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## **LONG ROLLING DIGITAL TECHNOLOGIES**

INDUSTRY 4.0 TOOLS  
FOR THE FUTURE

# TOMORROW'S MILL TODAY

## OPTIMIZE PLANT PRODUCTION WITH REAL-TIME DATA ANALYSIS

### MANAGE WHAT YOU MEASURE

Today's steel producers face the dual challenge of ensuring on-time delivery and meeting ever-demanding product requirements, while also running a lean operation. Management of a long rolling plant demands continuous optimization of both operating and business practices.

Imagine a long rolling facility, where individual pieces of equipment communicate with each other, where sensor information can be used not only for control purposes, but also to monitor the condition of the equipment. A mill where models are used to verify the process is within working limits and the equipment alerts operators when and where maintenance is required.

The definition of Industry 4.0 differs for each plant. In all cases, managers who track, measure and monitor their facility will harness the ongoing evolution in technology to optimize the entire value chain with improved and more flexible products.

As part of a global company, more than 7,000 employees of Primetals Technologies, based in 65-plus company offices, engineering, manufacturing and service centers, provide immediate support to our customers whenever required. With the added backing from the international office network of parent companies Siemens AG and Mitsubishi Heavy Industries, Ltd., our customers can benefit from services at more than 300 group sites located in some 190 countries.

Primetals Technologies has pioneered key technologies with installed and upgraded long rolling mills on six continents.

