



Condition Monitoring and Smart Maintenance in the Rail Sector

Condition based maintenance provides greater availability, planning capability and cost efficiency.

SAFETY AND COST EFFICIENCY AS DRIVERS OF A FUTURE-ORIENTED AND SUSTAINABLE MOBILITY.

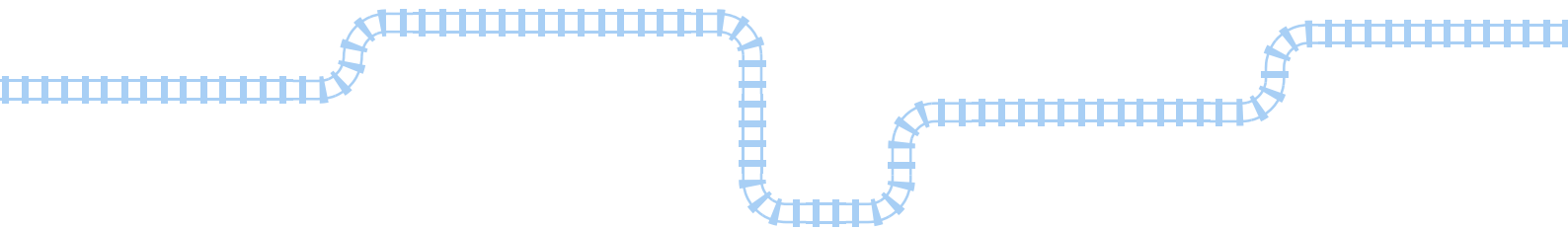
The operation and maintenance of rail vehicles and infrastructure is often not as cost-efficient as it could be due to fixed maintenance intervals. Rigid intervals cause unnecessary costs and affect the availability of vehicles and infrastructure. At the same time, the proper condition of components, units and technical systems is a key prerequisite for the safe, reliable and fast

transportation of people and goods, and it is becoming increasingly more important.

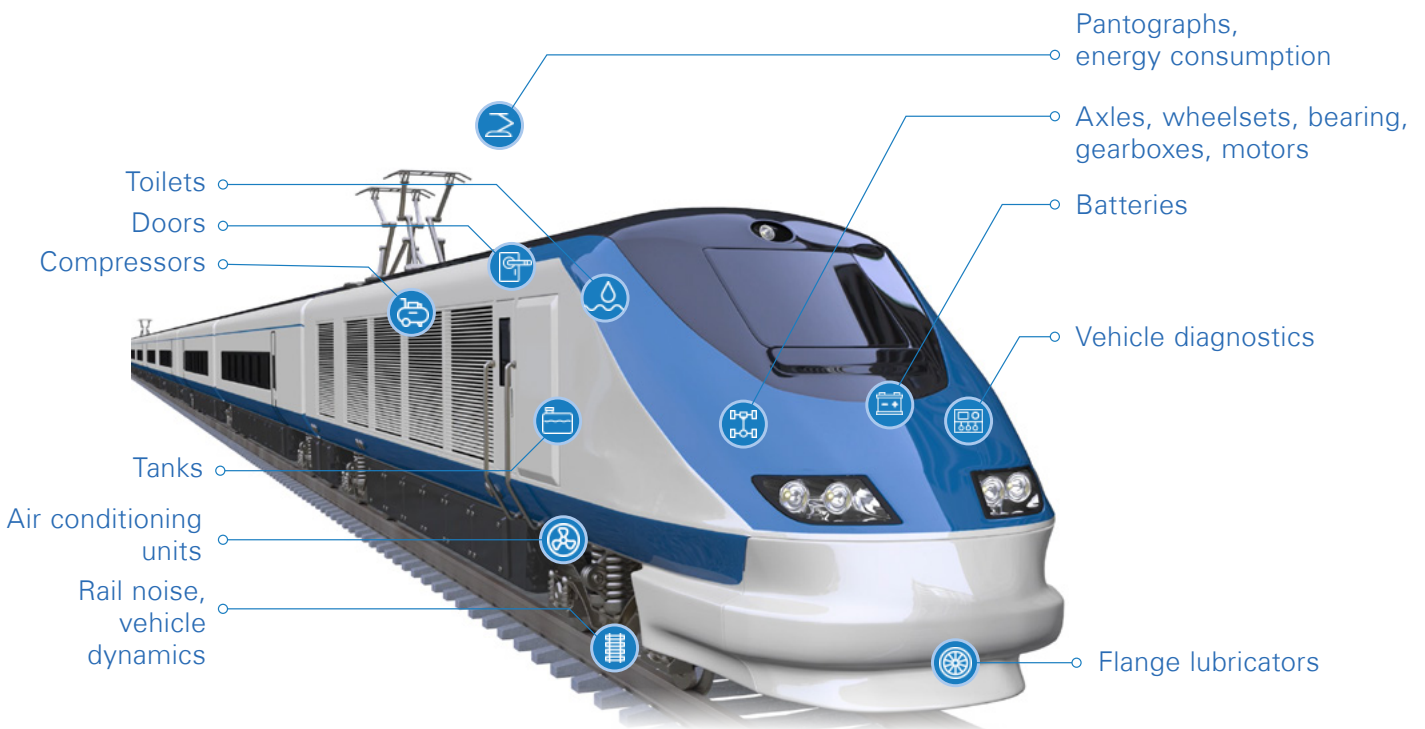
CONDITION BASED MAINTENANCE – THE MAINTENANCE AND REPAIR OF THE FUTURE.

