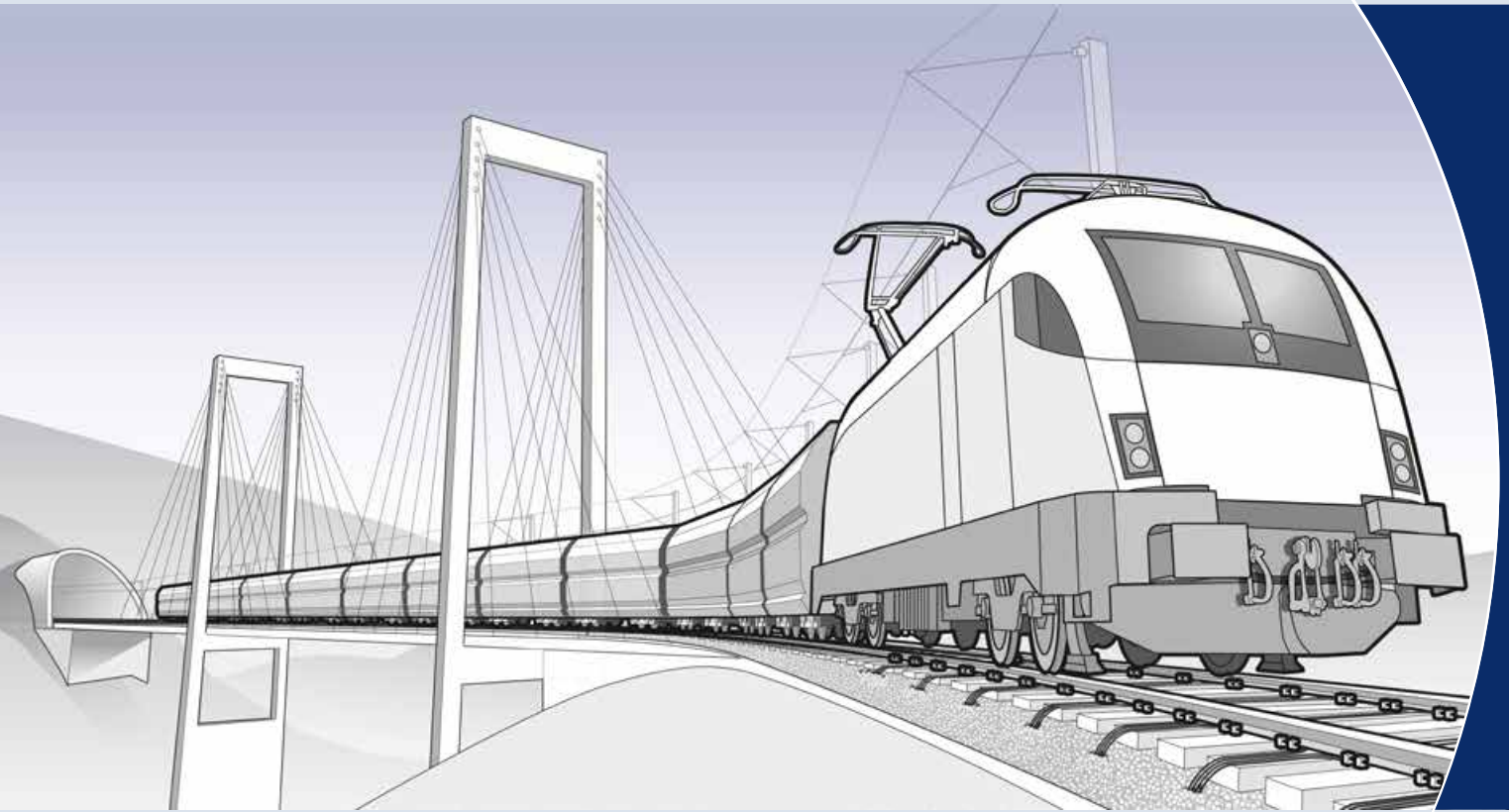


Infrastructure Structural Monitoring

Tunnel, Bridge, and Wayside Train Monitoring

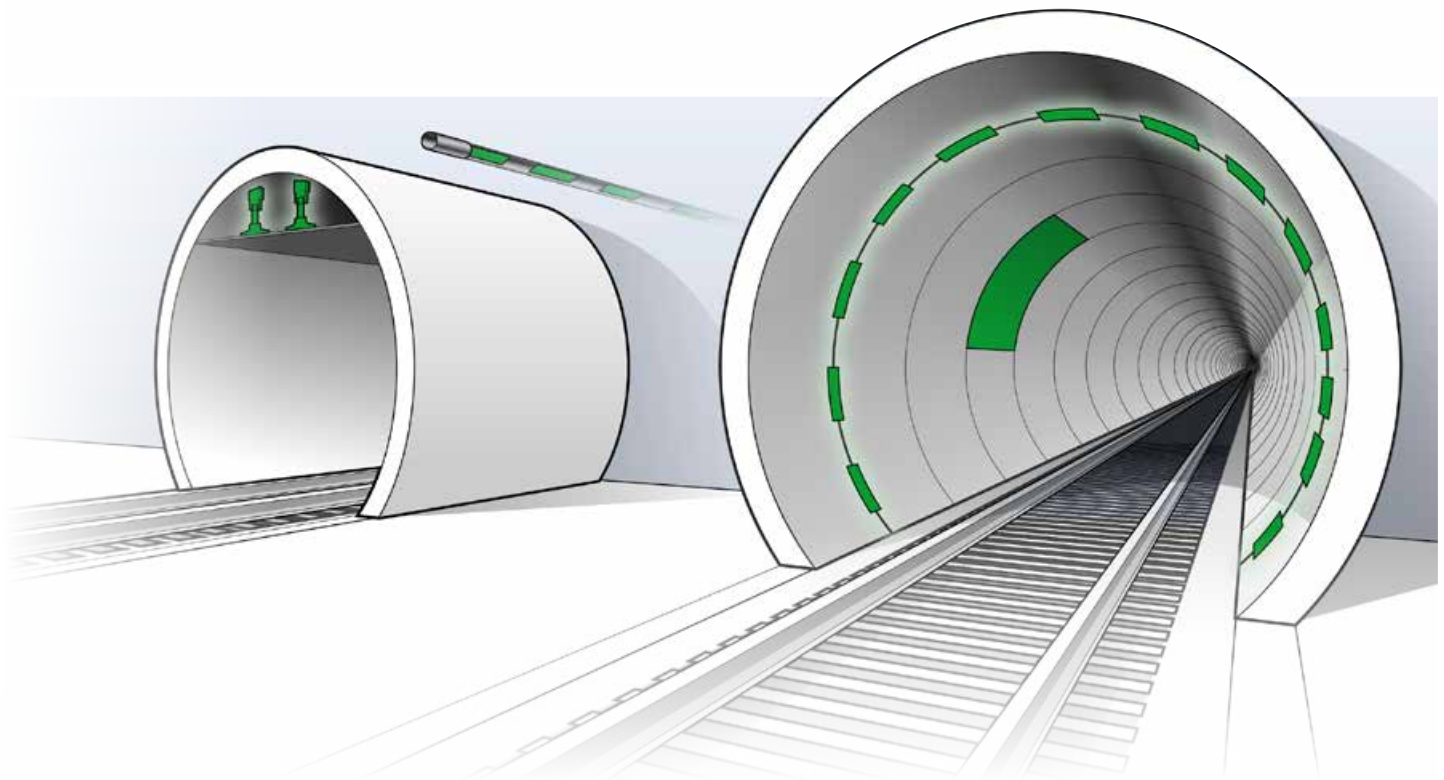
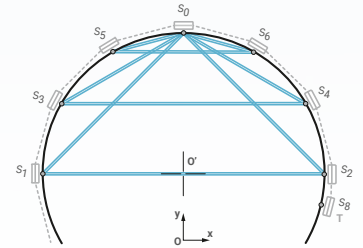


Tunnel

Tunnels are at the core of our infrastructure. They are found in large cities, mountains, and even under water. Mechanical deformations in a tunnel may present a significant safety hazard, particularly during operation and also during construction work on the tunnel itself or in its immediate surroundings. It is essential to know the stability and reliability of the structure. Over the past years, HBM has developed powerful alternatives to conventional monitoring systems for the following applications

- Instrumented tubbing segments
- Deformation and convergence estimation
- Fibre-optic inclinometer
- Monitoring of inaccessible ceilings

Deformation measurement and convergence estimation



- Tunnel design validation
- Tunnel convergence assessment
- Tunnel short-term monitoring during construction
- Tunnel long-term structural health monitoring



Bridge

Civil engineering structures need to withstand exponentially increasing applied loads, impacts, and environmental burdens. The continuous assessment of the resulting structural behavior is becoming mandatory so that faults can be detected at an early stage and safety is guaranteed.

