www.optimeas.de

OPTiMEAS

User report

SchafbergBahn

operated by Salzburg AG Tourismus

Bernhard Knapp
Managing Director **Zugkraft-kN GmbH**

*"With **optiMEAS** as a partner, we can offer the advanced maintenance solution with automatically integrated operating data. The wear and tear of machines, the consumption of operating resources and costs have been minimised by our Customers always have a clear view. That is our goal."*

Digital upgrade for the nostalgic steam locomotive

The fleet of Austria's steepest cog railway consists of steam and diesel locomotives. An oil-fired new-build steam locomotive has digitised the **tractive force kN** with IoT technology from **optiMEAS.** The measurement data from inside the locomotive is the decisive step towards advanced, data-driven maintenance.

Zugkraft-kN specialises in customer-specific solutions for servicing, maintenance and fleet management in rail transport. Together with optiMEAS, it uses customised maintenance software to support the historical maintenance of rail vehicles. **SchafbergBahn railway** operated by **Salzburg AG Tourismus**.

www.optimeas.de

The first steam locomotive runs digitally on the Schafberg

With gradients of up to 26 per cent, the almost six-kilometre-long **SchafbergBahn** on Lake Wolfgangsee is the steepest cog railway in Austria. It is mainly operated by oil-fired new-build steam locomotives. Modern sensor technology in combination with IoT hardware, software and the cloud reveals the physical processes in the locomotive - with significant advantages for operation and maintenance.

THE CHALLENGE: DIGITALISATION OF A STEAM LOCOMOTIVE

During the season, the **SchafbergBahn** steam locomotives operated by **Salzburg AG Tourismus are** an attraction for young and old. In winter, they are traditionally kept in the workshop, disassembled, cleaned, repaired and made fit for their next use.

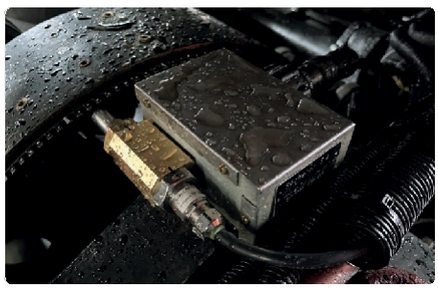
On the outside, it is a nostalgic steam locomotive

The Zugkraft-kN maintenance software supports the planning and documentation of the work. Engine drivers enter operating times, faults and necessary repairs in the **"digital handover book"**. Precise operating data directly from the vehicle, which shows whether the complex steam engine is working properly, is missing for the overall picture.
To close this gap, a new-build steam locomotive is to be digitised as a test vehicle. Apart from the safety switch-off, the locomotive has no electronics to speak of. The challenge is to **equip** the vehicle with **sensors** and **measurement technology** in such a way that it provides the relevant operating data and this data can be safely transferred to the maintenance software. As a project partner with a proven condition monitoring solution for railway applications, **Zugkraft-kN has brought optiMEAS** on board. IIII

THE SOLUTION: CONTINUOUS DATA ACQUISITION WITH CLOUD CONNECTION

The digitalisation solution consists of intelligent sensors, hardware, software and a cloud platform. The package does not come off the shelf, but is the result of close collaboration between **Zugkraft-kN**, **optiMEAS** and the **SchafbergBahn** workshop.

The system captures the relevant operating values via 14 analogue measuring points: various temperatures, pressures and water flow rates at the boiler, the temperature of the back-pressure brake when driving downhill and the oil pressures of the superheated steam lubrication pump, which supplies grease for important lubrication points. The system measures crankshaft speed signals to see whether the timing of the two cylinders is exactly the same. It also permanently records the battery voltage and charging current.