Our concept of condition based maintenance (CBM) tailors the maintenance intervals of your rail vehicles and systems to the actual rail condition. Via the smart use of existing data or additional sensors, we measure

the actual attrition, mileage and wear. Maintenance is only required when specified parameters are reached or exceeded. Based on our concept, the servicing and maintenance periods are as close as possible to the maximum service life of the individual parts, systems or vehicles. In many cases, we can even predict the remaining service life of components, thus enabling predictive maintenance.



We were able to successfully implement a wide range of applications in rail vehicles*



*In collaboration with partners

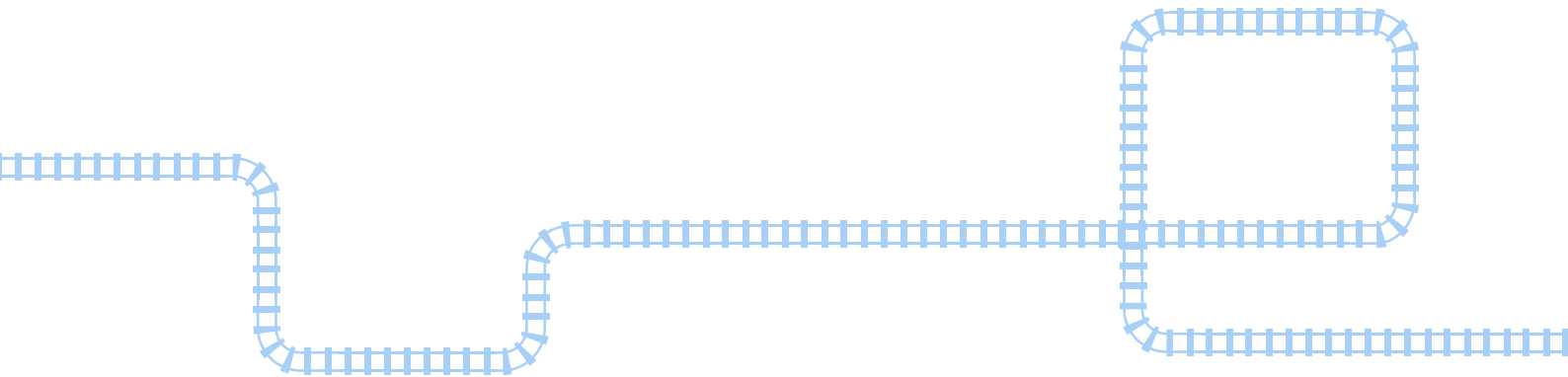
This allows you to extend the maintenance intervals for each vehicle. No technically feasible remaining service life is “wasted”, which helps you to protect your investments and to optimize the operating and maintenance costs.

You will benefit from a high availability, plannable service events and demand-oriented costs. At the same time, maintenance standards are at least as high as with fixed intervals specified by the manufacturers.

