Session3.2, Room Karam3
Operational performance/ Climate resilience

Moderator : Dr. Andrea Giuricin
CEO, TRA Consulting, Italy

Session3.2
Operational performance/ Climate resilience
Speaker Lists;

1	2	3	4	5
				
Mr.Andrea Vecchi	Mr.Fabio Sgroi	Mr.Kenta TAKASHINA	Mr.Niall Fagan	Mr.Philippe POULIGNY
Italy	Italy	Japan	United Kingdom	France

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11TH WORLD CONGRESS OF HIGH-SPEED RAIL

Marrakech, 7-10 MARCH 2023

TESTING AND IMPLEMENTATION OF THE EARTHQUAKE EARLY WARNING SYSTEM ON THE HIGH-SPEED LINE BETWEEN ROME AND NAPLES

Andrea, Vecchi
Head of Bridge and Structures Department, RFI, Italy
Session2-3.2, Operational performance / Climate resilience

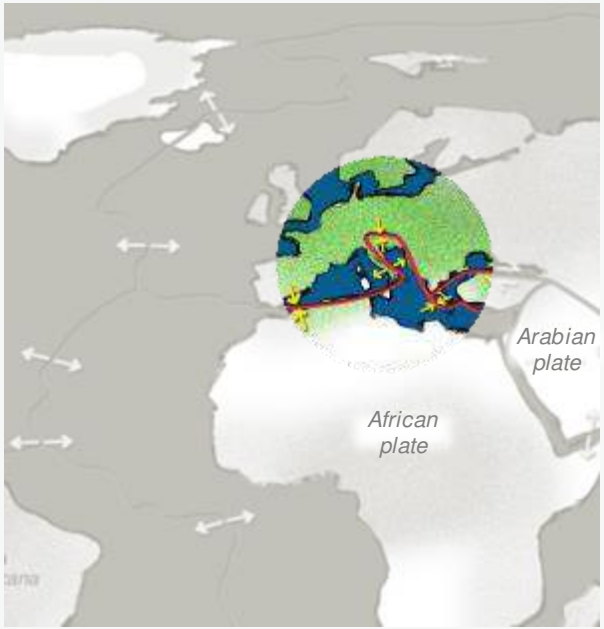
ONCF UIC

EXPOSITION OF THE ITALIAN INFRASTRUCTURE TO EARTHQUAKES

Italy is exposed to a considerable *seismic risk*.

ITALIAN SISMICITY

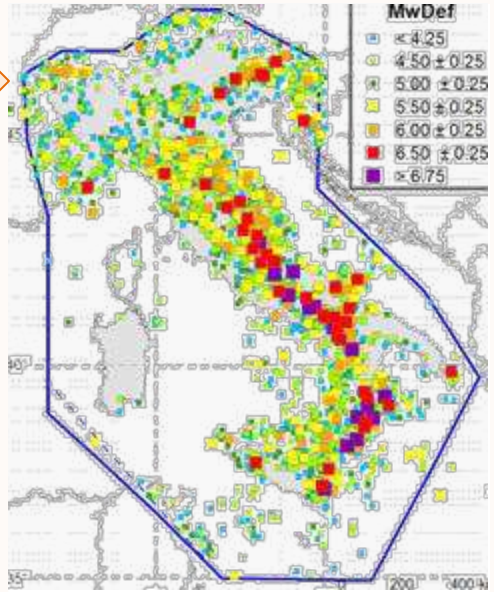
The mutual approach of *African* and *Eurasian plates* is the main reason of Italian seismicity.



EARTHQUAKES

More than 3.700 earthquakes over MW 4 catalogued between 1000 to 2022

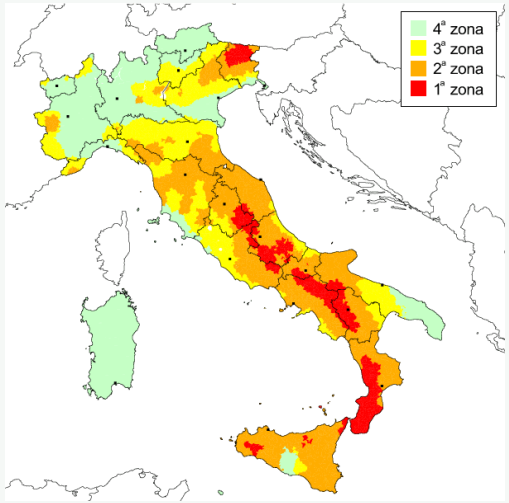
Mw 4 – 5	3043
Mw 5 – 6	669
Mw 6 – 6.5	53
Mw 6.5 – 7	29
Mw 7 – 7.38	9



ITALIAN NETWORK MANAGED BY RFI

Comparing the seismic zones of Italian territory and the distribution of railway lines, the *territory exposition to seismic risk* could be defined.

ITALIAN SEISMIC HAZARD

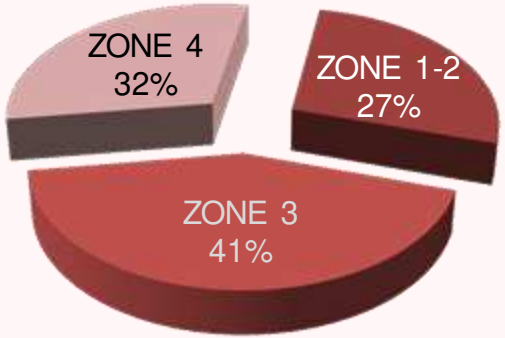


Zone 1	$a_g > 0{,}25$ g
Zone 2	$0{,}15$ g $< a_g \leq 0{,}25$ g
Zone 3	$0{,}05$ g $< a_g \leq 0{,}15$ g
Zone 4	$a_g \leq 0{,}05$ g

ITALIAN NETWORK

23.502 km conventional lines + 1.467 km high speed lines

EXPOSITION



Data evaluated considering a representative set of no. *7800 bridges*

SEISMIC RISK - MITIGATION STRATEGIES

The mitigation strategy adopted by RFI comprises 2 set of counter measures for mitigating the consequences of earthquakes.

PASSIVE MEASURES

aim to increase the *earthquake resilience* of the infrastructure

Seismic Vulnerability Assessment of the existing buildings and infrastructures

Seismic Strengthening Intervention of existing bridges

ACTIVE MEASURES

aim to reduce the consequences by adopting *operational measures* after the earthquake occurrence

Development of an Advanced and Fast Analytical Tool for predicting the areas that could have been most affected by an earthquake

Development of a Seismic Accelerometric Network for monitoring the ground shaking values recorded along the line and defining more precise intervention areas after the earthquake occurrence.

Testing and implementation of an Earthquake Early Warning System (EEWS) on the high-speed lines

EARTHQUAKE EARLY WARNING SYSTEM

GOALS

- Identify a critical earthquake and automatically activate an emergency procedure to *stop the trains in a few seconds*;
- In post event phase, provide a detailed survey of the *maximum shaking recorded along the line*.

MAIN FEATURES

High sensitivity accelerometer sensors record the ground shaking along the railway line and the system is able to distinguish train transit signals from earthquakes.

Prompt activation of emergency braking through a dedicated interface with existing signalling systems.

The system estimates the local intensity of an earthquake starting from the first seconds recorded by the closest stations to the epicenter.

After the inspections *it will be possible to reactivate rail traffic* through dedicated dashboards.

COOPERATION AGREEMENTS

International Research Cooperation

RFI Rete Ferroviaria Italiana – Gruppo Ferrovie dello Stato Italiane

Railway Technical Research Institute

Università degli Studi di Napoli Federico II

Business Operators

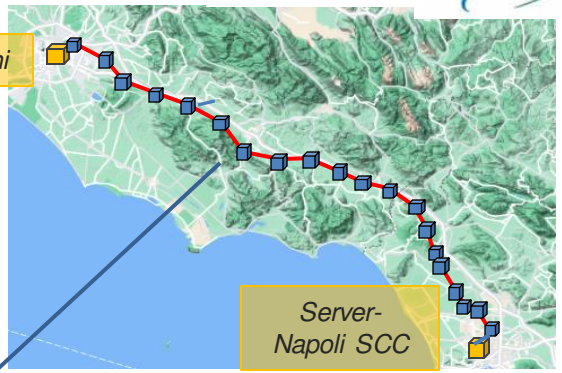
Hitachi – Inspire the Next

Sirti

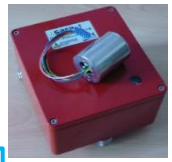
SolGeo

INFRASTRUCTURE FEATURES

- A *low latency Ring Data Network* has been installed.
- *Processing software* has been installed on *Central Server* in Naples;
- *Network switches* installed in 20 Technological Sites (TS);
- *20 Accelerometric Stations* have been installed in the technological sites;
- *12 Local Actuators* have been installed to stop railway traffic in the areas affected by the seismic event.

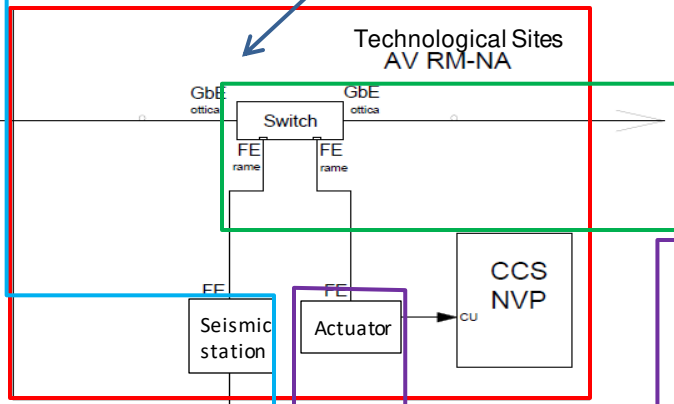


Acquisition system
(no-break power supply)



Surface sensor

Borehole sensor
- 20 m (only in 5 TS)



Switch

Actuator IS

EARTHQUAKE EARLY WARNING SYSTEM SOFTWARE WORKFLOW

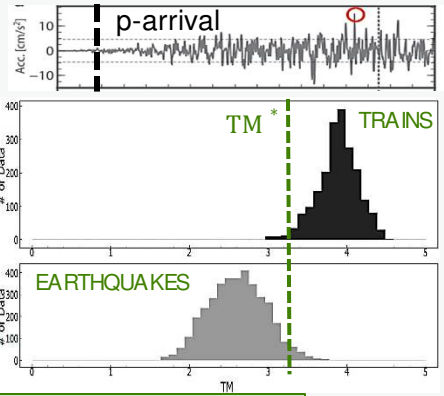
PICKING | TM CRITRIA | ONSITE MODULE

Real time identification of potential earthquake signal

Train signal discrimination

Prediction of PGA* at each node from p-wave amplitude

Train / noise spike



- An algorithm is able to estimate the *characteristic signal parameter Train Marker*
- A validation procedure excludes the signals with TM > TM* (TM* is a threshold reference value)

FIRST VALIDATION LEVEL

ADVANCED DECISION MODULE

Declaration of a potential earthquake

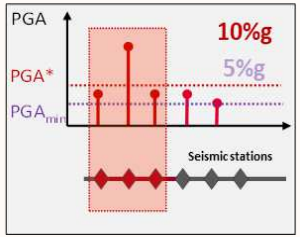
Earthquake over threshold

Estimation of the railway line part affected by the shaking above the threshold

Earthquake under threshold

The alert is declared when

- At a single node the PGA ≥ 10%g
- At adjacent nodes the PGA ≥ 5%

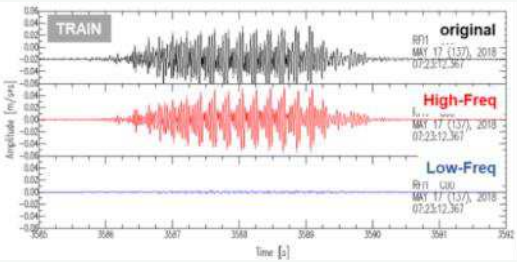


The module estimates the *section of the line where traffic suspension is required.* The *actuators*, responsible for the interface with signalling systems, are accordingly *activated* within the alerted area.

