

**A SELECTION OF THE MOST REMARKABLE  
SOLUTIONS OF PRIMETALS TECHNOLOGIES  
FOR THE DIGITALIZATION OF**

# **PROCESSING**



The final manufacturing steps in steel production are just as important as the first ones, as weak links must be avoided to safeguard end-product quality. Condition monitoring systems increase line reliability and help reduce operating costs.

# SIAS AUTOMATED SURFACE INSPECTION FOR FLAT PRODUCTS

Producers of flat-rolled steel are facing a growing trend toward zero-defect tolerances for surface quality. This trend, initiated by customers in the automotive industry, is increasingly becoming the norm in other sectors—namely in packaging, “white goods” (appliances), and others. From a quality management (ISO) perspective, it is necessary to standardize surface quality like any other product characteristic.

The Automatic Surface-Inspection System (SIAS) from Primetals Technologies is an online surface-quality control solution that helps address this challenge by detecting and automatically classifying all surface defects visible on the strip: inclusions, mechanical damage, scales, repeating defects such as roll marks and dents, as well as coating defects and other imperfections.

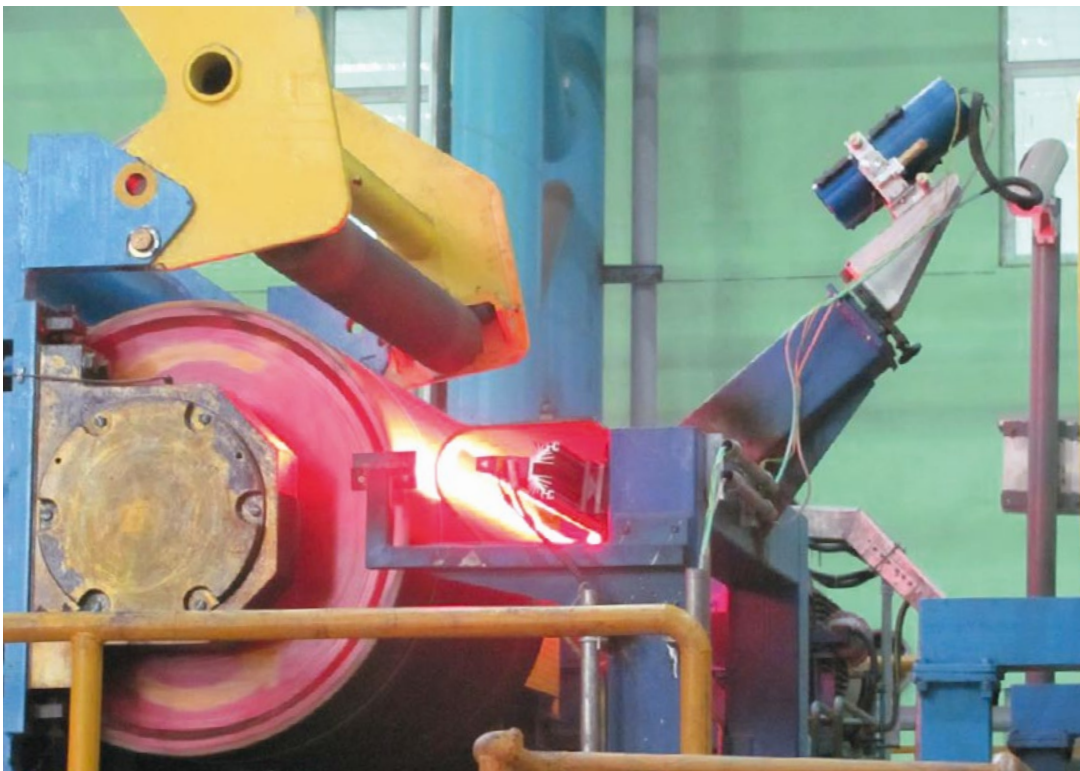
The system uses high-end cameras, optics, and lighting to provide a sharp, fine-resolution image of the strip surface. Recent developments in the next-generation platform include high-resolution and near-infrared vision techniques. The obtained image data is software-processed for defect identification: flaws are detected, automatically classified, and graded for severity. The results are displayed to the operator, and stored in the form of coil reports mapping the defects on every coil. They comprise defect data (size, position, type, and severity), defect

images, and context information such as mill/line speed and product texture. All information is stored in an open and SQL-compatible database structure, which allows for easy compilation into studies at a later stage e.g., to determine trends on groups of coils by grades or by dates.

