

INFRAOS INTEGRATED LIFE CYCLE OPTIMIZATION

Railway Health Management – From Tracks to Treatment

Why Strategic Asset Management Matters

THE GROWING IMPORTANCE OF ASSET MANAGEMENT IN MODERN INFRASTRUCTURE






Global shift

Asset management is emerging as essential as infrastructure ages and budgets tighten. The cost of failure is rising – and traditional methods are no longer enough.

ISO 55000 impact

International standards now guide how organizations approach asset performance, risk, and investment across the whole lifecycle
([see also this slide](#))

Many infrastructure owners face a common set of challenges:

-  Limited visibility into their asset inventory
-  Insufficient understanding of asset conditions
-  Uncertainty about the remaining lifespan of their assets
-  Difficulty in optimizing the balance between maintenance and renewal strategies
-  Concerns over the reliability of existing data and trustworthiness of new data

These are the challenges — and this is exactly what we're here to solve. Let us show you how.

Railway Health Management – From Tracks to Treatment

WHY THIS MATTERS TO INFRASTRUCTURE MANAGERS

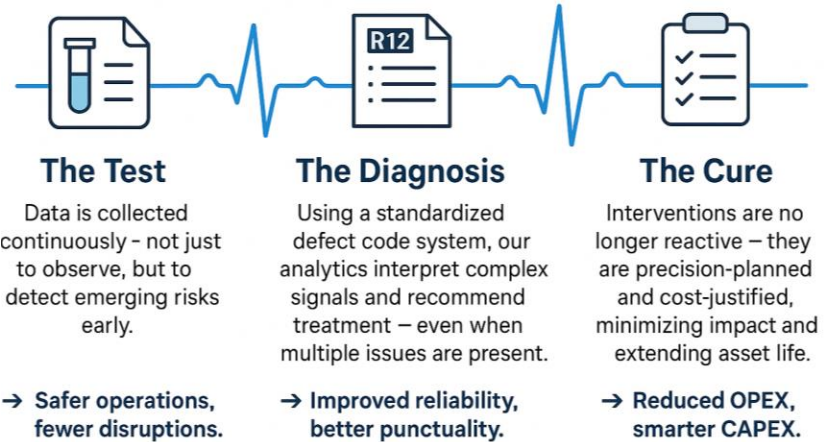
Managing railway infrastructure today is no longer just about fixing what breaks — it's about treating the right problem at the right time, in the right way.

Just like in modern healthcare, every step in the maintenance journey must deliver proven, measurable value:

- **The test:** Data is collected continuously — not just to observe, but to detect emerging risks early
→ *Safer operations, fewer disruptions.*
- **The diagnosis:** Using a standardized defect code system, our analytics interpret complex signals and recommend treatment — even when multiple issues are present
→ *Improved reliability, better punctuality.*
- **The cure:** Interventions are no longer reactive — they are precision-planned and cost-justified, minimizing impact and extending asset life.
→ *Reduced OPEX, smarter CAPEX.*

Just like a hospital aims to reduce both emergencies and costs through proactive care, your infrastructure deserves the same intelligent treatment.

This is Railway Health Management: InfraOS Integrated Life Cycle Optimization — developed for reality, aligned with EN standards, and evaluated against ISO 55001.