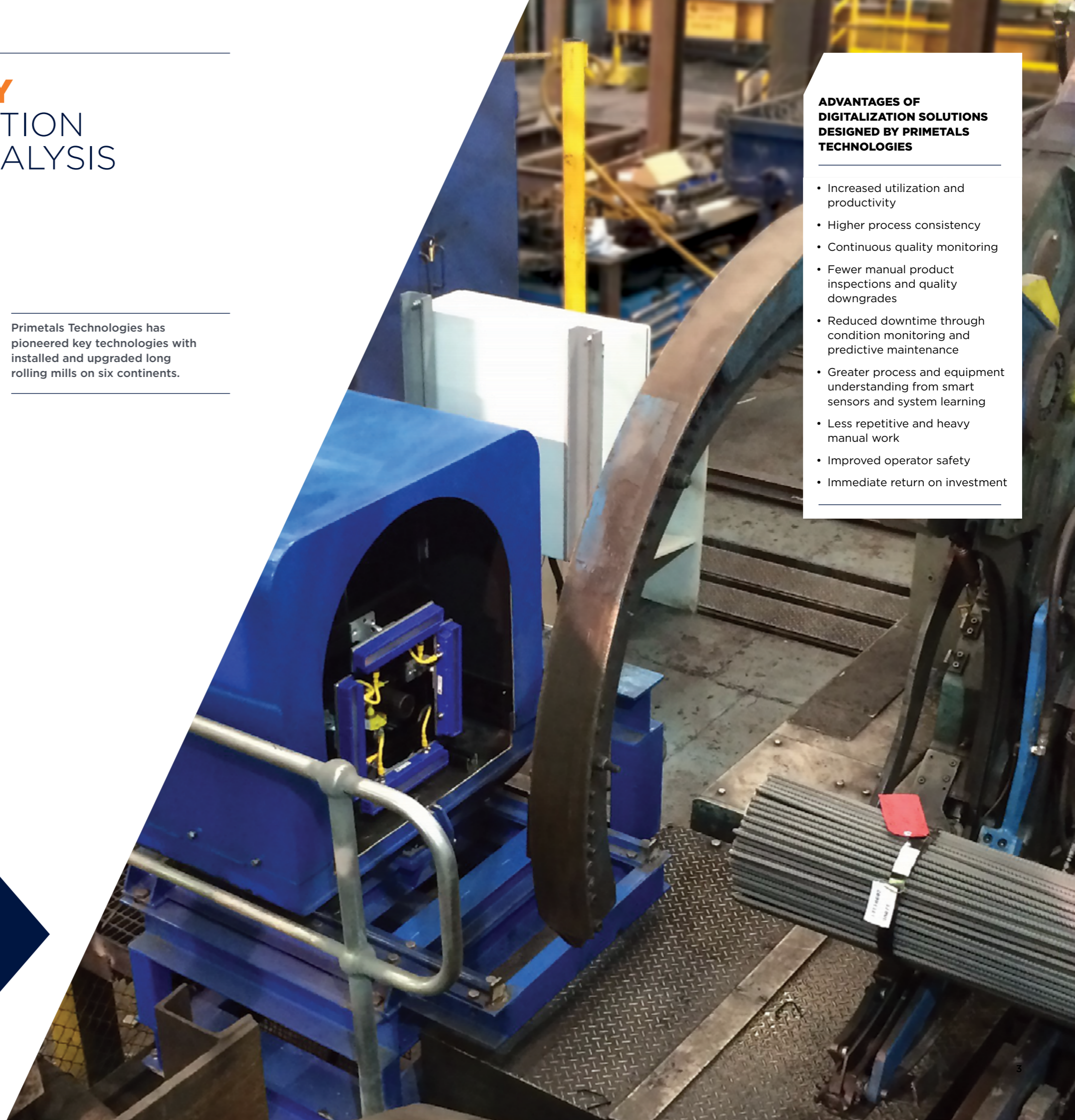
### ADVANTAGES OF DIGITALIZATION SOLUTIONS DESIGNED BY PRIMETALS TECHNOLOGIES

- Increased utilization and productivity
- Higher process consistency
- Continuous quality monitoring
- Fewer manual product inspections and quality downgrades
- Reduced downtime through condition monitoring and predictive maintenance
- Greater process and equipment understanding from smart sensors and system learning
- Less repetitive and heavy manual work
- Improved operator safety
- Immediate return on investment

