

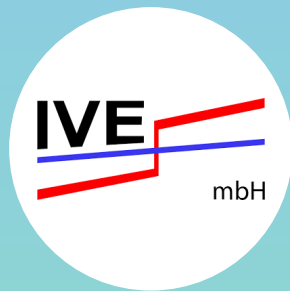
# CONSTRUCTION- AND MAINTENANCE WORKS

Getting things done



# SUPPLIERS OF TRACK WORKS PRODUCTS

## OVERVIEW



# Two Applications With Same General Principle

## CONSTRUCTION WORKS & MAINTENANCE WORKS – A GENERIC CONCEPT WITH SPECIFIC ELEMENTS

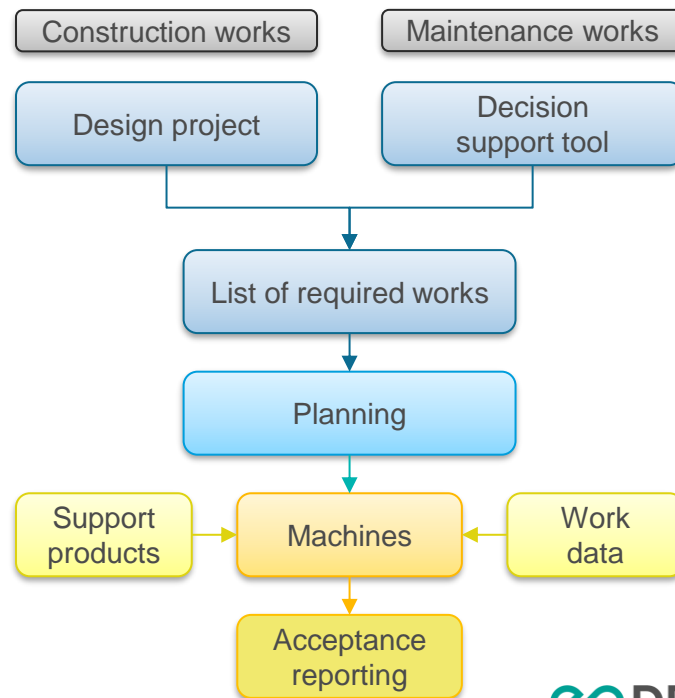
- The Digital Railway Solutions Alliance (DRSA) provides automated (even robotised) and precision-driven technologies that accelerate maintenance activities and improve work quality, reducing track downtime and ensuring that each possession window delivers maximum value.
- Track works cover two applications, respectively construction and maintenance, which have a lot in common, with the same general principle but varying input data and exact work types:
  - **Construction:** Large scale works with input of design data from *smart design* for renewal or new construction e.g. track bed renewal.
  - **Maintenance:** Small to intermediate scale works with input of work recommendation/orders from *decision support* and/or *condition monitoring* e.g. tamping.
- As such, a generic common model is defined, while each component is marked with its relationship.
  - C for construction
  - M for maintenance
- For detailed information on evaluation models, [see these slides](#)



# The General Principle

## STREAMLINING DATA FLOW FROM NEED TO EXECUTION

- The scope of the working groups includes:
  - **Input data:** lists of the required work:
    - Construction works: Result of the design process.
    - Maintenance works: Results from *decision support* tools.
  - **Planning process:** Logistics, safety, and operational plan for executing track works.
  - **Track works:** Execution of the actual work with relevant:
    - Machines e.g. tamping machine.
    - Support products e.g. smart glasses.
    - Work data e.g., input of lift/lining values.
  - **Acceptance reporting during work:** Quality control of executed work with standardized handover documentation
    - Construction works: As installed
    - Maintenance works: As maintained





1

**Track  
machines**



2

**Support  
products**





# TRACK MACHINES

The “yellow” fleet

# P&T: Plasser ScreenLiner Ballast Cleaning

Plasser & Theurer



REVOLUTIONIZING TRACK MAINTENANCE WITH EFFICIENT BALLAST CLEANING

- Ballast bed cleaning, as a maintenance measure, helps infrastructure managers worldwide achieve the desired service life of a track. The cleaned ballast regains most of its original properties and ensures safe and economically efficient railway operations. A variety of innovative equipment options are available to protect the environment, workers, and equipment.
- The Plasser ScreenLiner 3100 provides a comprehensive solution for ballast bed maintenance, delivering significant benefits in safety, cost efficiency, operational punctuality, and environmental sustainability. Its advanced features and high-performance capabilities make it a valuable asset for modern railway infrastructure management.



PICTURE IS LINK TO FURTHER INFORMATION

# P&T: Plasser ScreenLiner Ballast Cleaning

**Plasser & Theurer**

## BUSINESS CASE & BENEFITS

SAFETY	<ul style="list-style-type: none"><li>Enhanced Track Stability: By efficiently cleaning and redistributing ballast, the ScreenLiner 3100 ensures uniform load distribution, reducing the risk of track deformities and failures.</li><li>Precise Excavation: The machine's excavating chain, guided through a cutter bar, allows for precise formation cuts, minimizing unintended disturbances to the track structure.</li></ul>
FINANCIAL	<ul style="list-style-type: none"><li>Cost-Effective Maintenance: High-quality ballast screening reduces the frequency of required maintenance interventions, leading to long-term cost savings.</li><li>Resource Optimization: The machine's ability to process and reuse existing ballast decreases the need for new material, resulting in material cost savings.</li></ul>
PUNCTUALITY	<ul style="list-style-type: none"><li>Consistent High Output: With an excavating capacity of up to 650 m<sup>3</sup>/h, the ScreenLiner 3100 ensures that maintenance tasks are completed swiftly, minimizing disruptions to train schedules.</li><li>Adaptability: Its suitability for both short track possessions and long-term operations allows for flexible scheduling, ensuring timely project completion.</li></ul>
SUSTAINABILITY	<ul style="list-style-type: none"><li>Efficient Resource Use: By reprocessing ballast directly on-site, the machine reduces the environmental impact associated with transporting and producing new ballast.</li><li>Eco-Friendly Design: The ScreenLiner 3100 aligns with sustainable practices by promoting the reuse of materials and minimizing waste.</li></ul>

PERFORMANCE	<ul style="list-style-type: none"><li>High Excavation Capacity: The machine's capability to excavate up to 650 m<sup>3</sup>/h accelerates the ballast cleaning process, reducing overall project timelines.</li><li>Integrated Processes: Combining excavation, screening, and redistribution into a single operation streamlines workflows and eliminates the need for multiple machines.</li></ul>
SAVINGS	<ul style="list-style-type: none"><li>Minimal Setup Requirements: The ScreenLiner 3100's design allows for quick deployment, reducing downtime between maintenance activities.</li><li>Reliable Performance: Consistent high-quality output reduces the likelihood of rework or additional interventions, ensuring continuous operation.</li></ul>
WORK PREPARATION	<ul style="list-style-type: none"><li>Operational Flexibility: The machine's adaptability to various track conditions and its efficient operation enable maintenance tasks to be conducted with minimal disruption to regular train services.</li><li>Precision Engineering: Accurate formation cuts and ballast placement ensure that pre-work preparations are executed effectively, supporting seamless integration with ongoing rail operations.</li></ul>

# P&T: Plasser FormationLiner

Formation Rehabilitation

Plasser & Theurer



STRENGTHEN YOUR TRACKS FROM THE GROUND UP WITH ADVANCED FORMATION REHABILITATION

- The Plasser & Theurer FormationLiner (PM 1000 URM) formation rehabilitation machine offers significant benefits in enhancing safety, reducing maintenance costs, ensuring punctual operations, and promoting sustainability. Its advanced features and high-performance capabilities make it a valuable asset for modern railway infrastructure management.