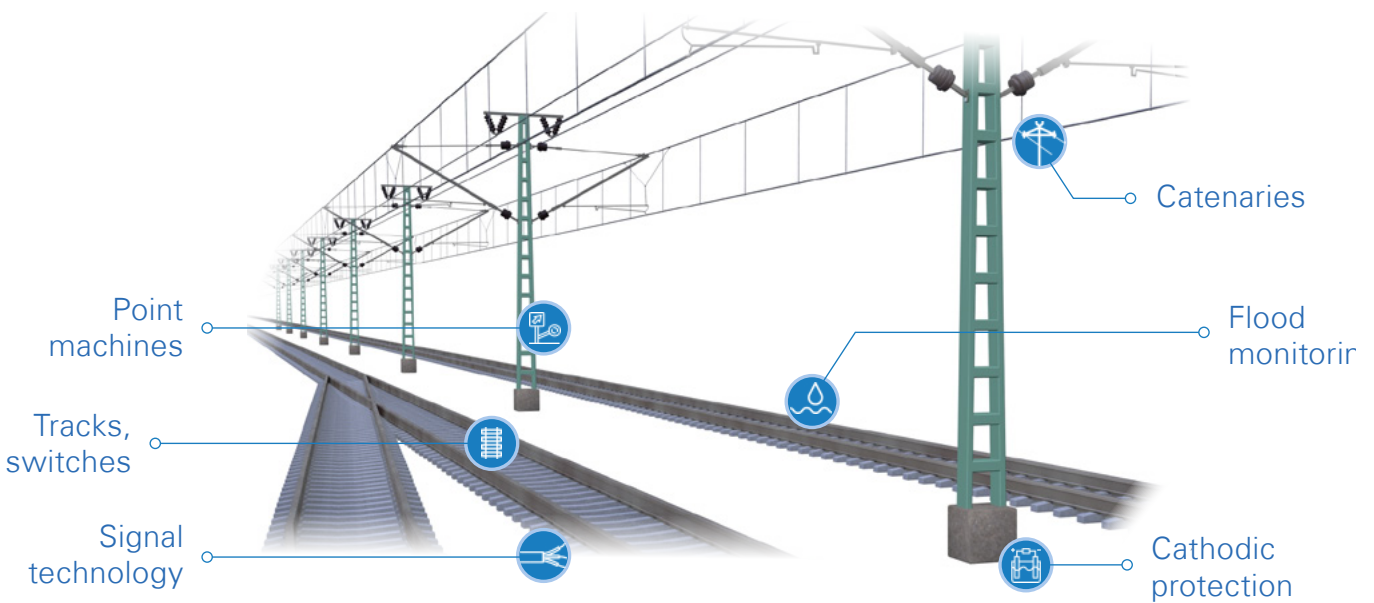
20 YEARS OF EXPERIENCE WITH THE CONSULTATION AND IMPLEMENTATION OF CONDITION MONITORING MAKE US THE BEST PARTNER FOR YOUR SPECIFIC APPLICATIONS.

Our CBM concept covers applications from monitoring and diagnostic analysis of almost all components in rail vehicles to their infrastructure. Both historical and current data are incorporated in the evaluation to ensure a high degree of accuracy of the

results. This includes not only available data from the trains, but also data from additionally installed sensors and environmental data.



Our portfolio of infrastructure services*



*In collaboration with partners

Condition Based Maintenance Leads to a Wide Range of Potentials

In close collaboration with you, we develop a customized concept based on your individual requirements.

Condition based maintenance unlocks a wide range of optimization potentials for you:

- Maintenance – CBM enables you to respond in a flexible manner to condition based maintenance requirements and to optimize them.
- Availability – Continuous monitoring via early warnings increases the reliability of your fleet.
- Costs – With optimized maintenance intervals, CBM ensures a reduction of costs in the long term.
- Safety – CBM measuring systems provide early and reliable warnings in case of a critical event, ensuring that your trains and tracks are working properly.

Our software detects and reports critical changes in condition. This gives you time to perform efficient countermeasures in response to the development of defects and to avoid expensive downtime.

