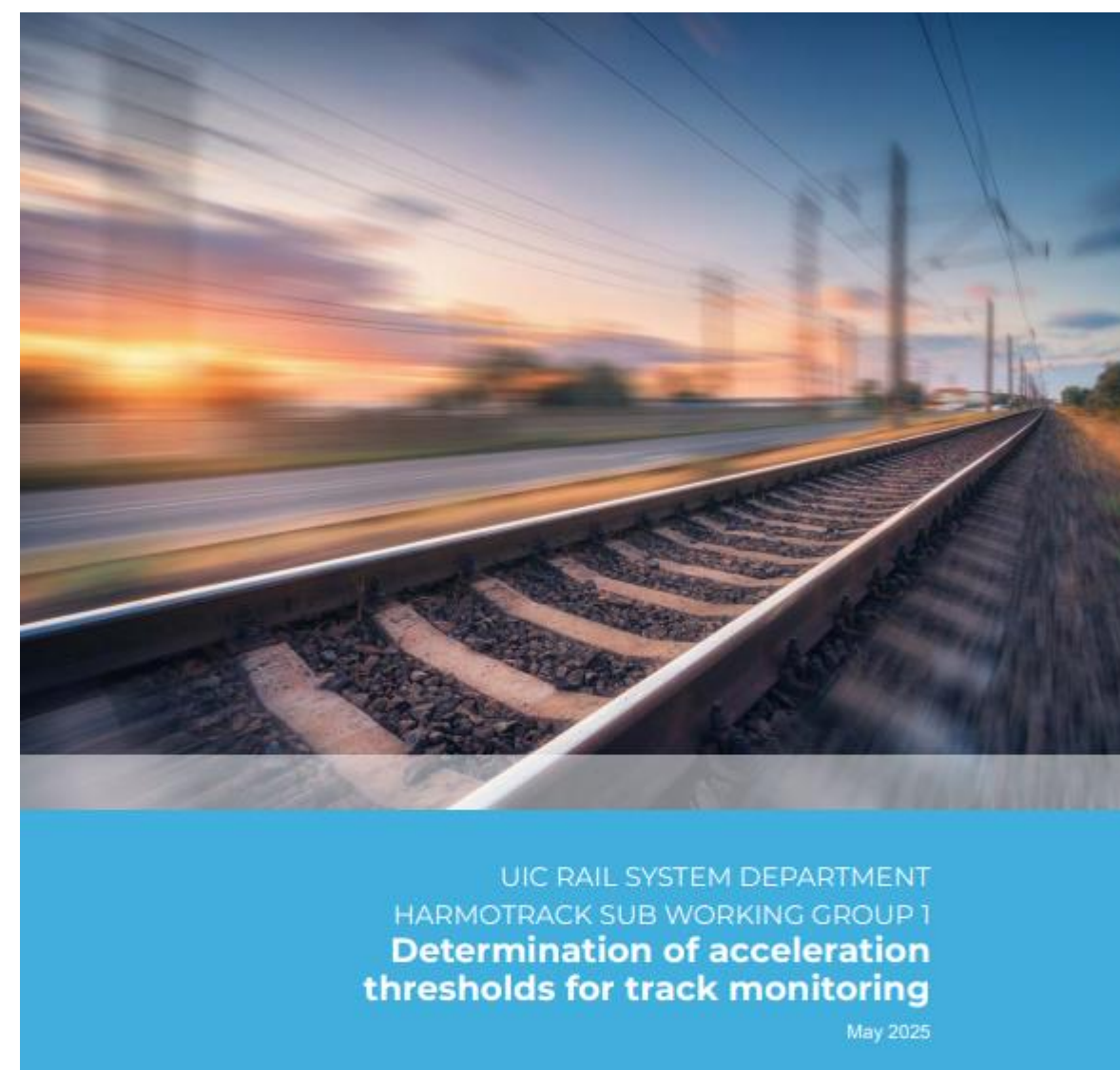


CROS-T

The UIC CROSS-T project studies the aerodynamic loads generated when high-speed trains pass freight trains in tunnels, where pressure waves can affect wagon safety and operations. Through simulations, it seeks to define limits and provide international guidance to ensure safe mixed traffic, improve interoperability, and support the shift of freight to rail.

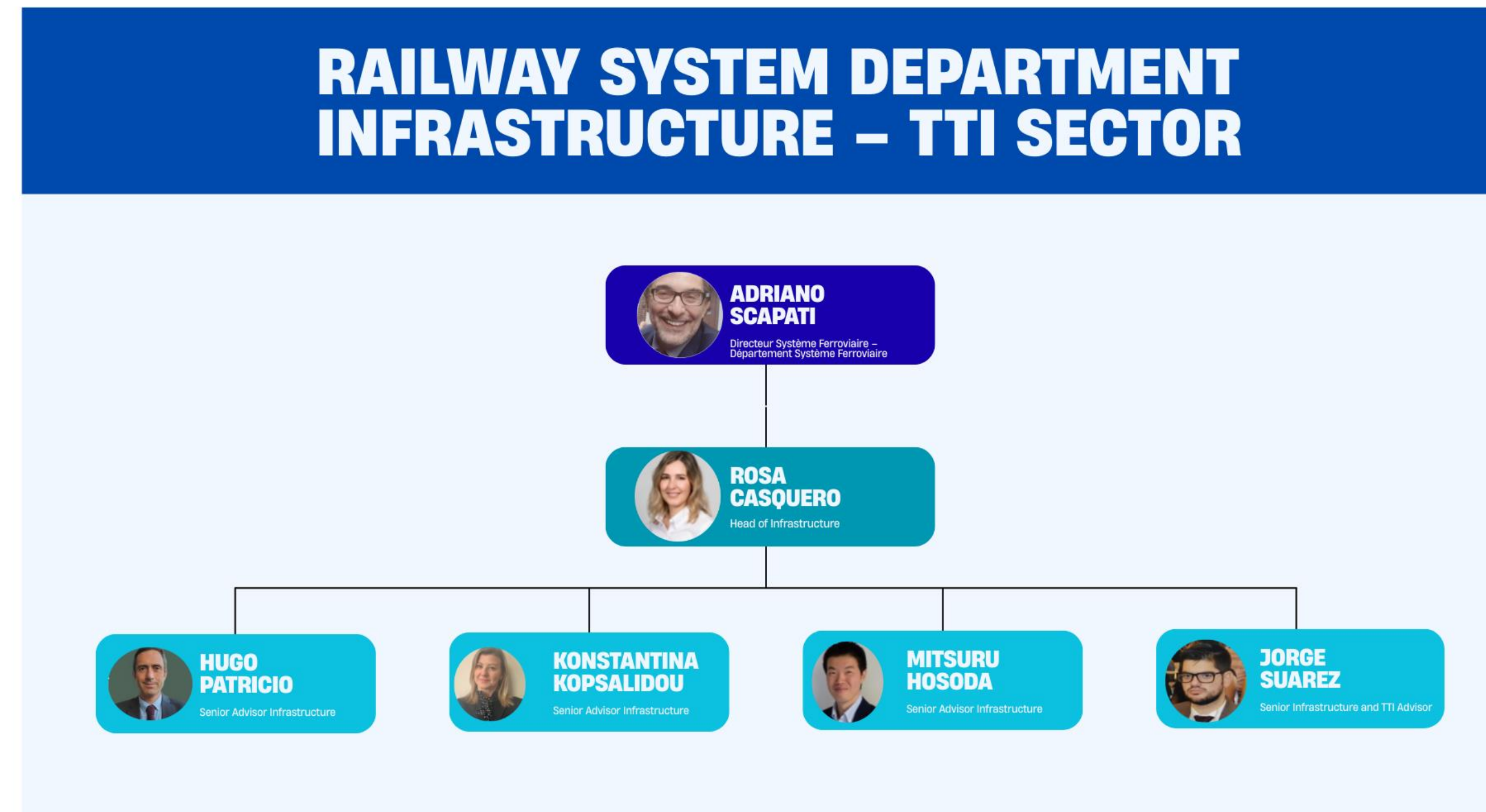
EXCELLENCE IN RAILWAY PUBLICATION AWARDS 2024

Harmotrack



UIC RSF General Information

Rail System Forum



RAIL SYSTEM FORUM
Robert Ampomah (NR)

TRAIN TRACK INTERACTION SECTOR
Chairman Anup Chalisey (RSSB)

Directeur Système Ferroviaire Welcome



SCAPATI Adriano

Directeur Système Ferroviaire

INTRODUCTION OF ADRIANO SCAPATI DIRECTOR OF RAIL SYSTEM DEPARTMENT

Mr. Adriano SCAPATI – UIC Rail System Dept. (seconded from “Ferrovie dello Stato Italiane” Group)

- About 30 years of experience across the aerospace, automotive, and railway sectors, from the launch of the Italian “High-Speed System” on 1996 (new Rolling Stock and Infrastructure – Design Phases, Testing and Commissioning, Maintenance, Signalling Systems, Depot and facilities at the stations) to the Operation of Intercity and International trains (in collaboration with SBB, SNCF, OBB, etc. - Managing Director and Member of Boards of Operation of “Cisalpino”, “Thello” and other European Operators).
- Last experience (2019-2024) as “Rolling Stock and Depot Director” (London) on the “*High Speed 2 Projects*” on the West Coast Main Line, in collaboration with the UK Department for Transport and First Group Ltd. - Stakeholder coordination, strategic and railway system vision, risk assessment, policy alignment, and strategic innovation, particularly in areas such as safety, sustainability, and customer travel experience.
- Professional experiences and relations have led me to work on complex and multicultural projects and teams, often in constantly evolving regulatory and technological contexts (Europe). I have led international teams in the definition and implementation of advanced solutions in the signalling systems (ATO, ERTMS), safety, digitalization of infrastructures and focus on the customer experience and services.

I am deeply inspired by UIC’s mission to foster global cooperation in the railway sector. I believe that the future of rail mobility depends on our collective ability to merge innovation with standardization, sustainability with efficiency, and local needs with international visions. Joining UIC in this pivotal leadership role would allow me to contribute not only my engineering and managerial expertise, but also my commitment to a shared, forward-looking rail system.

POINT 2. KEY INVITED SESSIONS

TTI sector - looking forward. Anup Chalisey. **RSSB**
Flying ballast. Miguel Rodríguez. **ADIF**

SWG Parallel Invited Session

SWG Pantograph-Catenary

1. *Pantograph testing for simulation models.* Manuel Tur. Polimi-UPV-Huddersfield
2. *Investigate pantograph-catenary interaction issues in neutral zones.* Mehdi Dib. RAIL ELECT Spa - Groupe GCF(SNTF)
3. *Current Developments in Rigid Catenary–Pantograph Wear Reduction: Insights from the University of Málaga.* Vid Bacic. Universidad de Málaga.

SWG Railway Dynamics and Gauges

Data-oriented

From Track to Tool: Turning Data into Compatibility Decisions. Amine Chakir SNCF

InterActive Pads for monitoring the interaction Wheel-Rail. Miguel del Sol. Universidad de Granada.

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Track component-oriented

Reduction of rapid variations in track stiffness around e.g. bridges and tunnels. Björn Paulsson Chalmers University of Technology.

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A new calculation framework for railway track designers and maintainers to better understand and estimate service loads. Yann Bezin. University of Huddersfield.

The dynamic amplification of railway loads in the design of under-track structures. Andrea Latorre. RFI.