[PICTURE IS LINK TO FURTHER INFORMATION](#)

# P&T: Plasser FormationLiner

Formation Rehabilitation

**Plasser & Theurer**

## BUSINESS CASE & BENEFITS

SAFETY	<ul style="list-style-type: none"><li>Enhanced Track Stability: By rehabilitating the track formation and installing a formation protective layer (FPL), the FormationLiner ensures improved load-bearing capacity, reducing the risk of track failures and enhancing overall safety.</li></ul>
FINANCIAL	<ul style="list-style-type: none"><li>Cost-Effective Maintenance: Efficient rehabilitation of the track formation reduces the need for frequent maintenance interventions, leading to significant cost savings over time.</li><li>Resource Optimization: The ability to recycle and reuse ballast on-site minimizes the need for new material procurement and transportation, resulting in reduced material costs.</li></ul>
PUNCTUALITY	<ul style="list-style-type: none"><li>Continuous Action Working Mode: The FormationLiner operates in a continuous action mode, enabling swift rehabilitation processes and minimizing track possession times, thereby reducing disruptions to train schedules.</li><li>Integrated Processes: Combining excavation, ballast recycling, and formation layer installation into a single operation streamlines workflows, ensuring timely project completion.</li></ul>
SUSTAINABILITY	<ul style="list-style-type: none"><li>Efficient Resource Use: The machine's capability to recycle ballast directly on-site reduces the environmental impact associated with transporting and producing new ballast.</li><li>Eco-Friendly Design: By promoting the reuse of materials and minimizing waste, the FormationLiner aligns with sustainable railway maintenance practices.</li></ul>

PERFORMANCE	<ul style="list-style-type: none"><li>High Excavation Capacity: Equipped with three excavating chains and an integrated ballast washing plant, the FormationLiner accelerates the rehabilitation process, reducing overall project timelines.</li><li>Integrated Operations: The combination of multiple rehabilitation processes into a single machine eliminates the need for multiple equipment deployments, streamlining operations and saving time.</li></ul>
SAVINGS	<ul style="list-style-type: none"><li>Continuous Action Mode: The machine's continuous working mode minimizes downtime between different rehabilitation stages, ensuring a seamless workflow.</li><li>Reliable Performance: Consistent high-quality output reduces the likelihood of rework or additional interventions, ensuring continuous operation.</li></ul>
WORK PREPARATION	<ul style="list-style-type: none"><li>Operational Flexibility: The FormationLiner's design allows for efficient deployment and operation during scheduled maintenance windows, minimizing disruptions to regular train services.</li><li>Precision Engineering: Accurate formation cuts and ballast placement ensure that pre-work preparations are executed effectively, supporting seamless integration with ongoing rail operations.</li></ul>

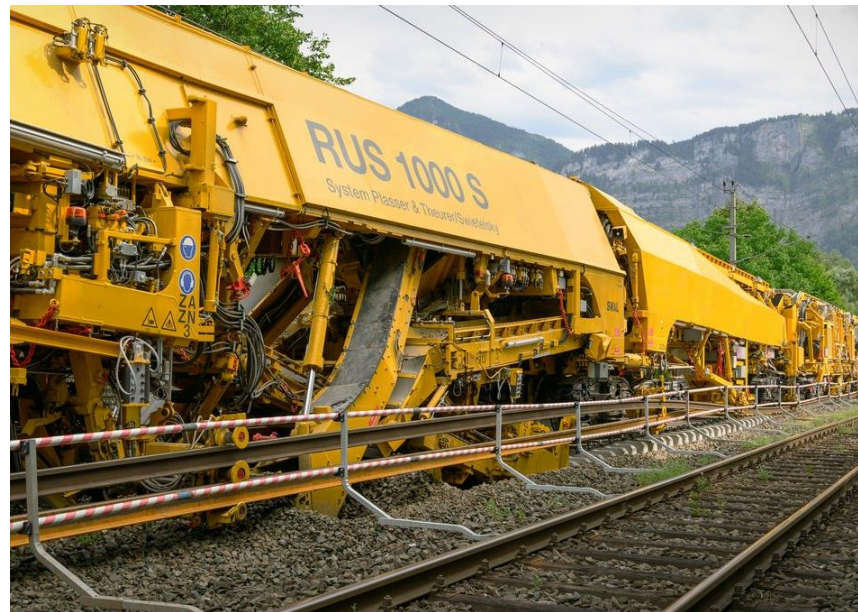
# P&T: Plasser MultiLiner Track Renewal & Cleaning

Plasser & Theurer



## STREAMLINING TRACK RENEWAL WITH INTEGRATED BALLAST CLEANING

- These maintenance works normally take place in two separate steps. A ballast cleaning machine cleans the ballast, and then a track relaying train renews the track. In the past, two weekend track possessions were often reserved to complete this job.
- With the MultiLiner, we combine two separate tasks, track renewal and ballast bed cleaning, into one machine. Incorporating two stages of work into a single process offers a major advantage: fewer operational hindrances as a result of simplified worksite logistics.
- Thanks to the MultiLiner, less time is required for any track possessions. Plus, it can exchange and rehabilitate more kilometers of rail while the duration of the possession remains the same.
- Another typical approach is to work in cycles during overnight track possessions. During the day, the tracks are open for passenger traffic. The MultiLiner is the ideal machine for this approach: trains can immediately travel on the rehabilitated track at speeds of up to 60 km/h.



PICTURE IS LINK TO FURTHER INFORMATION

# P&T: Plasser MultiLiner Track Renewal & Cleaning

## BUSINESS CASE & BENEFITS

SAFETY	<ul style="list-style-type: none"> <li>Integrated Track Renewal and Ballast Cleaning: By combining track renewal and ballast bed cleaning into a single operation, the MultiLiner minimizes the need for multiple machine passes, reducing worker exposure to trackside hazards.</li> </ul>
FINANCIAL	<ul style="list-style-type: none"> <li>Reduced Operational Costs: Combining two major maintenance tasks into one machine decreases the need for multiple equipment sets and labor forces, leading to significant cost savings.</li> <li>Efficient Use of Track Possessions: The MultiLiner's ability to perform dual functions in a single-track possession reduces the frequency and duration of service interruptions.</li> </ul>
PUNCTUALITY	<ul style="list-style-type: none"> <li>Minimized Service Disruptions: The machine's capability to perform track renewal and ballast cleaning simultaneously shortens maintenance windows, ensuring that train schedules are maintained with minimal disruption.</li> <li>High-Speed Post-Maintenance Operations: Allowing trains to operate at speeds up to 60 km/h immediately after rehabilitation ensures timely resumption of regular services.</li> </ul>
SUSTAINABILITY	<ul style="list-style-type: none"> <li>Efficient Resource Utilization: By integrating two maintenance processes, the MultiLiner reduces the need for additional machinery and resources, leading to a smaller environmental footprint.</li> <li>Enhanced Track Longevity: Comprehensive maintenance improves track durability, decreasing the frequency of future interventions and conserving materials.</li> </ul>

PERFORMANCE	<ul style="list-style-type: none"> <li>Simultaneous Operations: The MultiLiner performs track renewal and ballast cleaning concurrently, effectively halving the time required compared to performing these tasks separately.</li> </ul>
SAVINGS	<ul style="list-style-type: none"> <li>Efficient Track Possessions: By combining two major maintenance activities, the machine reduces the number of track possessions needed, leading to increased track availability for regular operations.</li> </ul>
WORK PREPARATION	<ul style="list-style-type: none"> <li>Rapid Deployment and Clearance: The MultiLiner's design allows for quick setup and removal, facilitating maintenance during limited windows and ensuring tracks are swiftly returned to regular service.</li> </ul>

# P&T: Unimat 09-8x4/4S Dynamic

Plasser & Theurer



HIGH PERFORMANCE WITH CONTINUOUS 2-SLEEPER TAMPING AND UNPARALLELED FLEXIBILITY IN TURNOUT MAINTENANCE

- Maximum flexibility in the turnout thanks to the pivoting tamping unit, tamping unit segments that can be lowered individually, and tilting tamping tines.
- Increased output during turnout maintenance thanks to continuous working action.
- High track position durability and resistance to track distortion thanks to dynamic track stabilization.
- Reduces speed restrictions: optimized availability of the infrastructure after maintenance with dynamic track stabilization.
- The frame is designed to treat the heaviest types of superstructure (heavy-haul lines).
- High maximum working output thanks to 2-sleeper tamping technology; great flexibility in the turnout thanks to the 8x4 tamping unit .
- Spacious multi-purpose areas (e.g. workshop, crew area)
- Fast approval at reduced cost thanks to the use of standardized machine components and systems.