Expected return on Industry 4.0 investment\*



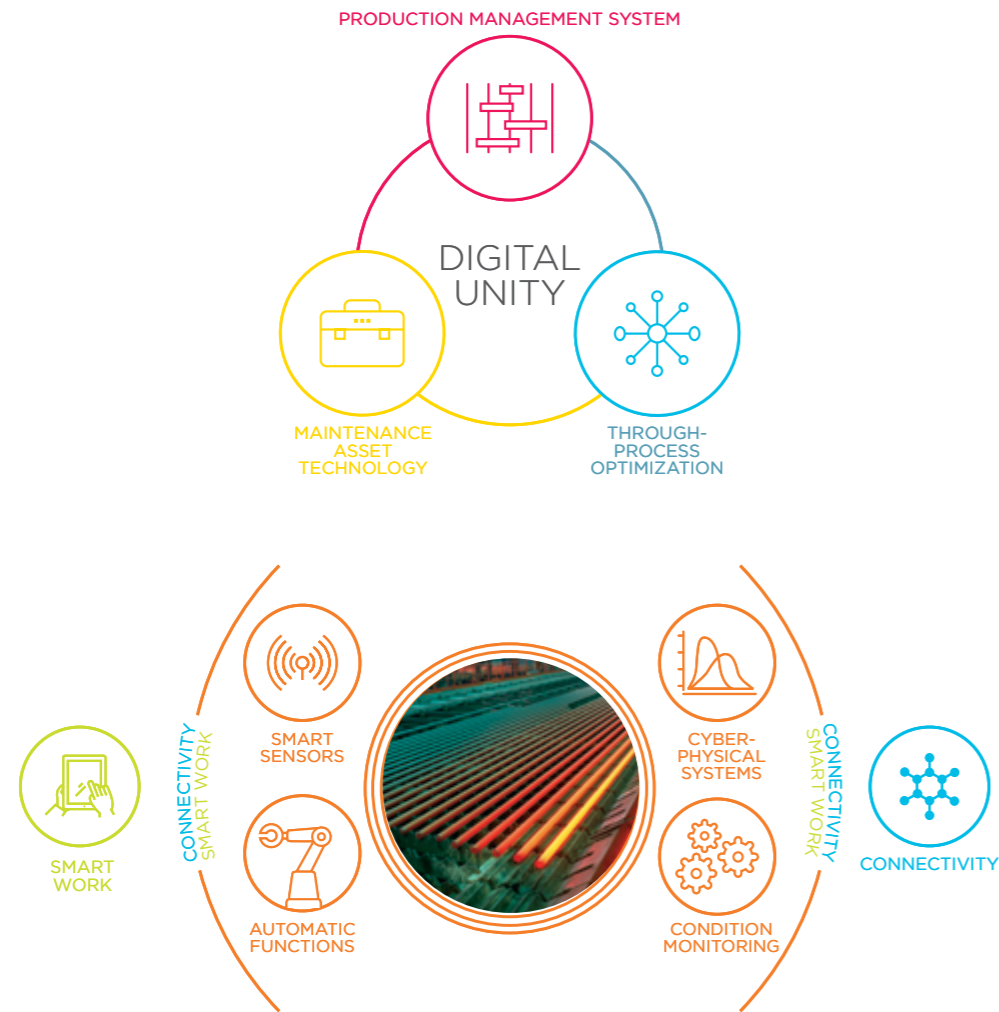
\*Source PwC





# THE DIGITAL TRANSFORMATION OF STEEL PRODUCTION

## INTELLIGENT COMBINATION OF PROCESS AUTOMATION, INFORMATION TECHNOLOGY AND CONNECTIVITY



### MAINTENANCE MANAGEMENT SYSTEM

Upcoming machine utilization and the types of products planned for production are considered when predicting a machine's future condition. The machine's current condition and predicted future condition will be made available to the plant's computerized maintenance management system as a basis for the optimized, holistic planning of maintenance actions and shutdowns.



### THROUGH-PROCESS OPTIMIZATION

Through-process optimization is an integrated knowledge-based concept developed by Primetals Technologies to improve efficiency and quality across all plants of a steel producer. The aim of TPO is to shorten time to market, especially in the case of cutting-edge products.



### PRODUCTION MANAGEMENT SYSTEM

The production management system covers the metals production process from iron- and steelmaking to rolling to shipping of the final product. The Primetals Technology PMS production management solution is based on PSImetals, which provides a comprehensive set of modules specifically developed for the metals industry already proven in many installations.



### UNDERSTAND, MEASURE, AUTOMATE AND IMPROVE YOUR PROCESSES

Smart sensors provide previously unavailable, continuous real-time process and plant data, whether directly measuring physical values or by using existing sensors to indirectly calculate additional information. Smart sensors support:

- Advanced automatic functions
- Process models
- Condition monitoring



### AUTOMATE YOUR PROCESSES

Fully automated functions remove tasks which are:

- Repetitive
- Labor-intensive
- Dangerous



### ALL THE NECESSARY INFORMATION – WHEN AND WHERE NEEDED

It takes a vast array of information sources to ensure the best possible operation and maintenance of a plant. The core concept of "Smart Work" is personnel automatically receiving pertinent data, on time and through media selected to optimally perform a task.



### YOUR PLANT AND ITS DIGITAL TWIN

Process models, digital "twins" of the plant, enable process optimization in real-time as well as offline simulation. This capability improves process guidance and provides full support for further process development.



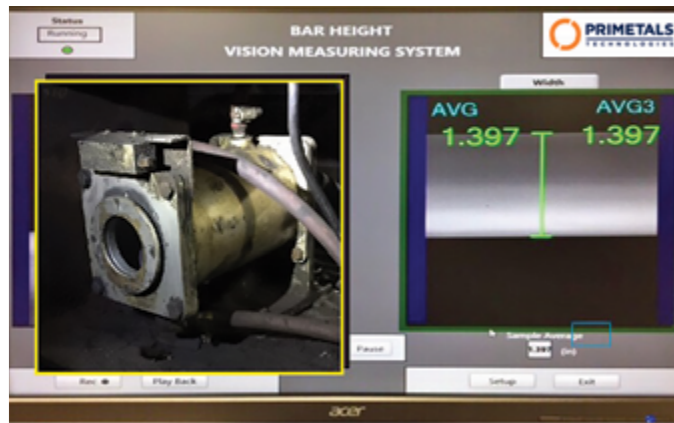
### KNOWING HOW YOUR PLANT "FEELS"

Condition monitoring supplies comprehensive information about the status of the equipment and its respective processes. This service facilitates predictive maintenance and reduces unplanned outages, thus improving plant availability and increasing plant productivity.