INTERNATIONAL UNION
OF RAILWAYS

Social Dinner

 Starting at 20:00 CET

TTI

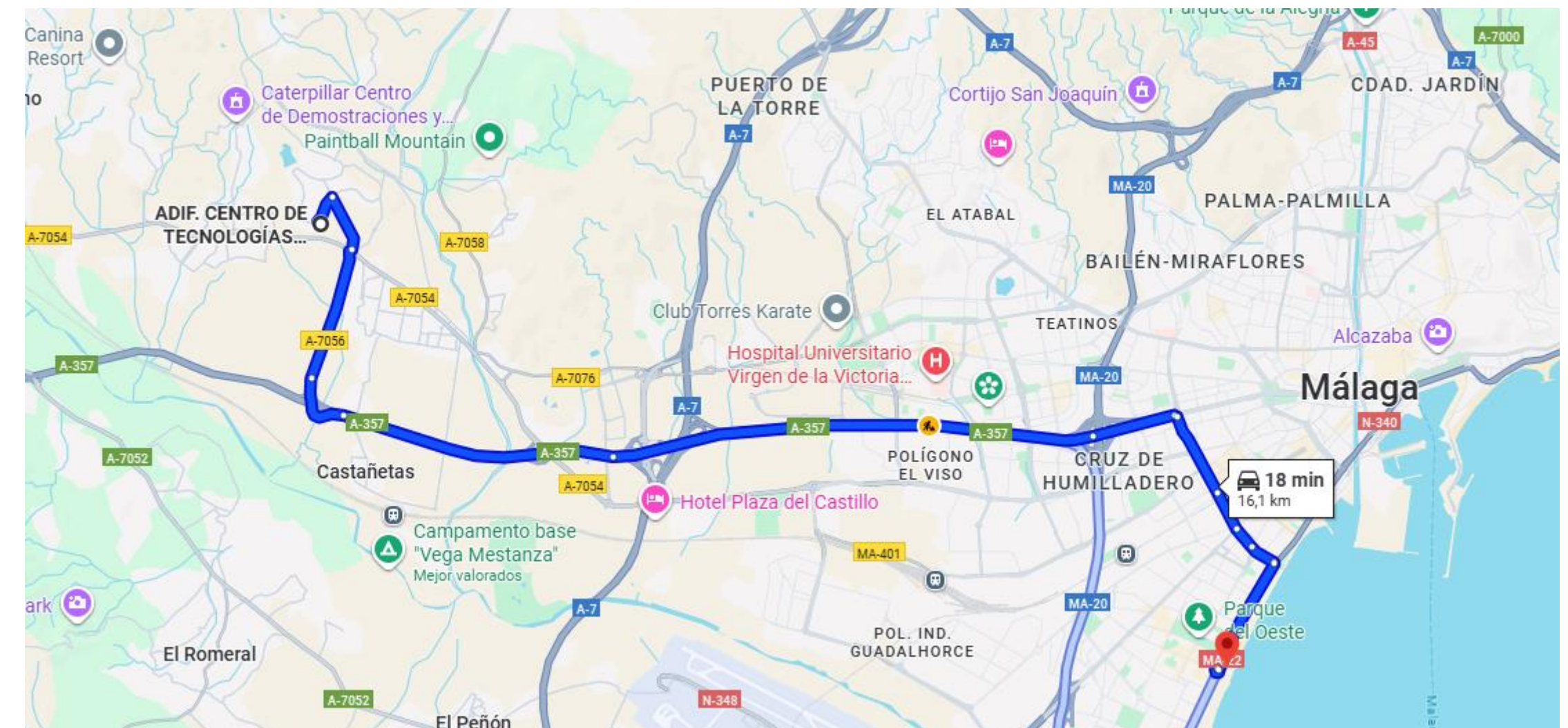
Train-Track Interaction



INTERNATIONAL UNION
OF RAILWAYS

📍 Chiringuito La Campana Playa

[Paseo Marítimo Antonio Banderas, 9, Carretera de
Cádiz, 29004 Málaga](#)



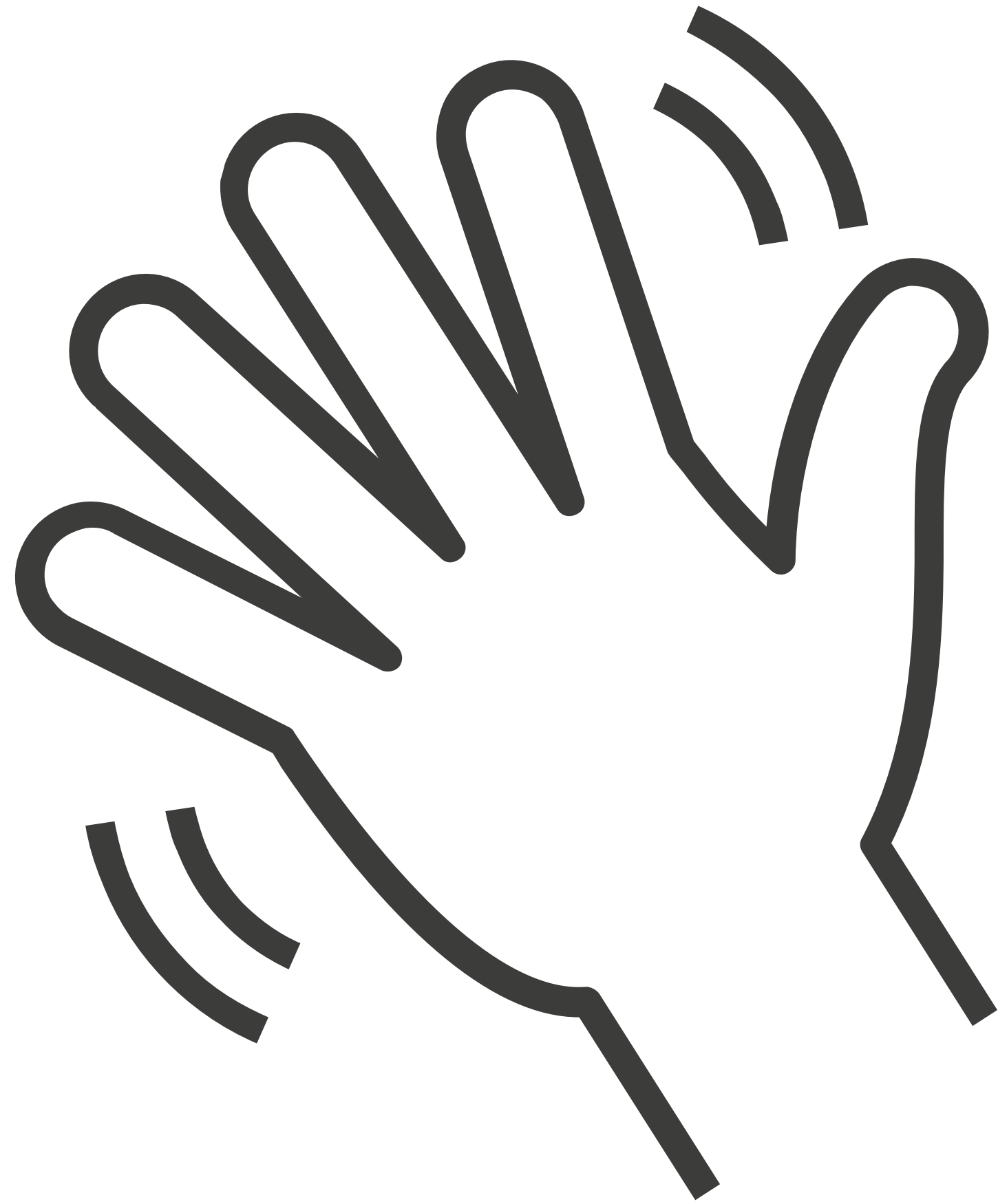
Train-Track Interaction

POINT 3. SUBWGS PARALLEL INVITED SESSION

15'

Break time





INTERNATIONAL UNION
OF RAILWAYS

See you tomorrow

Starting at 9:00 CET



Train-Track Interaction

Agenda

Day 2



Train-Track Interaction

Day 2. 18th September 2025

09:00-10:45 Point 4. Workshop on TTI strategy

Parallel working sessions on the different TTI SubWGs

Identifying key topics and building the Mission and Vision.

SWG Railway Dynamics and Gauges.

SWG Pantograph-Catenary.

General session to exchange each SubWG's conclusions.

10:45-11:00 Coffee break

11:00-11:30 Point 5. Opt-In 2026

Reminder and preparation of proposed opt-in projects for 2026.

11:30-12:00 Point 6. Ongoing projects update

The status of ongoing projects will be briefly presented.

- P384/ HARMO-TRACK project, which aims to harmonise data formats and thresholds for track geometry and dynamic measurements.
- P652/ CROSS-T project aimed at ensuring safe train operations when crossing in mixed traffic lines.
- P653/ AERONOISE project, which focuses on developing an improved noise emission measurement method for high-speed trains.
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- P849 / CONFORCES project, which aim to validation of measurements of the Wheel-rail contact forces through instrumental wheelsets for UIC Leaflet 518 homologation purposes.

12:00-12:20 Point 7. Migration plan

Follow-up and decision on revision of leaflets and IRS.

12:20-12:45 Point 8. AOB and Next Meeting dates

- Next meeting.

12:45-13:00 Final remarks and closure

Anup Chalisey, Chairman for the TTI Sector.

13:00-14:00 Lunch

Lunch at the Málaga TechPark.

POINT 4. WORKSHOP TTI STRATEGY

Parallel Working Sessions



➤ SWG Railway Dynamics & Gauges

- Rosa y Mitsuru
- Konstantina y Jorge



➤ SWG Pantograph-Catenary

- Anup



Part 1: Vision, Engagement & Collaboration

 **Define Clear Mission & Vision:** Understand TTI's unique value to the industry.

 **Strengthen Member Engagement**

- ✓ Promote active involvement of members
- ✓ Improve the Opt-in process, focusing on member needs.
- ✓ Increase critical mass in each subsector.

 **Enhance Collaboration**

- ✓ Improve links with other groups (PoSE, RST, ENE, Track Experts).
- ✓ Establish an RU/IM advisory board to understand expectations.

 **Recognition:** Be the go-to UIC unit for transversal topics

Part 2: Meetings, Knowledge & Competitiveness



Optimize Meetings

- ✓ Make meetings more engaging to attract in-person attendance
- ✓ Consider meeting formats: out-of-Paris physical meetings, plenaries per subgroup, more (online) SWG meeting.



Knowledge Sharing

- ✓ Organize seminars/workshops on operational/maintenance issues.
- ✓ Develop training programs with UIC Academy and other experts.



Strategic Focus & UIC's Value

- ✓ Survey industry for key issues to shape strategy.
- ✓ Align TTI strategy with other sub-sectors.
- ✓ Address critical infrastructure (defense, climate change).
- ✓ Define UIC's competitive advantage, especially against environments offering financial returns.
- ✓ Focus on pre-standardization steps and recommendations for using standards

SWG Aerodynamic and Acoustics

Enhanced Cooperation

Improve collaboration and define competences with UIC Noise & Vibration (N&V) Expert Group to avoid overlap.

Technical Priorities

- ✓ Integrate acoustics into other areas (e.g., Pant-Cat interaction).
- ✓ Address ISO 3095 / TSI for better aerodynamic noise characterization.
- ✓ Guideline for operational conditions of crossing trains (infra & RS considered).
- ✓ Speed is not the only key factor.
- ✓ Investigate top-of-rail materials for reduced noise/wear.
- ✓ Set requirements for high-speed rolling stock aerodynamic noise and a guideline for wind tunnel acoustic tests.

Industry Involvement

Attract manufacturers like Talgo, CAF, Alstom.

SWG Railway Dynamics & Gauges



Rolling Stock & Infrastructure Interaction

- ✓ Evaluating how new trains impact track maintenance.
- ✓ Creating a system for sharing train data between operators and infrastructure managers..



Gauging & Standardization

- ✓ Developing a practical "how-to" guide for gauging (the space trains need to pass).
- ✓ Promoting a unified gauge and assessment method across Europe. Fewer complications.



Track Lifecycle & Performance

- ✓ Investigating how to increase track life (up to 60 years!) and related maintenance.
- ✓ Assessing how to apply "Harmotrack" outcomes to improve infrastructure management.



High-Speed Comfort

Reviewing homologation for trains over 300km/h to ensure maximum passenger comfort.



Publish the White Paper and ensure operational safety

SWG Pantograph-Catenary



Collaboration & Key Issue

- ✓ Increase cooperation with the Rolling Stock sector (short-term project).
- ✓ Study frequent pantograph-induced catenary breakages to find solutions.
- ✓ Investigate pantograph-catenary interaction issues in neutral zones, especially with new operators.