# P&T: Unimat 09-8x4/4S Dynamic

## BUSINESS CASE & BENEFITS

<b>SAFETY</b>	<ul style="list-style-type: none"> <li>Reduced on-track exposure: The machine combines lifting, lining, tamping, and stabilization, reducing the need for multiple machines and manual activities on live tracks.</li> <li>Precision tamping and automatic correction significantly reduce geometry-related safety risks.</li> <li>Operator comfort and automation features ensure fewer human errors during operation.</li> </ul>
<b>FINANCIAL</b>	<ul style="list-style-type: none"> <li>All-in-one solution: Fewer machines and personnel are needed due to multifunctionality.</li> <li>High output: Faster completion reduces possession time and total project costs.</li> <li>Less ballast degradation: Thanks to optimized tamping, maintenance cycles are extended, lowering recurring costs.</li> </ul>
<b>PUNCTUALITY</b>	<ul style="list-style-type: none"> <li>Dynamic track stabilization allows trains to resume service at line speed shortly after tamping—no need for speed restrictions post-maintenance.</li> <li>Simultaneous 4-rail tamping in turnouts saves significant time over traditional two-pass operations.</li> <li>Automated processes and quick setup reduce delays due to human factors.</li> </ul>
<b>SUSTAINABILITY</b>	<ul style="list-style-type: none"> <li>Efficient ballast use: Reduced over-tamping prevents unnecessary ballast wear.</li> <li>Fewer machine runs = lower fuel use and emissions.</li> <li>Longer track life through precise, data-driven interventions.</li> </ul>

<b>PERFORMANCE</b>	<ul style="list-style-type: none"> <li>Simultaneous tamping of turnout and plain line without needing to switch configurations.</li> <li>Continuous action tamping design increases work output per hour.</li> <li>Integrated stabilization removes the need for separate stabilizer runs.</li> </ul>
<b>SAVINGS</b>	<ul style="list-style-type: none"> <li>Quick setup and automation speed up mobilization at each site.</li> <li>Minimized rework due to high-precision technology and automatic geometry control.</li> <li>Fewer required possessions thanks to high productivity.</li> </ul>
<b>WORK PREPARATION</b>	<ul style="list-style-type: none"> <li>Pre-programmable geometry correction plans can be prepared based on measurement car data before work starts.</li> <li>Modular design allows the machine to be scheduled efficiently during regular service intervals, fitting into short work windows.</li> </ul>

# P&T: Plasser TampingAssistant

Plasser & Theurer



SIMPLIFYING COMPLEX TAMPING TASKS FOR OPERATORS OF ALL SKILL LEVELS

- The Tamping Assistant is an assistance system that supports the machine operator step by step during the process of handling the machine. In principle, it works similarly to an adaptive cruise control or a lane assistant in a car that supports drivers while driving. So far there have been few regulations as to how to document the maintenance of railway tracks. The result is inconsistency in documentation and a lack of transparency in track maintenance. This can be particularly challenging for infrastructure operators. The Tamping Assistant is the first step towards traceable, optimized and consistently protocolled maintenance.
- The Tamping Assistant is an AI-based assistance system. The tamping machine, which is equipped with the Tamping Assistant, scans and assesses the railway track. The Tamping Assistant then provides recommendations for action. It makes suitable suggestions for the lifting and lining unit, the additional lifting and the tamping unit. This not only makes it easier to operate the machine, it also reduces the risk of incorrect use. If necessary, an operator can intervene manually at any time.



PICTURE IS LINK TO FURTHER INFORMATION

# P&T: Plasser TampingAssistant

## BUSINESS CASE & BENEFITS

SAFETY	<ul style="list-style-type: none"><li>Enhances safety by automating and assisting tamping operations, reducing human error and improving precision.</li><li>Minimizes worker exposure to hazardous environments and heavy machinery through the optimized workflows.</li></ul>
FINANCIAL	<ul style="list-style-type: none"><li>Reduces operational costs by increasing the accuracy and efficiency of tamping, resulting in fewer reworks and extended track lifespan.</li><li>Optimizes resource use, reducing fuel consumption and labor costs.</li></ul>
PUNCTUALITY	<ul style="list-style-type: none"><li>Improves punctuality by ensuring more efficient and accurate tamping, reducing the likelihood of track defects and unplanned maintenance.</li><li>Minimizes disruptions through faster completion of track maintenance.</li></ul>
SUSTAINABILITY	<ul style="list-style-type: none"><li>Supports sustainability by optimizing machine usage, reducing energy consumption and material waste.</li><li>Extends track life through precision tamping, reducing the frequency of heavy maintenance cycles.</li></ul>

PERFORMANCE	<ul style="list-style-type: none"><li>Accelerates tamping operations by providing <b>real-time assistance and automation</b>, reducing the time needed to complete maintenance tasks.</li><li>Improves machine productivity through optimized workflows and reduced idle time.</li></ul>
SAVINGS	<ul style="list-style-type: none"><li>Reduces rework and downtime by ensuring high precision on the first attempt, maximizing effective use of track possession time.</li><li>Minimizes disruptions and delays caused by inefficient tamping processes.</li></ul>
WORK PREPARATION	<ul style="list-style-type: none"><li>Allows smoother integration of tamping activities into maintenance windows with minimal disruption.</li></ul>

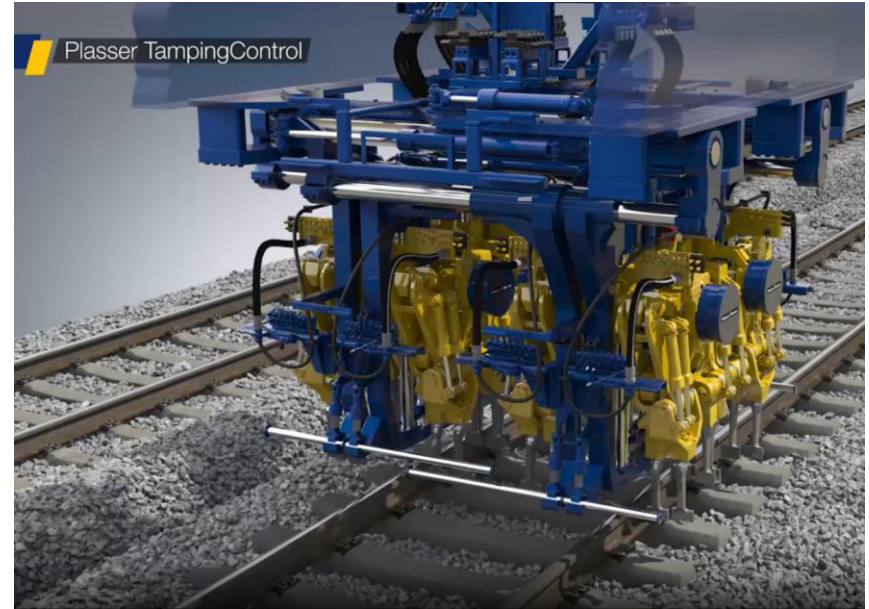
# P&T: Plasser TampingControl

Plasser & Theurer



EMPOWERING OPERATORS WITH DIGITAL TOOLS FOR SUPERIOR TRACK STABILITY

- The Plasser TampingControl system enhances tamping quality by providing real-time data on the condition of the track and the tamping process. It optimizes the filling and compaction of the ballast to ensure the stability of the track geometry over time. By continuously monitoring the tamping cycles, it delivers precise control and documentation, enabling efficient and reliable maintenance operations.



*PICTURE IS LINK TO FURTHER INFORMATION*

# P&T: Plasser Tamping Control

## BUSINESS CASE & BENEFITS

SAFETY	<ul style="list-style-type: none"><li>• Enhances safety by using advanced digital tools to monitor and control tamping processes, reducing the likelihood of human error.</li><li>• Ensures consistent track quality, minimizing risks associated with track irregularities or misalignments.</li></ul>
FINANCIAL	<ul style="list-style-type: none"><li>• Reduces maintenance costs by increasing the precision of tamping operations, decreasing the need for rework.</li><li>• Optimizes resource use, such as machinery and labor, through efficient, data-driven tamping control.</li></ul>
PUNCTUALITY	<ul style="list-style-type: none"><li>• Improves punctuality by ensuring high-quality tamping that reduces the need for corrective maintenance and unplanned downtime.</li><li>• Speeds up maintenance tasks, minimizing disruptions to railway operations.</li></ul>
SUSTAINABILITY	<ul style="list-style-type: none"><li>• Promotes sustainability by extending track lifespan through precise and consistent tamping, reducing material and energy use.</li><li>• Minimizes environmental impact by decreasing the frequency of heavy maintenance interventions.</li></ul>