SECOND VALIDATION LEVEL

SYSTEM CALIBRATION AND PERFORMANCE EVALUATION

ONSITE INSTALLATION & CALIBRATION



1. *Preliminary characterization of each site* to define the *best position* for the installation of sensors.
2. A specific calibration of the *TM algorithm* for each site.
3. *PGA prediction law calibration* on Italian National accelerometric Network dataset.

REAL-TIME OPERATION MONITORING

Continuous recording from the beginning of 2020, for monitoring:

- telemetry *data latencies*;
- the *system stability* and proper operation of all its components;
- comparing *system declaration* with INGV seismic bulletin;
- the *noise / earthquake discrimination* criterion performance.

OFF-LINE TESTING

- *3 datasets of real events* have been selected to simulate the occurrence of an earthquake along the Rome - Naples high speed line.
- *train signals* have been used to contaminate seismic records by railway noise.
- a large number of *simulations* have been performed with a *partial or total overlap between earthquakes and train signals*.

SYSTEM PERFORMANCE RESULTS

Performance on real-time operation : 03/2020 - 07/2022. Over 1.5 million of triggers analyzed.

FIRST VALIDATION LEVEL

- 94% — Train Signals detection
- 6% — Train Signals passing to Second Validation step
- 0% — Missed Earthquake records

SECOND VALIDATION LEVEL

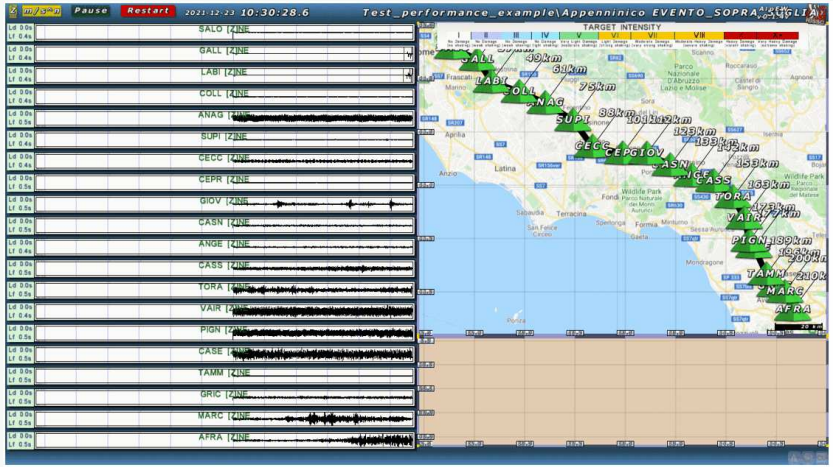
- 10 — Under-threshold Earthquakes correctly detected (ML 3.0-3.5) and no alert.
- 0 — False alerts
- 0 — Earthquakes over Threshold

Performed Offline Earthquake simulations show promising results with a performance above 90% of correct alert declarations.

EARTHQUAKE SCENARIO SIMULATION

SPECIALIST GRAPHICAL INTERFACE

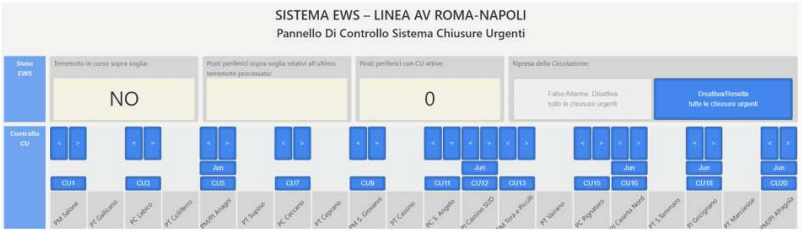
- A *simulation with earthquake source parameters* compatible with a seismic event MW 6.5 located near Rome has been performed.
- The *railway noise* has been simulated.
- The *red lines* represent the arrival times defined in real-time by system.
- The *yellow part of the Helicorder* are *Time Windows* analyzed by the platform for PGA predictions.



TRAFFIC CONTROL INTERFACE

Railway Traffic Control Interface was developed to:

- Check the status of the Early Warning system
- Check the status of actuators: *Active*, *Inactive*, *Error*
- Restore rail traffic at the emergency end.

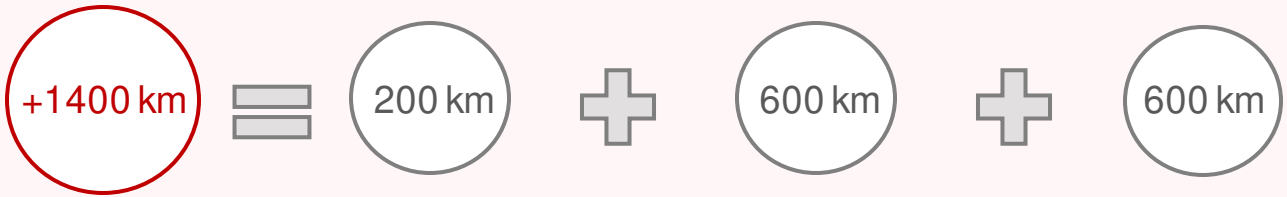


CONCLUSIONS

The EEWS has been tested along the RM-NA high speed railway line for more than two years showing *robustness and excellent performance of first validation level* (with more than 94% of correct trains discriminations) and no alert has been declared.

The EEWS has *correctly detected 10 under-threshold earthquakes* occurred during the experimental activities. *No false and missed alarms have been occurred*.

Until 2031 an *expansion of the EEWS* is planned on the main strategic railway lines of the RFI railway infrastructure.



THANK YOU

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ITALO – CLIMATE RISK ASSESSMENT

Fabio Sgroi
H&S Manager, Italo, Italy

Iuliia Shustikova
Senior Associate, WTW, United Kingdom

Session2-3.2 Operational performance / Climate resilience

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ITALO / SCOPE

- Italo Nuovo Trasporto Viaggiatori (Italo) worked with WTW to develop a portfolio-wide assessment to identify, prioritize, and report their main climate-related risks and opportunities.
- In close alignment to requirements of the Task Force for Climate-related Financial Disclosures (TCFD), the analysis is structured upon three main modules:
  - Physical Climate Risk Assessment
  - Transition Climate Risk & Opportunity Analysis
  - TCFD Gap Analysis and Road-Mapping
- The analysis allowed Italo to inform their climate-related disclosure strategy, support risk management decisions, strengthen the further the governance structure, and to better plan for future operational resilience.

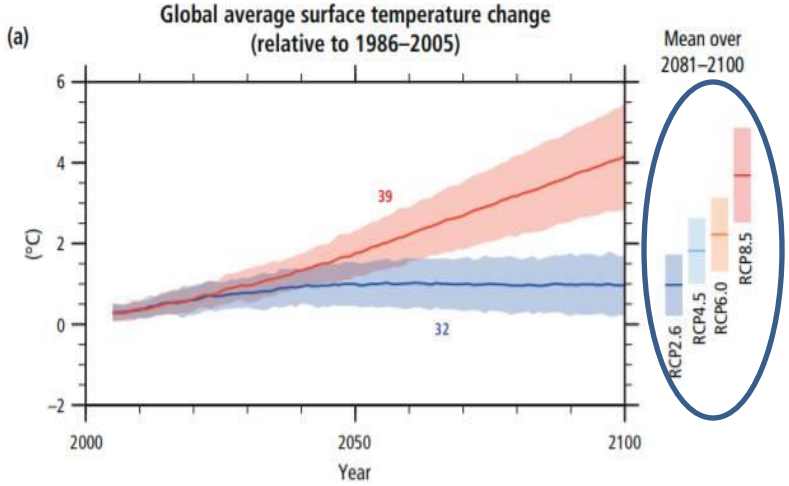
METHODOLOGY AND SCENARIOS

Module 1) Physical Climate Assessment

Module 2) Transition Risk Assessment

Module 3) TCFD Gap Analysis and Road Map

Three climate scenarios are utilized to assess the climate change impact over three main time horizons (2030, 2050, 2100), for RCP2.6, RCP4.5 and RCP8.5



Upper Bound
Hot House World

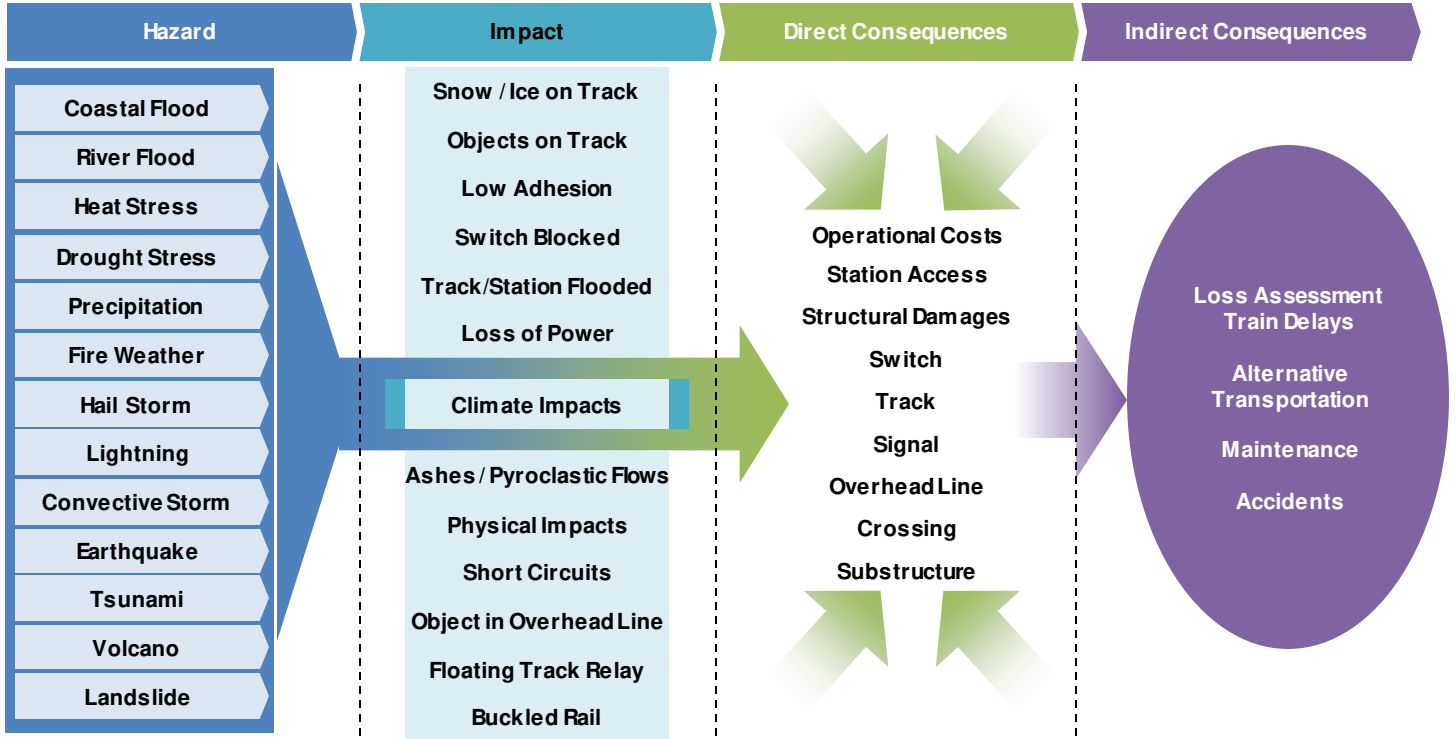
- Low transition risk in the short and long term
- Physical risks become increasingly frequent and severe in the long term.

Lower Bound
Low Carbon Economy

- High transition risk in the short term
- Physical risks are less severe than under the 4 degree scenario

PHYSICAL RISK ASSESSMENT

A first workstream assessed the Physical Climate Risks of Italo's portfolio of assets (owned and not owned) based on current conditions as well as future climate change impact projections, as a function of different time horizons and climate scenarios (Representative Concentration Pathways – RCP). The analysis focused on the physical climate risk exposures of assets and railway infrastructure utilized by Italo, and the physical risks identified covered both acute (event-driven) and chronic risks (longer-term shifts in climate patterns).