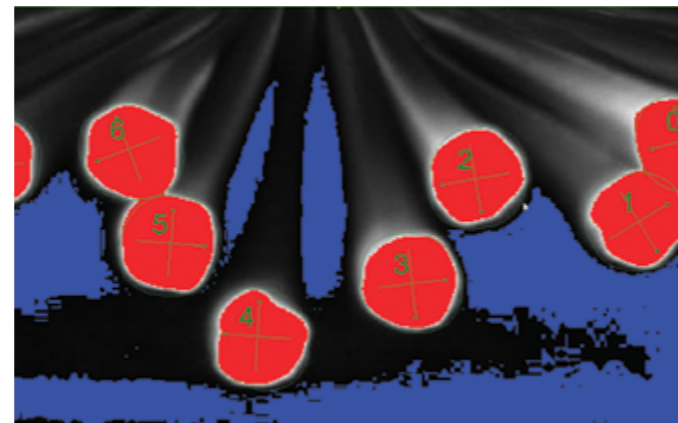


### GET CONNECTED – ANYTIME – ANYWHERE

Advanced technologies now allow for information to be communicated beyond former limitations. From the collection of sensor data in harsh environments or from mobile equipment, to displaying information on smart devices, digitalization moves data from the shop floor to the bottom line.



Bar height measurement sensor



Bar counter



Patent-pending automated trimming station robot



Condition monitoring supports a robust, preventative maintenance program

### SMART SENSORS FOR DATA INTELLIGENCE

Smart sensors provide valuable real-time data on the process and product of your long rolling mill, either by directly measuring physical values or by using existing measurements. These sensors enable the implementation of advanced automatic functions to create process models and monitor conditions. The continuous flow of mill information facilitates increasingly sophisticated monitoring and control of the entire plant.

Installing software packages developed around targeted smart sensors provides new and improved process metrics, leading to a more intelligent rolling process and minimizing mill setup time. Implementing condition monitoring and predictive maintenance can significantly improve overall plant operations, resulting in higher quality, yield and flexibility.

Examples of smart sensor functions:

- Dynamic speed, dimension and length measurement
- Laying head pattern control on the Stelmor® conveyor
- Remote product tracking
- Crop optimization
- Phase transformation monitoring

### VISION SYSTEMS

Optics and image processing go beyond what the human eye can see. Artificially intelligent vision systems can provide valuable information on the rolling process for both control and operational functions throughout the plant.

### LASER GAUGES

The ability to measure actual speed directly increases product quality, metallic yield and mill utilization. These devices can be used for measuring both actual product speed and length. Models are designed to withstand extremely harsh environments, covering the full range of mill conditions from caster area to finishing end.

Applications include:

- Product speed setup
- Tension control
- Billet length measurement
- Cut length optimization
- Laying head pattern control

### AUTOMATIC FUNCTIONS

Coupling information from smart sensors with robot manipulators enables a high level of automation within the plant. Repetitive, labor-intensive and dangerous tasks are optimal candidates for automation technology.

Long rolling applications can include:

- Guides change, adjustment and maintenance
- Shear blade change
- Bar sampling and testing
- Cobble removal
- Short bar removal
- Block ring and guide changes
- Laying head pipe change
- Coil ring trimming
- Product marking
- Product labeling
- Storage and logistics
- Parts cleaning

### EQUIPMENT CONDITION MONITORING

Comprehensive information about the condition of the equipment and the respective processes enables predictive maintenance, helping to avoid unplanned outages. The strategic placement of sensors in and on mechanical equipment throughout the plant provides digital information about the condition of that equipment and is collected and analyzed.

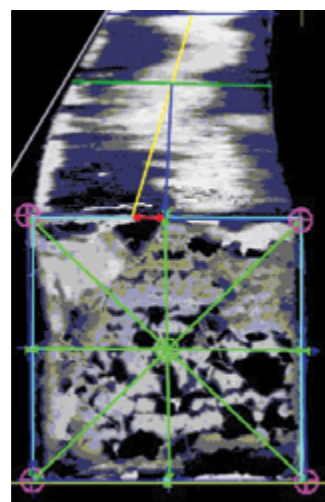
A maintenance management system combines this real-time data with predictive models, based on years of operational know-how and maintenance experience.