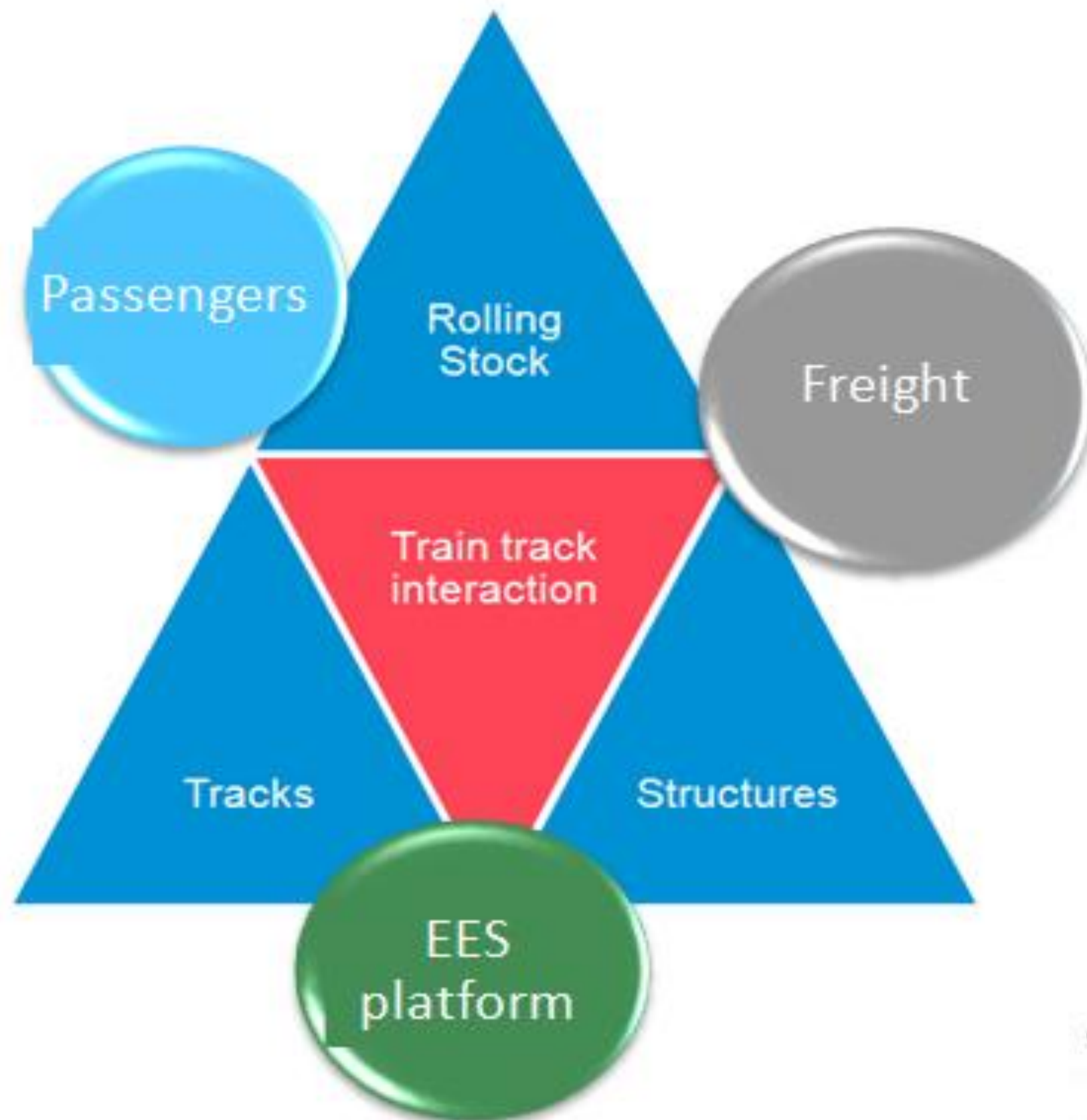
Simulation & Testing Advancement

- ✓ Promote simulation and lab testing to substitute on-track tests.
- ✓ Build confidence by comparing simulations with real measurements and diverse configurations.
- ✓ Apply railway dynamics simulations to pantograph-catenary interaction studies (co-simulations).
- ✓ Develop pantograph testing for simulation models and more realistic overhead line models.



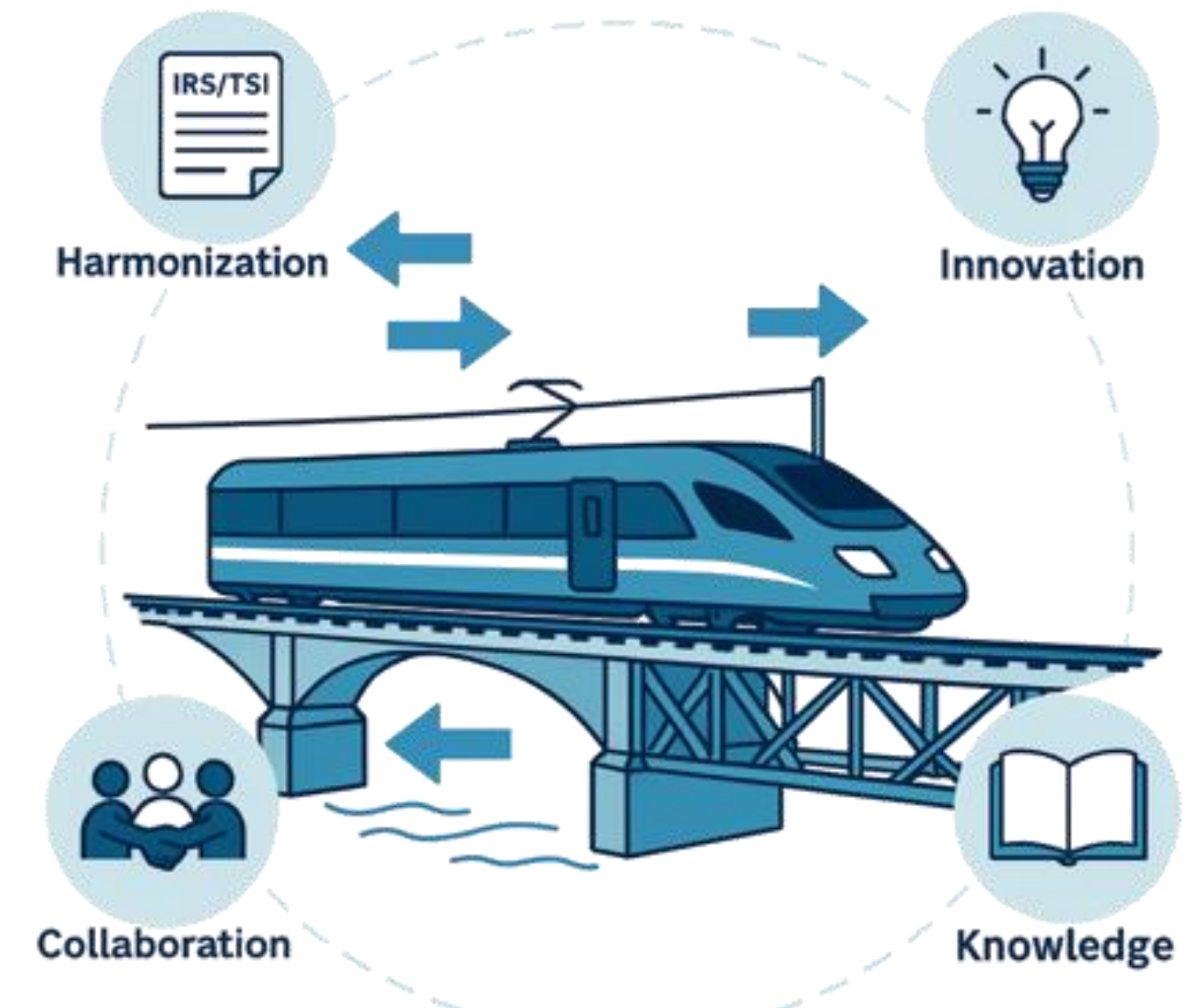
Publish the White Paper

Strategy and objectives



TTI Sector – Strategic Objective

Strengthen the TTI sector by positioning it as the international technical reference for the interaction between railway infrastructure and rolling stock, driving collaboration among IM and RU and fostering innovation, standardization, and knowledge transfer within the UIC.