Visual inspections do not provide sufficient information to extend a structure's lifetime; however, online structural health monitoring allows anomalies to be detected in time. This will optimize maintenance and reduce operating costs.

Monitor your entire structure's life-cycle – from its design, construction, and operation to its rehabilitation or end-of-service-life using HBM's turnkey solutions for:

- Continuous monitoring
- Displacement, deflections as well as inclination and vibration measurements
- Material testing and load assessment
- Strain and temperature distribution



- Bridge design validation
- Bridge load assessment
- Bridge short-term monitoring during construction
- Bridge long-term structural health monitoring



Wayside Train Monitoring^{+Measurement}

Optimizing the Infrastructure

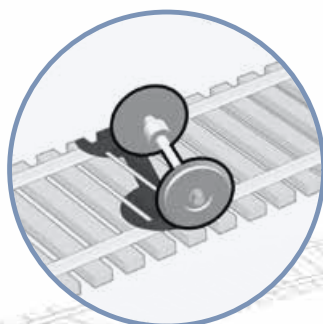
Argos® provides an immediate overview of the reliable data regarding the actual load on your rail network.

Wayside Train Monitoring^{+Measurement}

- Real-time overview of the load on the track (vertical and lateral, static and dynamic loads)
- Reliable and real-time warnings for infrastructure users (incorrect loading, on-route load shifts, lack of maintenance)
- Preventive measures to avoid derailments
- Reduction of risks caused by non-compliant vehicles
- Optimization of the risks and costs of track maintenance
- Reduction of the legal and financial risks
- Sound measurement data provides a basis and not just estimates

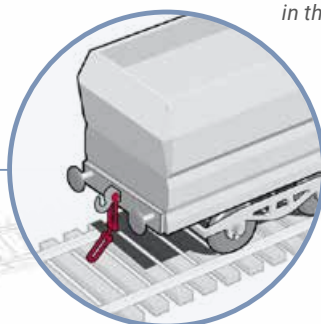
DERAIL Module:

The sensor detects derailed axles.



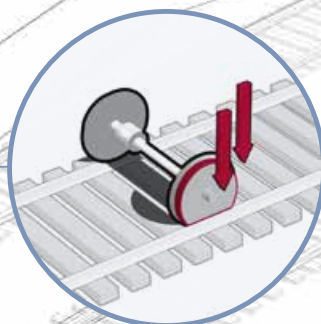
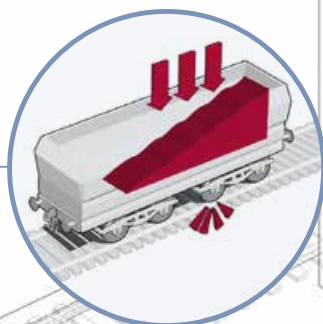
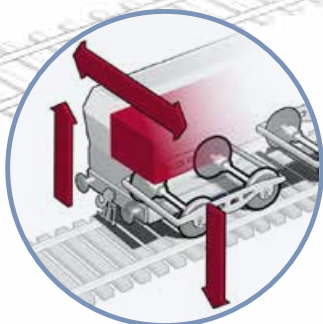
DED Module

To protect installations in the infrastructure

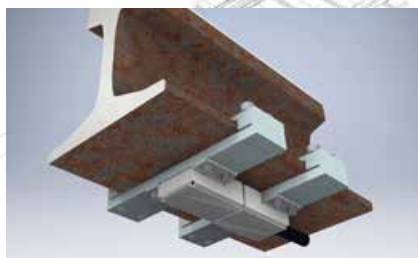


WIM Module

A dynamic scale which controls the load distribution on a vehicle with the highest accuracy