The resulting service schedule enables:

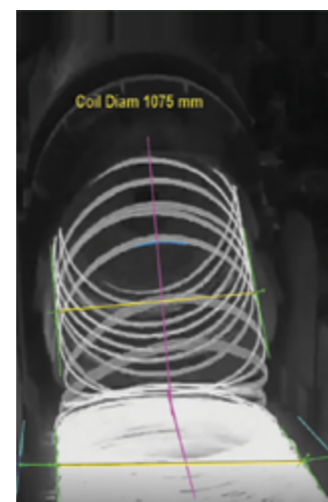
- Improved plant availability and productivity
- Optimization of maintenance costs
- Rationalized schedule of maintenance workforce
- Higher product quality



Shear crop measurement



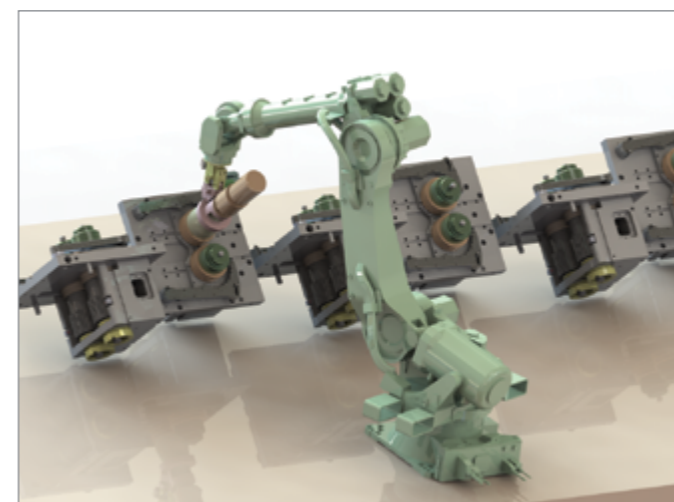
Billet dimension monitoring



Laying head camera



Property sensor



Automated roll changing robot



Smart Work makes data accessible on site

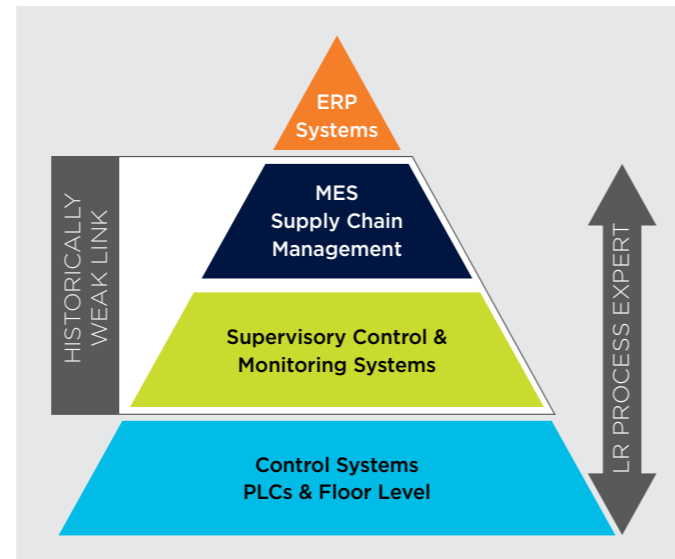


# LONG ROLLING PROCESS EXPERT

## MEETING THE PROCESS CHALLENGE

Operators and managers need both reliable data and accurate reporting on one platform. By collecting and utilizing this information to measure and compare KPIs against set targets or world standards, an operation can be monitored and measured from a performance and improvement standpoint.

LR Process Expert monitors and collects data from the raw material stage through to downstream processes. Its domain extends from enterprise resource planning (ERP), through Manufacturing Execution Systems (MES) down to control systems and sensors. The system delivers valuable mill reports to the operations staff and management, so they can easily assess the plant's performance through the KPIs and optimize production. Multiple interconnected systems can evaluate plant-to-plant performance at the corporate level.