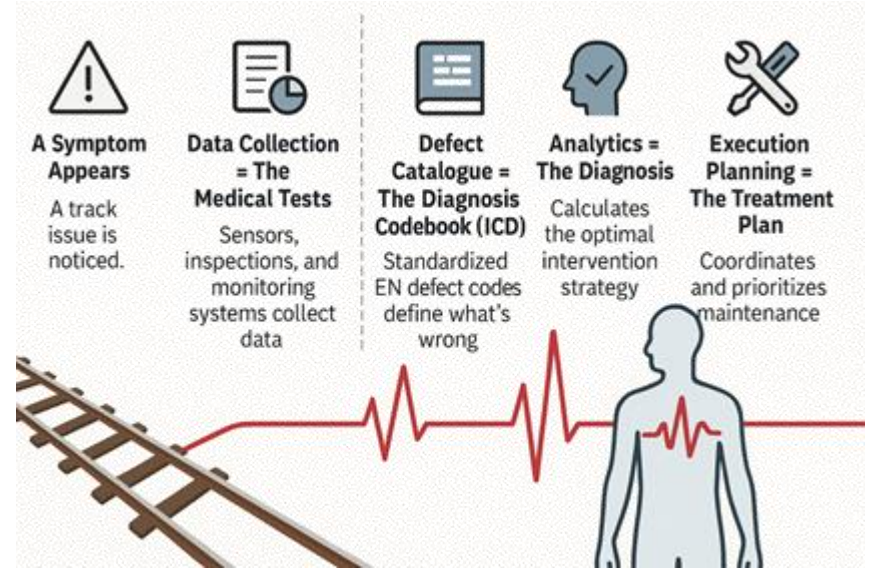
Railway Health Management – From Tracks to Treatment

RAILWAY MAINTENANCE – JUST LIKE A MEDICAL DIAGNOSIS

When a problem appears on the track, we don't just react — we diagnose and treat it like a doctor would with a patient.

- **Condition Monitoring** = Blood Tests
Objective data from sensors and inspections reveals what's really going on and is reported with standardized EN defect codes (currently under development in CEN/TC 256/SC 1/WG 21) to ensure everyone speaks the same language.
- **Decision Support** = Diagnosis Engine
Whether it's a simple issue or multiple overlapping problems, analytics finds the best course of action.
- **Track Works** = Treatment Plan
Maintenance is executed with precision, efficiency, and cost-effectiveness.

It's infrastructure intelligence – from symptom to solution

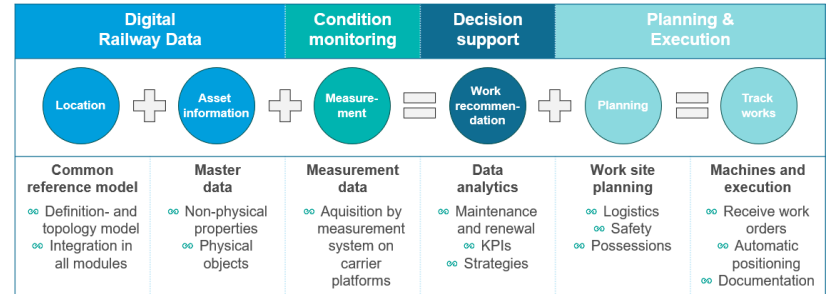


Railway Health Management – From Tracks to Treatment

WE CALL OUR SOLUTION: INFRAOS – AN INTEGRATED SYSTEM FOR RAILWAY HEALTH MANAGEMENT

Our system connects every step — from track location and asset data all the way to precise work execution. Think of it like a full medical workflow: patient history, test results, diagnosis, and treatment.

- **Digital Railway Data** = Patient Record (Location + Asset Information)
Like a medical history, we start with a complete, integrated digital reference of your railway — topology, assets, and master data across the network.
- **Condition Monitoring** = The Medical Tests (Measurement Data)
Through automated inspections and sensor inputs, we continuously collect condition data — just like taking vital signs and lab results.
- **Decision Support** = The Diagnosis Engine (Data Analytics)
Using standardized defect codes and strategic KPIs, our logic recommends the most effective intervention, factoring in lifecycle strategy and asset criticality. Also for making a long term plan based on prediction of condition to estimate the perfect point in time for intervention.
- **Planning & Execution** = The Treatment Plan (Machines & Execution)
We transform recommendations into reality — with safe, efficient, and well-coordinated track works. Logistics, safety, and documentation are built-in.



The result? Targeted maintenance, fewer disruptions, and optimized cost — all through an intelligent, end-to-end process.