Derived from upon ARUP's Tomorrow's Railway and Climate Change Adaptation (Tracca) framework, and integrated with WTW's findings from Italo's physical climate change assessment

PHYSICAL RISKS METHODOLOGY

- WTW's ***Global Peril Diagnostic*** and ***Climate Diagnostic*** platforms are utilized to assess Italo's exposures to current and future climate conditions, for the two workstreams in scope.

- Each climate hazard is ranked on a **scale of 0 to 5 based on detailed climate and natural hazard datasets**. The hazard scoring is linked to likelihood and/or intensity - where applicable – and **the ratings for the hazard scores are summarized below**.

Hazard Rankings Key

Score	Hazard Ranking	Description
0	No Hazard / No Data	No Hazard/ No Data
1	Very Low	Low frequency and/or with low loss potential
2	Low	Could happen but with low loss potential and/or minimal to no disruption
3	Medium	Occurs often with low loss potential or occasionally with medium loss potential
4	High	Occurs often and/or causes significant loss and disruption
5	Very High	Occurs frequently and/or causes significant loss and disruption

PHYSICAL RISKS RESULTS

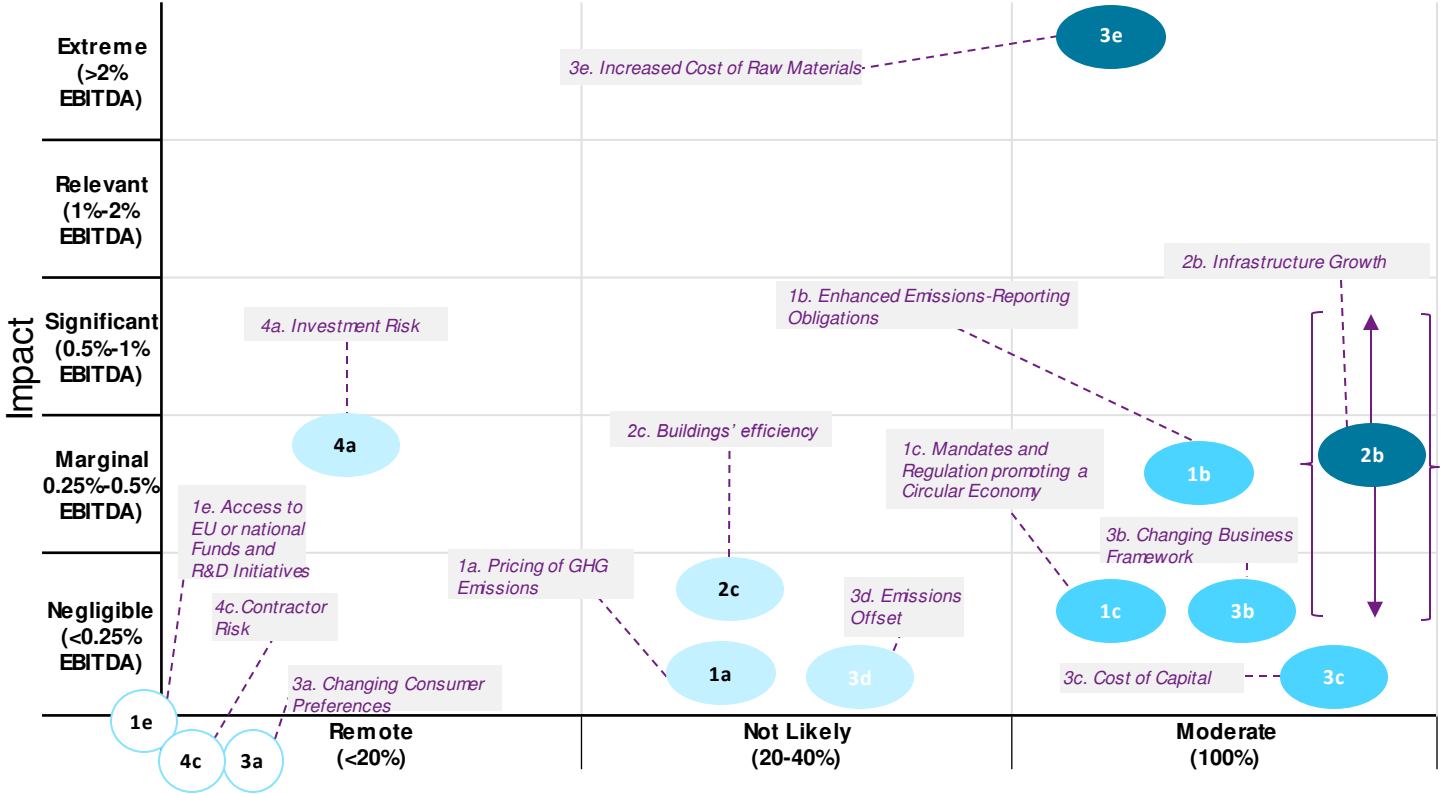
Exposure Summary	Assets		Routes		Potential Impacts
Climate Hazard	Current Climate	+4°C Climate	Current Climate	+4°C Climate	
Combined Index	1.9	2.3	1.9	2.6	Overall the hazard for assets and routes within Italo's portfolio is increasing
Coastal Flood	0.5	0.8	0.3	0.5	Scour, structural damage, tunnel and track flooding, Coastal erosion
River Flood	2.0	2.0	1.8	2.0	Slope failure, Bridge scour, flooding of track and assets, damage to electronic equipment
Heat Stress	2.6	3.9	2.7	4.0	Heatwaves, Wildfires. Buckling of rails; Thermal Expansion in Structures
Drought Stress	2.0	4.7	1.9	4.8	Differential Thaw settlement of track bed in mountainous regions.
Precipitation	3.4	3.4	3.4	3.4	Track misalignment of poles supporting overhead lines
Fire Weather	2.0	3.0	1.1	3.0	Damage to power lines and railroads, smoke and heat damage to buildings and maintenance centers
Tsunami	0.1		0.1		Destructive inundation of coastal erosion
Landslide	1.5		1.8		Infrastructure slope failure, rockfall, avalanches

TRANSITION RISKS METHODOLOGY

- WTW performed an assessment of Italo's **climate transition risks** across a medium-term time horizon (2030).
- There were **16 risks/ opportunities** identified for Italo as a result of transition to a **low carbon economy.** These were assessed in the context of current actions and planned mitigation (i.e. **residual risk**).
- Overall, Italo is considered to have a **low level of transition risk exposure.**
- **The transition to a low carbon economy presents numerous opportunities for Italo.** This includes:
  - **green financing** options to fund fleet development
  - the possibility of increased revenue from **infrastructure growth**
  - the sale of **white certificates.**

Policy & Legal	
1a	Pricing of GHG Emissions
1b	Enhanced Emissions-Reporting Obligations
1c	Mandates and Regulation promoting a Circular Economy
1d	Climate Change Litigation
1e	Access to EU or National Funds and R&D Initiatives
Technology	
2a	Costs to Transition to Climate Resilient / Low Emission Technology
2b	Infrastructure Growth
2c	Buildings' efficiency
Market	
3a	Changing Consumer Preferences
3b	Changing Business Framework
3c	Cost of Capital
3d	Emission Offset
3e	Increased Cost of Raw Materials
Reputation	
4a	Investment Risk
4b	Organisation Risk / Opportunities (Talent Management)
4c	Contractor Risk

TRANSITION RISKS RESULTS AND EXHIBITS (IMPACT/LIKELIHOOD)



Key*

- No exposure
- Low overall exposure
- Moderate overall exposure
- Medium overall exposure

Unquantified

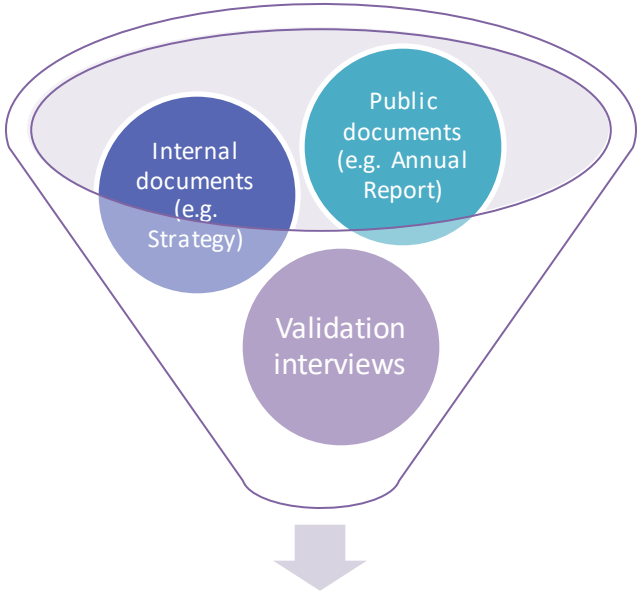
- 1d — Climate Change Litigation
- 4b — Organisation Risk/ Opportunities (Talent Management)
- 2a — Costs to Transition to Climate Resilient/ Low Emission Technology

- Impact is based on Italo's 2020 EBITDA of €111.8M
- Likelihood (%) refers to annual likelihood and is based on Italo's ERM frequency scales (e.g. 20% is equivalent to a one in 5 year event).

TCFD GAP ANALYSIS

WTW's TCFD Gap Analysis tool screens how closely an organisation's existing activities, policies and plans fulfil the TCFD recommendations across the four themes

- Includes **32** proprietary detailed criteria
- Is based on guidance materials and supporting literature published by the TCFD
- Looks beyond published disclosures and considers internal action / activities not yet disclosed
- Assesses for three key aspects of performance:
  - ✓ transparency / meeting requirements
  - ✓ quality of response
  - ✓ quality of climate management & action



TCFD Gap Analysis Tool

RESULTS

For each theme Italo received a detailed breakdown of the score and a set of short-term, long-term and reporting focused recommendations

ITALO'S ACTION PLAN (1)

Action	TCFD Area	TCFD Criteria
Climate risk identification and assessment	Strategy	- Climate-related risks and opportunities description over short, medium and long term - Impact of climate-related risks and opportunities on business
	Risk Mgmt	Processes for managing climate-related risk description
Climate risk assessment and monitoring integration into existing ERM process	Governance	Board's oversight
	Metrics & Targets	Integration into the organition's overall risk management
	Risk Mgmt	Integration into the organition's overall risk management
Climate risk procedure	Risk Mgmt	Process for managing climate-related risk desription
	Governance	Management's role in assessing and managing climate-risk and opportunities

ITALO'S ACTION PLAN (2)

Action	TCFD Area	TCFD Criteria
Develop emissions reporting scope	Metrics & Targets	- Disclose the metrics used - Organisation's processes for managing climate-related risk
Setting SBTI targets	Metrics & Targets	
Information about climate risks and opportunities	Governance	- Board's oversight - Management's role description
	Strategy	Impact on the organisation's strategy and financial planning
CDP Climate Change Disclosure	Governance	
«Climate Change» Training Panel for Managers & Board	Governance	Organisation's processes for managing climate-related risk
Collaborate with RFI and promote information-sharing activities	Strategy	NA

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Resilience initiatives of a climate change and disaster in JR EAST

Kenta TAKASHINA
Senior Manager EAST JAPAN RAILWAY COMPANY JAPAN
Session2-3.2 Operational performance / Climate resilience

ONCF UIC

Introduction of East Japan Railway Company(JR East)

Maintenance — Rolling Stock, Infrastructure

Operation — Various transport modes: Trains, Monorails, Buses

Non- Rail Business — Suica: Hotels, Retail, Real estate etc.