## MANAGEMENT TOOL

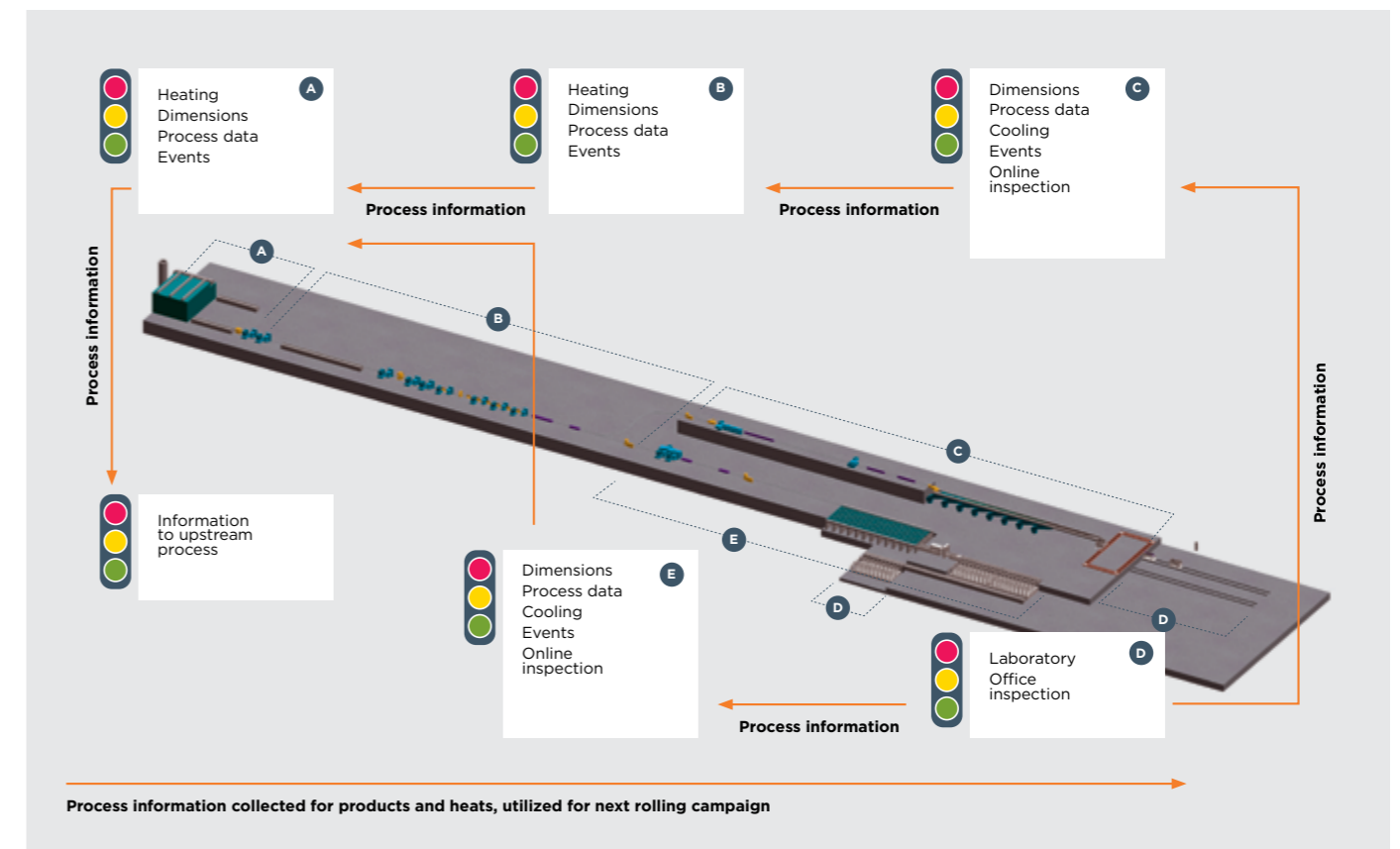
The LR Process Expert provides a valuable tool for corporate management to measure performance of individual plants and to evaluate shift-to-shift and plant-to-plant performance within the enterprise for:

- Operations
- Quality
- Process control
- Maintenance

## DATA COLLECTION

Critical data is collected from:

- Operations
- Maintenance
- Quality



Rules-based quality control system for fully integrated rolling mill

## CYBER PHYSICAL SYSTEMS

With advancements in software and powerful network systems, we now have the tools to collect, sort and analyze large amounts of data. Utilizing these tools in Cyber Physical Systems (CPS) allows the production performance to be monitored, analyzed and measured against Key Performance Indicators (KPIs) to ensure the planned production is being followed.

Connecting the real-time data from all sensors and devices with process models provides a digital representation, or twin, of the plant as a CPS. Utilizing these representations, intelligent process modeling enables offline simulation and testing during commissioning, development of new processes, evaluation of, and self-adaptation to, issues from product quality to equipment performance. Sophistication of such models is increasing rapidly due to powerful techniques such as artificial intelligence, neural networking and deep learning.