DERAIL



Instant



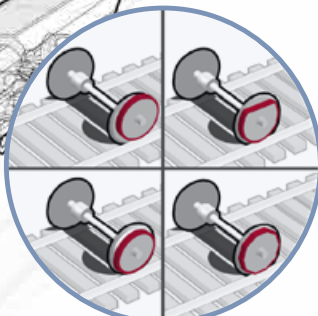
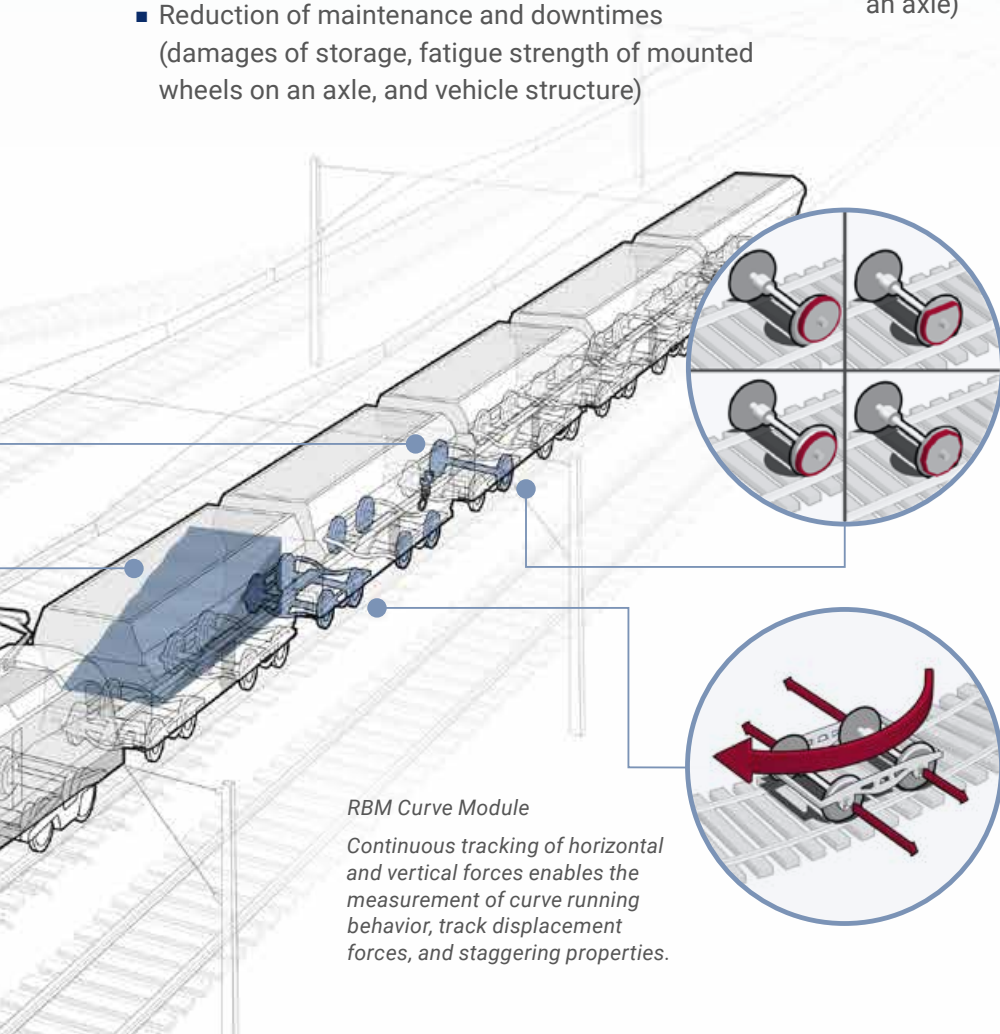
WIM

Solutions for Vehicle Operators

Argos® Systems provides you with pioneering solutions for the modern and efficient operation of vehicles. Here, you can also take advantage of reliable and accurate measurement data.

Wayside Train Monitoring^{+Measurement}

- Precise measurements of defects in the wheel shape
- Reliable data for predictive maintenance (e.g. for wheel maintenance)
- Detailed information on vehicle running behavior and load data increases safety and reliability in operation
- Reduction of maintenance and downtimes (damages of storage, fatigue strength of mounted wheels on an axle, and vehicle structure)
- Immediate preventive detection of vehicles with a risk of derailment
- Full quality control and complete maintenance over the vehicle's entire service life
- Assessment of suppliers and components (e.g. regarding deterioration of mounted wheels on an axle)



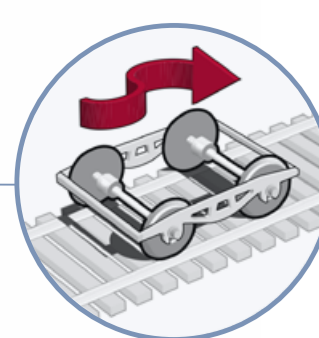
OOR Module

Detects deviations from the ideal roundness of a wheel (flat positions, polygonizations, duality, eccentricity) with high precision



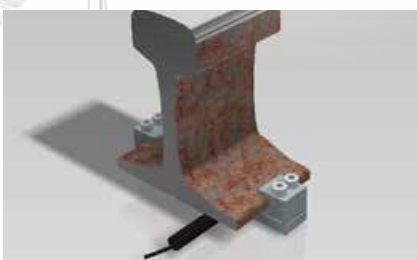
RBM Curve Module

Continuous tracking of horizontal and vertical forces enables the measurement of curve running behavior, track displacement forces, and staggering properties.