Railway Health Management – From Tracks to Treatment

GROUNDING IN EXPERTISE. DRIVEN BY VISION. READY TO COLLABORATE!

This is not just an idea — it's a concept built by people who know the industry, inside out. We're turning years of operational insight, standardization work, and technology experience into a solution the sector truly needs.

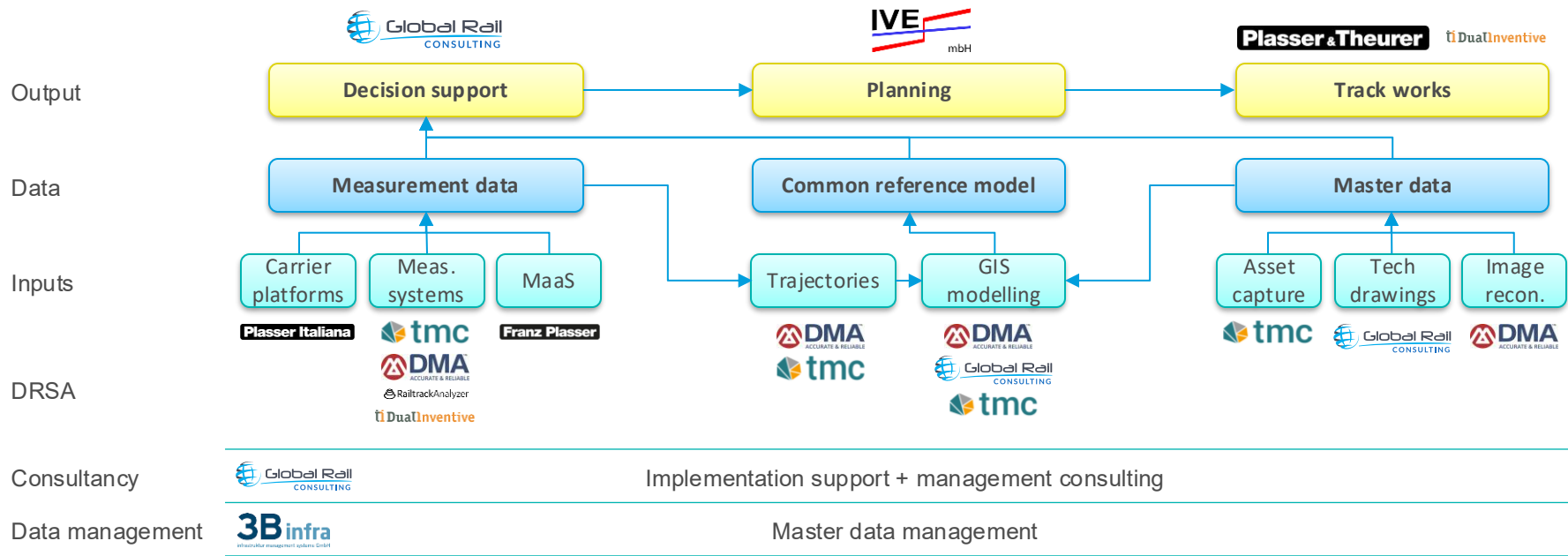
- **Built by railway asset management professionals:** We understand both the pain points and the potential — and we're building around real-world constraints.
- **Rooted in European standards** and ongoing CEN work: We align with existing frameworks like EN 50126, ISO 55001, and the upcoming EN defect catalogue — shaping the future, not just reacting to it.
- **Powered by ready-to-deploy tools and platforms:** We offer the full technology stack: condition monitoring hardware, analytics engines, and work planning modules — all built for integration.
→ *Delivered as a system or as-a-service.*
- **Looking for visionary partners:** We're seeking infrastructure owners, operators, or contractors who want to shape the next generation of track maintenance — together.

The vision is clear. The foundation is solid. Now it's time to build.