## CONNECTIVITY

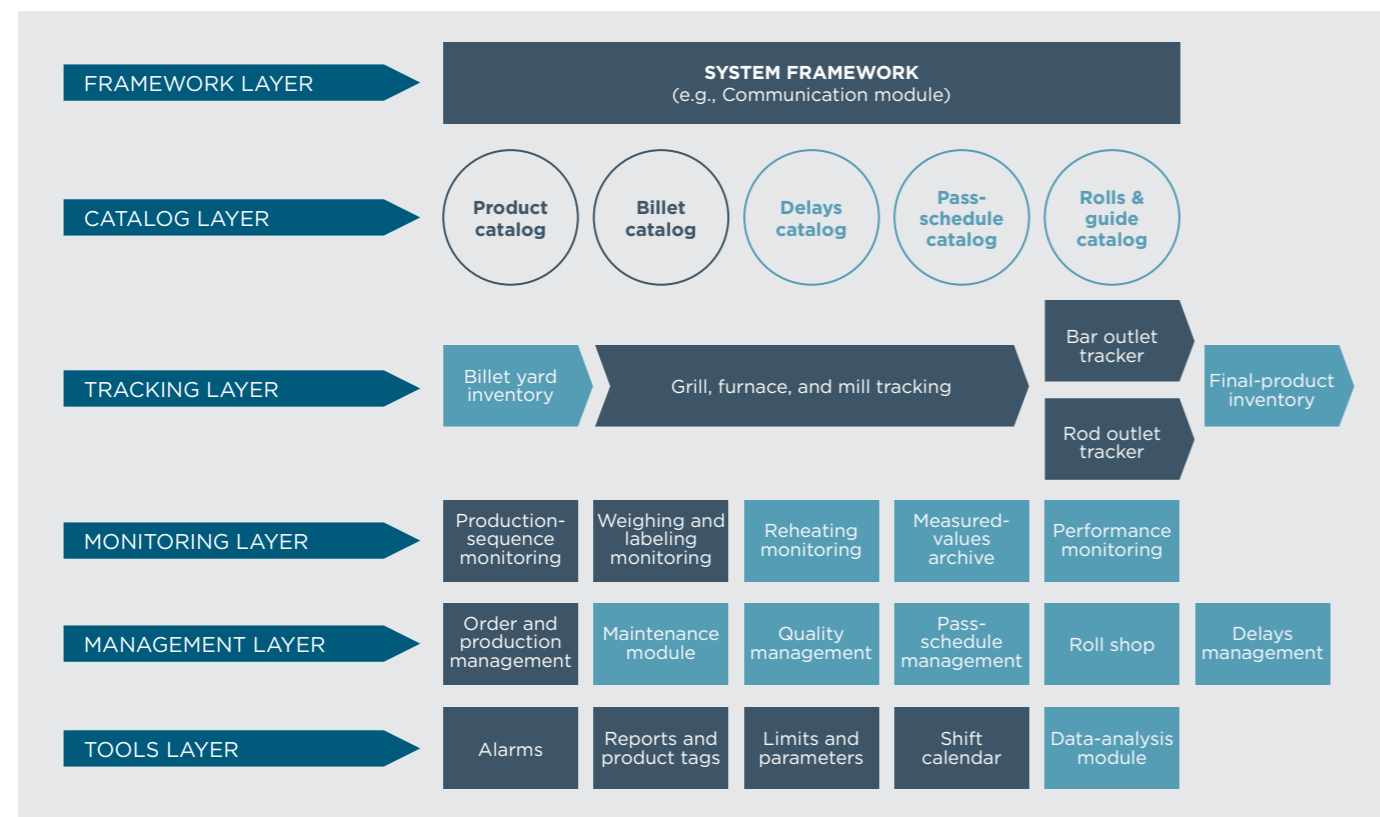
Advanced communication technologies allow data to be transmitted far beyond former limitations. Sensors can be quickly and inexpensively added to physical or wireless networks to collect data from any environment. Such real-time feedback can be displayed on smart devices for plant monitoring as well as utilized in the control of the process.

## SMART WORK

The best possible operation and maintenance of a plant requires a vast array of information sources. The core concept of Smart Work is that all personnel will automatically receive exactly the information they need at precisely the time they need it to complete their specific job. This means that all information is automatically tailored to the actual needs of the staff.

Examples:

- Online documentation via QR-coded equipment
- Augmented reality to guide maintenance work



Overview of the LR Process Expert modules developed by Primetals Technologies

# THE FACTORY OF THE FUTURE



## THE FULLY AUTOMATED FACTORY

In a fully automated factory, the digitalization of the mill plant can be complete, from the liquid phase to the finished product.

