Shaping the next

industrial revolution

with you.

2022 SEAISI, Kuala Lumpur

Tailored Digital Products for Asset Optimization

SMS group

SMS digital

14 - 18
NOVEMBER

Sunway Pyramid
Convention Centre
Malaysia

2022 SEAISI
STEEL MEGA
EVENT & EXPO
Technology • Sustainability • Construction

The world of metals becomes increasingly challenging

PROCESS CHALLENGES

› Ensure plant utilization

› Improve punctuality (OTIF)

› Secure profitability

› Reduce operational costs

› Employee safety

EFFICIENCY AND SUSTAINABILITY

› Reduce carbon footprint

› Improve efficiency

› Utilization of green energy

› Apply energy certification

MARKET CHALLENGES

› Global overcapacities

› Smaller lot sizes

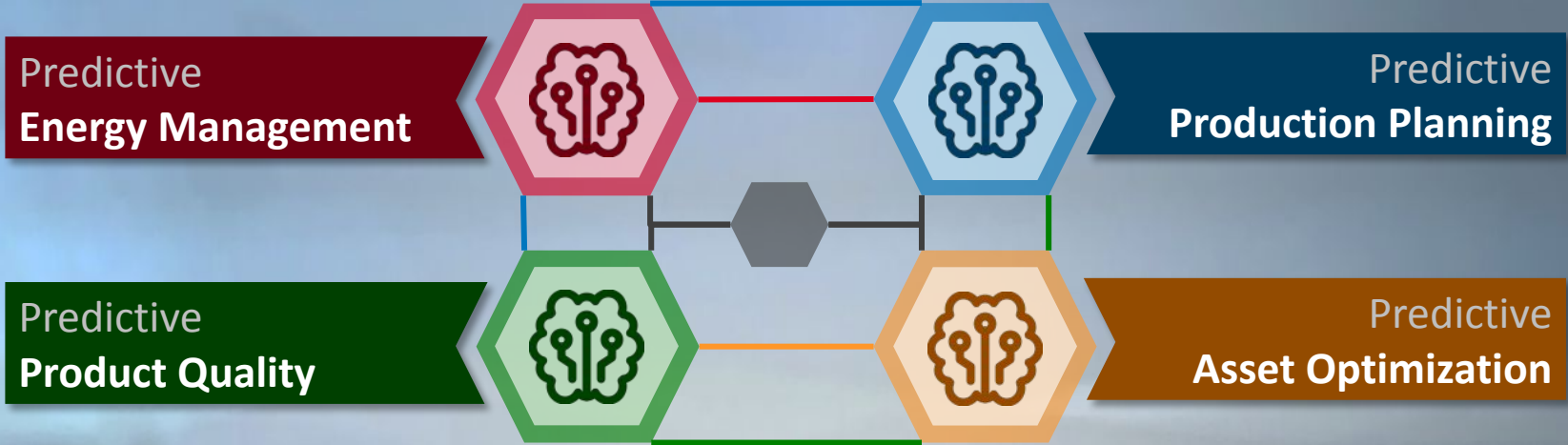› Product quality certification

› Resource price fluctuations

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The world of metals becomes increasingly challenging

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EFFICIENCY AND SUSTAINABILITY

MARKET CHALLENGES

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› **Industry 4.0**

› **Artificial intelligence**

› **Data-driven decision making**

› AR / VR / 3d visualization

› **Cloud computing / big data**

› Robotics and ~~drone services~~

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Autonomous Plant Operation
Four Dimensions to Boost Efficiency and Sustainability