From Vision to System – How it All Connects

THIS IS NOT A MONOLITHIC PRODUCT — IT'S A MODULAR ECOSYSTEM, BUILT ON COLLABORATION AND INTEGRATION.
THE DRSA CAN DELIVER ANY ELEMENT THAT THE CLIENT WOULD LIKE TO PROCURE (OR THEY CAN PROVIDE THEMSELVES)



It is Easier to Standardize When There is a Standard

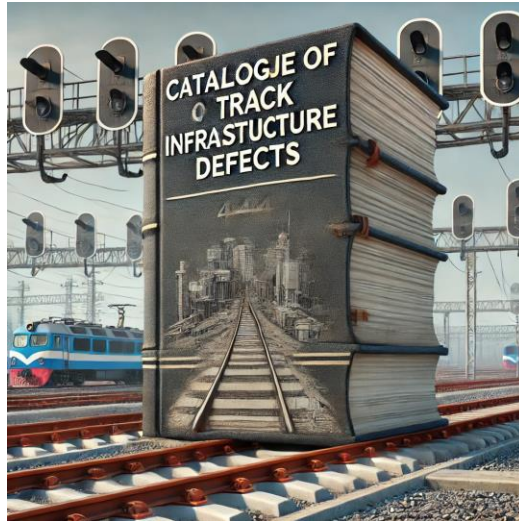
BASED ON THE FUTURE EN-STANDARD, ENABLING CONSISTENT, DATA-DRIVEN INFRASTRUCTURE MANAGEMENT ACROSS ALL ASSET TYPES.

DRSA are developing solutions for integrated infrastructure management of all major maintenance and renewal processes of:

- ✓ Rails
- ✓ Sleepers
- ✓ Track bed
- ✓ Switches & crossings
- ✓ Catenary

A solution consists of modular components within all steps of the life cycle optimisation part of the [loop](#) including data integration between them.

See next slides for examples.

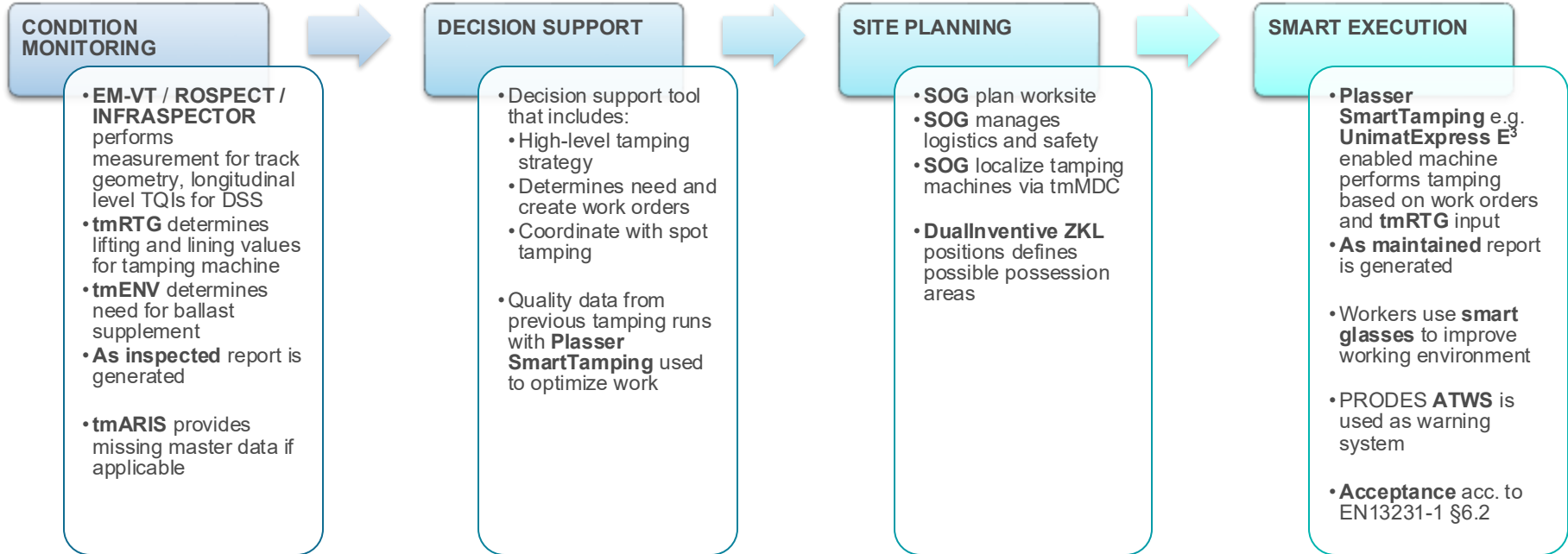
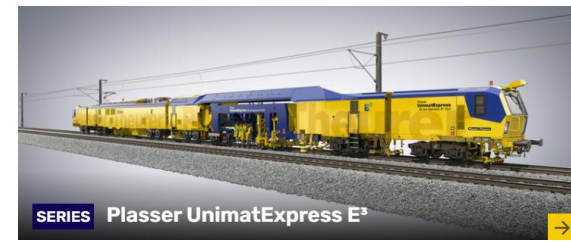