Digitalization makes this possible, utilizing the individual tools and portfolios mentioned to bring all this information together with the addition of:

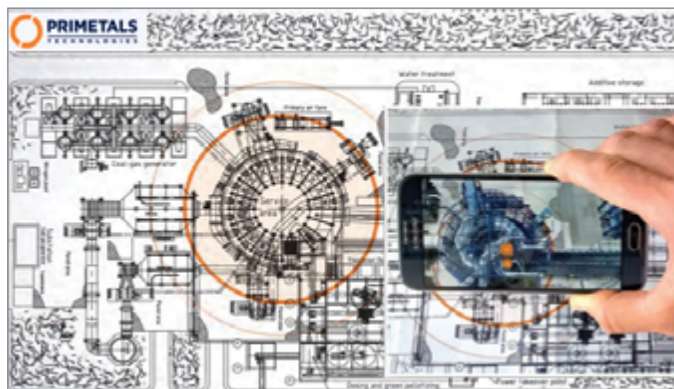
- Production planning
- Plant maintenance
- Product quality

The full process is monitored from meltshop to the final shipping of the finished product.

## ROADMAP TO A DIGITAL FUTURE

Do you feel your company is ready for digitalization? Primetals Technologies offers Industry 4.0 audits for long rolling mill operations to provide an initial answer to that question.

The audit process examines a company's strategic plans out 3, 5, and 10 years, conducts plant analysis and benchmarking, defines the customer's global targets and recommends technological upgrades to improve quality, productivity and flexibility for both immediate and longer-term returns on investment.



# EXCELLENCE FROM EXPERIENCE

## SELECTED SUCCESS STORIES IN LONG ROLLING DIGITALIZATION



### PRODUCT MEASURING SYSTEM

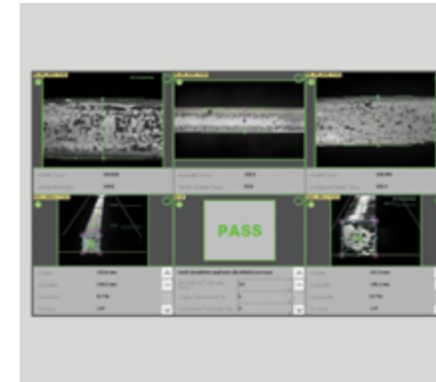
**Customer**  
Nucor Connecticut, USA

**Plant type**  
Single strand rod mill

**Our solution**  
Provide a laser-based speed measuring system

**Technical data**  
Plain carbon steels, 150,000 tpy, 35 tph, 5.5 - 14.3 mm plain rounds

**The result**  
Section control through the roughing and intermediate mill has improved with accurate measurement of stock speed between stands.



### BILLET DIMENSION MEASURING SYSTEM

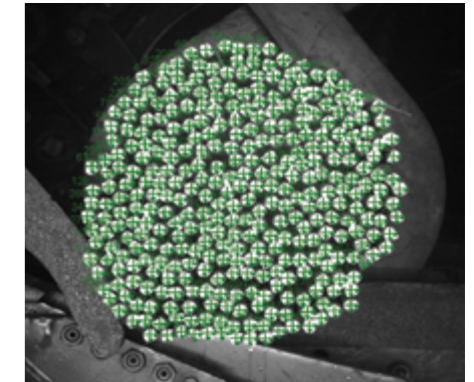
**Customer**  
Valsabbia, Italy

**Plant type**  
Single strand bar mill

**Our solution**  
Provide a vision-assisted billet dimension measuring system to ensure billet-to-billet size consistency

**Technical data**  
Reinforcing bar 6 - 40 mm, bar bundles 6 - 15 m long

**The result**  
Dimensions of billets from the billet yard can now be reliably verified before preparing for the rolling mill.



### NON-CONTACT BAR COUNTING

**Customer**  
OneSteel, Melbourne, Australia

**Plant type**  
Single strand bar mill

**Our solution**  
Install a non-contact bar counting system ahead of the bar bundling station

**Technical data**  
Plain rounds 26 - 33 mm, reinforcing bar 12 - 40 mm, bar bundles 1.5 - 2.4 t

**The result**  
The new bar counting system provides accurate and repeatable bar bundle count, without a need for manual verification.



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Brochure No.: T06-1-N668-L4-P-V2-EN

Printed in USA

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