

# SKF

## Digitalisation and Condition Monitoring in the Railway Industry



A freight train hauls thousands of tonnes across a frozen landscape, the steel contracting with every kilometre. In the depot, a high-speed train is prepped for another run, its motors humming under the strain of acceleration and braking cycles.

Deep underground, a metro system pulses with the relentless stop-start motion of rush hour, its wheelsets grinding through tight curves.

To the naked eye, everything is running smoothly. But in the bearings, gearboxes and axles, something else is

happening. A barely perceptible rise in temperature. A shift in vibration patterns. The first whispers of wear.

For decades, rail maintenance has been a waiting game. Teams check components, listen for anomalies and hope they catch problems early. But problems don't wait. Bearings can fail mid-run. Gearboxes can grind themselves apart between scheduled inspections.

A wheel defect that starts as a faint vibration can become a critical failure at 300km/h.

The industry is waking up to a new reality: the tracks are speaking. And the smartest operators are listening.

## From Blind Inspections to Data-Driven Maintenance

Mechanical failure doesn't happen in an instant. It's a slow, inevitable build-up of stress. A bearing runs hotter than usual. A gearbox starts vibrating in a way it never has before. The warning signs are always there. The challenge has been detecting them in time.

Now, sensors embedded in rolling stock are making it impossible to ignore. Wireless nodes track wheelset vibrations as they happen. Wired condition monitoring systems detect anomalies throughout the entire bogie, from the wheelset to the drivetrain, and even track shocks and damages. These systems also enable digital noise mapping, pinpointing noisy curves and automatically identifying areas to target for reducing urban train noise. It's a smart, seamless way to make our trains quieter and our cities more peaceful.

This isn't just monitoring – it's providing insights into the state of the equipment. **SKF Insight Rail**, a self-powered wireless sensor, catches bearing and wheel damage before it spirals into a breakdown. **SKF IMx-Rail**, an advanced vibration monitoring system, detects rail track damages as well as gearbox, traction motor and axlebox failures long before the train hits the depot. Also, when the train is equipped with microphones it can provide **digital noise mapping**. Operators aren't reacting anymore. They're getting ahead of the problem.

## Data without Decisions Is Just Noise

Rail operators now have access to more data than ever. Every train, every axle, every rotating component is feeding live information into digital systems. But raw data means nothing without action.

Take a metro operator battling excessive wheel wear. Before, maintenance teams waited for complaints about noise and rough rides. Now? Digital noise mapping flags the problem before passengers even notice. Engineers adjust lubrication schedules. Rail grinding is optimised. The fix happens before the issue becomes a crisis.

Elsewhere, a high-speed network spots an emerging vibration pattern in a fleet of traction motors. SKF IMx-Rail confirms it: an early-stage defect is forming. No guesswork – just hard data. The trains stay in service, but the affected units are scheduled for maintenance before a failure forces them out of operation.

Freight operators, dealing with the brutal physics of long-haul loads, are pushing their overhaul intervals further than ever. SKF Insight Rail provides real-time bearing health updates, eliminating unnecessary replacements. Instead of tearing down perfectly good components, they only intervene when the data says it's time.

This is what condition monitoring does: it turns information into decisions.



## Beyond Monitoring: The Digital Thread that Ties It All Together

Tracking faults is one thing. Predicting them with precision is another.

The digital thread is closing that gap. It connects real-world sensor data with AI-driven analysis and SKF's decades of engineering expertise.

It's a feedback loop where every bearing, every gearbox and every wheelset contributes to a living database. Machine learning detects faults, but more importantly it learns from them. The result? Operators see problems coming and know exactly when and how to act.

Instead of wondering 'Is something wrong?', maintenance teams are asking 'What's the risk, how long do we have and what's the best move?'

And it doesn't stop there. The digital thread extends beyond the train itself, influencing supply chain decisions. With real-time condition data, spare parts logistics can be optimised, ensuring the right components are available before they're needed.

No overstocking, no emergency shortages – just smarter inventory management based on actual fleet conditions. Operators can forecast demand more accurately, reduce waste and cut unnecessary costs while keeping trains running without disruption.

## Extreme Environments, Zero Room for Error

Not all railways operate in predictable conditions. Some deal with subzero winters where steel becomes brittle. Others battle relentless heat that eats away at lubricants. Coastal networks face a constant fight against corrosion and salt exposure.

Failures in these environments don't come with a warning. A traction motor seizing in extreme cold can shut down an entire line. Bearings running too hot in the desert can accelerate wear beyond safe limits.

Ignoring the warning signs isn't an option.

SKF systems are built for this reality. Vibration

monitoring detects heat-stressed components before they seize up mid-run. Coastal rail operators use SKF Insight Rail to track corrosion-prone wheelsets before salt does its worst.

For **railways operating under extreme conditions**, condition monitoring is the key to staying ahead of mechanical stress and avoiding costly disruptions.

## The Future of Rail Maintenance Is Already Here

A decade ago, maintenance was about fixing what was broken. Today, it's about ensuring things don't break in the first place and reducing maintenance efforts to when they are actually needed.

Rail operators moving to condition monitoring are seeing the results:

- Fewer service disruptions
- Longer asset lives
- Lower lifecycle costs
- Maximum fleet availability

Rail operators are moving towards condition monitoring to cut failures, reduce costs and improve reliability. For those ready to make that shift, SKF's digital solutions provide the visibility, intelligence and predictive power to keep rail fleets running stronger, longer and smarter.

## Trains Don't Guess. Neither Should You.

Your fleet is talking. Every wheel rotation, every gearbox shift, every bearing in motion – it's all data.

The difference between running smoothly and breaking down is knowing how to use it.

SKF gives you the power to read the signs before they become problems, act before failures hit, and run your operations with total confidence.

Stop following the old rules. Redefine rail maintenance.

**Talk to SKF** and take control of what's ahead.