All solutions are based on standardization of data exchange and build upon the future EN-standard “Catalogue of defects for track infrastructure”.

- Standardization enables consistency – A common defect classification system ensures uniform measurement, reporting, and interpretation across all stakeholders.
- Seamless data integration & automation – Standardized inputs allow for streamlined analytics, predictive maintenance, and efficient work order generation.
- Optimized maintenance & collaboration – Improved planning, reduced costs, and enhanced cooperation between infrastructure managers, contractors, and suppliers.

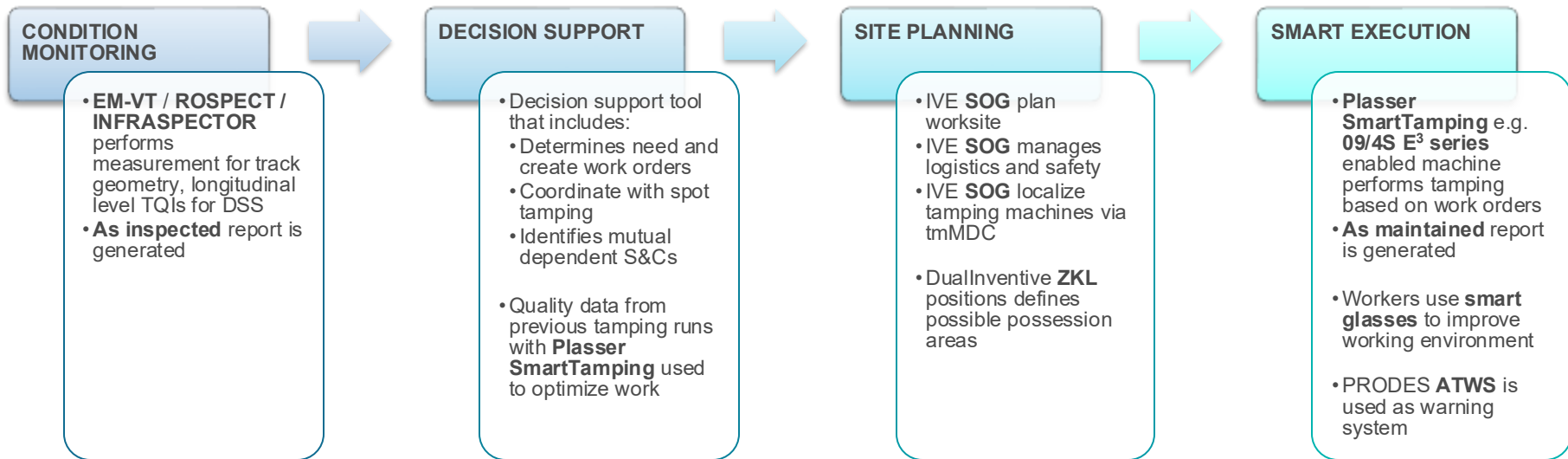
From Data to Maintenance

A REAL-WORLD MAINTENANCE WORKFLOW: LINE TAMPING



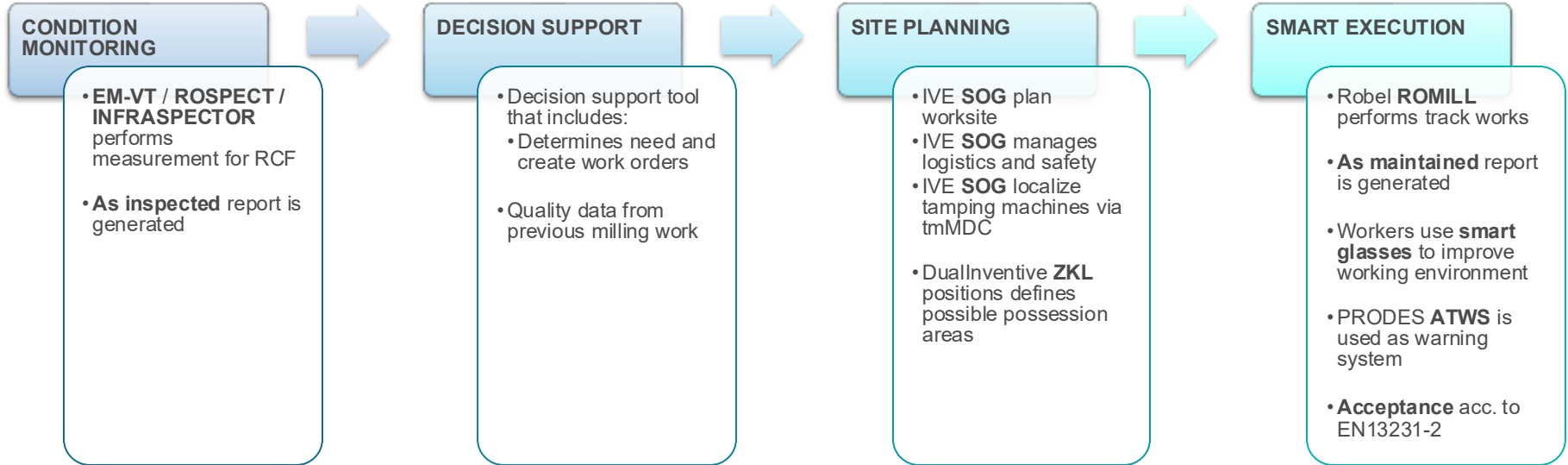
From Data to Maintenance

A REAL-WORLD MAINTENANCE WORKFLOW: S&C TAMPING



From Data to Maintenance

A REAL-WORLD MAINTENANCE WORKFLOW: RAIL REPROFILING



End-to-End Integration Across All Asset Types