PERFORMANCE	<ul style="list-style-type: none"><li>• Speeds up tamping tasks by leveraging automated and real-time monitoring systems for more efficient execution.</li><li>• Reduces operational delays by providing immediate feedback for adjustments during tamping.</li></ul>
SAVINGS	<ul style="list-style-type: none"><li>• Minimizes downtime by enabling precise and reliable tamping operations that require fewer corrections.</li><li>• Ensures optimal use of work windows through data-driven processes, reducing delays caused by inefficiencies.</li></ul>
WORK PREPARATION	<ul style="list-style-type: none"><li>• Supports the preparation by providing insights that optimize tamping operations during maintenance windows.</li></ul>

# Robel: ROBOT

## REVOLUTIONIZING RAIL MAINTENANCE WITH AUTOMATED PRECISION

- Robot-assisted, automated maintenance and repair to increase lay time with fewer staff and reproducible results
- JOB to be done:
  - Fully automated local defect repair on Rail
  - Fully automated switch frog maintenance
  - Materials R350HT, R260Mn, Mn13
- Core Processes:
  - inspect, mill out defects, weld up structure, reprofile, QC-measurement and OTA documentation of the repair.
- Machine:
  - Track based “box in box” system placed on standard flat wagon
  - Realization: Containers as load on standard flat wagon:
  - Hybrid power supply: Battery pack and Diesel generator



PICTURE IS LINK TO FURTHER INFORMATION

# Robel: ROBOT

## BUSINESS CASE & BENEFITS

SAFETY	<ul style="list-style-type: none"><li>• Robot-assisted, automated maintenance and repair to increase lay time with fewer staff and reproducible result</li></ul>
FINANCIAL	<ul style="list-style-type: none"><li>• Robot-assisted, automated maintenance and repair to increase lay time with fewer staff and reproducible result</li></ul>
PUNCTUALITY	<ul style="list-style-type: none"><li>• Robot-assisted, automated maintenance and repair to increase lay time with fewer staff and reproducible result</li></ul>
SUSTAINABILITY	<ul style="list-style-type: none"><li>• Robot-assisted, automated maintenance and repair to increase lay time with fewer staff and reproducible result</li></ul>

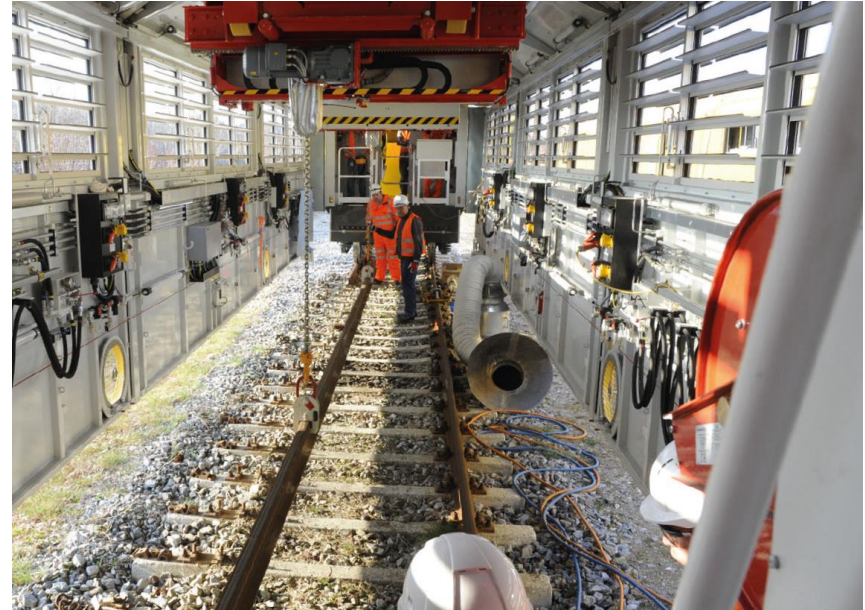
PERFORMANCE	<ul style="list-style-type: none"><li>• Speeds up maintenance tasks through high-precision automation, significantly reducing task completion times compared to manual methods.</li><li>• Reduces setup and execution time for complex maintenance activities.</li></ul>
SAVINGS	<ul style="list-style-type: none"><li>• No need to set up equipment, as it is all handled by the robot</li></ul>
WORK PREPARATION	<ul style="list-style-type: none"><li>• Supports planning and coordination by providing accurate, real-time data for subsequent maintenance.</li></ul>

# Robel: Mobile Maintenance Train (ROMIS)



## PRECISION TRACK MAINTENANCE ON THE MOVE

- The ROMIS System by ROBEL is a mobile maintenance solution designed to enhance safety and efficiency in railway construction and repair. It comprises two primary components:
- ROMIS WORK: This mobile maintenance unit serves as a workshop with direct track access.
- ROMIS STORE: Functioning as the system's warehouse, this intermediate car offers optimal storage for machines and materials, customizable to client specifications.
- The system is equipped with two chain hoist models, offering a combined load capacity of 4 tons, facilitating the transport of equipment and materials along the entire length of the ROMIS WORK unit and the ROMIS STORE area.
- Key functionalities of the ROMIS System include rail replacement up to 10 meters, renewal of insulating joints, maintenance of rail joints, replacement of small iron parts, correction of track geometry with vertical vibrating tampers, and work on switches and cross switches, among other tasks.



PICTURE IS LINK TO FURTHER INFORMATION

# Robel: Mobile Maintenance Train (ROMIS)



## BUSINESS CASE & BENEFITS

SAFETY	<ul style="list-style-type: none"><li>Enhances safety by reducing manual handling of heavy equipment through automated and mechanized maintenance tasks.</li><li>Minimizes risks to workers by integrating mobile, precise solutions that operate efficiently in controlled environments.</li></ul>
FINANCIAL	<ul style="list-style-type: none"><li>Reduces costs through multi-functional capability, enabling various maintenance tasks with a single, adaptable system.</li><li>Cuts labor expenses by automating repetitive or resource-intensive activities, optimizing operational efficiency.</li></ul>
PUNCTUALITY	<ul style="list-style-type: none"><li>Increases punctuality by reducing time spent on track maintenance tasks, ensuring faster handover of operational tracks.</li><li>Streamlines workflows, minimizing delays caused by equipment inefficiencies or manual errors.</li></ul>
SUSTAINABILITY	<ul style="list-style-type: none"><li>Promotes sustainability by optimizing resource use and reducing energy consumption through mechanized efficiency.</li><li>Extends infrastructure life by enabling precise, condition-based maintenance with minimal waste or material overuse.</li></ul>

PERFORMANCE	<ul style="list-style-type: none"><li>Speeds up maintenance tasks with mobile, all-in-one systems that integrate multiple functions into a single operational flow.</li><li>Enables rapid deployment and task execution with fewer setup requirements.</li></ul>
SAVINGS	<ul style="list-style-type: none"><li>Reduces downtime by performing multiple maintenance activities during a single-track possession window.</li><li>Minimizes interruptions by ensuring tools and equipment are readily available and integrated into the ROMIS system.</li></ul>
WORK PREPARATION	<ul style="list-style-type: none"><li>Ensures readiness for upcoming tasks by integrating data collection, tool storage, and planning functionalities into one system.</li></ul>

# Robel: ROMILL



OPTIMIZE YOUR TRACKS' PERFORMANCE WITH ROMILL'S ADVANCED RAIL TREATMENT SYSTEMS

- The ROMILL System by ROBEL is a comprehensive rail maintenance solution designed to address the challenges posed by increasing passenger numbers, higher speeds, and heavy freight traffic, all of which contribute to accelerated rail wear and defects.
- Integrated Technologies: Combines advanced milling, grinding, and measurement technologies to restore rail profiles efficiently.
- Single-Pass Operation: Measures rail defects, corrects them, and documents the results in one pass, optimizing wheel-rail contact and extending rail service life.
- Comprehensive Maintenance: Addresses rail defects such as cracks and deformations, reducing safety risks, delays, downtimes, wear, life cycle costs, noise pollution, and rolling resistance.
- By implementing the ROMILL System, railway operators can achieve sustainable and efficient rail maintenance, ensuring optimal performance and safety of rail infrastructure.