The results are also available to the operator in real time, allowing immediate reaction. Through the SIAS coil-grading software, the quality department can determine instantly whether the coil surface quality matches the requirements of the customer—and what action to take if this is not the case.

SIAS is available for all flat-product rolling and processing applications: hot mills, pickling lines, cold mills, continuous annealing lines, metallic coating lines, hot-dip galvanizing lines, electrolytic galvanizing and tinning lines, color-coating lines, and stainless steel lines.

In recent times, advances in digitalization have made it possible to perform analyses remotely and help customers more quickly whenever support is required. Remote-access services for SIAS, as offered by Primetals Technologies in combination with a customer-support hotline, have the advantage of including prompt hardware diagnosis, providing support over a longer time span, and facilitating remote defect-detection analysis.



Light bar and camera of a SIAS installation for one side of the strip.



Side trimmer, equipped with a condition-monitoring system from Primetals Technologies

Learn more about BOX Concept, the condition-monitoring solution from Primetals Technologies on page 34.

## CONDITION-MONITORING SYSTEM FOR PROCESSING LINES

Primetals Technologies' condition-monitoring system for processing lines uses predictive-maintenance algorithms to pinpoint incidents before they occur.

The condition monitoring system (CMS) is part of the newly developed Through-Process Optimization solution (TPO) of Primetals Technologies, which encompasses the intelligent Through-Process Quality Control (one of the company's "Industry 4.0" IT systems), Through-Process Know-How (the vast application knowledge that optimally tunes the IT system to customer requirements), and the Total Condition Optimizer (Expert System for processing lines). Each of these tools is designed to enable customers of Primetals Technologies to tackle new market challenges: to develop new products, improve product quality, and increase the overall competitiveness of their production lines. The CMS focuses on predictive and proactive maintenance with the aim

of increasing line reliability while decreasing operating costs. Without the CMS, maintenance has to be either corrective (reactive maintenance) or systematic (preventive maintenance). The downside to reactive maintenance is that it requires an unscheduled stop of the line, resulting in a drop in line availability and production losses. On the other hand, preventive maintenance can sometimes be carried out too early and therefore involves unnecessary costs. The CMS, meanwhile, is the ultimate approach for predictive conditional maintenance; maintenance is performed "on time," thereby optimizing the lifetime of each component by avoiding any unscheduled stoppage and anticipating component end-of-life.

For the processing-line equipment built by Primetals Technologies, the company's French-based Mechatronics team is responsible for developing, configuring, and commissioning the CMS. The team comprises mechanical, electrical, automation, IT, and process specialists whose expertise can be called upon remotely via the "CMS Remote Hotline." Customers can use the hotline to help them better diagnose a problem through "proactive maintenance," but Primetals Technologies experts can also train customers and help them to develop new rules in the CMS installed on their production lines.

### CMS FOR THE SIDE TRIMMER

These days, most of the equipment supplied by Primetals Technologies includes a CMS module. This also applies to the side trimmer, which comprises several key components—hydraulic, pneumatic, servo motors, and knives—all individually monitored by the CMS.

There is particular emphasis on the condition of the knives, which directly affects the edge quality of the sheet and, indirectly, other areas such as the operating speed of the motors and the consumption of electrical energy. In the worst case, the sub-optimal condition of the knives could even damage downstream equipment.