High-speed

Integrated Railway Network

Metropolitan Area

Regional

Total network: 7,402 km
Total No. of Passengers: 13million /day
Total No. of Trains: 12,000 /day
No. of employees: approx. 48,000
100% private company without any subsidy

JR EAST HSR Network

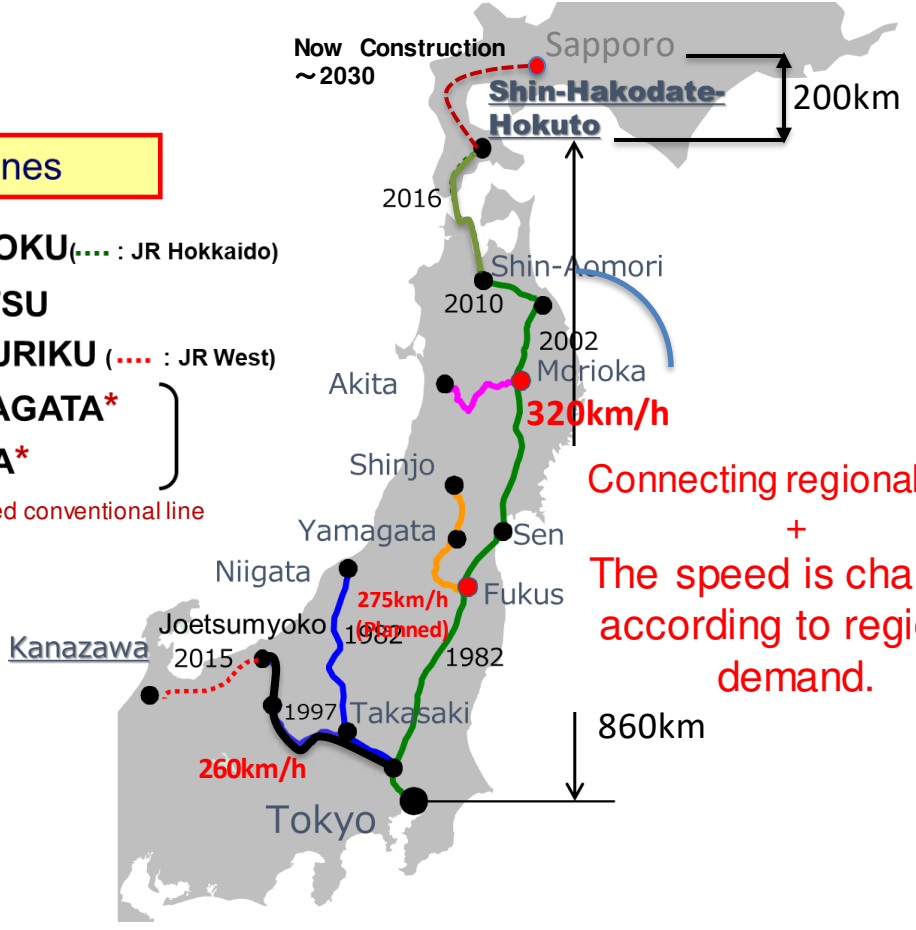
5 lines

- TOHOKU(···· : JR Hokkaido)
- JOETSU
- HOKURIKU (···· : JR West)
- YAMAGATA*
- AKITA*

* Converted conventional line

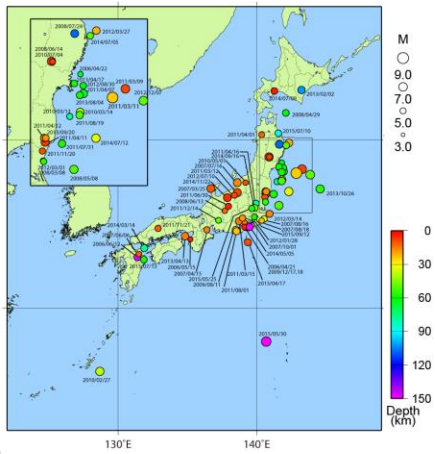
Shinkansen Network: 1,470km
No. of Regular Trains: 324 /day
Max. Commercial Speed: 320km/h

1/5 of JRE's network length but make 1/3 of its transport revenue



Connecting regional area
+
The speed is changed according to regional demand.

Social responsibility to enhance our resilience to disasters and to operate our high-speed trains sustainably



https://www.ktr.mlit.go.jp/bousai/bousai00000127.html

◇Requiring Earthquake preparedness

Concentrated in East Japan

※ 2011.3 Great East Japan earthquake (M9)

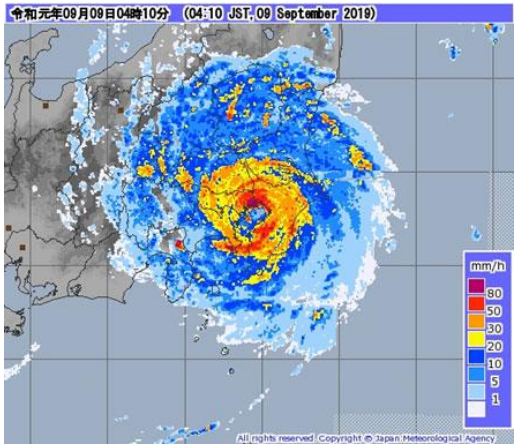
Significant safety risks, especially for HSR

Rolling stock derailments, destruction of structures, etc.

◇Climate change by global warming

Increasing risk

Strong typhoon, Heavy Rainfall, Deluge flood…



Japan Meteorological Agency

Introduce our approach to earthquakes and natural disasters

Earthquake ・・・Significant safety risks

Most threatening of all natural disasters

It is unpredictable

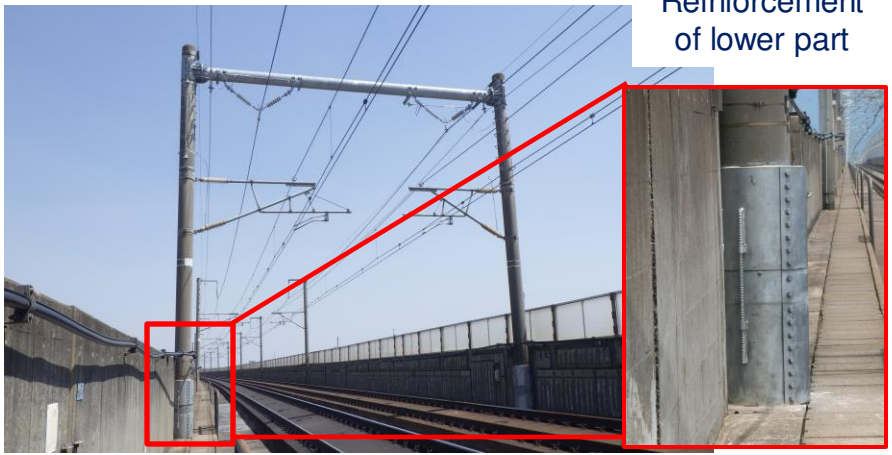
Our three earthquake counter measures

1. Seismic reinforcement of structures in advance
2. Minimizing damage by preventing derailment
3. Stop running trains as soon as possible

1 Seismic reinforcement of structures

Priorities are determined by experience and analysis

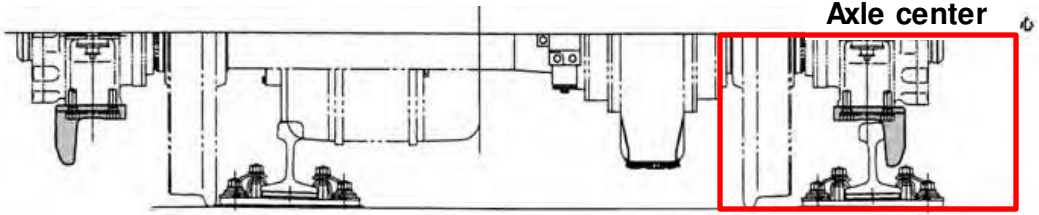
Structural reinforcement of utility poles

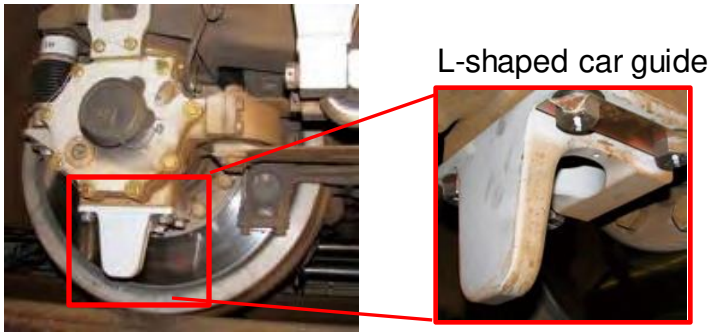


Seismic reinforcement of elevated railway tracks

2 Minimize damage by preventing derailment (Rolling stock & ground facilities)

L-shaped car guide mechanism (Rolling stock bogie)