Modern ultrasonic sensor technology monitors flows in historical pipes - and defies all weather conditions

The sensors are located on specially welded tubes and are carefully wired. The measurement technology with the railway-certified IoT edge device **smartRAIL** and intelligent measurement modules is housed in a specially manufactured ceiling drawer: **smartI/O** 8I12 for battery current measurement,

Modern measurement and IoT technology inside

measurement and the pressure sensors with 4-20mA interface, **smartI/O** MIO for digital inputs, **smartI/O** 8TC for temperatures, **smartI/O** 2QENC for speed diagnostics and **smartI/O** BATMON for battery monitoring. **smartRAIL** offers GPS and intelligent functions for data acquisition and processing via its **smartCORE** software. Supplementary software modules realise individual applications. For example, the AlphaSystem™ algorithm, which actually specialises in combustion engines and transmissions, calculates
speed signals relevant status indicators of the steam control system.

The physical measured variables are recorded in high time resolution and continuously stored on the **smartRAIL** with the position data. The system regularly transmits the data to the **optiCLOUD** via mobile radio, where it is available for the maintenance software and in-depth analyses. Despite travelling through tunnels, no information is lost.

At the same time, the device sends current GPS and selected operating data at short intervals
to the cloud for the live view on dashboards. It is possible to scroll back in time as required.

optiMEAS

By linking to the maintenance software, this information can also be found in the digital handover book.

The measuring module for the battery voltage, **smartI/O** BATMON, is located in front of the main switch and ensures that the condition monitoring system is available around the clock. The module's intelligent energy management prevents the battery from becoming so discharged that it is no longer possible to start the locomotive. IIII

Boiler, back pressure brake, battery and much more. The dashboard visualises how the steam locomotive is doing.

THE BENEFIT:
PRECISE DATA ON THE "STATE OF HEALTH" ENABLES IMPROVEMENTS AND COST SAVINGS

The digitalised steam locomotive on the Schafberg went into operation just in time for the start of the 2023 season. Since then, it has been constantly communicating what it is doing and how it is doing. This transparency is to be used to avoid downtime, support maintenance and save costs.

Anomalies in the current operating data indicate possible faults. The fact that the actual operating values can also be accessed retrospectively simplifies diagnosis of irregularities and emergency shutdowns. Were there problems with the water pump, oil pressures or abnormal temperatures? The measurement data provides valuable information on how the incident occurred and how it can be prevented in the future.

With the seamless data from the locomotive, **Zugkraft-kN** has the necessary database to determine limit values for key operating variables. The aim is to display limit value violations in the digital logbook in future and to automatically trigger alarms before a major fault or even a locomotive failure occurs.

Furthermore, trends and possible dependencies between operating variables can now be recognised, for example between oil consumption and the selected temperature range. This knowledge can be utilised for improvements and savings.

The solution offers great added value for maintenance: if the measurement data shows that components are worn or pipes are clogged, the workshop can focus directly on these issues. Conversely, routine maintenance can be postponed if critical parts are still in order. This saves time and material.

The new steam locomotive is the test vehicle for the smart **SchafbergBahn**. If the solution proves successful, the plan is to transfer it to the other locomotives and later to the ships on the railway.
the Wolfgangsee. The smart steam locomotive is already an additional tourist attraction. The plan is for passengers to be able to follow **the** locomotive's engine power live on their mobile devices using a **QR code.** IIII

Bernhard Knapp working on the locomotive. Maintenance and servicing work can now be optimally planned

ADVANTAGES AT A GLANCE:

" Live overview
" Continuous operating data in the cloud
" Fewer failures
" Lower consumption of operating resources
" Support for the workshop
" Extension of maintenance intervals

COMPONENTS USED BY OPTIMEAS:

" Intelligent measuring modules (**smartI/O** 8I12, **smartI/O** MIO, **smartI/O** 8TC, **smartI/O** 2QENC, **smartI/O** BATMON)
" IoT Edge Device **smartRAIL** with software **smartCORE**
" **optiCLOUD**

FURTHER INFORMATION:

www.optimeas.de
www.zugkraft-kn.at
www.5schaetze.at
www.digital-usecase.info

optiMEAS
Measurement and Automation Systems GmbH
Software Solutions GmbH

Tel: +49 (0) 61 72/99 77 12-0
Email: info@optimeas.de | www.optimeas.de
Am Houiller Platz 4/B | 61381 Friedrichsdorf