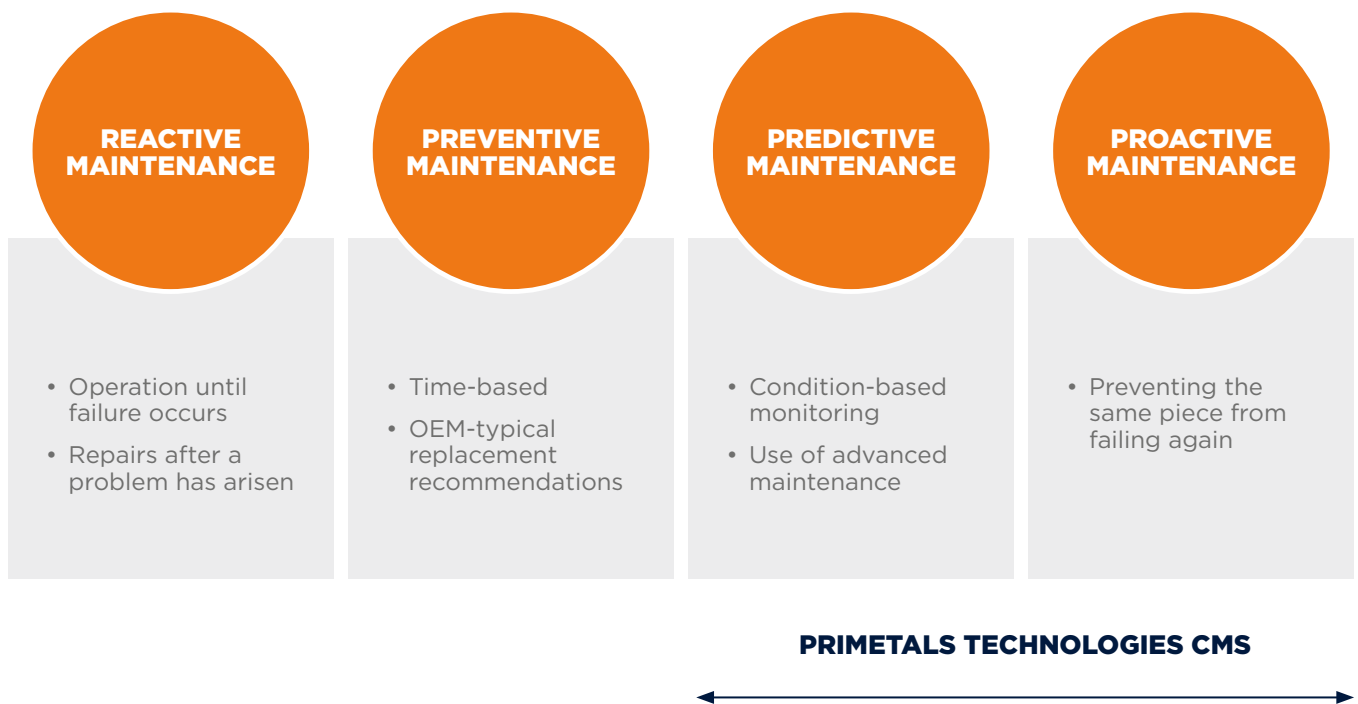
With previous maintenance strategies, knives have to be