TTI Sector – Strategic Abstract

1. Alignment with IMs and RUs

2. Strengthening SWGs

3. Visibility & Communication

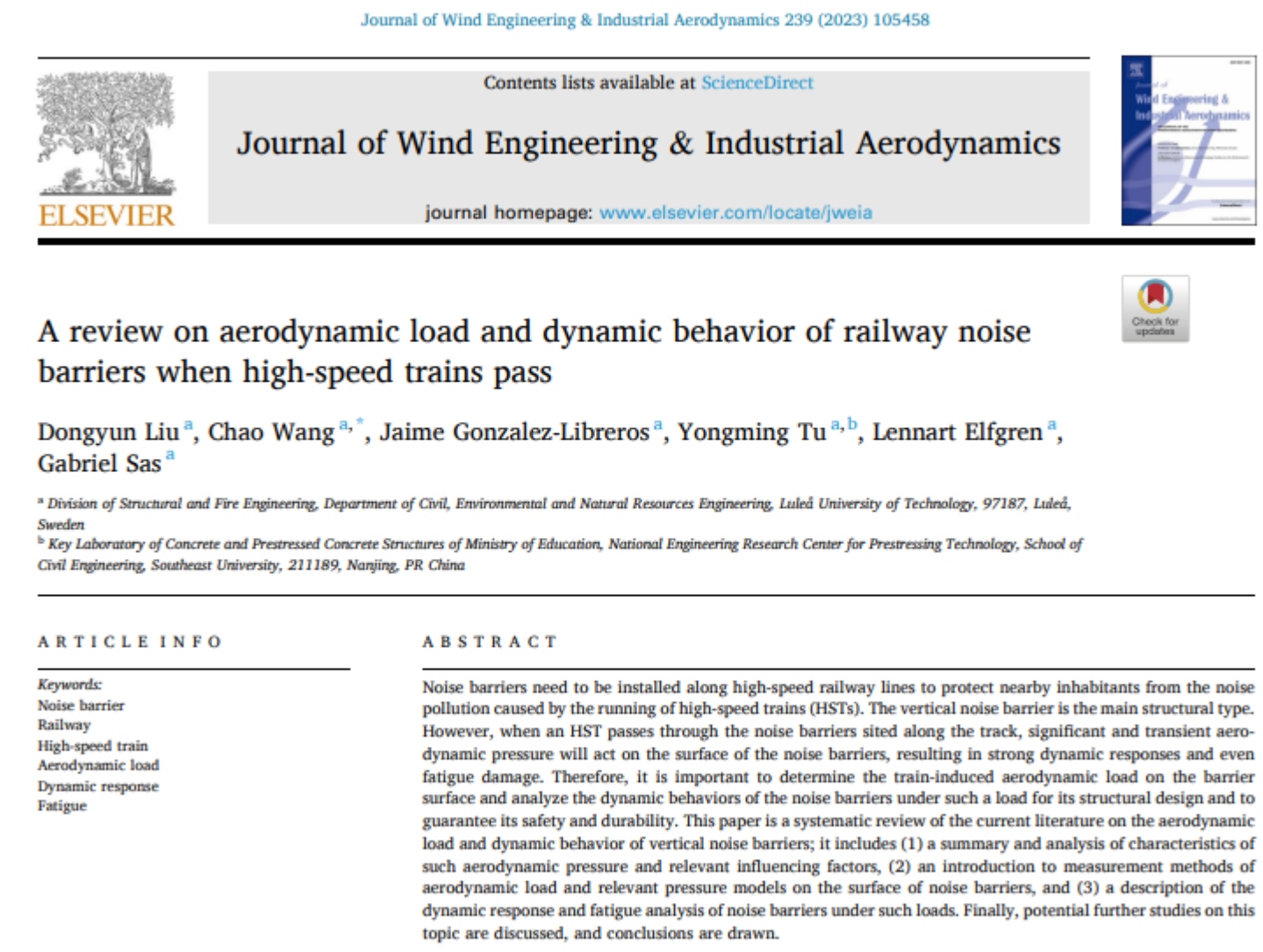
4. Innovation & Strategic Projects

5. Synergies & Standardization



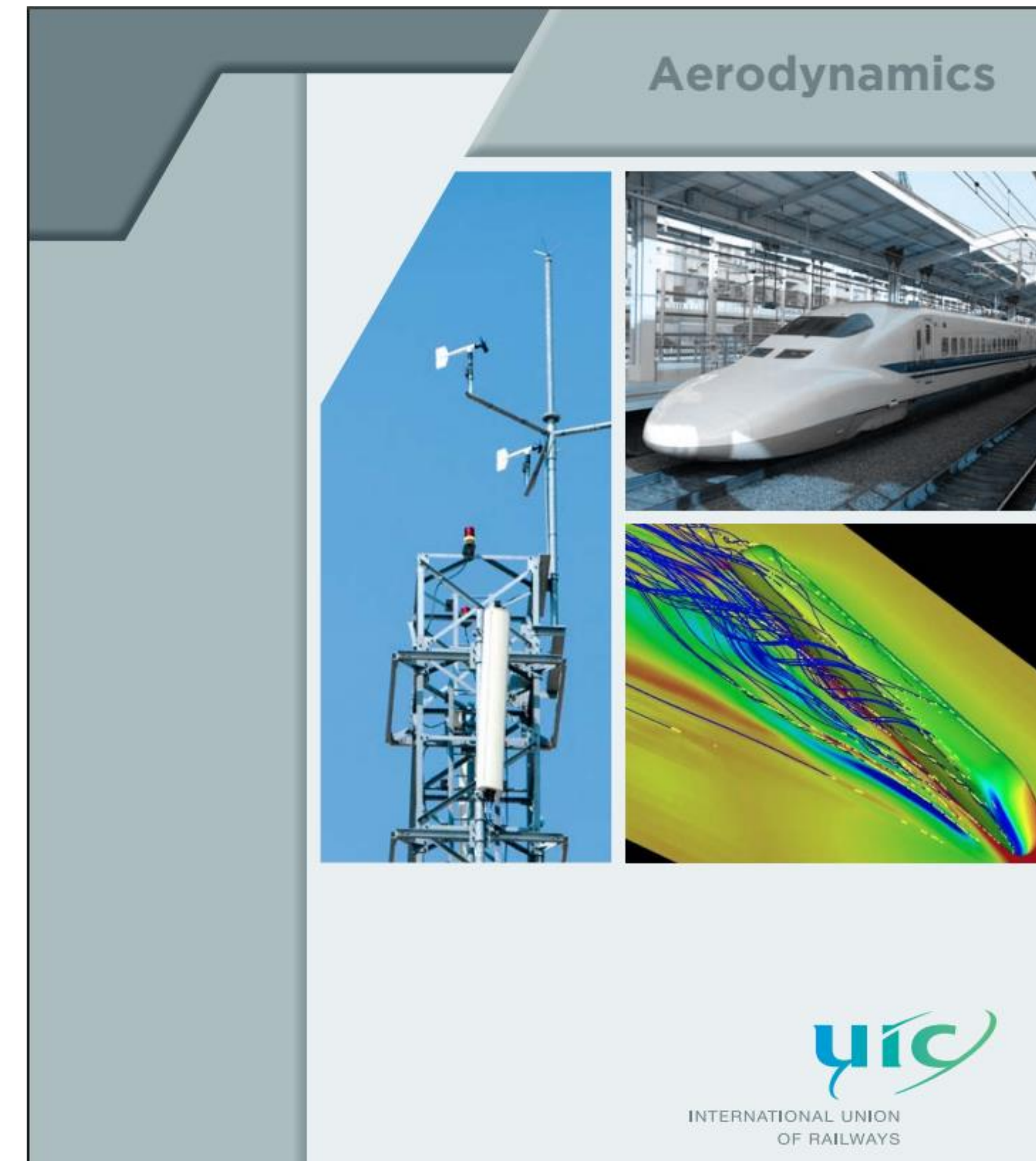
AXIS 1: ALIGNMENT WITH IMs and RUs

- Identify key IMs and RUs contacts.
- Conduct surveys on technical priorities.
- Analyze the current technological landscape.



AXIS 2: STRENGTHENING SWGs

- Consolidate existing thematic areas.
- Define mission and vision for each group.
- Publish technical whitepapers.
- Minority sectors: Aerodynamics & Acoustics, and Pantograph–Catenary Interaction, with few experts spread across different countries.
- Need for TEG coordination to collaborate and differentiate.





AXIS 3: VISIBILITY AND COMMUNICATION

- Increase global awareness and participation.
- Organize technical webinars.
- Create a TTI newsletter/observatory.

NEWSLETTER

Issue No. 12 | April 2024

Málaga Plenary Session

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Sed do eusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad aud euism verendus ultamullam risce, ulsque ausrim secequat.





AXIS 4 : : INNOVATION AND PROJECTS

- Promote strategic Opt-In projects.
- Launch 'TTI Innovation Challenges'.
- Promote publication of articles in high-impact journals



Sub Working Group 1

*Determination of
acceleration
thresholds for
track monitoring*

Technical report



AXIS 5 : SYNERGIES AND STANDARDIZATION

- Collaborate with ERA and standardization bodies.
- Coordinate UIC Leaflets to IRS migration.



Moving Europe towards a sustainable
and safe railway system without frontiers.



Objectives: Success Indicators for ETTI Opt-in (2026)

- Four players: RFI, ADIF, Network Rail, SNCF, DB, OBB
- Two/Three mid players: IP, SBB, Trafikverket.
- RSSB as a constant presence.

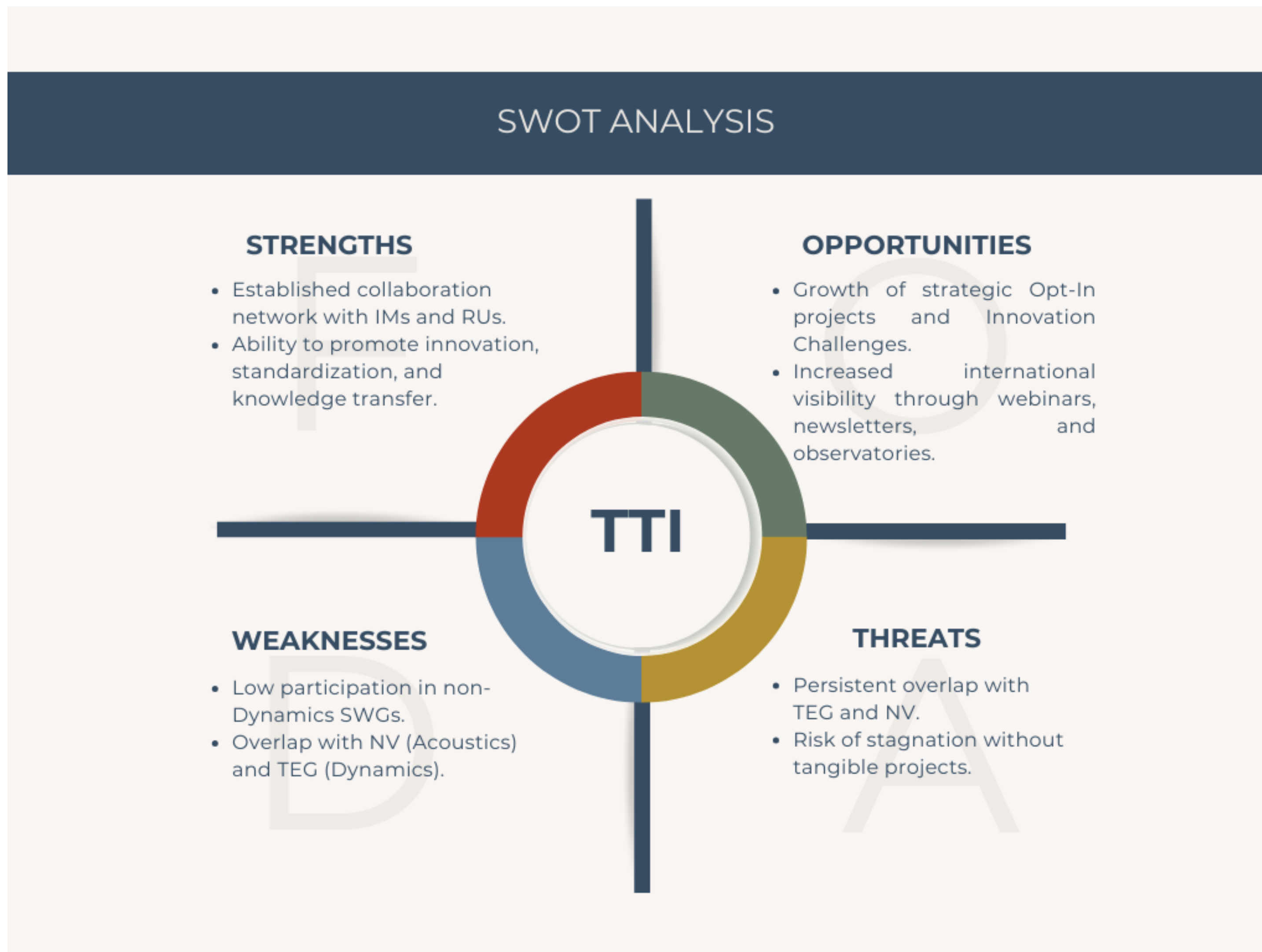


Current weaknesses

- Low participation in non-Dynamics SWGs
- Overlap with NV sector (Acoustics)
- Overlap with TEG sector (Dynamics)
- Difficult to find experts beyond academia
- Few experts are UIC members → weak sector base
- UIC can offer a common collaboration framework
- Better to boost specific projects than only rely on meetings

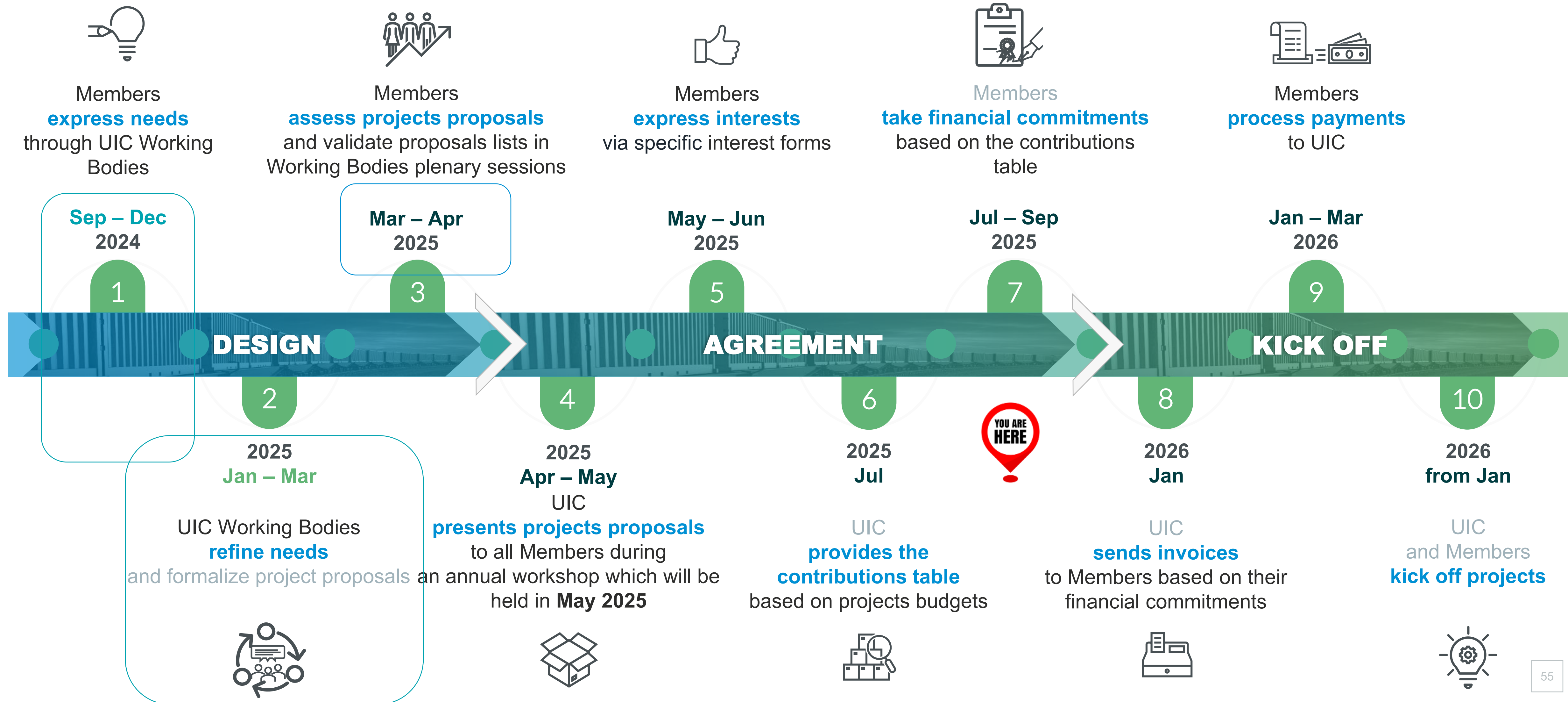


SWOT ANALYSIS



News from UIC

UIC Opt-In Process



15'