Reinforcement of the ground facilities

Preventing breaks At glued insulated joints

Reinforcement

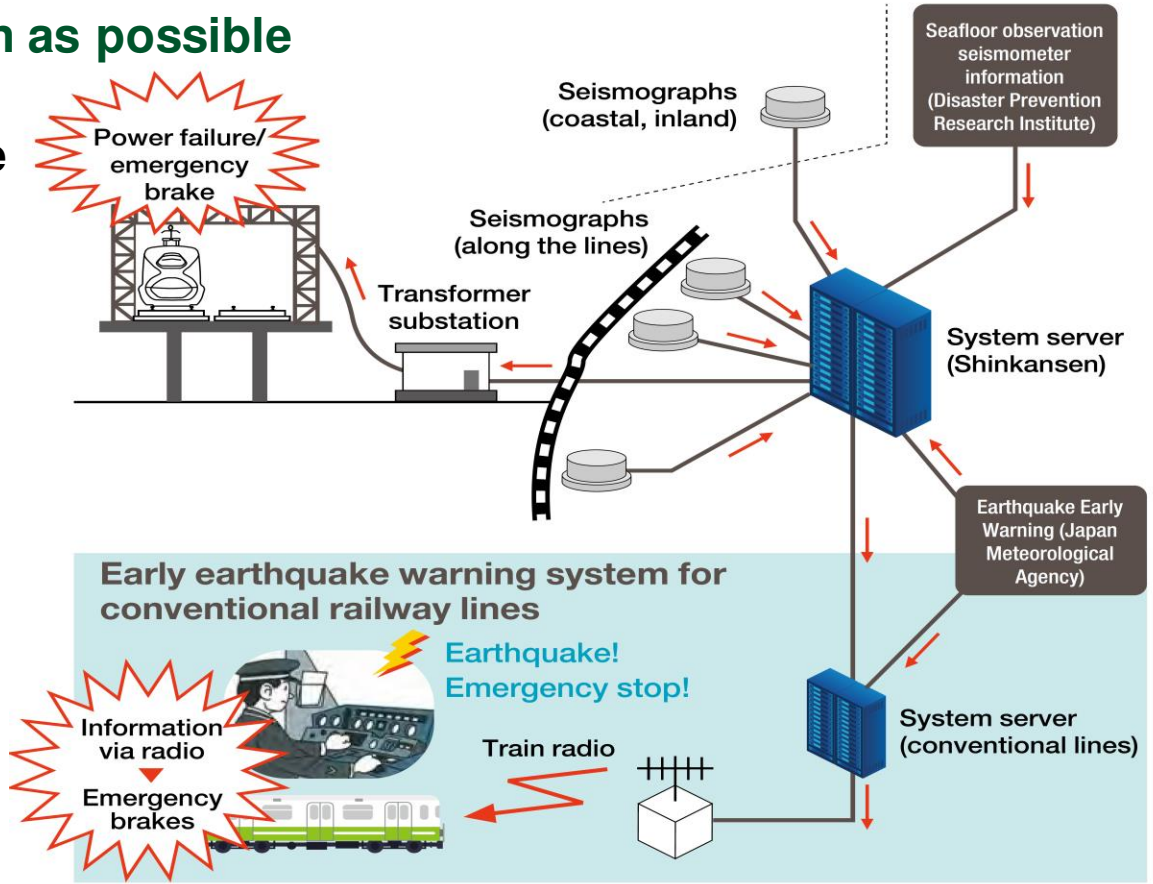
Rail rollover prevention devices

3 Stop running trains as soon as possible

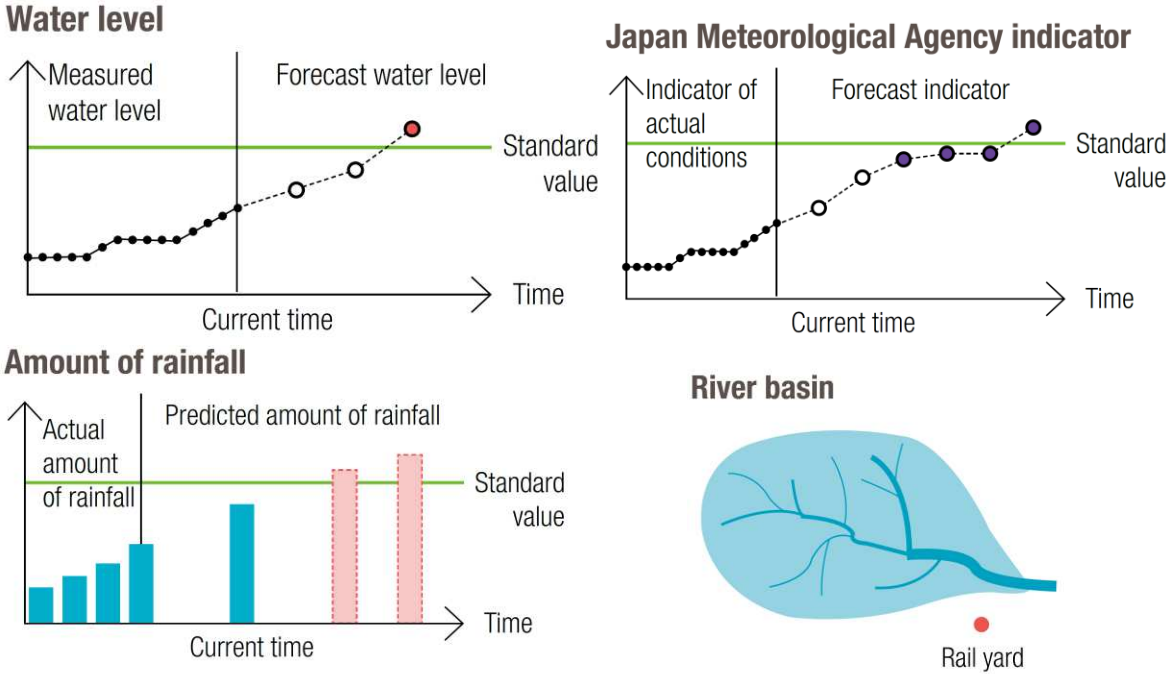
Shinkansen Early Earthquake Detection System

Installed seismographs along the HSR lines, in coastal areas and inland, in combination with a Seafloor observation seismometer, Earthquake Early Warning to provide early warnings of even minor movements.

Constructing systems to ensure that high-speed trains can stop as quickly as possible in the event of an earthquake.



An example of the measures for natural disasters
Indicators to aid decisions about evacuating rolling stock
In recent years, global warming has increased the threat of heavy rainfall and typhoons

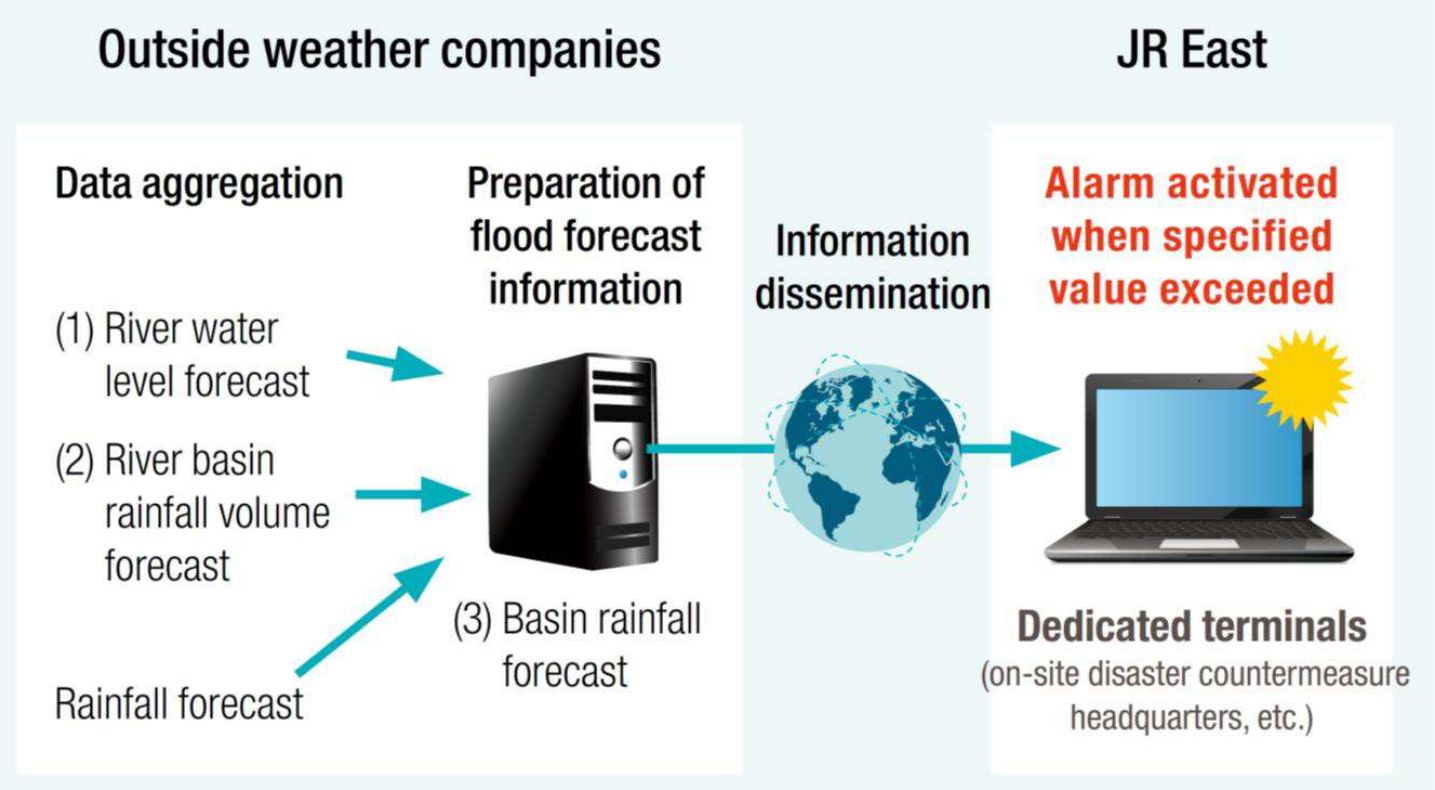


The largest typhoon in 2019 caused river flooding at the NAGANO rail yard

Some Shinkansen were submerged under the water

Photo source) Ministry of Land, Infrastructure, Transport and Tourism, Japan

Protects vehicles from sudden rainstorms caused by extreme weather conditions



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11TH WORLD CONGRESS OF HIGH-SPEED RAIL

Marrakech, 7-10 MARCH 2023

Designing High Speed Railways for High Reliability and Climate Resilience,
incorporating Data Driven Technology

Niall Fagan
Head of Engineering, Network Rail, United Kingdom
Session2-3.2 Operational performance / Climate resilience

ONCF UIC

DESIGNING A HIGH SPEED RAILWAY FOR HIGH RELIABILITY

Aim – to demonstrate that a Client-led, engineering-biased approach is appropriate to meet high reliability and resilience targets by

Integration of Engineering, Asset Management and Operations

- Clear vision of operating strategy and requirements – including climate resilience
- Importance of early Client-led engineering designs
- Systems Engineering and Specifications
- Incorporation of asset management strategies into designs

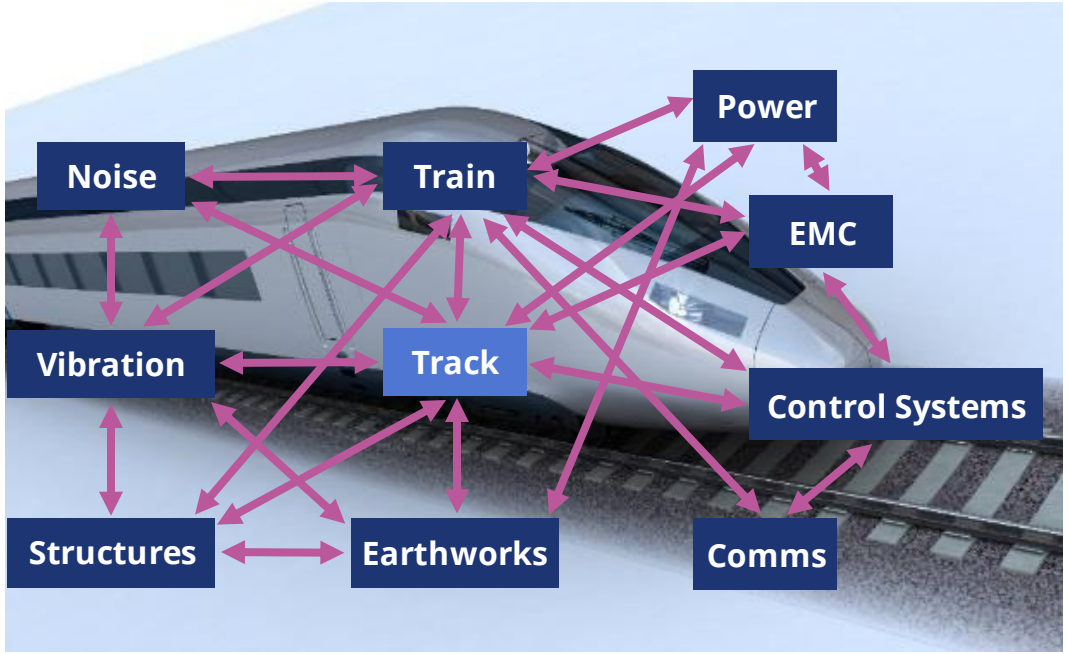
HS2 in the UK will be used as a case study

A COMPLEX TECHNICAL SYSTEM… with multiple interactions

Operating Conditions
- Trains per hour
- Speed
- Reliability
- Availability

Loading
- Internal (Trains etc)
- External (Climate)
- Asset behaviour/deterioration

Constraints
- Environment
- Topography
- Population density
- Political influence

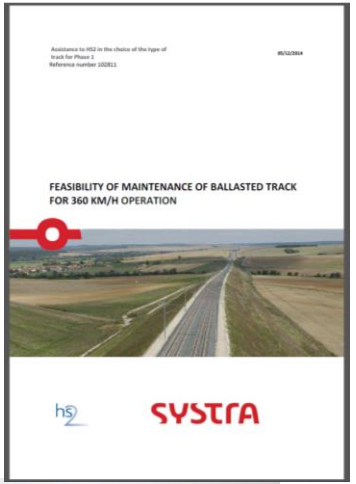


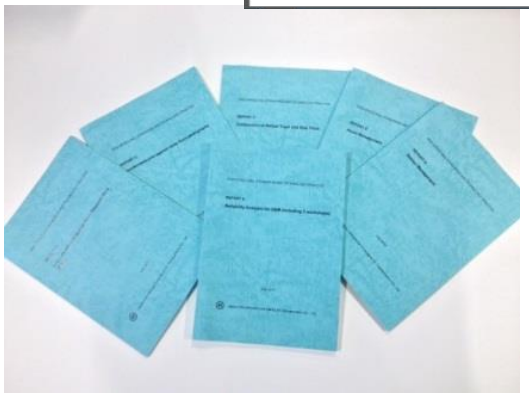
Especially important for a high speed, high capacity railway with stringent reliability targets