Predictive
Energy Management

Predictive
Production Planning

Predictive
Product Quality

Predictive
Asset Optimization

> Actionable items

> Maintenance tasks

DATA FACTORY

Edge divices and Smart sensors

X-Pact® Electric and automation solutions

TECHNICAL SERVICE

> Maintenance schedules

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November 17, 2022

4
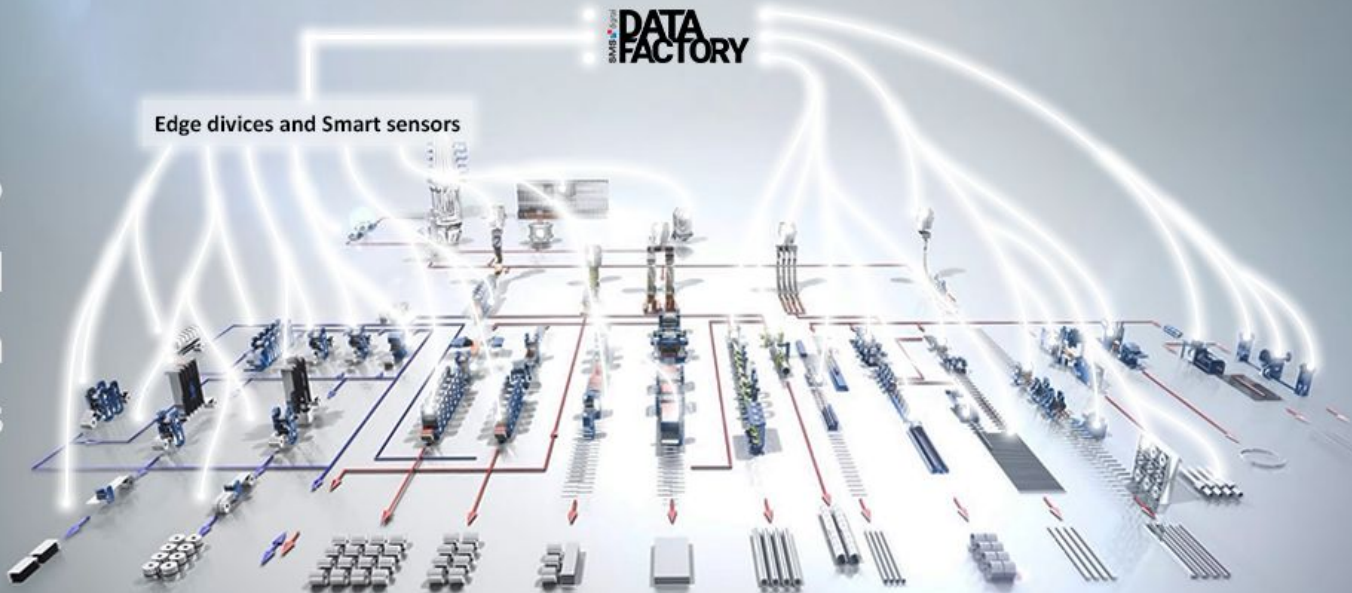
Equipment Lifecycle & maintenance strategies

Preventive	Condition based	Predictive	Reactive

Asset Performance

Failure starts to occur

Early signals

Repeated occurrence

Audible noise

Functional problems

Equipment failure

Most cost-efficient

Costs

Risk

Remaining-useful life

Time-to-failure
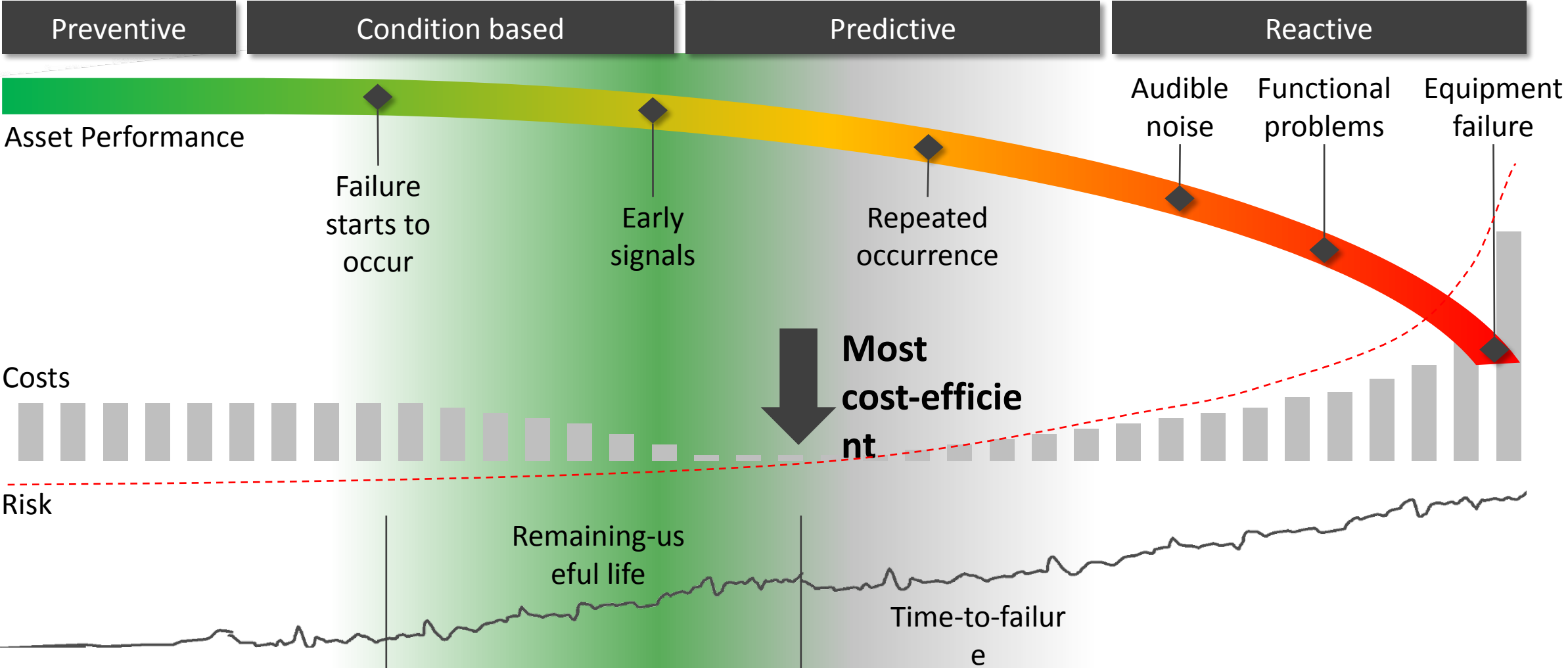
Predictive Asset Optimization (tailor-made) Approach