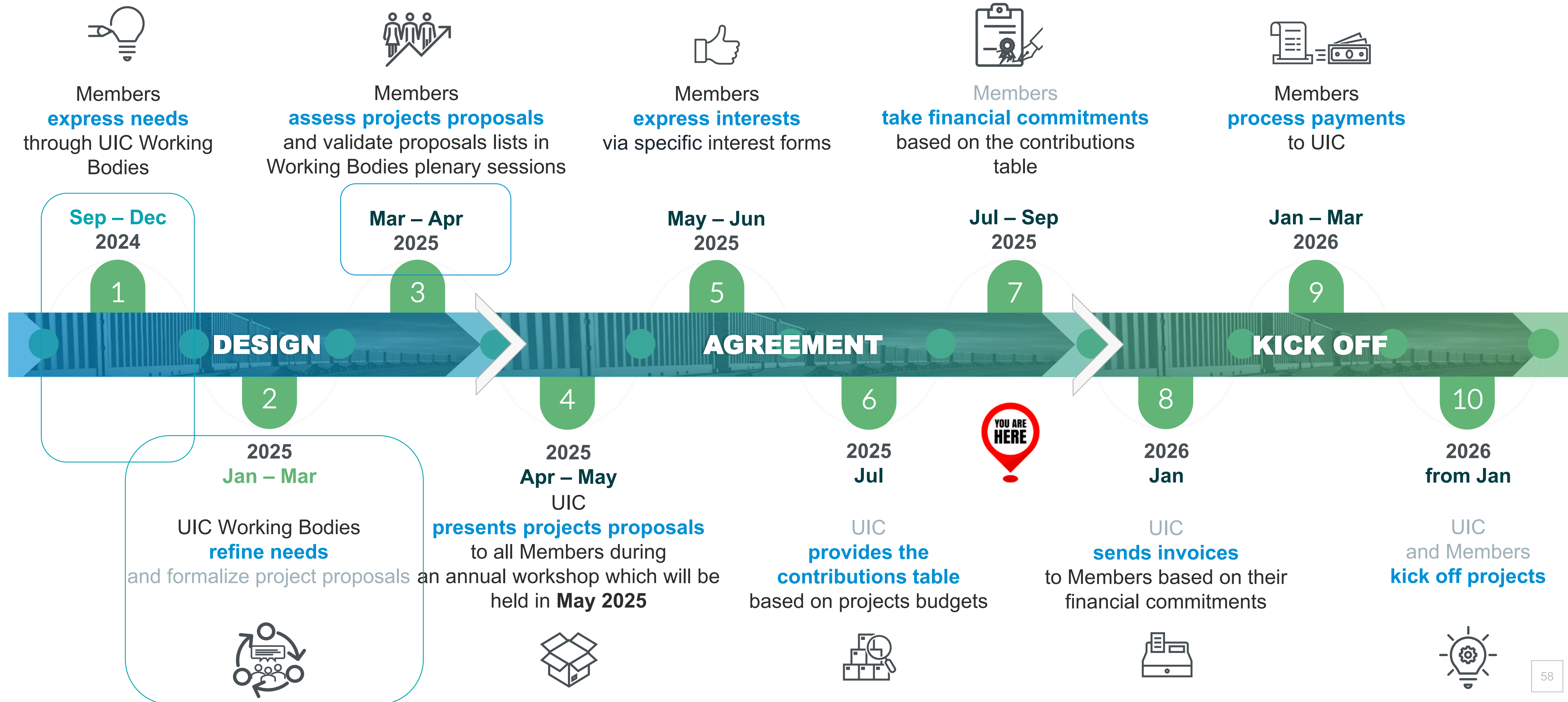
Break time



POINT 5. OPT-IN PROJECTS FOR 2026

News from UIC

UIC Opt-In Process





INTERNATIONAL UNION
OF RAILWAYS

UIC WORK PROGRAMME 2026

**ETTI
(Experts Group on Train-Track Interaction)
2026/RSF/XXX**

Rosa CASQUERO (Head of the TTI Unit)

Project Management Workshop - May 2026



Project Summary

« RSF » / « TTI » / « ETTI »

Background

The UIC TTI Group of Experts was born several years ago to address the railway cross-cutting subjects of acoustics, aerodynamics, dynamics, gauges and pantograph-catenary interaction. Its most characteristic features are the wide variety of topics and their great complexity, leading to a shortage of experts on the subject..

This group had never own budget, whereas most of the UIC sectors are financed to have own resources and avoid dependency form UIC specific opt-ins or external incomes.

Scope

Enhance the group of train-track interaction experts to become the world reference on this complex railway issues. It's key to have a sufficient number of experts in all the disciplines involved, to establish together the sector strategy and to produce high added value to solve the railway community's problems in this field.

Duration & Cost

- From 2026 on – Permanent activity
- Per year : 75 k€ (reduced fee for TEG&PoSE members)



Objectives, Drivers & Benefits

Objectives

- Address the railway cross-cutting subjects of acoustics, aerodynamics, dynamics, gauges and pantograph-catenary interaction
- Set the sector strategy and follow a clear roadmap to make these disciplines grow up
- Become a forum of knowledge exchange of numerous experts from all the associated fields
- Identify key projects and research actions to be developed at UIC or in collaboration with other bodies (academia, laboratories, safety agencies, standardization bodies, funding institutions, etc.)
- Organize technical seminars/workshops/activities to share and enhance knowledge and expertise
- Provide trainings to own and external members

Benefits

- Increasing train-track interaction expertise to provide specific solutions for complex current problems
- Influence and collaborate on key regulations/standards related to TTI (CEN, ISO, AREMA, TSI...)
- Have a dedicated forum of exchange (so far there is nothing equivalent on these fields)
- Train UIC members on this complex engineering subjects

Drivers

- Increasing knowledge
- Solving complex railway problems



Key Points

TTI complexity

- Understanding train-track interaction requires deep knowledge on infrastructure and vehicle
- It requires a thorough knowledge of physics and mathematics applied to railways
- Most experts have knowledge just on one side
- Finding the right experts is key

Some examples of TTI most relevant concerns

- Wheel-rail contact mechanics, transition zones or components' degradation models
- High-Speed and Very-High-Speed Train Dynamics (critical speed, dynamic stability, etc.)
- Noise and Vibration: structure-borne noise, ground vibration, mitigation measures
- Aerodynamic knowledge for mix-traffic operations' optimization
- Inconsistency of clearance gauges' national rules for cross-border operations
- Reliability of simulations for pantograph-catenary interaction tests



Deliverables, Dependencies & Support

Deliverables

- Internal report on specific topics (for project members)
 - Delivery date: upon demand of the ETTI
- UIC public Whitepapers (to describe the state of the art and identify knowledge gaps)
 - Delivery date: following the TTI roadmap
- UIC public reports (to share findings and exchanges on specific topics)
 - Delivery date: upon demand of the ETTI

Dependencies

- Strong collaboration with UIC Noise&Vibrations, Rolling Stock and Energy Sectors
- Coordination with standardisations bodies such as CEN or ISO
- Cooperation with ERA, EIM, CER and UNIFE among others

Support

- Target audience: train-track interaction experts from IMs, RUs and academia





Budget

YEARLY BUDGET ESTIMATE				
RESOURCES	Project contributions		75.000 €	from project members
	TOTAL RESOURCES		75.000 €	
SPENDINGS	UIC staff		25.000 €	
	Subcontracting		30.000 €	
	Travels & receptions		12.000 €	seminars or workshops
	General & administrative		3.000 €	
	Other		5.000 €	
	TOTAL SPENDINGS		75.000 €	



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UIC WORK PROGRAMME 2026

CorruTrack
(Mechanisms and mitigation of rail corrugation)
2026/RSF/XXX

Rosa CASQUERO (Head of the TTI Unit)

Project Management Workshop - May 2026



Project Summary

« RSF » / « TTI » / « CorruTrack »

Background

Rail corrugation (wavy-shaped irregularity on the rail's rolling surface) causes multitude of impacts in the railway system:

- Track and infrastructure damage
- Operational disruptions: noise and vibrations, speed restrictions and affection to passenger comfort
- Wear and Tear on Rolling Stock
- Ultimately safety issues
- Operational and financial impact

Removal operations: regular grinding/friction modifiers/potentially full track replacement/purchase of affected buildings (severe cases).

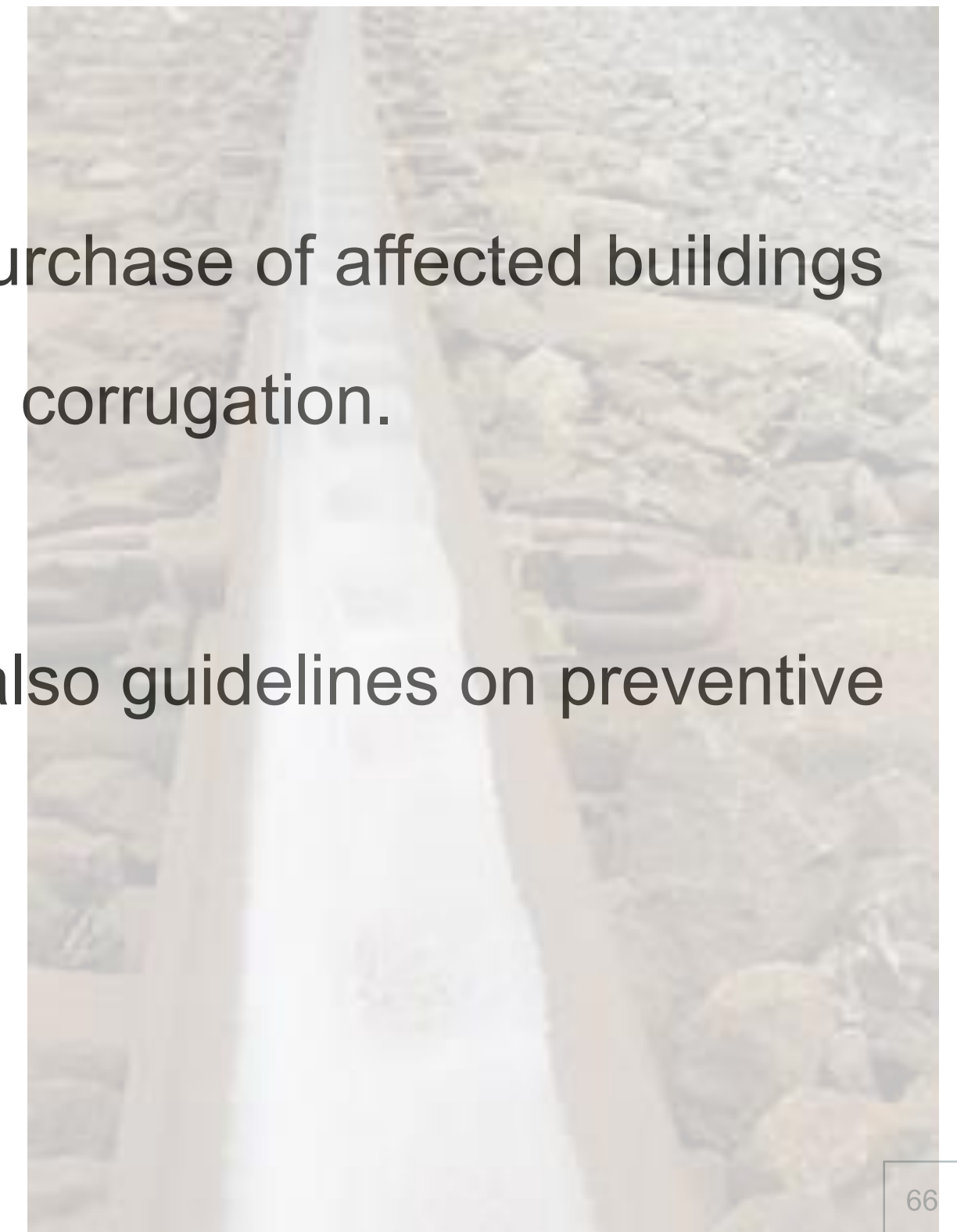
Current situation: lack of agreed and definitive explanation for the mechanisms behind rail corrugation.

Scope

Provide deeper and agreed understanding of the mechanism, open tools to model it and also guidelines on preventive and corrective measures to minimize its appearance and growth.