[PICTURE IS LINK TO FURTHER INFORMATION](#)

# Robel: ROMILL



## BUSINESS CASE & BENEFITS

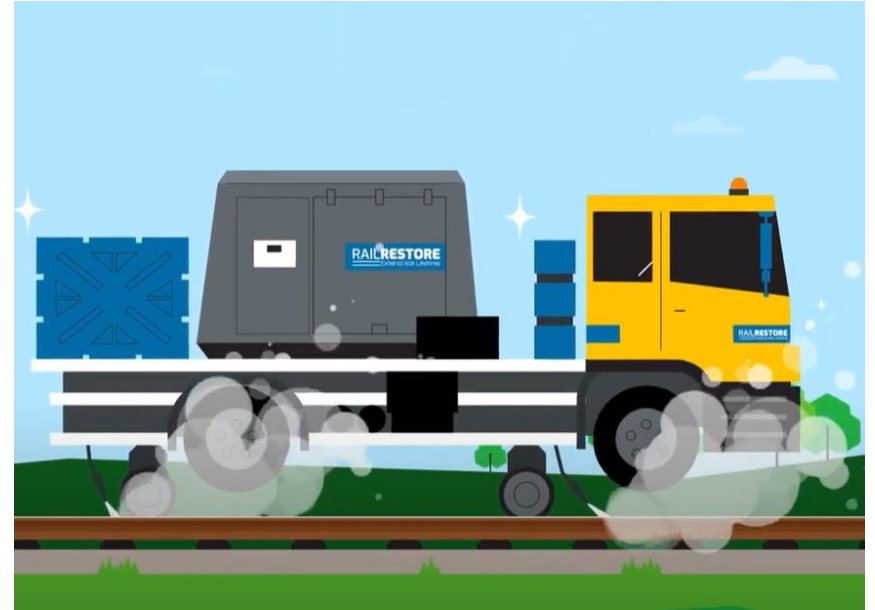
SAFETY	<ul style="list-style-type: none"><li>• Enhances safety by automating rail maintenance tasks, reducing manual intervention and exposure to hazards.</li><li>• Removes rail defects with precision, lowering the risk of derailments or infrastructure failures.</li></ul>
FINANCIAL	<ul style="list-style-type: none"><li>• Reduces costs by minimizing the need for extensive track closures and labor-intensive grinding operations.</li><li>• Extends rail life through precise defect removal, reducing the frequency and cost of replacements.</li></ul>
PUNCTUALITY	<ul style="list-style-type: none"><li>• Improves punctuality by allowing milling operations to be completed during short maintenance windows, minimizing disruptions to train schedules.</li><li>• Provides reliable defect removal, reducing unplanned delays due to infrastructure issues.</li></ul>
SUSTAINABILITY	<ul style="list-style-type: none"><li>• Supports sustainability by recycling removed material and reducing waste compared to traditional grinding methods.</li><li>• Improves energy efficiency by using precise, targeted milling techniques.</li></ul>

PERFORMANCE	<ul style="list-style-type: none"><li>• Accelerates rail defect removal with highly efficient milling technology, completing tasks faster than traditional methods.</li><li>• Reduces operational delays through automated and continuous milling processes.</li></ul>
SAVINGS	<ul style="list-style-type: none"><li>• Minimizes track downtime by completing maintenance tasks efficiently within short possession windows.</li><li>• Reduces delays caused by rework or incomplete defect removal, ensuring higher reliability of operations.</li></ul>
WORK PREPARATION	<ul style="list-style-type: none"><li>• Provides data for pre-maintenance planning, supporting better decision-making and scheduling.</li></ul>

# RailRestore: Rail Cleaning and Reprofilng

EXTEND RAIL LIFETIME – USING ONLY WATER AND A BIT OF SAND

- Rail Restore specializes in extending the lifespan of railway infrastructure through advanced waterjet technology. Their services include:
  - **Precision Cleaning:** Eliminates insulating layers such as leaves, rust, and grease from both groove and Vignole rails, enhancing safety and punctuality.
  - **Anti-corrosion & surface hardening:** Remove rust and increase surface hardness to increase resilience
  - **Material Removal:** Conducts preventive maintenance by removing approximately 0.2 mm of material to address minor profile changes, small damages, and mill scale, thereby improving asset longevity.
- Rail Restore's innovative approach to rail maintenance aligns with ISO 55000 standards, enhancing safety, financial efficiency, punctuality, and sustainability within railway operations.



PICTURE IS LINK TO FURTHER INFORMATION

# RailRestore: Rail Cleaning and Reprofilng

## BUSINESS CASE & BENEFITS

SAFETY	<ul style="list-style-type: none"> <li>Improves track safety by removing hazardous materials like rust and grease, reducing the risk of accidents.</li> <li>Employs eco-friendly waterjet technology that eliminates fire hazards associated with traditional maintenance methods.</li> </ul>
FINANCIAL	<ul style="list-style-type: none"> <li>Extends rail lifespan, reducing the frequency of costly replacements and repairs.</li> <li>Minimizes downtime and associated costs through rapid and effective maintenance processes.</li> </ul>
PUNCTUALITY	<ul style="list-style-type: none"> <li>Ensures timely removal of track contaminants, preventing delays caused by track-related issues.</li> <li>Facilitates scheduled maintenance with minimal disruption to regular train services.</li> </ul>
SUSTAINABILITY	<ul style="list-style-type: none"> <li>Utilizes only water and sand in the cleaning process, reducing environmental impact.</li> <li>Produces no fine particles and low CO2 emissions, promoting eco-friendly maintenance practices.</li> </ul>

PERFORMANCE	<ul style="list-style-type: none"> <li>Modular and scalable applications allow for quick setup and execution of maintenance tasks.</li> <li>High-pressure waterjet technology accelerates cleaning and material removal operations.</li> </ul>
SAVINGS	<ul style="list-style-type: none"> <li>Swift maintenance procedures reduce track closure times, enhancing overall efficiency.</li> <li>Effective removal of contaminants ensures longer periods between required maintenance.</li> </ul>
WORK PREPARATION	<ul style="list-style-type: none"> <li>Certain cleaning operations can be performed without halting regular train services, maintaining operational continuity.</li> <li>Detailed assessments enable maintenance teams to prepare interventions without necessitating additional track closures.</li> </ul>



# PLANNING, SUPPORT PRODUCTS & ACCEPTANCE

For all types of track works

# DualInventive: ZKL 3000 RC

ti DualInventive  
Transforming Rail Safety



## REMOTE-CONTROLLED PRE-DEFINED TRACK POSSESSION ZONES

- The ZKL 3000 RC is a Network Rail approved, preinstalled, SIL-4 rated, remotely operated Track Circuit Operating Device. It enables rail workers to perform work efficiently and safely. It has been designed to be both simple to install and cost effective.
- The system can remain in track and be switched remotely in a matter of seconds, removing the need to enter the 4' to place or remove protection once installed. The ZKL 3000 RC is (de-)activated by an app on a smartphone or tablet.
- When switched, it simulates a train in the section, causing the track circuit to show 'occupied' thus placing the protecting signals at danger. The section is immediately blocked, enabling rail workers to perform work on the track efficiently and safely.



[PICTURE IS LINK TO FURTHER INFORMATION](#)

# DualInventive: ZKL 3000 RC

## BUSINESS CASE & BENEFITS

SAFETY	<ul style="list-style-type: none"> <li>Increases safety level as track possessions are established automatically at known areas every time.</li> <li>SIL4 approved &amp; meets EN 50126 &amp; all EU-(cyber) security regulations</li> <li>Enhances worker safety by remotely activating track circuit operating devices, eliminating the need for workers to physically access tracks before they are secured &amp; eliminates the risk of placing the protection in the wrong track.</li> <li>Reduces the risk of accidents in hazardous environments and minimizes human exposure to live railways.</li> </ul>
FINANCIAL	<ul style="list-style-type: none"> <li>CAPEX is relatively high, as investment and installation of the equipment is needed.</li> <li>OPEX is annual subscription to safety cloud. Devices can stay in track for up to 4 years since the Asset management license enables remote monitoring of all key elements of the asset.</li> <li>ROI is relatively short because of increased productivity in possessions.</li> </ul>
PUNCTUALITY	<ul style="list-style-type: none"> <li>There is no risk of forgotten cables or signs, reducing the risk of delays after the work has finished.</li> <li>Possessions are pre-planned &amp; can be activated and deactivated in seconds.</li> </ul>
SUSTAINABILITY	<ul style="list-style-type: none"> <li>Reduces energy consumption and emissions by using track possessions more effectively and thereby reducing the number needed incl. transport to/from site</li> </ul>