CLIENT-LED SPECIFICATION AND DESIGN

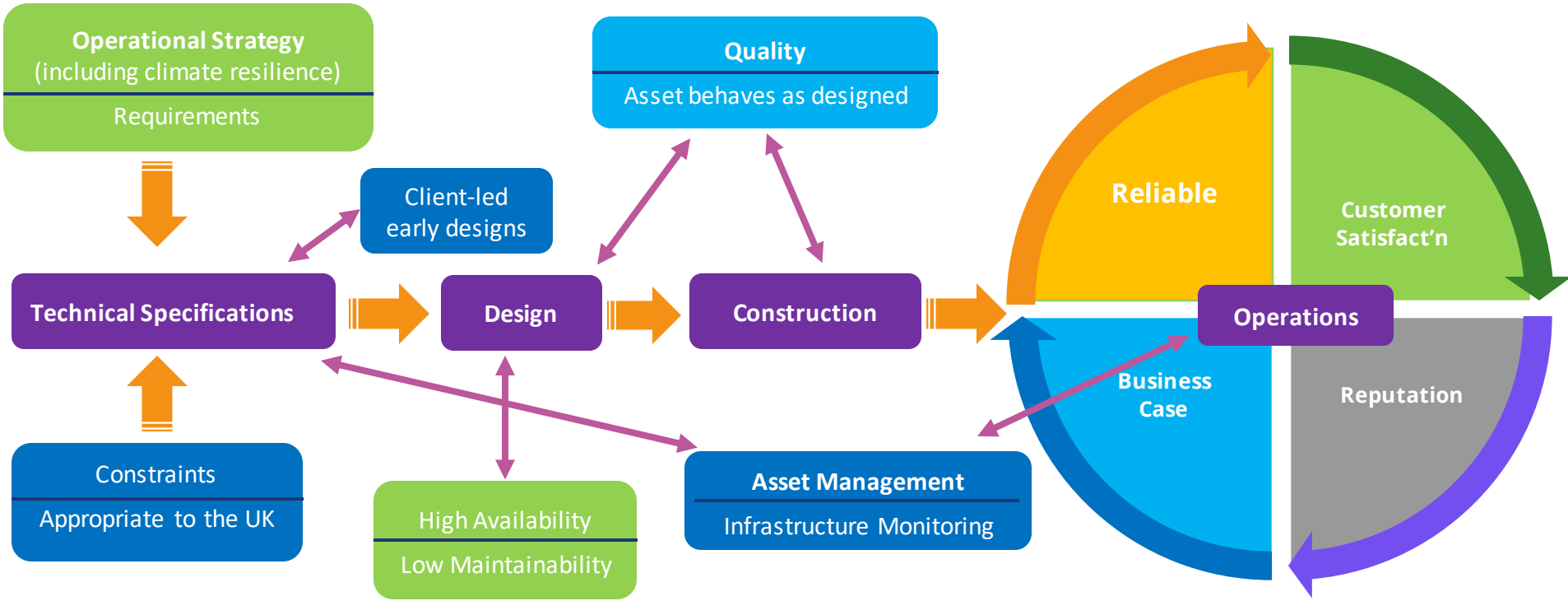
Client organisation should:

- Own the vision, strategy and… the risks
- Collaboration with high speed partners and research institutions
  - Workshops, investigations and reports
  - Objective evidence only
- Incorporate current best practice and lessons from around the world (HS and conventional rail)
- Identify likely failure modes to inform specification and design
- Understand the likely climate change impacts
  - Warmer, wetter winters and hotter, drier summers are predicted in the UK
- Carry out modelling and early design to inform the specification





SPECIFYING A SUCCESSFUL OUTCOME



CASE STUDY: HS2 Choosing the right trackform

Developed a structured evaluation process

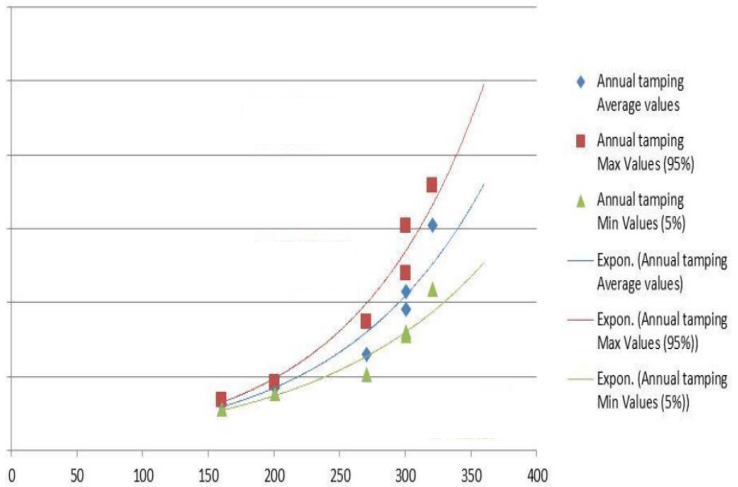
Key Inputs

- Technical performance
- Environmental impacts
- Sustainability and resilience
- Operational implications
- Construction programme
- Maintenance & renewals implications
- Capital costs
- Life cycle costs
- Whole life value for money

1. Identify Decisions
2. Define Options & Criteria
3. Assess Options
4. Evaluate Decision
5a Approval
5b Implement Decision

Statistical analysis by Systra/SNCF of all LGV maintenance databases to predict potential tamping effort for HS2 tonnage and speed

(km)	160 km/h	200 km/h	220 km/h	230 km/h	270 km/h	300 km/h	320 km/h
LN1	6,8 km				283,6 km	484,2	
LN2		14 km	5,6 km		25,6 km	448,8 km	
LN3	0,8 km	14 km	49,8 km	17,8 km	92,2 km	506 km	
LN4						188,6 km	
LN5	0,6 km					317 km	58 km
LN6			0,8 km			84,6 km	475,8 km



CASE STUDY: HS2 Choosing the right trackform

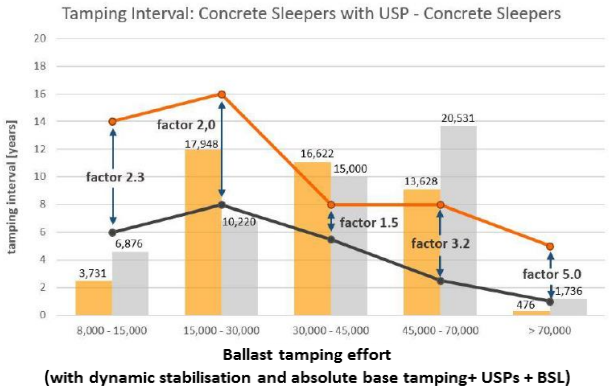
More research to determine performance with bitumen asphalt sub-ballast layer and Under Sleeper Pads

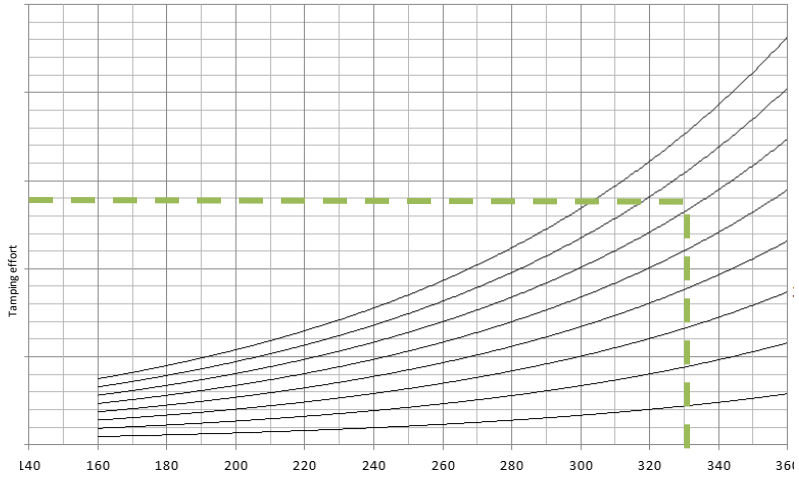
Outputs

- The tamping effort required to maintain ballasted track is a function of tonnage (and speed to a lesser extent)
- Cumulative tonnage is the key input into the degradation of the track system
- The life span of ballast is also a function of the number of tamps…

Higher tonnage = more tamping = lower ballast life = more renewals

Demonstrated that Ballastless Track was better suited to meet the operating strategy and climate resilience

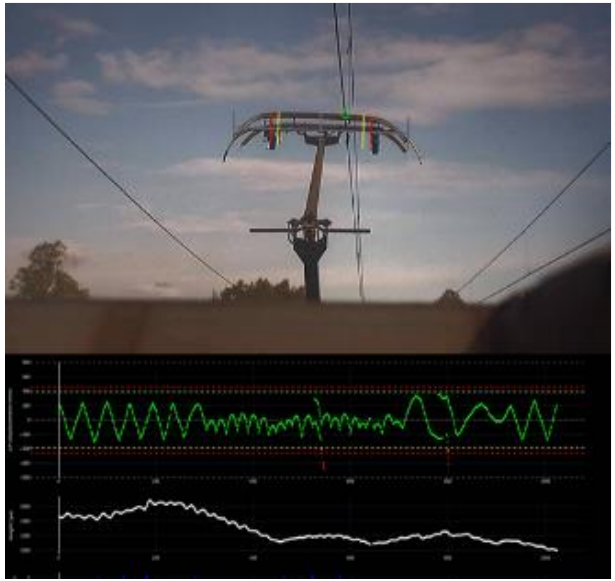




CASE STUDY: HS2 Infrastructure Measurement and Monitoring (IMM) Strategy

AIM

- To identify existing and emerging technologies in:
  - Unattended Measurement Systems (UMS)
  - Dynamic Infrastructure Measurement (DIM)
  - Asset Condition Monitoring (ACM)
- Select candidate technologies
- Develop integrated system that delivers the asset management strategy to achieve reliability targets

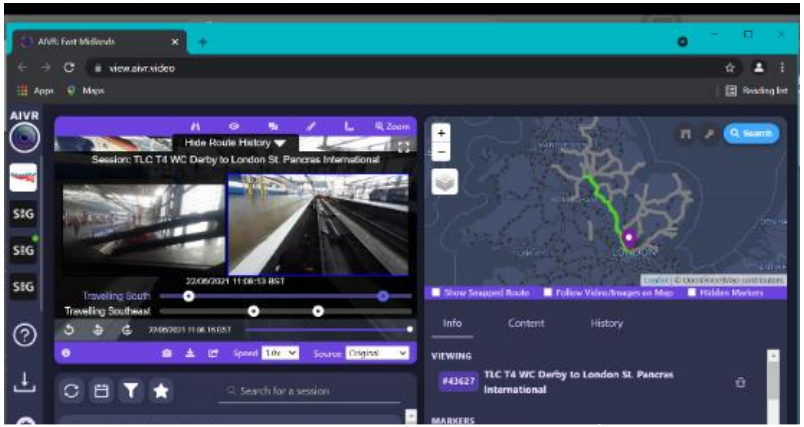


Specifications, designs and procurement strategies all focussed on achieving the reliability targets with low maintenance liability – integrated digital systems