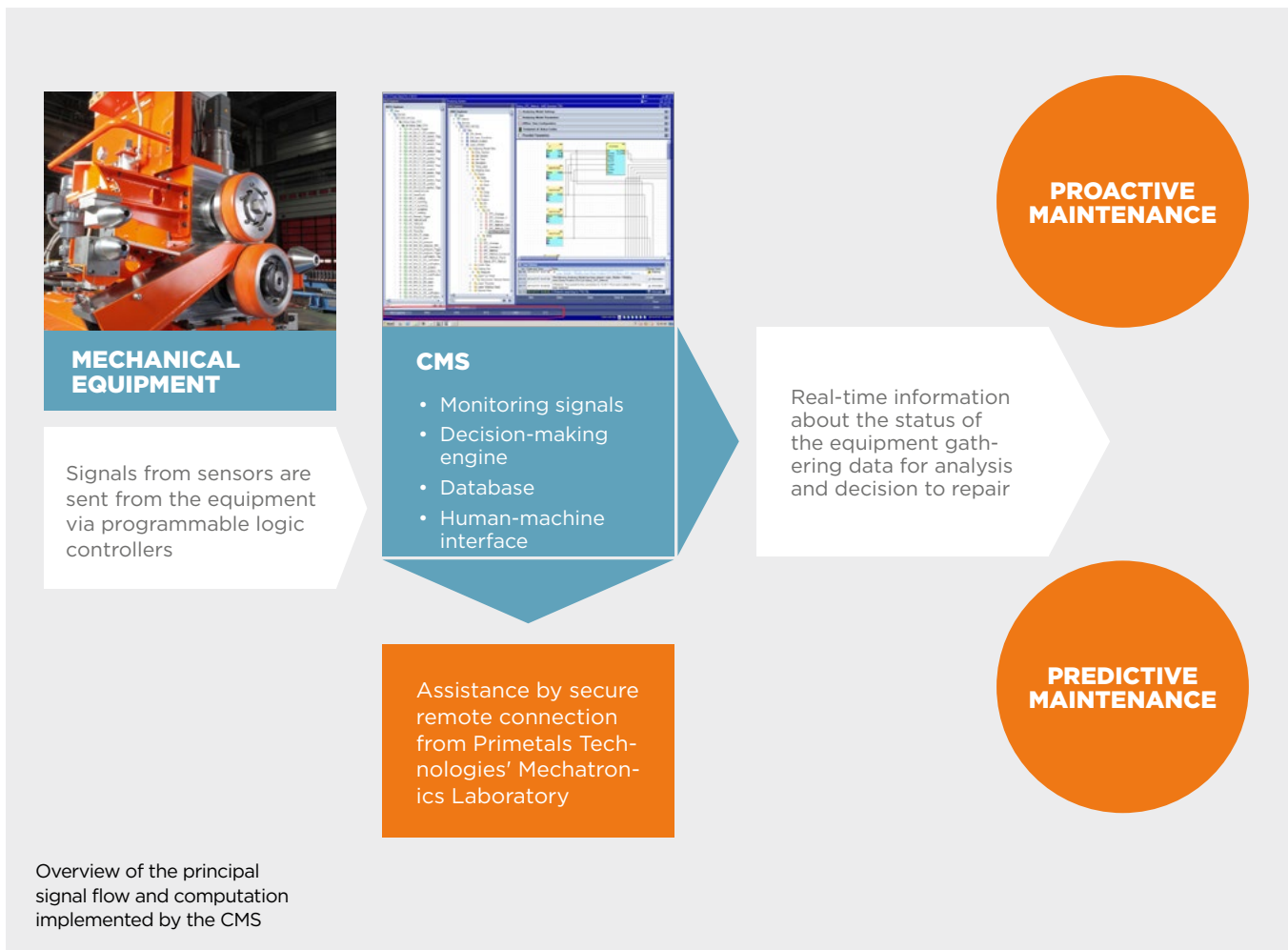
changed according to the length of strip cut in kilometers. This presented two main drawbacks: knives were often changed too early (while still operational and in good condition) or too late (after product deviations occurred). Now, however, the CMS uses specific cameras to inspect the edges and analyze the picture obtained in order to qualify edge quality, detect any wear or breakout, and also swiftly warn operators that a change of the knife is necessary.

### VIBRATION-ANALYSIS BASED MONITORING

Any machine in operation produces a degree of vibration generated by its movements, which can be rotary or linear. Small levels of ambient vibration are perfectly acceptable, whereas high and increasing levels of vibration are symptomatic of an anomaly and have to be prevented. Vibrations are largely a result of the centrifugal forces acting on rotating machine parts, and can come from a misalignment of machine-drive trains, bearing damage, gear defect, imbalance, and other causes.