FROM MEASUREMENT TO MAINTENANCE AND RENEWAL — SUPPORTED BY DEFECT CODES, ALIGNED WITH FUTURE EN-STANDARD

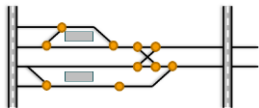
Area	Measurement system	Defect codes	Maintenance	Construction & Renewal
Rail	Rail profile	Aa#	RailRestore, Robel ROMILL & ROMIS Speno grinders	Robel ROREXS, ROLOAD & ROBOT P&T Track renewal-series P&T Welding APT
	Ultrasonic			
	Eddy current/RSCM/Phase array			
	Corrugation	Ab#		
Sleeper	Superstructure images	Ac#	Robel ROMIS & small machinery	P&T AssemblyLiner
Track bed	Relative track geometry	Ad1#	P&T Tamping machines P&T BallastMaster P&T TrackStabilizer	P&T AssemblyLiner P&T ScreenLiner P&T ShoulderLiner P&T MultiLiner P&T FormationLiner
	Absolute/referenced track geometry	Ad2#/Ad3#		
	Ground penetrating radar	Ae#/Ba#/Bc#		
	Laser scanning	-		
	Driver's view video	-		
S&Cs	Turnout & crossing	C#	Robel ROMIS	P&T URM
	Hand tools			
Catenary	Catenary geometry (radar/optical)	-	P&T CatenaryCrafter	P&T CatenaryLiner
	Wire wear			
	Power rail			