Duration & Cost

- From 2026 to 2028- 3 years
- Per year : 90 k€ - Total 270 k€





Objectives, Drivers & Benefits

Objectives

- Successfully simulate the specific mechanism behind the growth of rail corrugation as it occurs in real cases.
- Agree on the main mechanism(s) that cause the phenomenon
- Develop open tools to model it
- Provide guidelines for preventive and corrective maintenance to minimize its appearance/growth

Benefits

- Extend rail, wheel, track components and subgrade's lifespan
- Provide knowledge and solutions to increase railway maintenance's efficiency
- Reduce noise and vibration problems derived from corrugation
- Solve this long-standing engineering problem

Drivers

- Maintenance costs' reduction
- Enhancement of railway safety, operation and environmental performance



Key Points

Key aspects to be considered

- Ability to precisely simulate the steady-state conditions experienced by a vehicle on curves
- Availability of complex models that capture the full range of track vibrations
- Availability of models for railway wheelset vibration that account for flexibility and rotational effects.
- Capacity to integrate non-steady wheel-rail contact models, thanks to recent development and advancements in computational power

Practical approach

- Project experts will provide diverse and real corrugation cases
- Simulations will be validated against the real cases
- Performance of field tests to check preventive/corrective measures derived from the project



Deliverables, Dependencies & Support

Deliverables

- Internal report (for project members)
 - Title: UIC project Corrugation, development and results
 - Delivery date: 2028
- UIC Guidelines
 - Title: Corrugation mechanisms and mitigation measures
 - Delivery date: 2028

Dependencies

- Coordination with Noise and Vibrations Sector

Support

- Target audience: Wheel-rail dynamics and maintenance experts from IMs and RUs





Budget

YEARLY BUDGET ESTIMATE				
RESOURCES	Project contributions	90.000 €	from project members	
	TOTAL RESOURCES	90.000 €		
SPENDINGS	UIC staff	30.000 €		
	Subcontracting	45.000 €		
	Travels & receptions	7.000 €		
	General & administrative	3.000 €		
	Other	5.000 €		
	TOTAL SPENDINGS	90.000 €		



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UIC WORK PROGRAMME 2026

Model4Pant
(Improvement of pantograph-catenary simulation tools)
2026/RSF/XXX

Position

Project Management Workshop - May 2026



Project Summary

« RSF » / « TTI » / « Model4Pant »

Background

Simulations of OHL-pantograph interaction are an essential tool in designing new lines:

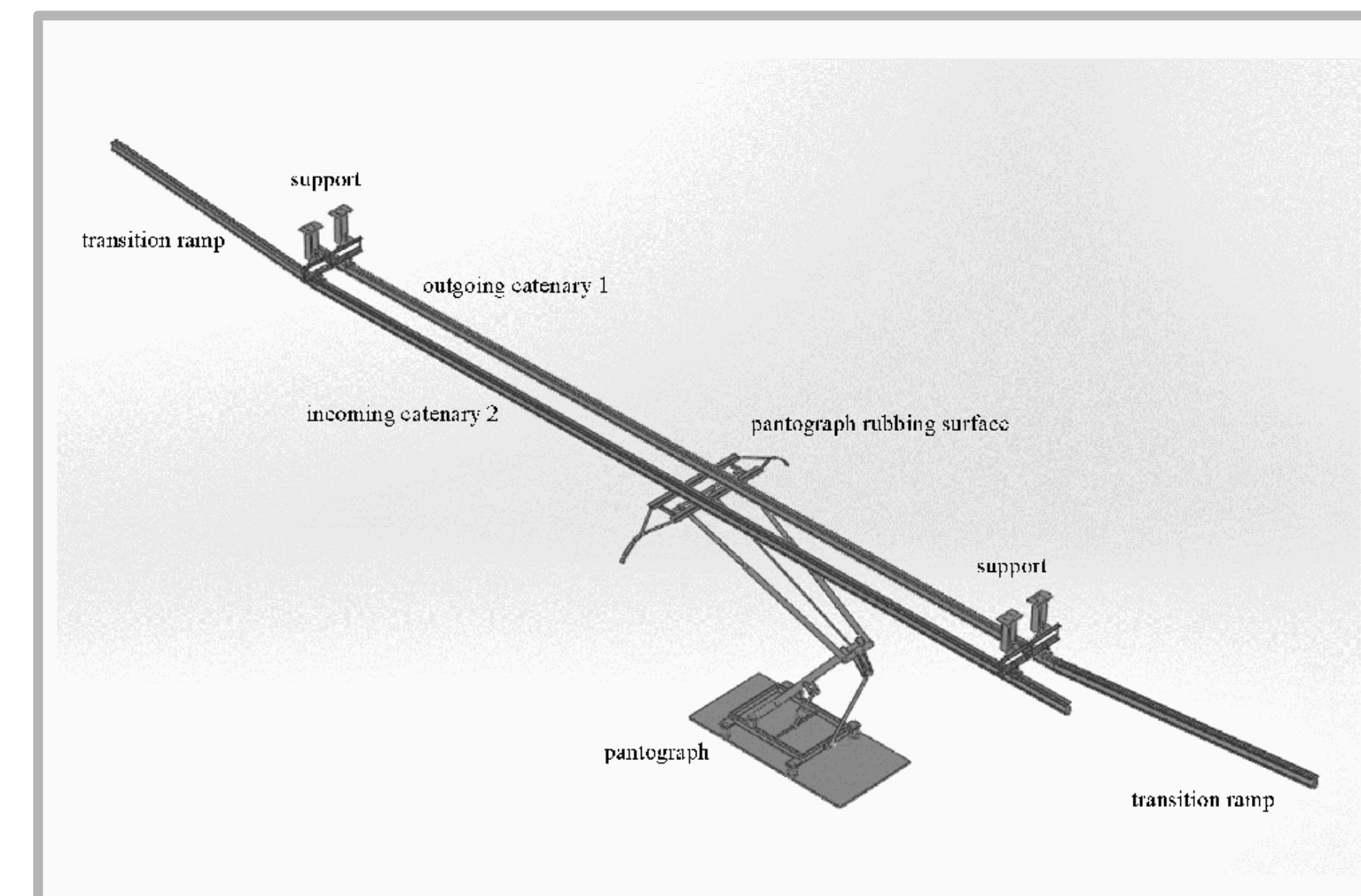
- ❖ Objectives : assistance for design of new lines, assessment the interoperability compliance (Energy and Loc&Pas TSI) and analysis of in-service problems
- ❖ Concerns: rely on models that imply uncertainties - > quantification and improvement

Scope

Strengthen OHL-pantograph simulation tools to increase their current reliability and foster their applicability as a powerful means to reduce costs and improve safety throughout the entire lifecycle of the electrification project.

Duration & Cost

- From 2026 to 2028- 3 years
- Per year : 90 k€ - Total 270 k€





Objectives, Drivers & Benefits

Objectives

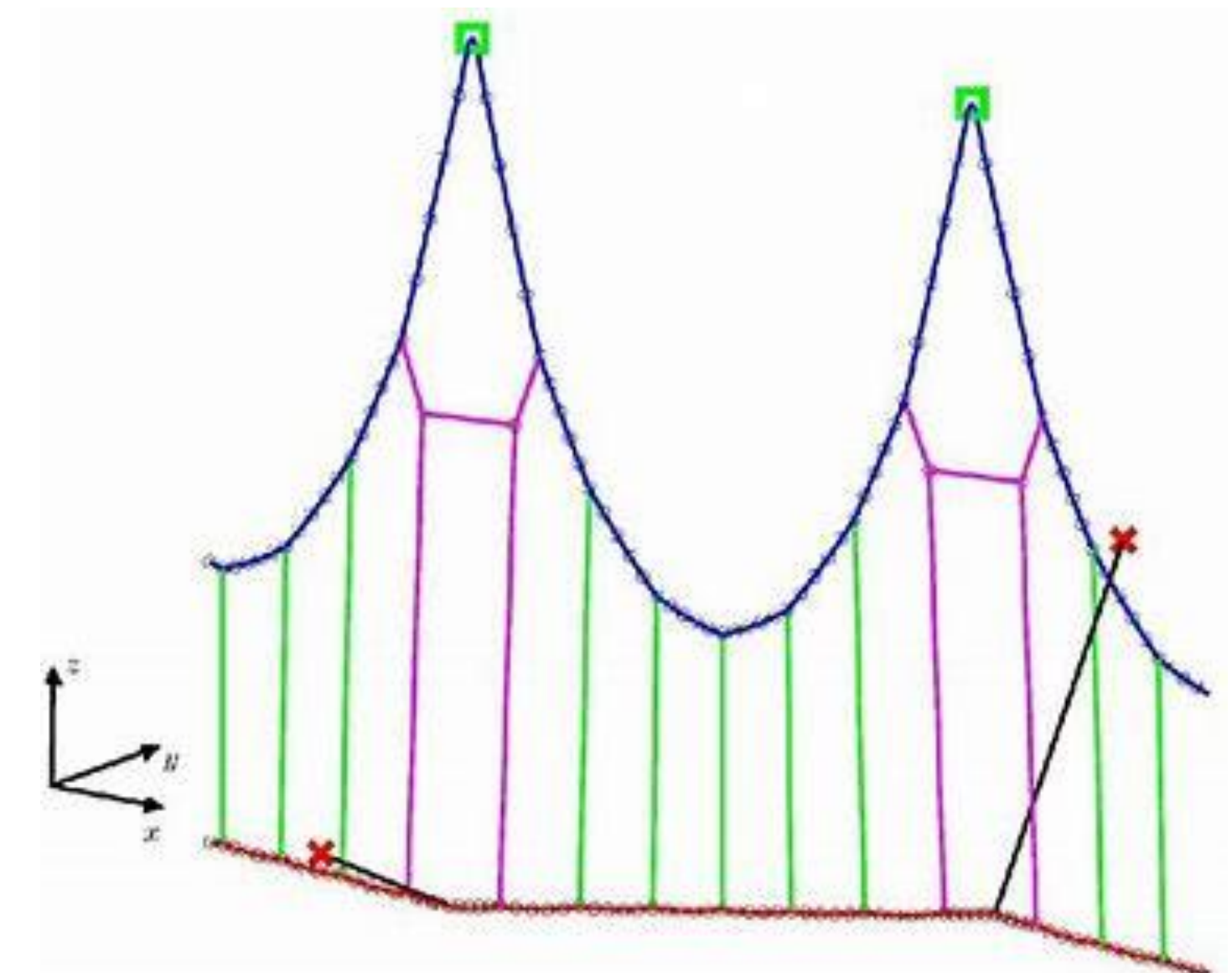
- Standardize how pantograph should be tested to obtain numerical models valid for simulations
- Provide an accepted procedure for dynamic testing and pantograph parameters acquisition
 - ❖ Develop a UIC methodology to build a pantograph model from lab test
 - ❖ Guide for choosing the best model for every overhead line type

Benefits

- Improve confidence on simulations: long-term goal of replacing in-line test by simulations
- Promote interoperability assessment by means of simulation
- Reduce homologation costs and tests costs
- Improve the exchange of data between different bodies

Drivers

- Cost reduction and time saving
- Safety enhancement





Key Points

Limitations of the current standards

- EN50318 Validation of simulation codes & EN50317 Instrumented pantograph testing
 - Don't provide rules or guidelines to identify the parameters of the pantograph model
 - Each catenary type needs a different pantograph model for an accurate simulation

Methodology

- Build a pantograph model from laboratory test rig
- Simulate pantograph-catenary interaction using a simulation code
- Compare simulations with on-track results (contact force, contact wire elevation,...)

Additional information

- Consider a representative sample of pantographs, overhead line types and simulation codes
- Comparison of different lab testing technologies will be performed



Deliverables, Dependencies & Support

Deliverables

- Internal report (for project members)
 - Title: UIC project Model4Pant-Methodology, development and results
 - Delivery date: 2028
- UIC Guidelines
 - Title: Dynamic testing and pantograph parameters acquisition for pantograph-OHL simulations
 - Delivery date: 2028

Dependencies

- Close connection with UIC Energy and Rolling Stock Unit and experts
- Build connections with ERS for TSI aspects

Support

- Target audience: experts from IMs and Rus
- Strong support from universities





Budget

YEARLY BUDGET ESTIMATE						
RESOURCES	Project contributions		90.000 €	from project members		
	TOTAL RESOURCES		90.000 €			
SPENDINGS	UIC staff		30.000 €			
	Subcontracting		45.000 €			
	Travels & receptions		7.000 €			
	General & administrative		3.000 €			
	Other		5.000 €			
	TOTAL SPENDINGS		90.000 €			



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UIC WORK PROGRAMME 2026

BridgeStiff
2026/RSF/xxx

Hugo Patricio

Senior advisor Infrastructure and Asset Management



Project Summary

« RSF » / « TTI » / « BridgeStiff »

Scope

- There is a strong correlation between a high substructure stiffness gradient and a high growth rate of local irregularities in vertical track geometry, and this fact is common around bridge abutments. Track stiffness measurement is an opportunity to find these locations and prevent further maintenance problems. Once these spots are located, simulations can be run to reduce the stiffness gradient with different track components combinations.
- The aim of the project is developing a cost-efficient and reliable stiffness measuring device, as well as a simulation tool to link the stiffness outputs with different track configurations. An IRS providing design and maintenance guidelines on stiffness management at bridges will be produced as well.