CASE STUDY: HS2 Infrastructure Measurement and Monitoring (IMM) Strategy

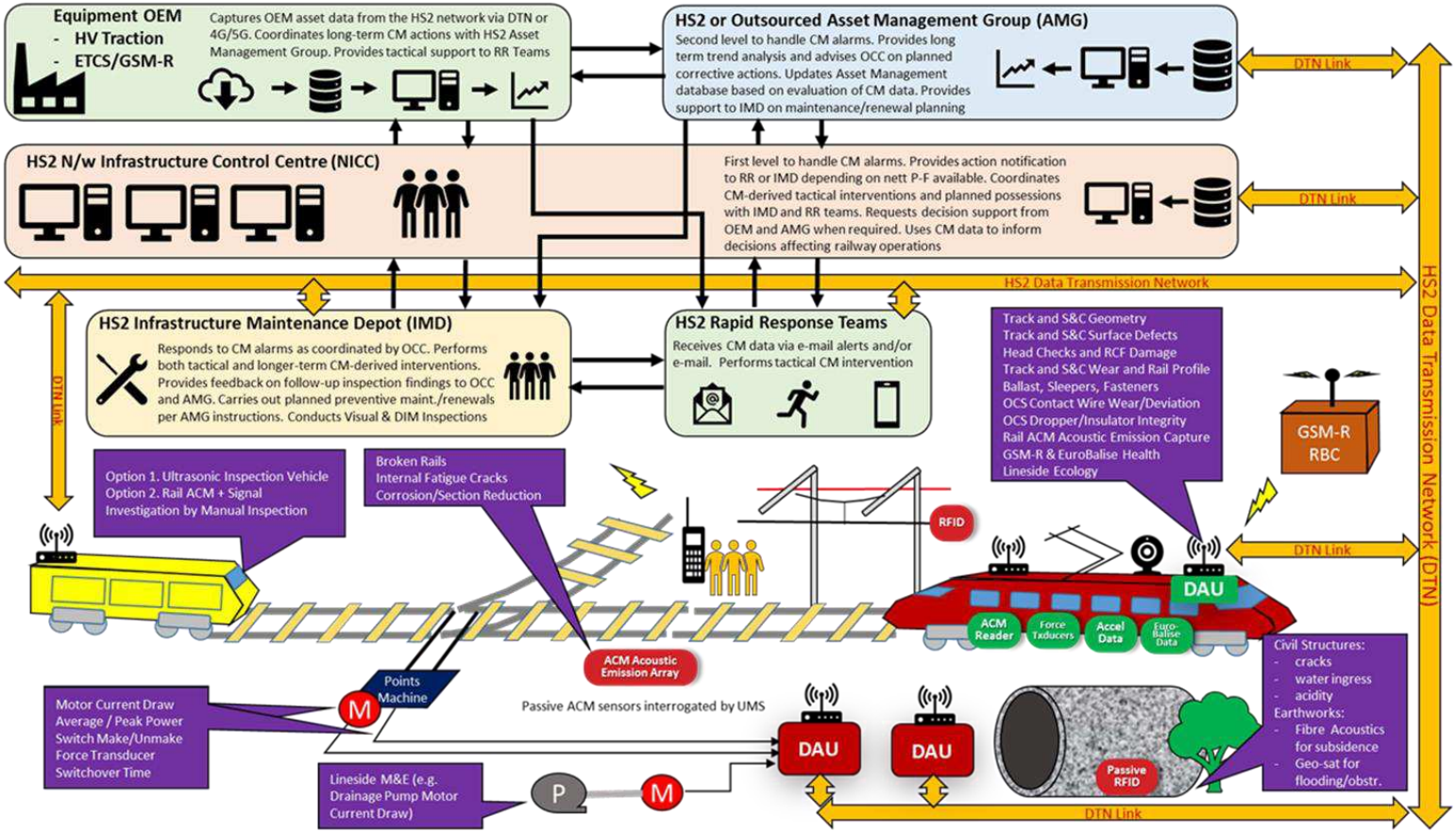
Failure Modes Effects and Criticality Analysis

- 105 potential failure modes identified and analysed
- 70% of these are detectable in principle using UMS, off-board DIM, or ACM technologies



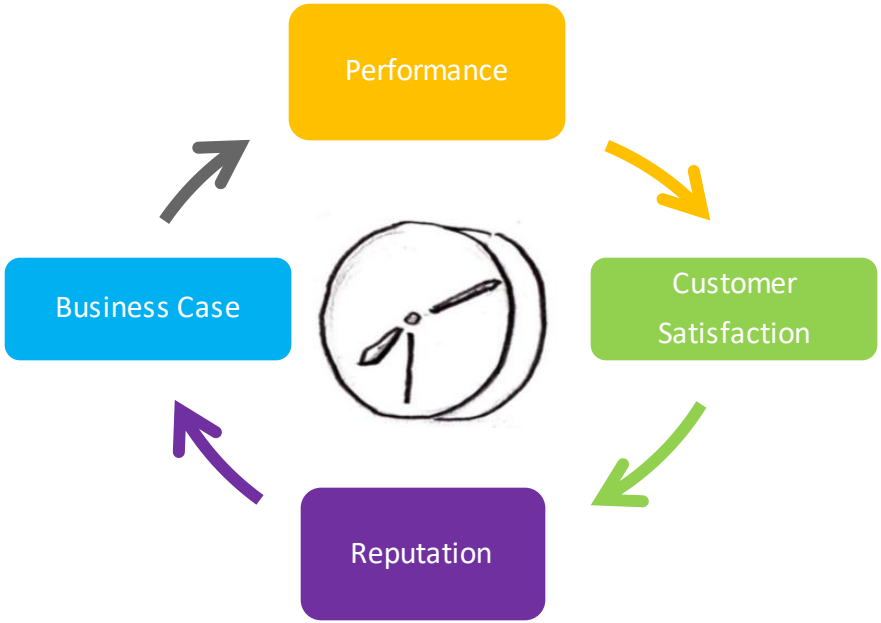
Severity Rating	Rating Description	Rating Definition	No. of failure modes
I	Catastrophic	Infrastructure failure that may cause death or loss of high speed train through derailment, or collision with another train or obstacle	11
II	Critical	Infrastructure failure that may severe injury, prevent train movement or service cancellation through line closure	33
III	Marginal	Infrastructure failure which may impose a speed restriction, significant reduction in passenger ride quality, or delay to a scheduled arrival time of 5 minutes or more	22
IV	Minor	Infrastructure failure which does not affect safety or level of service, but will result in unscheduled maintenance or a dela y to a scheduled arrival time of <5 minutes	39

Case Study: HS2 Initial IMM Concept



Reliable and sustainable high speed railway

- Reliability
- Safety
- Resilience
- Sustainability
- Quality
- Risk management



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Rails painted white. Interest or false good idea

Philippe POULIGNY
Head of Track design and maintenance Division, SNCF Network
Session2-3.2 Operational performance / Climate resilience

ONCF UIC

Rails painted white. Interest or false good idea

Sommaire

- Evaluation de l'effet de la peinture blanche
  - Essais sur le Réseau LGV de la SNCF
  - Résultats et conclusions
- Avis des services Techniques (pour / contre et conclusion)
- Cas de certains autres réseaux

Evaluation de l'effet de la peinture blanche

Essais sur le Réseau LGV de la SNCF

❖ Situation de l'essai

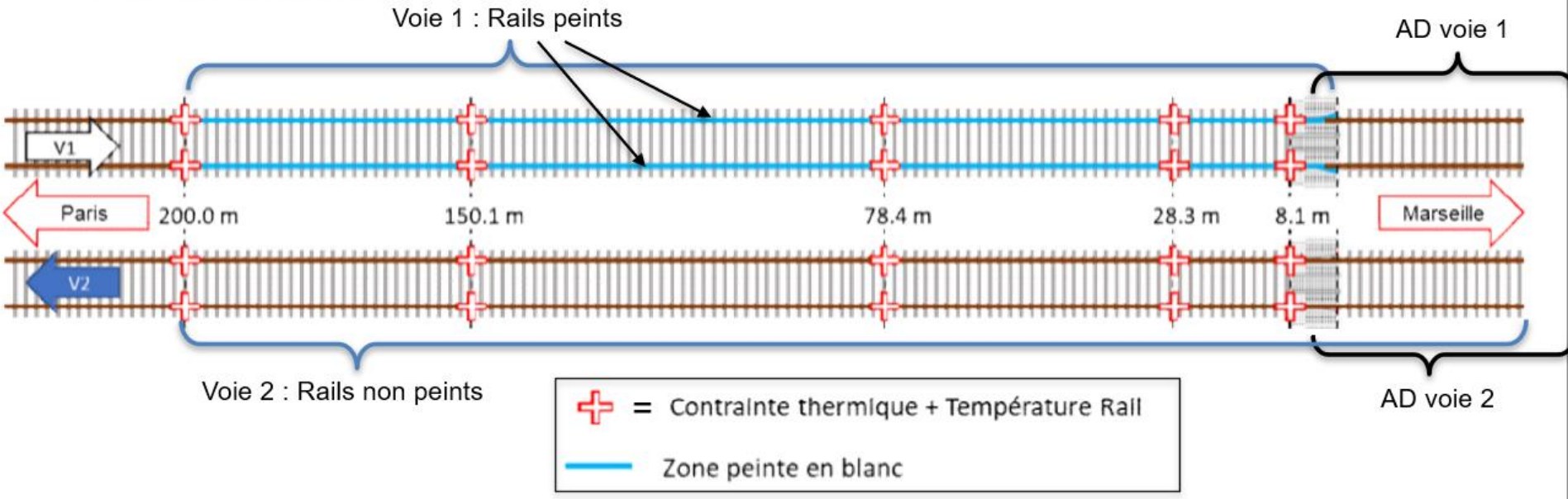
LGV SEE PK 621+550 – Viaduc « des Angles »
Lieu soumis à un fort ensoleillement et dégagé.
Conditions où la peinture blanche sera la plus intéressante

Peinture blanche monocouche protection UV, appliquée manuellement après nettoyage du rail

Evaluation de l'effet de la peinture blanche

Essais sur le Réseau LGV de la SNCF

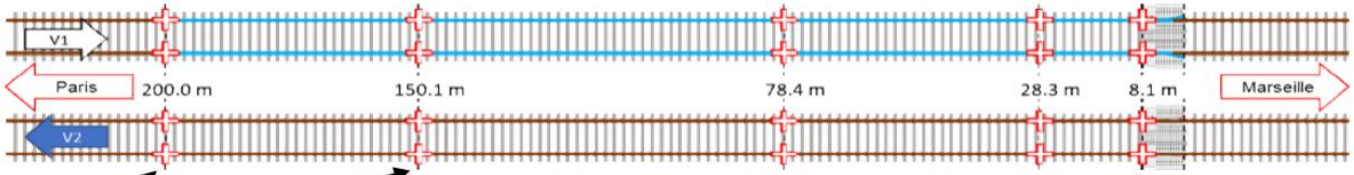
❖ **Grandeurs mesurées**



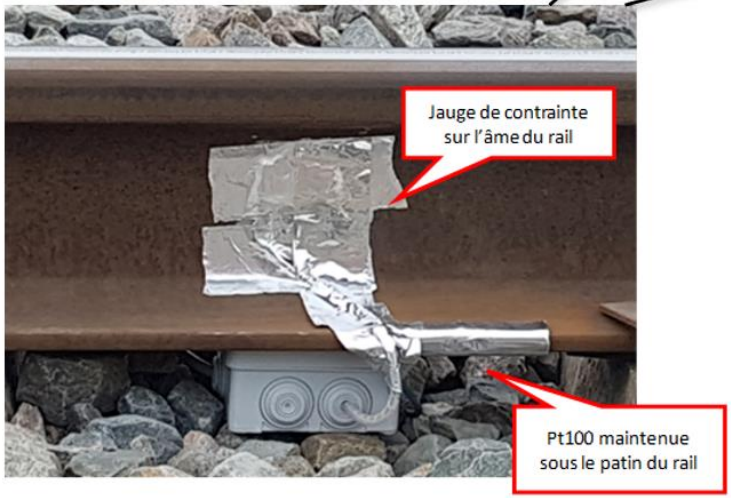
Evaluation de l'effet de la peinture blanche