RBM Straight Module

Measurement of the horizontal forces for detecting unstable running behavior of vehicles



OOR



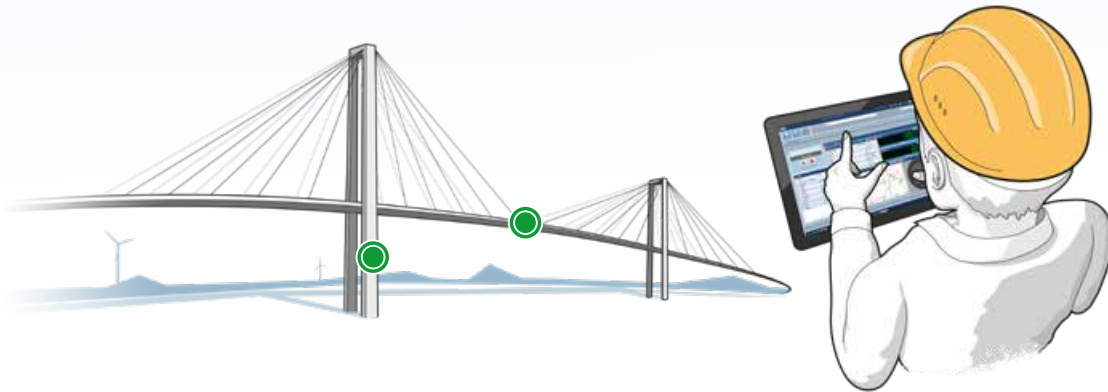
RBM Curve



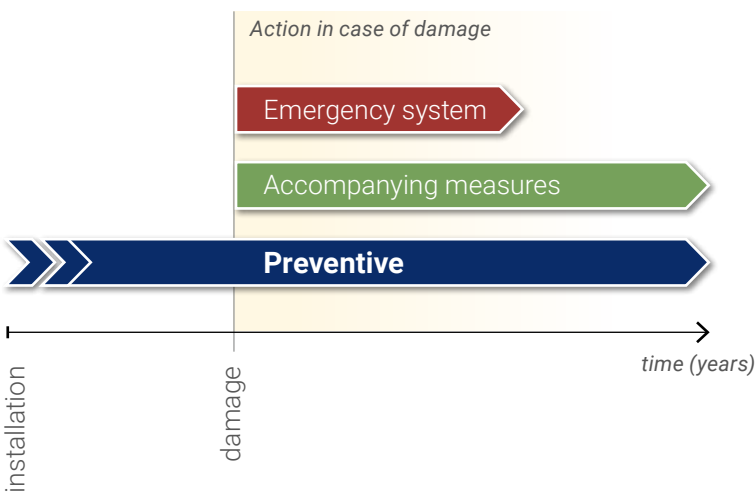
RBM Straight

How Safe and Efficient is Your Infrastructure?

The monitoring of structural behavior can detect anomalies in time, thus enabling maintenance and repair to be implemented more efficiently, which immediately results in reduced operating costs. Replacing schedule-driven maintenance with condition-based maintenance is the main goal of infrastructure monitoring.



Monitor your entire structure's life-cycle from its design, construction, and operation to its rehabilitation or end-of-service life using HBM's monitoring solutions for critical structures.



Benefits of Monitoring



- **Extension of service life**

Short- or long-term monitoring of the assets' behavior and integrity can extend their service life past their design life, resulting in huge savings.