INFRAOS LAM Data Exchange Framework

STANDARDIZED DATA MODEL TEMPLATES AND GOVERNING PRINCIPLES FOR INFRAOS SOLUTIONS

CRM

Common Reference Model



A common reference model provides a standardized framework for identifying and referencing assets (tracks) consistently across the entire infrastructure network.

The CRM plays a critical role in ensuring that both measurement data and master data are accurately aligned to the same positions along the linear assets (railway tracks).

MSD

Measurement Data



Measurement data consists of dynamic information collected from various sensors and monitoring equipment.

This data comes from sources such as measurement systems, images, point clouds, vibration sensors, temperature sensors, and other systems for asset health and performance monitoring.

MDM

Master Data




Master data comprises static, fundamental information about the assets, such as asset type, specifications, installation dates, maintenance history, and ownership details.

This data is essential for maintaining an accurate inventory of all assets and supports informed decision-making.

Future EN-Standard for Defect Codes

“IT IS EASIER TO STANDARDIZE WHEN THERE IS A STANDARD”

- Any data that flows within an InfraOS solution must be standardized
- DRSA is creating an internal data standard framework that supports any need of the other work groups to create integrated solutions
- Measurement data must be compatible with the future EN-standard “Catalogue of defects for track infrastructure” which is under development in CEN/TC 256/SC1/WG21
- Data structure and format must be platform independent and cross-compatible for all relevant DRSA products

Defect code	Ad1111x
Defect name	Superstructure – Track bed – Relative track geometry – Longitudinal level – D1 – Isolated defect
Definition	A localized relative track geometry deviation in longitudinal level D1 ($\lambda=3-25$ m) exceeding predefined thresholds, requiring targeted maintenance intervention.
References	EN13848-5
	

Why a New Defect Standard is Needed?

CEN/TC 256/SC1/WG21 – CATALOGUE OF TRACK INFRASTRUCTURE DEFECTS

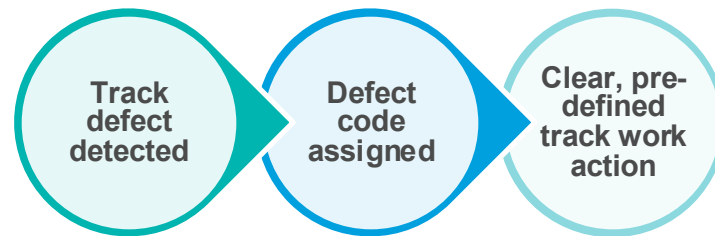
Current challenge:

- Today, every railway infrastructure manager uses their own definitions for track defects.
- This leads to misinterpretation, inefficiencies, and lack of consistency in defect management.

The future with the new standard:

- A unique defect code will be assigned to every track-related defect.
- Inspired by EN 17397 (Rail Defects Classification), ensuring clarity and industry-wide adoption.
- When a defect is referenced, everyone will know exactly what it is, eliminating confusion.

Impact: A standardized, universal language for track infrastructure defects that improves maintenance efficiency and cross-border railway operations.



Today (confusion)	Future (standardized)
Defect described differently by each infra manager	Single defect code used by everybody
Maintenance depends on interpretation	Maintenance is predictable & aligned
Risk of errors, inefficiencies	Efficiency & clarity