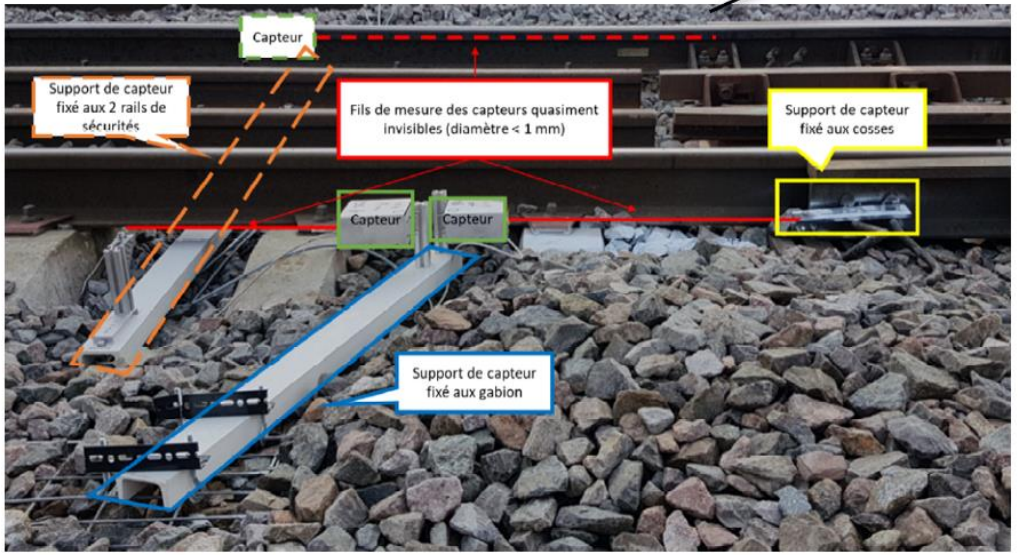
Essais sur le Réseau LGV de la SNCF

AD voie 1



❖ **Grandeurs mesurées**



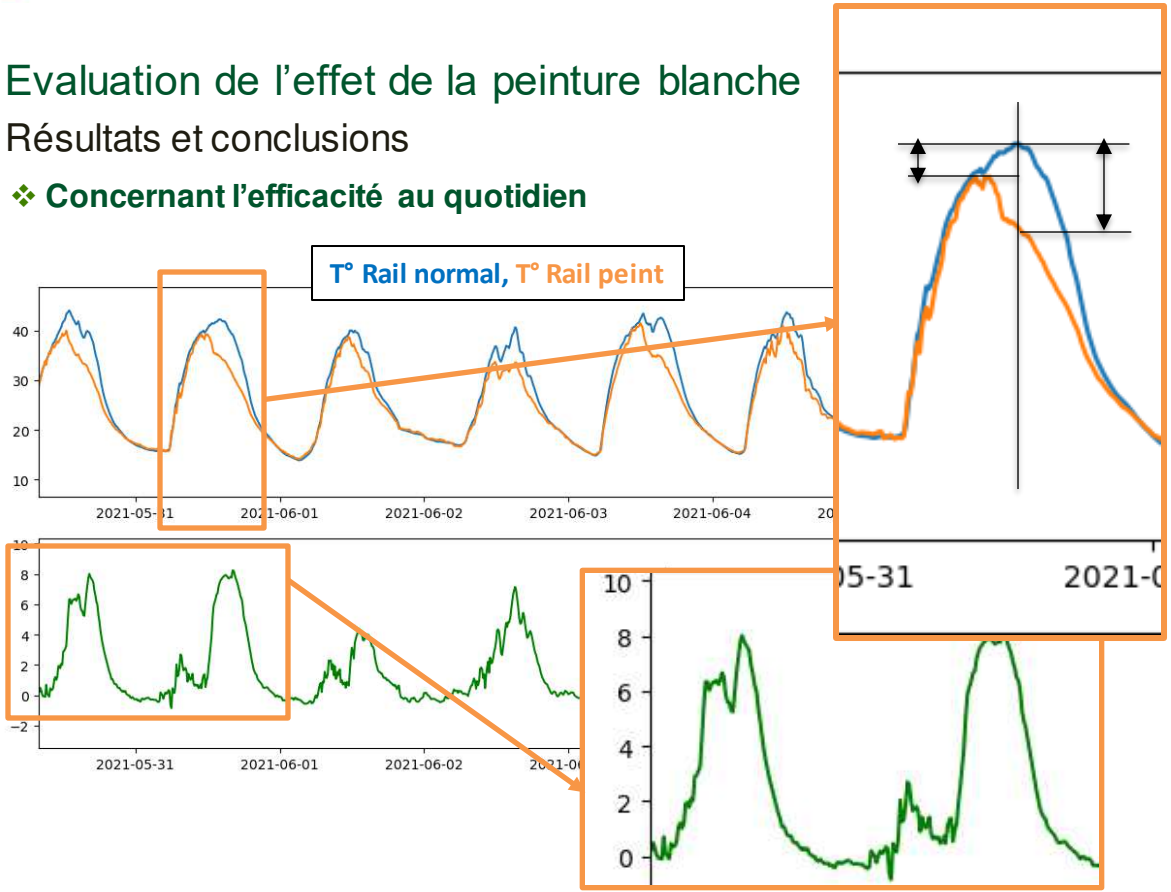


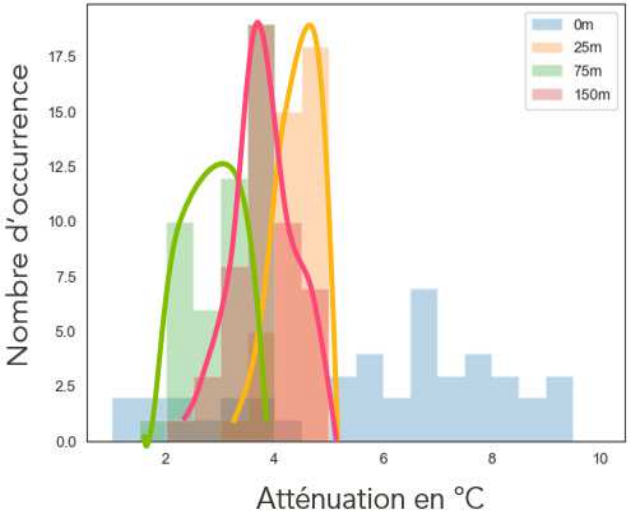
RAILS PAINTED WHITE. INTEREST OR FALSE GOOD IDEA

Evaluation de l'effet de la peinture blanche

Résultats et conclusions

❖ **Concernant l'efficacité au quotidien**





Pour cette raison, on définit l'atténuation sur une journée par :

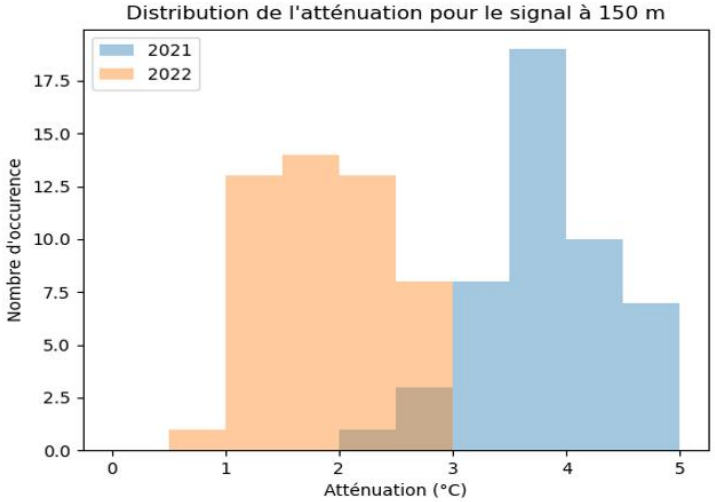
$$\text{Atténuation} = \max_{24h} T^{V2} - \max_{24h} T^{V1}$$

Sur 90 % des jours où la température du rail a dépassé 45°C, on a eu une **atténuation d'au moins 3°C**

Evaluation de l'effet de la peinture blanche

Résultats et conclusions

❖ **Concernant l'efficacité après une année**



Après moyenne de toutes les zones de mesure

1ère année : atténuation de 3°C
2ème année : atténuation de 1,6°C

RA ST OR FALSE GOOD IDEA

Evaluation de l'effet de la peinture blanche

Résultats et conclusions

❖ Conclusion générale

-3°C

DANS 90% DES CAS POUR LES TEMPÉRATURES > 45°C À AVIGNON

-15%

DE LA COMPRESSION AU SEIN DU RAIL (EN MOYENNE) POUR UNE TEMPÉRATURE DE LIBÉRATION DE 25°C

VALABLE

UNE ANNÉE

L'ANNÉE SUIVANTE, ON A UNE ATTÉNUATION DE 1,5°C DANS 90% DES CAS

Cas d'utilisation sur le réseau français

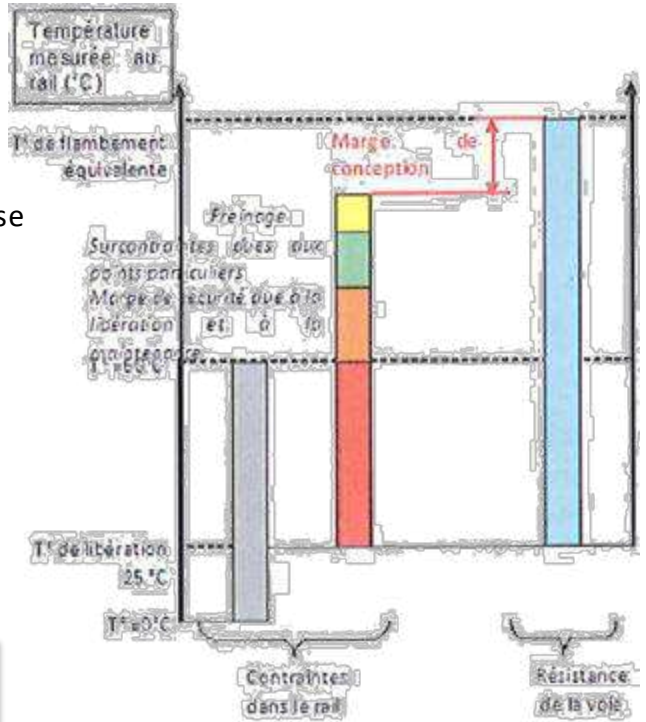
Avis des services Techniques : arguments contre et conclusion

1) Avis technique : Nos voies sont conçues pour résister à un échauffement de 51°C minimum, soit 25 + 51 = 76°C de contrainte.
Température inatteignable en théorie, même avec le réchauffement climatique, mais baisse possible avec le temps…

2) Risque vis-vis des circuits de voie : L'application de la peinture blanche ne doit pas perturber le shuntage des trains.

3) Risque environnemental : Compatibilité de la peinture blanche et de son mode d'application avec l'écologie → tonnes de solvants dans la nature ?

4) Risque technico économique : Le respect des règles de maintenance LRS et de la géométrie sont plus claires, sécuritaires et durables à moyen terme.



→ Pas de peinture systématique envisagée sur le Réseau LGV ou classique

Cas d'utilisation sur le réseau français

Avis des services Techniques : arguments pour et conclusion

1) Avis technique : malgré la qualité et la précision de la maintenance, il existe des zones « fragiles ». Les causes de fragilité peuvent être :

. Manque localisé de ballast,

. Opération de maintenance non effectuée (homogénéisation ou libération)

La peinture peut « renforcer » la tenue en période chaude et réduire les surveillances ou les réductions de vitesse?

-

2) Avantage technico économique : La mise en peinture de ces zones (courtes) peut être moins chère que la surveillance par agents à pied de ces zones ou l'arrêt des circulations.

→ **Une analyse du nombre et du type de zones où l'utilisation de la peinture blanche serait appropriée est en cours**

→ **Dans tous les cas, pas de peinture systématique. Il s'agira éventuellement de peindre quelques zones présentant des désordres (quelques centaines de mètres max)**

Cas d'utilisation sur d'autres réseaux

Réseau Italien,

1) Stratégie de peinture :

Rail peint uniquement aux endroits où la température est susceptible de dépasser ces seuils sur la base de l'historique des températures.

→ 50% au nord

→ 100% au sud

2) Règles LRS en saison chaude:

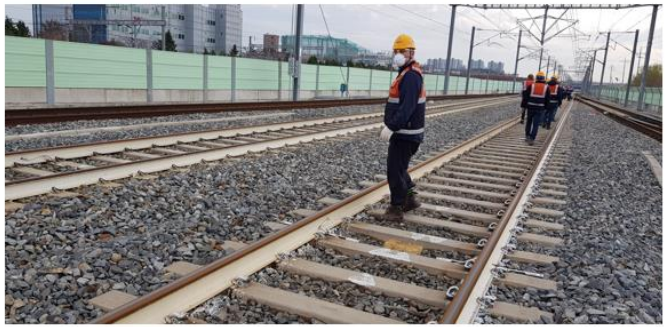
. T° Rail > 1er seuil → ralentissement des circulations

. T° Rail > 2ème seuil → arrêt des circulations

Réseau Coréen

1) Stratégie de peinture :

Peinture systématique des rails des zones ballastées



THANK YOU

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