The CMS analyzes vibrations using feedback from special piezoelectric sensors installed on certain parts of the equipment. These sensors look for vibrations on different axes. By correlating the dominant frequencies with different elements of the equipment, the CMS is able to determine the origin of the vibration. »





### EDGE MONITORING SYSTEM

The EdgeMon edge monitoring system typically consists of four cameras mounted on the rotating turrets of the side trimmer to the left and right of the steel strip. In this setup, two cameras are installed on each side of the side trimmer. One of them is actively used while the other remains in maintenance position. The sensors of EdgeMon are directly mounted on the shear block. Triggering of the camera for knife breakout detection is done with either a rotary encoder on the shaft of the knives or with the plant-speed signal. This trigger has to be provided by the supplier of the side trimmer. EdgeMon monitors and visualizes the trimmed edges, and evaluates the cut-to-break ratio—a typical quality parameter for trimmed edges. Furthermore, knife breakouts can be detected automatically based on periodic analysis. Typical detection reliability, based on figures from different plants, is about 90%. For other more unusual defects that are not detected automatically, visualization helps the operator to recognize them immediately.

### PROPERTYMON MEASURING SYSTEM

PropertyMon is a quality-monitoring system for the online detection of mechanical and magnetic properties of the

steel strip for various types of processing lines. Measurable steel grades are hot- and cold-rolled ferromagnetic steel strips including micro-alloyed, interstitial-free, dual-phase, and transformation-induced plasticity steels. The system performs continuous and contact-free inspection over the entire strip length based on an electromagnetic measurement principle. All values are immediately available and stored in PropertyMon's internal database.

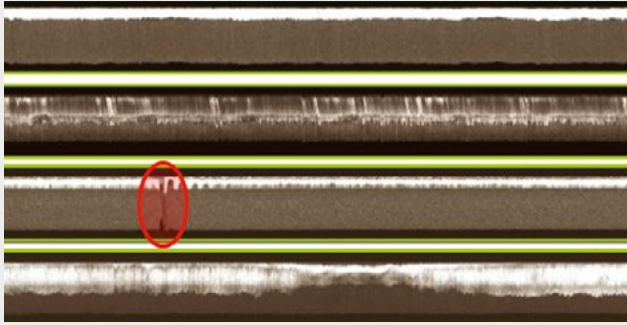
### THE MECHATRONICS LAB IN MONTBRISON

Process or maintenance optimization does not happen overnight; as every steel producer knows, improvements

**The CMS analyzes vibrations with special piezoelectric sensors installed on certain parts of the equipment.**

## EDGE MONITORING SYSTEM

The EdgeMon system monitors and visualizes the trimmed edges of the steel strip. It evaluates the cut-to-break ratio and conducts regular analyses to detect any knife breakouts. The detection rate achieved by EdgeMon is high, with about 90% of all identified problems found automatically.



- ◀ **Good:** The cut-to-break ratio is stable and at a correct level; the edge shape is correct.
- ◀ **Knife worn:** The cut-to-break ratio is stable but not at a correct level. Adjust the gap, knife shows partial wear and has to be changed.
- ◀ **Breakout:** Strip edge is damaged; check knife.
- ◀ **Inhomogeneous:** The cut-to-break ratio is not stable; knife shows partial wear and has to be changed.

**Primetals Technologies has chosen to thoroughly embrace digitalization, with advanced solutions and remote-access functions for quick and easy-to-obtain customer support from a specialist.**

are usually time-consuming. It takes significant and relentless effort to be a market leader that continually improves equipment quality, develops new products, and minimizes production downtime. Primetals Technologies is fully aware of this fact and supports its customers for the entire lifecycle of their equipment. For this purpose, the company has installed a multi-disciplinary, highly skilled team in a brand new Mechatronics laboratory at its French facility. The team is involved in the design, development, commissioning, and optimization of processing line equipment, and is always available to swiftly assist customers around the world.

### CUSTOMER-ORIENTED SOLUTIONS

Customers will often benefit greatly from a quick yet highly professional analysis of their equipment and a solution-oriented discussion with an experienced Primetals Technologies specialist. This is why remote access for fast and easy-to-obtain support is now available for all solutions supplied by Primetals Technologies. This has become possible thanks to the recent forays in digitalization and "Industry 4.0"-type technologies, which Primetals Technologies has chosen to thoroughly embrace to optimally serve its customers. ●



Laser welders supplied by Primetals Technologies France are tested and fine-tuned at the Montbrison Mechatronics Lab prior to installation to ensure optimal operation at the customer's site.