PERFORMANCE	<ul style="list-style-type: none"> <li>Speeds up track access setup and removal with remote-controlled activation, allowing maintenance teams to start work immediately.</li> <li>Eliminates delays caused by manual processes, making the worksite more productive.</li> </ul>
SAVINGS	<ul style="list-style-type: none"> <li>Time of establishing a track possession is significantly reduced from 10-60 minutes to a few seconds.</li> <li>Significantly reduces non-productive time by enabling quick and efficient track circuit activation without requiring manual access to the tracks.</li> <li>Ensures more effective use of planned work windows, maximizing productive hours.</li> </ul>
WORK PREPARATION	<ul style="list-style-type: none"> <li>Track possession zones are fixed in pre-planning</li> <li>Supports flexible planning by ensuring track circuits are ready in advance for upcoming maintenance activities.</li> </ul>

# DualInventive: RSS 3000RC

ti DualInventive  
Transforming Rail Safety



REMOTELY CONTROLLED INTERLOCKING SAFETY SOLUTION THAT ESTABLISHES PROTECTED WORK ZONES

- Integrates directly into existing interlocking systems to automatically secure red signals or divert routes away from active work zones, improving both safety and rail network capacity.
- Permanently installed in signal equipment rooms or lineside cabinets, it allows remote zone activation through MTinfo 3000 — removing the need for on-track manual setup.
- Creates large, reliable safety zones by inhibiting entire train paths or routes with a single device, helping workers focus on tasks with fewer interruption.
- Fully SIL 4 certified and maintenance-free, it is based on proven ZKL 3000 RC technology and designed for seamless integration into existing safety systems.



# DualInventive: RSS 3000RC

## BUSINESS CASE & BENEFITS

SAFETY	<ul style="list-style-type: none"> <li>Increases safety level as track possessions are established automatically at known areas every time, both for Track circuits and for Axle counter areas.</li> <li>SIL4 approved, meets EN 50126 &amp; all EU-(cyber) security regulations</li> <li>Enhances worker safety by remotely blocking track circuits or axle counters, eliminating the need for workers to physically access tracks before they are secured.</li> <li>Reduces the risk of accidents in hazardous environments, minimizes human exposure to live railways &amp; eliminates the risk of placing the protection in the wrong track</li> </ul>
FINANCIAL	<ul style="list-style-type: none"> <li>CAPEX are relatively high, as investment and installation of the equipment is needed</li> <li>OPEX is annual subscription to safety cloud. Devices can stay in the relays cabinet up-top 10 years since the Asset management license enables remote monitoring of all key elements of the asset</li> <li>Derived savings on not needed manual work is high</li> <li>ROI is relatively short because of increased productivity in possessions</li> </ul>
PUNCTUALITY	<ul style="list-style-type: none"> <li>There is no risk of forgotten cables or signs, reducing the risk of delays after the work has finished</li> <li>Possessions are pre-planned &amp; can be activated and deactivated in seconds</li> </ul>
SUSTAINABILITY	<ul style="list-style-type: none"> <li>Reduces energy consumption and emissions by using track possessions more effectively and thereby reducing the number needed incl. transport to/from site</li> </ul>

PERFORMANCE	<ul style="list-style-type: none"> <li>Speeds up track access setup and removal with remote-controlled activation, allowing maintenance teams to start work immediately.</li> <li>Eliminates delays caused by manual processes, making the worksite more productive.</li> </ul>
SAVINGS	<ul style="list-style-type: none"> <li>Time of establishing a track possession is significantly reduced from 10-60 minutes to a few seconds</li> <li>Significantly reduces non-productive time by enabling quick and efficient track circuit activation without requiring manual access to the tracks.</li> <li>Ensures more effective use of planned work windows, maximizing productive hours.</li> </ul>
WORK PREPARATION	<ul style="list-style-type: none"> <li>Track possession zones are fixed in pre-planning</li> <li>Supports flexible planning by ensuring possessions limited by track circuits and axle counters are ready in advance for upcoming maintenance activities.</li> </ul>

# DualInventive: RDI 3000

**ti DualInventive**  
Transforming Rail Safety



RDI 3000 REMOTELY DEPLOYS DETONATORS AND SIGNALS TO PROTECT WORKERS AND MAXIMIZE TRACK ACCESS TIME

- Provides instant remote activation of red flags, warning lights, and detonators via the MTinfo 3000 platform, significantly reducing setup time at the worksite.
- Ideal for complex or unsignalled areas such as sidings, yards, or large engineering possessions where conventional signaling is unavailable or insufficient.
- Enhances on-track safety and access time by allowing multiple RDIs to be grouped and switched simultaneously, creating expansive, clearly defined work zones.
- Compliant with international safety standards, the unit is fail-safe (SIL 4) rated, solar-charged, and tested to withstand challenging weather and environmental conditions.



# DualInventive: RDI 3000

## BUSINESS CASE & BENEFITS

SAFETY	<ul style="list-style-type: none"> <li>Increases safety level: Sign, Signal Flag and detonator are established automatically at known areas every time</li> <li>SIL3 approved, meets EN 50126 &amp; all EU-(cyber) security regulations</li> <li>Enhances worker safety by remotely demarcating the work zones eliminating the need to physically access tracks before they are secured.</li> <li>Reduces the risk of accidents in hazardous environments, minimizes human exposure to live railways &amp; eliminates the risk of placing the protection in the wrong track</li> </ul>
FINANCIAL	<ul style="list-style-type: none"> <li>CAPEX are relatively high, as investment and installation of the equipment is needed</li> <li>Opex is annual subscription to safety cloud. Devices can stay in the track for up to 2 years since the Asset management license enables remote monitoring of all key elements of the asset</li> <li>Derived savings on not needed manual work is high</li> <li>ROI is relatively short because of increased productivity in possessions</li> </ul>
PUNCTUALITY	<ul style="list-style-type: none"> <li>There is no risk of forgotten flags, detonators or signs, reducing the risk of delays after the work has finished</li> <li>Possessions are pre-planned &amp; can be activated and deactivated in seconds</li> </ul>
SUSTAINABILITY	<ul style="list-style-type: none"> <li>Reduces energy consumption and emissions by using track possessions more effectively and thereby reducing the number needed incl. transport to/from site</li> </ul>

PERFORMANCE	<ul style="list-style-type: none"> <li>Speeds up track access setup and removal with remote-controlled activation, allowing maintenance teams to start work immediately.</li> <li>Eliminates delays caused by manual processes, making the worksite more productive.</li> </ul>
SAVINGS	<ul style="list-style-type: none"> <li>Time of establishing a track possession is significantly reduced from 10-60 minutes to a few seconds</li> <li>Significantly reduces non-productive time by enabling quick and efficient track circuit activation without requiring manual access to the tracks.</li> <li>Ensures more effective use of planned work windows, maximizing productive hours.</li> </ul>
WORK PREPARATION	<ul style="list-style-type: none"> <li>Track possession zones are fixed in pre-planning</li> <li>Supports flexible planning by ensuring track circuits are ready in advance for upcoming maintenance activities.</li> </ul>

# DualInventive: CRM 3000

ti DualInventive  
Transforming Rail Safety



A SMART, MAGNETICALLY MOUNTED IOT SENSOR PROVIDING REAL-TIME TEMPERATURE MONITORING AND ALERTS

- Continuously monitors rail temperatures using low-power NB-IoT connectivity and transmits data to the cloud-based Insight platform for real-time visibility.
- Easily installed and repositioned thanks to its magnetic attachment, reducing both installation time and the need for specialized tools or personnel.
- Improves safety and operational efficiency by eliminating manual temperature checks, thereby minimizing service disruption and track worker exposure.
- Enables proactive intervention through configurable thresholds, alerts, and alarms — preventing potential issues like track buckling due to thermal expansion.