- **Reduction of operational risk**

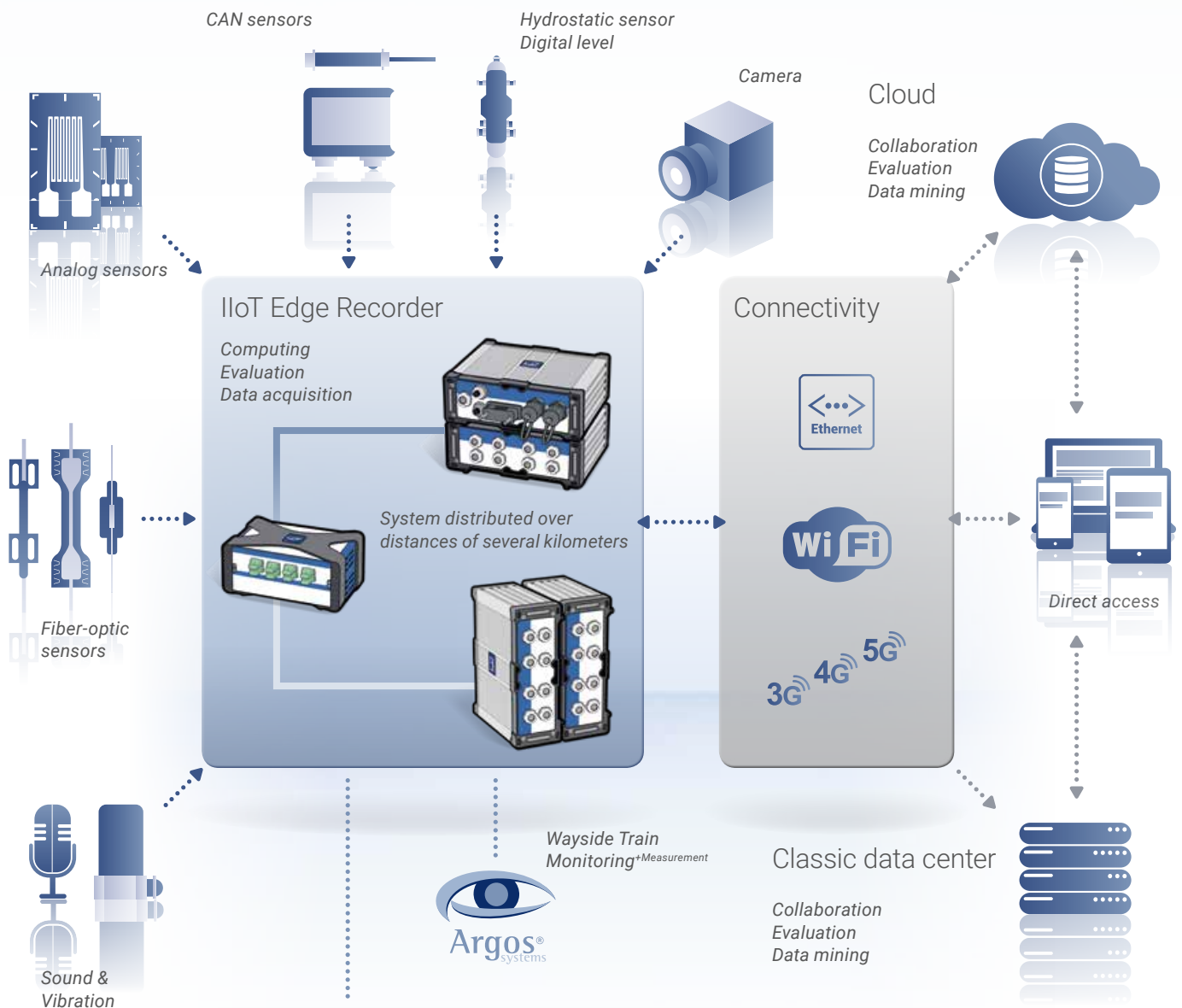
Early detection of damage leads to the prevention of critical assets and structural faults, reducing intervention times and repair costs.

- **Design validation**

Instrumentation of structures during construction can be a valuable tool to validate sophisticated construction methods and new materials.

Modular Solution for Efficient Asset Health Monitoring

A customized solution including sensors, measuring amplifiers, data acquisition software, edge computing, server and cloud solutions, and analysis tools provides the technical basis for efficient monitoring. However, correct sensor installation, commissioning, and maintenance as well as conditioning of reports are indispensable to ensure successful results of asset health monitoring systems.



- Ultra-robust (vibration, shock) according to MIL-STD202G
- Extended temperature range: -40...+80 °C, dew-point resistant
- Dust- and water-proof with ingress protection grade IP65 and IP67
- Fire protection rating according to DIN EN 45545-1:2013
- Reliable design offering 10,000 plug cycles
- Distributed system

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measure and predict with confidence