Duration & Cost

- From 2026 to 2028 - 3 years
- Per year : 100 k€ - Total 300 k€



source: *Bridge Approaches and Track Stiffness*, Federal Railroad Administration 2007



Objectives, Drivers & Benefits

Objectives

- Develop a reliable and cost-efficient track stiffness measuring device
- Develop a simulation tool to assess system' stiffness under different track configurations
- Publishing an IRS providing design and maintenance guidelines on stiffness management at bridges

Drivers

- Safety and Reliability:
 - Ensuring the structural integrity and safety of railway tracks, especially around bridge abutments.
 - Reducing the risk of track failures and accidents by identifying and mitigating high stiffness gradients
- Cost Efficiency:
 - Developing a cost-effective stiffness measuring device to minimize expenses
 - Reducing long-term maintenance costs through early detection and optimization of track configurations

Benefits

- Early Detection: Identify locations with high stiffness gradients early, preventing further maintenance issues
- Cost Savings: Reduce maintenance costs by optimizing track configurations and addressing issues proactively
- Improved Safety: Enhance the safety and reliability of railway tracks, especially around bridge abutments
- Data-Driven Decisions: Use accurate stiffness measurements to make informed decisions about track design and maintenance
- Optimized Track Performance: Improve track performance by reducing stiffness gradients through simulation and optimization
- Comprehensive Guidelines: Provide clear design and maintenance guidelines for managing track stiffness, aiding in consistent and effective practices



Deliverables, Dependencies & Support

Deliverables

- Internal report
 - Stiffness Measuring Device prototype: A functional prototype of the stiffness measuring device.
 - Technical Specifications: Detailed documentation of the device's technical specifications and capabilities
 - Test Results: Reports on field tests and validation of the device's accuracy and reliability
- Simulation Tool
 - Software: A simulation tool that integrates stiffness measurement data with various track configurations
 - Simulation Models: Pre-built models for different track configurations and scenarios
- IRS for Stiffness Management:
 - A document providing design and maintenance guidelines for managing track stiffness at bridges
 - Case Studies: Examples and case studies demonstrating the application of the guidelines

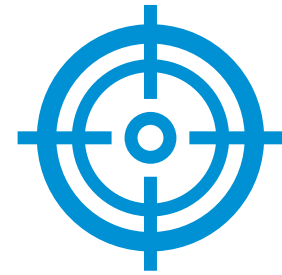
Dependencies

- Historical Maintenance Data: Access to historical data on track maintenance and performance around bridge abutments.
- EU projects addressing transition zones and simulation models (In2Zone, In2Track3)

Support

- Members supporting the Project Trafikverket





Budget

YEARLY BUDGET ESTIMATE

RESOURCES	Project contributions	100,000 €	<i>(Opt'in project members)</i>
	Other income		
	TOTAL RESOURCES	100,000 €	
SPENDINGS	Staff	21,000 €	<i>(UIC Staff)</i>
	Subcontracting	60,000 €	<i>(Consultancy, etc.)</i>
	Others costs	7,000 €	<i>(Documents, etc.)</i>
	Travels & Reception	5,000 €	<i>(Meetings, etc.)</i>
	General & Administrative	7,000 €	<i>(General support)</i>
	TOTAL SPENDINGS	100,000 €	



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Thank you for your attention



CONTACT

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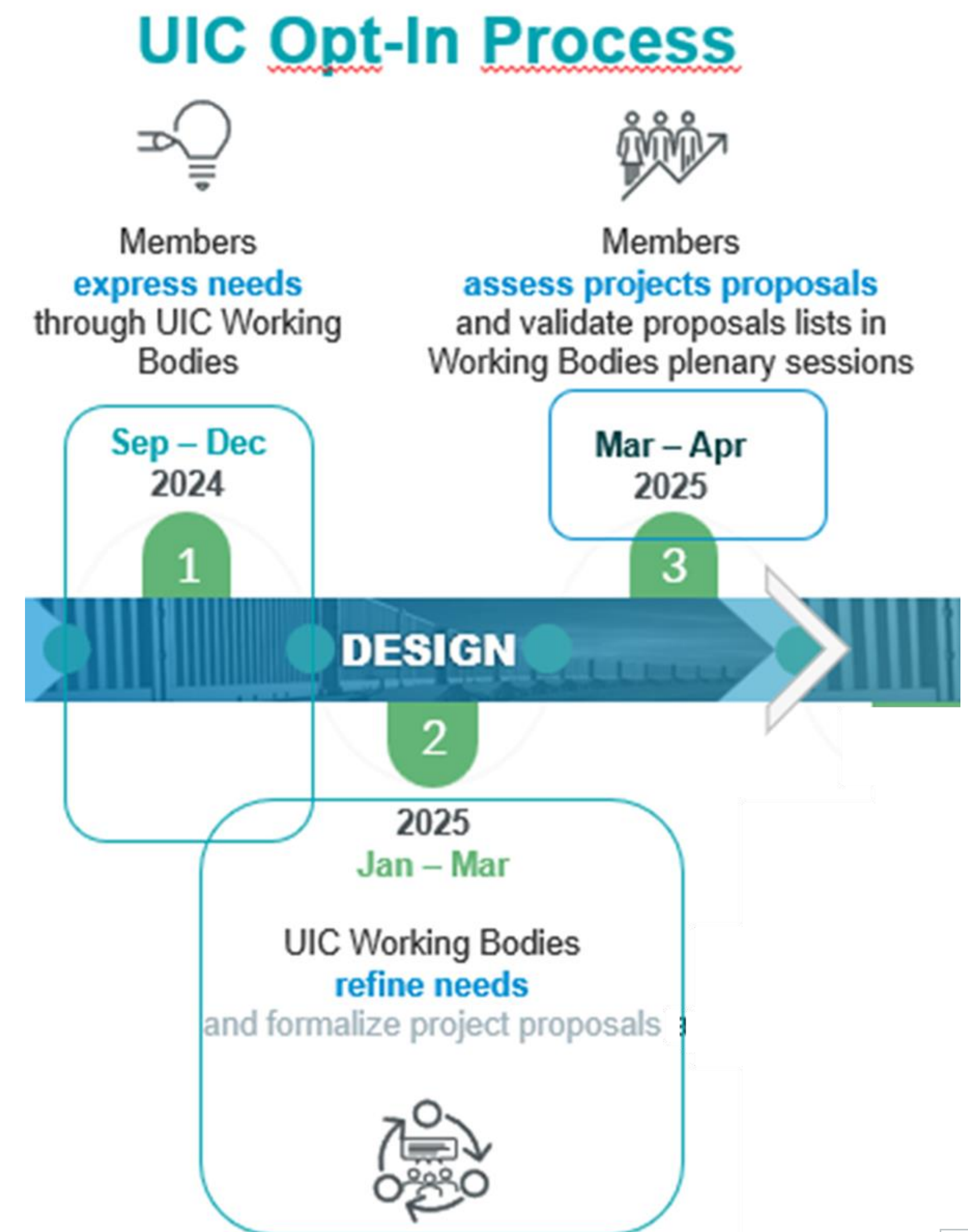


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NEXT TTI PROJECT

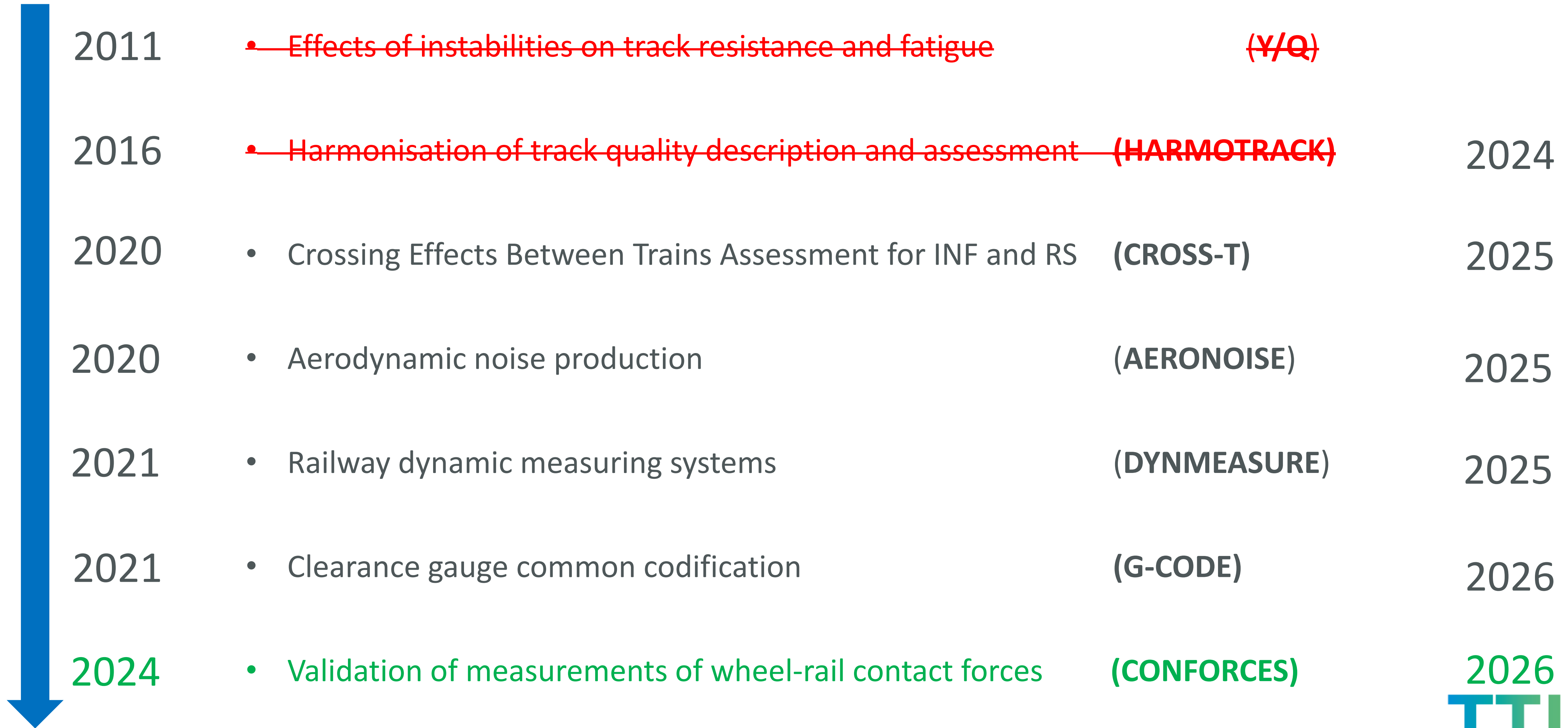
- ✨ **Share your vision:** we are still on time to suggest **new topics**.
- 🚀 **Boost innovation:** turn it into an **Opt-In 2027** project.
- 🤝 **Collaborate globally:** join forces with IMs and RUs worldwide.
- 📅 **Deadline:** don't wait until the last minute, contribute now
- 👉 **Your ideas can become the next big UIC–TTI project!**



POINT 6. ON GOING PROJECTS UPDATE



TTI ONGOING PROJECTS





TTI ONGOING PROJECTS

- ✓ **P849 / CONFORCES** project, which aim to **validation of measurements of the Wheel-rail contact forces through instrumental wheelsets for UIC Leaflet 518 homologation purposes.**
- ✓ **P653/ AERONOISE** project, which focuses on developing an improved noise emission measurement method for high-speed trains.
- ✓ **P703/ DYNMEASURE** project, which aims to identify the right framework for application of the various measuring systems trackside and on-board.
- ✓ **P384/ HARMO-TRACK** project, which aims to harmonise data formats and thresholds for track geometry and dynamic measurements.
- ✓ **P652/ CROSS-T** project aimed at ensuring safe train operations when crossing in mixed traffic lines.



P849 / CONFORCES

Objectives

- Analysing and proposing guidelines for evaluating wheelset precision and its accuracy in running conditions
- Analysing and proposing guidelines for measurements of wheel-rail contact forces through instrumented wheelsets
- Describing an accepted method for measurement of wheel-rail contact forces through instrumented wheelsets that includes calibration

Scope

- Infrastructure Managers (IMs)
- Railway Undertakers (RUs)
- Rolling stock and vehicle validation instruments manufacturers
- Homologation bodies
- Technical Universities



P653/ AERONOISE



UIC project AERONOISE (P000653) - Measurement and analysis systems to characterize the aerodynamic noise of high-speed trains.