# DualInventive: CRM 3000

## BUSINESS CASE & BENEFITS

<b>SAFETY</b>	<ul style="list-style-type: none"> <li>Reduces need for foot patrols, removing staff from hazardous environments (e.g., hot weather, active tracks).</li> <li>Prevents rail buckling accidents by providing real-time alerts when rail temperatures approach critical thresholds.</li> <li>Enables safer execution of high-risk tasks, such as welding or rail replacement, by verifying temperature suitability in advance or during work.</li> </ul>
<b>FINANCIAL</b>	<ul style="list-style-type: none"> <li>Minimizes OPEX by eliminating recurring manual inspections and reducing labor hours.</li> <li>Protects CAPEX investments by preventing damage to track caused by thermal expansion or heat-related faults.</li> <li>Offers a scalable, low-maintenance system with long-term cost benefits through remote monitoring and a rental-based model.</li> </ul>
<b>PUNCTUALITY</b>	<ul style="list-style-type: none"> <li>Supports smarter operational decisions, such as maintaining regular service instead of imposing conservative speed restrictions.</li> <li>Allows early warnings for critical temperature thresholds, reducing the need for emergency speed drops or unscheduled inspections.</li> <li>Improves planning of temperature-sensitive works, like ballast compaction or ultrasonic testing, minimizing disruptions.</li> </ul>
<b>SUSTAINABILITY</b>	<ul style="list-style-type: none"> <li>Reduces carbon footprint by eliminating the need for vehicle-based inspections or manual patrols.</li> <li>Supports energy-efficient point heating by linking automated control to real-time temperature data.</li> <li>Promotes condition-based interventions rather than fixed, potentially unnecessary procedures</li> </ul>

<b>PERFORMANCE</b>	<ul style="list-style-type: none"> <li>Confirms correct thermal conditions in advance, enabling quicker start of welding or rail replacement tasks.</li> <li>Allows real-time monitoring during operations, reducing delays caused by uncertainty around temperature limits.</li> <li>Facilitates better coordination of temperature-sensitive tasks like ballast compaction or ultrasonic testing.</li> </ul>
<b>SAVINGS</b>	<ul style="list-style-type: none"> <li>Enables temperature verification before and after work windows, reducing the need to occupy track for prep or closeout.</li> <li>Minimizes on-site diagnostics during possessions by providing remote data access.</li> <li>Allows execution of tasks without manual confirmation on-site, streamlining the work sequence.</li> </ul>
<b>WORK PREPARATION</b>	<ul style="list-style-type: none"> <li>Shifts inspection-related tasks, like confirming rail temp suitability, outside of possessions via remote monitoring.</li> <li>Allows point heating control and monitoring to be managed entirely off-track, reducing the need for physical access.</li> <li>Enables planners to verify work conditions remotely and ahead of time, decoupling key prep steps from possession time.</li> </ul>

# DualInventive: SmartGlasses

ti DualInventive  
Transforming Rail Safety



STAY SHARP AT NIGHT: ENHANCING ALERTNESS AND REDUCING FATIGUE FOR RAILWAY WORKERS

- The smart safety glasses meet EN166 safety standards and are equipped with technology specifically designed to support track workers' alertness.
- One key feature is the ability to project low-intensity blue light onto the eye at optimal times, controlled via a self-learning app. This blue light has a stimulating effect on the brain, which can increase alertness and reduce sleepiness (Muller, 2023).



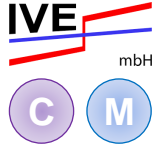
# DualInventive: SmartGlasses

## BUSINESS CASE & BENEFITS

SAFETY	<ul style="list-style-type: none"><li>Improves focus and reaction times through blue light stimulation, directly lowering risks associated with human error.</li></ul>
FINANCIAL	<ul style="list-style-type: none"><li>Boosts worker productivity by maintaining higher energy levels and minimizing errors, leading to more efficient operations.</li></ul>
PUNCTUALITY	<ul style="list-style-type: none"><li>Helps ensure maintenance tasks are completed on time by reducing delays caused by fatigue-related inefficiencies or incidents.</li></ul>
SUSTAINABILITY	<ul style="list-style-type: none"><li>Promotes worker well-being by addressing health risks associated with night shifts, leading to better long-term workforce sustainability.</li><li>Reduces downtime and unnecessary repeat work caused by errors, contributing to more efficient resource use.</li></ul>

PERFORMANCE	<ul style="list-style-type: none"><li>Improves worker efficiency and accuracy, enabling maintenance tasks to be completed more quickly and effectively.</li><li>Reduces the time lost to fatigue or lapses in focus, keeping work on schedule.</li></ul>
SAVINGS	<ul style="list-style-type: none"><li>Prevents delays caused by fatigue-related accidents or errors, ensuring minimal disruption during planned work windows.</li><li>Helps workers sustain productivity throughout their shifts, maximizing effective work hours.</li></ul>
WORK PREPARATION	<ul style="list-style-type: none"><li>Supports proactive fatigue management, minimizing the impact on operational schedules.</li></ul>

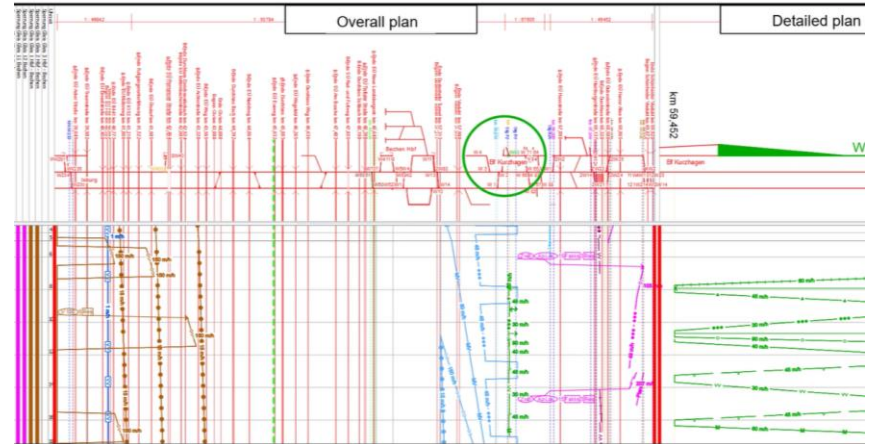
# IVE: SOG Suite



TAILORED FOR RAIL CONSTRUCTION, ENABLING EFFICIENT PLANNING, CONTROL, AND MONITORING OF PROJECTS

- The SOG Program System is a comprehensive solution for managing track maintenance, encompassing planning, monitoring, and control.
- It provides true-scaled infrastructure drafts, detailed mapping of construction processes, and real-time GNSS tracking to monitor progress and address deviations.
- Key modules include SOG BAU for construction scheduling, SOG BAP for operating procedure planning, SOG SIP for safety planning, SOG SIV for construction site monitoring and documentation.
- Open interfaces enable numerous data imports such as infrastructure data and data exports such as resource requirements, operating times, etc..
- It ensures efficient, safe, and optimized railway maintenance with detailed documentation for time, resource and cost management.

## Overall Plan - Detailed Plan



PICTURE IS LINK TO FURTHER INFORMATION (ONLY IN GERMAN)

## BUSINESS CASE & BENEFITS

SAFETY	<ul style="list-style-type: none"> <li>Enhances safety through precise safety planning, including visualization of warning systems and barriers.</li> <li>Prevents safety gaps with detailed and integrated construction progress and safety measures.</li> </ul>
FINANCIAL	<ul style="list-style-type: none"> <li>Reduces costs by optimizing resource allocation and minimizing delays through real-time tracking and plan adjustments.</li> <li>Improves billing accuracy by exporting operating times for calculation and invoicing.</li> </ul>
PUNCTUALITY	<ul style="list-style-type: none"> <li>Streamlines workflows with detailed construction progress plans, ensuring on-schedule project completion.</li> <li>Reduces delays through real-time monitoring and quick corrective actions using GNSS tracking and live updates.</li> </ul>
SUSTAINABILITY	<ul style="list-style-type: none"> <li>Promotes sustainability by efficiently allocating resources and reducing material waste through precise planning.</li> <li>Minimizes environmental impact by optimizing construction site duration and reducing idle machinery.</li> </ul>