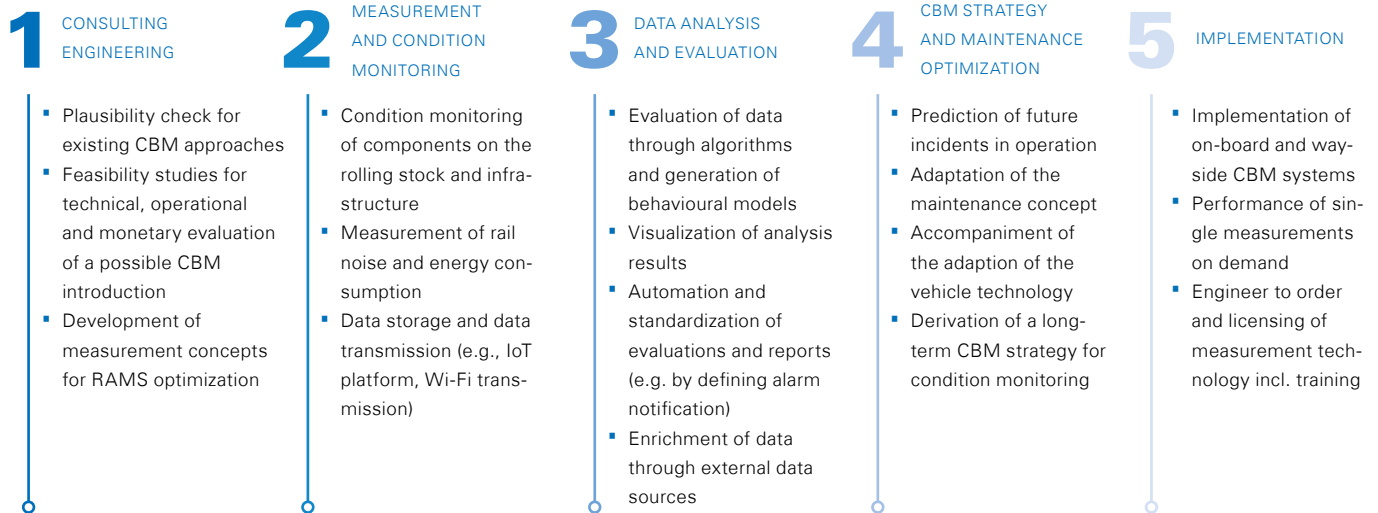
OUR CBM SERVICE PORTFOLIO COVERS ALL SERVICES OF THE VALUE CHAIN

Using five modules, we can support you from the consultation to the implementation of your specific CBM solution. Regardless of whether you are just at the beginning with your venture or you already have systems in place - we will be at your side every step of the way. The modular structure of our approach allows us to provide you with services tailored specifically to your needs. Supported by our partners, we are able to cover the entire value chain for you.

You will no longer be surprised by any breakdown or need for repair. You will be able to optimally schedule maintenance and inspections into the operating process and prevent costly consequential damages. We support you with optimizing your maintenance at every step of the process.



Our modular CBM approach



WE ARE A RELIABLE PARTNER IN THE RAIL SECTOR FOR IMPLEMENTING CBM.

- One of our successful reference projects is the development and implementation of an on-board diagnostics system for railway bogies for the ICE fleet of DB Fernverkehr, the long-distance division of the Deutsche Bahn.

Challenges

- Development of an online measurement system for data acquisition, selection, verification, transformation, modeling and evaluation
- Development of a measurement and sensor concept, adaptation and cabling
- Development and practical verification of failure algorithms

Solution

- Feasibility study
- Definition of the damage matrix
- Testing of the prototype system on the ICE 2
- Redesign of the monitoring and diagnostic system for long-distance railway bogies for the ICE 3
- Equipping six ICE 3 trains connected to an MVB* with the final monitoring and diagnostic system and supervision of test runs

Customer benefits

- Demonstration of different technical solutions of an on-board diagnostics system
- Early detection of technical failures in bogies and wheelset bearings
- Increase of availability by reducing corrective action and increasing preventive maintenance measures

*MVB – Multifunction vehicle bus according to the IEC 61375 standard or integration into the train control system (MVB bus)







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Your business and your maintenance facility – our solutions for you! In the Rail Technology business field, TÜV Rheinland offers services for the entire sector worldwide. More than 400 rail experts provide assessment, certification and consulting services. Our customers include operators of infrastructure, long-distance transport, cargo, local rail transport and local public transport, as well as manufacturers of rail vehicles and components, and public authorities and government ministries. The experts at TÜV Rheinland provide support in areas such as development and approval processes, vehicle procurement procedures or any aspects of transport contracts, and optimize repair facilities, maintenance programs and corporate processes.

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