PROPOSAL FOR EXTENDED ACOUSTIC TEST
METHODOLOGY



P703/ DYNMEASURE


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—DYNMEASURE:
AXLE LOAD MEASUREMENT DEVICES



PHASE 1: TECHNOLOGY REVIEW
DRAFT -CC

 **sener** January 2025

—DYNMEASURE:
AXLE LOAD MEASUREMENT DEVICES



PHASE 2: OPERATIONS, SAFETY, AND
MAINTENANCE STRATEGY
DRAFT -CC

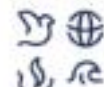
 **sener** June 2025

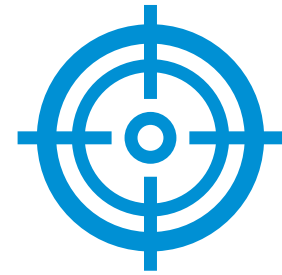

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DYNMEASURE:
AXLE LOAD MEASUREMENT DEVICES

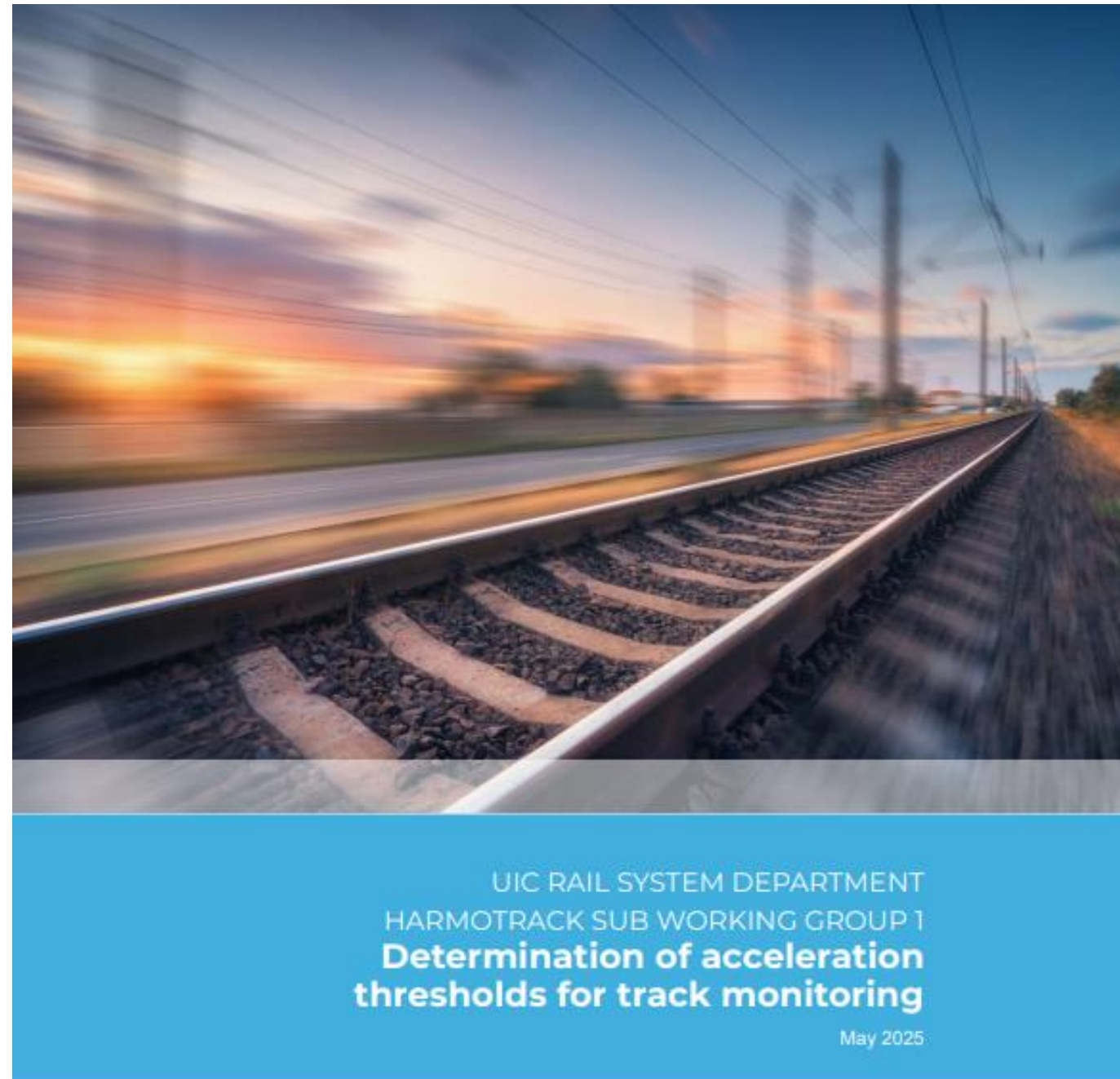


PHASE 3: COST-BENEFIT ANALYSIS
DRAFT -AA

 **sener** OCTOBER 2025



P384/ HARMO-TRACK



UIC Technical Report (March 2025)

SUB WORKING GROUP 2

Use of axle box acceleration measurements to detect and characterise short rail defects

UIC Technical report (April 2025)

SUB WORKING GROUP 3

Use of low-cost devices for measuring acceleration onboard trains



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P652/ CROSS-T

CROSSing effects between Trains - CROSS-T Project

Terry Johnson

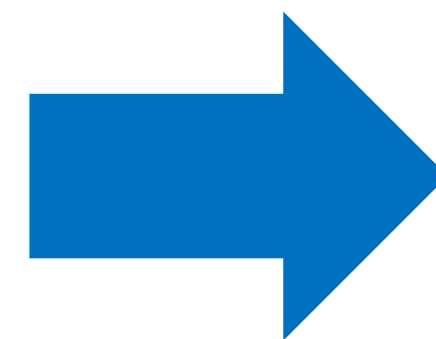
RSSB

18 September 2025

POINT 7. MIGRATIONS PLANS

UIC leaflets-IRS Migration plan

- IRS are the evolution of UIC “Leaflets”: voluntary documents that promote best practices, standards, and the harmonization of technical, operational, and maintenance aspects.
- It is mandatory to maintain the normative framework related to each railway sector.
- To this end, dedicated working groups will be set up to perform these tasks, namely updating existing regulations, developing new ones, and repealing outdated provisions.



UIC leaflets-IRS Migration plan



Leaflet No	Name	UIC Comments
505-4	Effects of the application of the kinematic gauges defined in the 505 series of leaflets on the positioning of structures in relation to the tracks and of the tracks in relation to each other	Partially copied in EN15273-3. Nothing to be added from our perspective
506	Rules governing application of the enlarged GA, GB, GB1, GB2, GC and GI3 gauges	Nothing to be added from our perspective. Unless members think the opposite, migrate as it is.
505-5	History, justification and commentaries on the elaboration and development of UIC leaflets of the series 505 and 506 on gauges	No amendment needed with regards to 2010
505-6	General rules for interoperable rolling stock gauges (without unloading freight or disembarking passengers) in cross-border traffic between UIC and OSJD Rus	Needs to be updated based on 50505-1
518	Testing and approval of railway vehicles from the point of view of their dynamic behaviour - Safety - Track fatigue - Ride quality	Will be reviewed as part of CONFORCES project
519	Method for determining the equivalent conicity	EN15302 has been transformed into technical report PD CEN/TR 17792:2022. Take advantage of this to review. No need of developing a project like EQUIVALENT CONICITY for this
779-1	Effect of the slipstream of passing trains on structures adjacent to the track	Not urgent action for PoSE
779-11	Determination of railway tunnel cross-sectional areas on the basis of aerodynamic considerations	Not urgent action for PoSE

POINT 8. AOB AND NEXT MEETING DATES

Next Face to Face meeting

Previous Plenary Meeting:

- Hosted by ADIF in Málaga
- 17 and 18 September 2025
- + 40 physical attendants

**Next one → Open to candidates
September or October 2026**

Location to be decided



Our intention: **not at UIC premises**



FINAL REMARKS AND CLOSURE



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Thank you for your attention



CONTACT

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TTI

Train-Track Interaction

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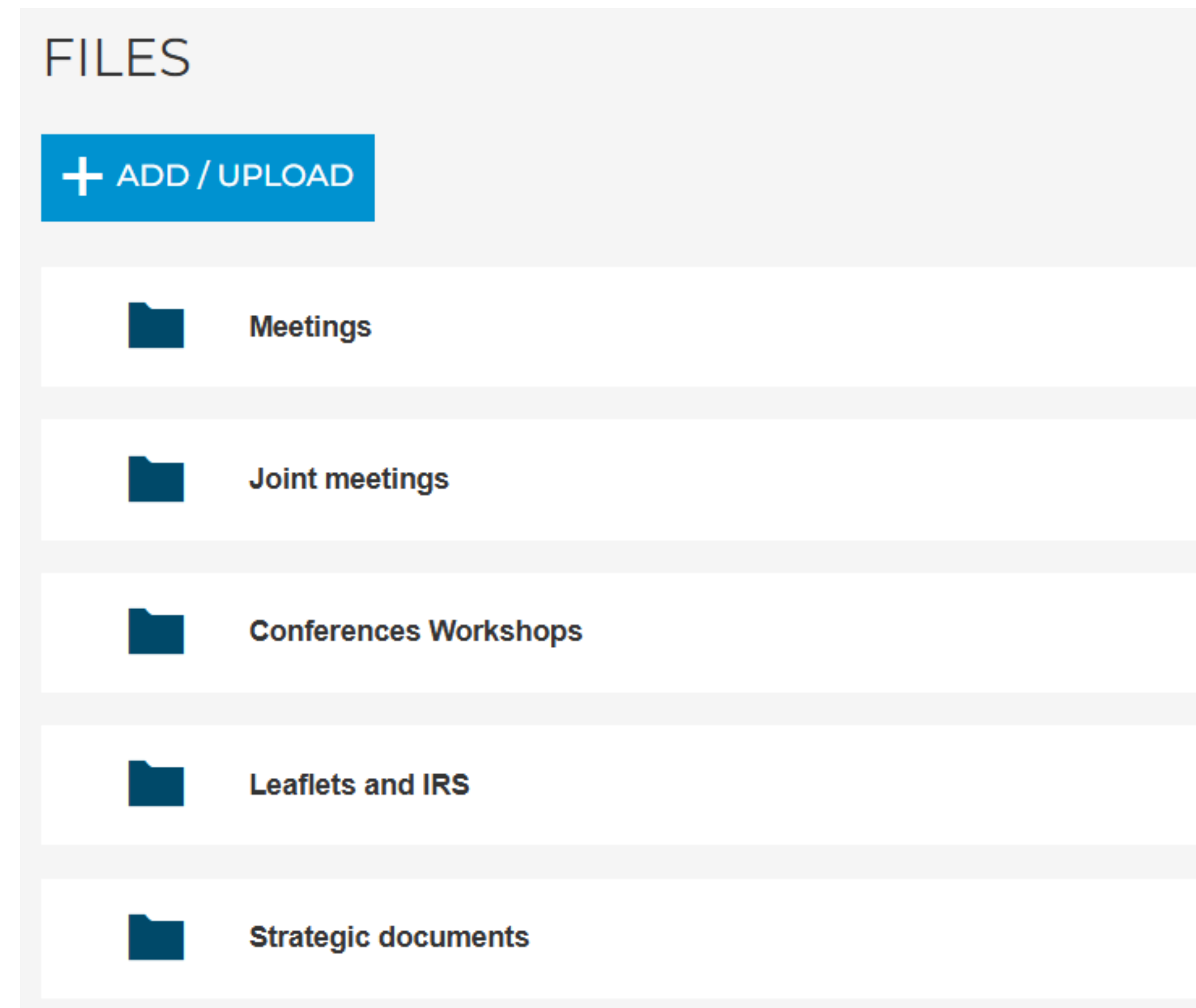


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UIC RSF General Information

Train-Track Interaction. <https://extranet.uic.org>



Approval of previous Plenary Meeting's Minutes



AGENDA/ MINUTES OF THE MEETING	
Name of body concerned:	Interfaces and Interaction between Infrastructure subsystem and Rolling Stock (TTI) Sector
Meeting name:	TTI Sector Plenary Meeting
Date, time (from [hour] to [hour]):	13-14 March 2025, 12:00-12:00 (CET)
Location:	UIC HQ, Paris

Participants

Name	Abbreviation	Organisation
Onsite		
David Villalmanzo Resusta	DV	ADIF, TTI former Chairman
Anup Chalisey	AC	RSSB, TTI new Chairman
Rosa Deneb Casquero Soler	RC	UIC, TTI, Rail System Department
Jesús Palma Béjar	JB	UIC, TTI, Rail System Department
Gennaro Sica	GS	HS2
Daniilo Sorrentino	DS	SNCF Réseau
Samuel Pelisson		SNCF Réseau
Online		
Alejandro Mendizábal	AM	ADIF
Mónica Pelegrín	MP	ADIF
Francisco Badea	FB	Universidad de Nebrija
Terry Johnson	TJ	RSSB
Martin Li	ML	Trafikverket
Mehdi Dib	MD	SNTF subsidiary
Andrea Collina	ACol	Politecnico de Milano
Manuel Tur	MT	Universidad Politécnica de Valencia
Hugo Patricio	HP	UIC, Infrastructure, Rail System Department
Alvaro López	AL	Rail Baltica
Jose Manuel Cabral	JC	SENER

All the presentations will be uploaded on the UIC Extranet.

Point 1. Welcome and general information

The session was opened by Jesús Palma, who gave the floor to DV, former TTI Chairman and just appointed Infrastructure Chairman. DV thanked the experts for the collaboration during the last years, offered his support to the new TTI Chairman and the whole sector and suggested cross-cutting collaborations between both sectors. AC, new TTI chairman, expressed his enthusiasm and eagerness to support TTI sector and remind that one of the key topics of the meeting was

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