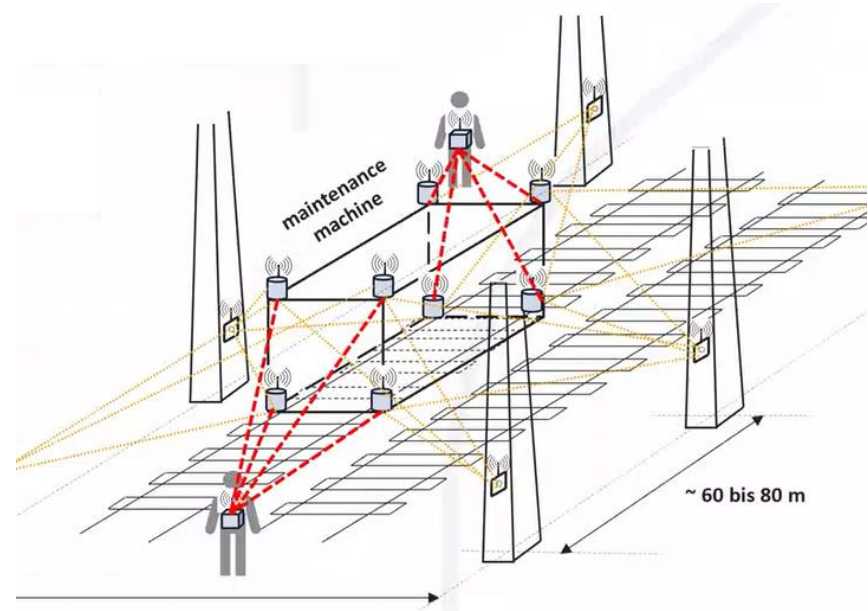
PERFORMANCE	<ul style="list-style-type: none"> <li>Accelerates planning and execution through integrated modules for scheduling, resource management, and safety visualization.</li> <li>Allows quick adjustments with real-time data integration from GNSS tracking and live feedback.</li> </ul>
SAVINGS	<ul style="list-style-type: none"> <li>Reduces downtime by proactively addressing deviations from planned schedules using target/actual comparisons.</li> <li>Ensures seamless execution of construction and safety tasks, maximizing productive time on-site.</li> </ul>
WORK PREPERATION	<ul style="list-style-type: none"> <li>Enables pre-work through detailed construction and operating plans that can be prepared without disrupting regular traffic.</li> <li>Provides visualized data for pre-planning, such as infrastructure layouts and resource requirements, ensuring readiness before execution.</li> </ul>

# PRODES: Automatic Train Warning System



## MACHINE-BASED AUTOMATIC WARNING SYSTEM

- Automatic Train Warning System (ATWS) which moves from being based on physical devices in the infrastructure to making the machine the central “device”
- Achieve absolute localization for both machine and staff on the track - knows how they are located relative to each other.
- Can be seen as permanent geo-fencing
- Needs small-sized transmitters on each catenary mast
- Software runs and is controlled on the machine.
- Compatible with conventional interlocking-, CBTC- and ETCS-based CCS (control- and command systems)
- Can be used with absolute coordinates (fix points) and its own relative coordinate system
- Expected to be SIL4 certified
- Compared to traditional systems, it can additionally warn workers of machine movement



# PRODES: Automatic Train Warning System

## BUSINESS CASE & BENEFITS

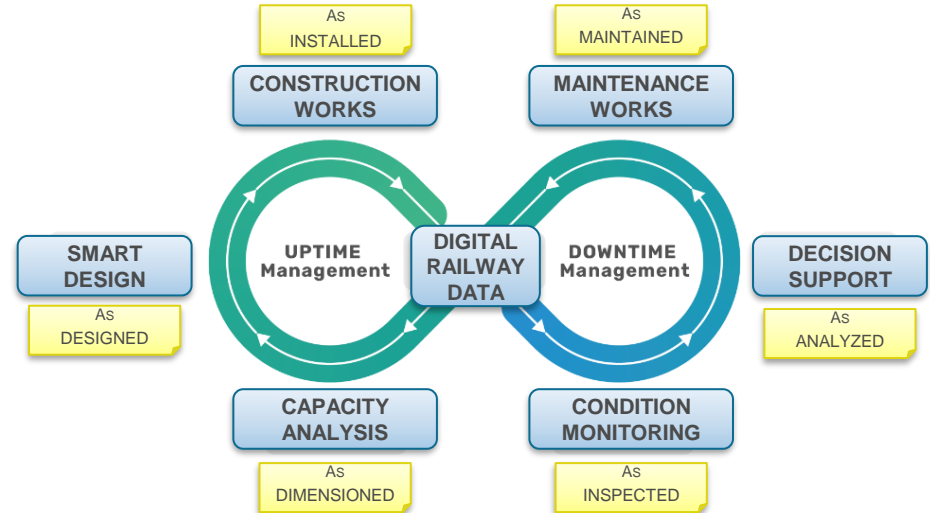
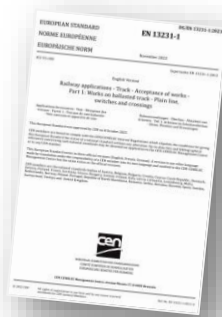
SAFETY	<ul style="list-style-type: none"> <li>Enhanced worker safety: The system provides warnings to workers about machine movements, significantly reducing the risk of accidents.</li> <li>Absolute Localization: Ensures precise positioning of machines and personnel, minimizing potential conflicts or hazardous situations.</li> <li>SIL4 Certification: Intermediate safety integrity level ensures reliability and reduces system failures that could compromise safety.</li> <li>Permanent geo-fencing: Establishes a constant safety perimeter, providing continuous monitoring and alerts for safety-critical zones.</li> </ul>
FINANCIAL	<ul style="list-style-type: none"> <li>Efficient workforce utilization: Ready-to-use automated localization and warnings streamline operations, reducing downtime and maximizing worker efficiency.</li> <li>Quick installation of transmitters: Small and easy-to-install transmitters minimize disruptions during setup.</li> </ul>
PUNCTUALITY	<ul style="list-style-type: none"> <li>Minimized downtime: Real-time alerts and monitoring reduce delays caused by incidents, accidents or miscommunication.</li> <li>Operational flexibility: Compatibility with conventional interlocking, CBTC, and ETCS-based CCS ensures integration with existing railway systems, avoiding disruptions.</li> </ul>
JUST. 1	<ul style="list-style-type: none"> <li>Energy efficiency: The system's reliance on software and compact hardware minimizes energy use.</li> </ul>

PERFORMANCE	<ul style="list-style-type: none"> <li>Centralized control on machines: Simplifies setup and operation, saving time during deployments and inspections.</li> <li>Automated warnings: Eliminates manual intervention for safety monitoring, speeding up workflows.</li> </ul>
SAVINGS	<ul style="list-style-type: none"> <li>Permanent geo-fencing: Constant safety zones reduce the need for extensive pre-work safety inspections.</li> <li>No installation time: Sensors are permanently installed and ready to use</li> </ul>
WORK PREPARATION	<ul style="list-style-type: none"> <li>Eliminates pre-work associated to ensure work site safety: No need to pre-install automatic warning equipment</li> </ul>

# Generic: (Acceptance) Reporting

STANDARDIZED HANDOVER DOCUMENTATION: AS INSTALLED & AS MAINTAINED

- Handover documentation as standardized reports with representation, and if applicable, visualization of principal data according to each phase to international standards
- Bridges the gap between fieldwork and asset management, improving overall efficiency and safety while aligning with international quality standards.
- As inspected
  - Track geometry: EN13848
    - Longitudinal level
    - Alignment
    - Twist
    - Gauge
- As installed/maintained
  - Ballasted track: EN13231-1



# Generic: (Acceptance) Reporting

## BUSINESS CASE & BENEFITS

SAFETY	<ul style="list-style-type: none"><li>• Ensures precise and reliable data for track geometry (EN13848) and ballast condition (EN13231-1), reducing safety risks caused by deviations or improper maintenance.</li><li>• Supports accurate assessment and proactive identification of potential hazards.</li></ul>
FINANCIAL	<ul style="list-style-type: none"><li>• Minimizes costs by providing detailed, standardized reports that enable precise planning and optimized use of resources for inspections and maintenance.</li><li>• Reduces rework by improving the transparency and traceability of data.</li></ul>
PUNCTUALITY	<ul style="list-style-type: none"><li>• Improves operational punctuality by facilitating faster decision-making through clear data visualization and adherence to international standards.</li></ul>
SUSTAINABILITY	<ul style="list-style-type: none"><li>• Promotes sustainable maintenance practices by optimizing resource use through precise condition-based data.</li><li>• Reduces material waste by accurately targeting maintenance needs.</li></ul>

PERFORMANCE	<ul style="list-style-type: none"><li>• Standardized reports allow for rapid analysis of track conditions, improving decision-making efficiency at the work site.</li></ul>
SAVINGS	<ul style="list-style-type: none"><li>• Reduces delays in transitioning data from the worksite to asset management by ensuring transparent handover and compatibility with international standards.</li></ul>
WORK PREPARATION	<ul style="list-style-type: none"><li>• Enables accurate pre-assessment of track conditions without disrupting normal rail operations, thanks to comprehensive measurement data.</li></ul>