Rule-based Monitoring

Condition monitoring with static thresholds defined by experts

Domain expertise

ML-based Monitoring

Condition monitoring with dynamic thresholds defined by ML and pattern recognition

Domain expertise · Sensor data

Predicative Operation

Prediction of process parameters, time to failure, remaining lifetime and failure identification

Maintenance data

Domain expertise · Sensor data

Prescriptive Operation

Prescription of actionable items for process adaptations, maintenance tasks and schedules

Maintenance data

Domain expertise · Sensor data

Sensor data → Failure history → Actionable items →

Asset intelligence

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Process Condition Analyzer – Tailor-made approach
Condition and Process Prediction

SMS group's tailor-made approach for asset optimization

› Early identification of process deficiencies and unsuitable production parameters

› Automatic process supervision and guided operator support

› Increasing transparency and visibility of all process and production related data across the whole process chain
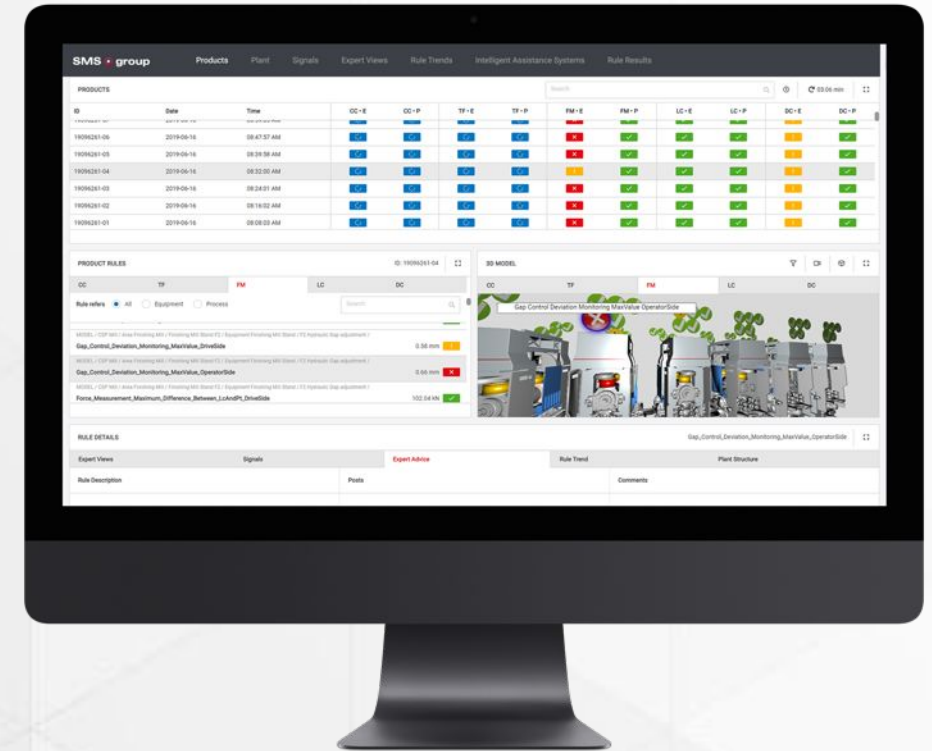
SMS Asset Optimization Platform

- › Configurable Asset Optimization Platform
- › Made by Engineers for Engineers
- › Captures Know-How from experts and data
- › Real-time decision support
- › Predefined content for SMS assets

VPN

DATA FACTORY Suite

SMS Edge Device

Digital Ready

DataXpert Overview
Tailor-made Asset Platform for Steel Industry

Presentation Layer

Service Layer

Integration Layer

Visualization and Interaction

BIXpert™ BIXpert

Data Processing

Process + Maintenance Rules — RULESXpert

Interprocess Communication — *Webservice*

ML Modeling — AIXpert

DATA FACTORY — Data Storage — InfluxDB, Prediktor, SQL

Data Gathering — InfluxDB, Prediktor, SQL

OPC UA MQTT [...] Modbus
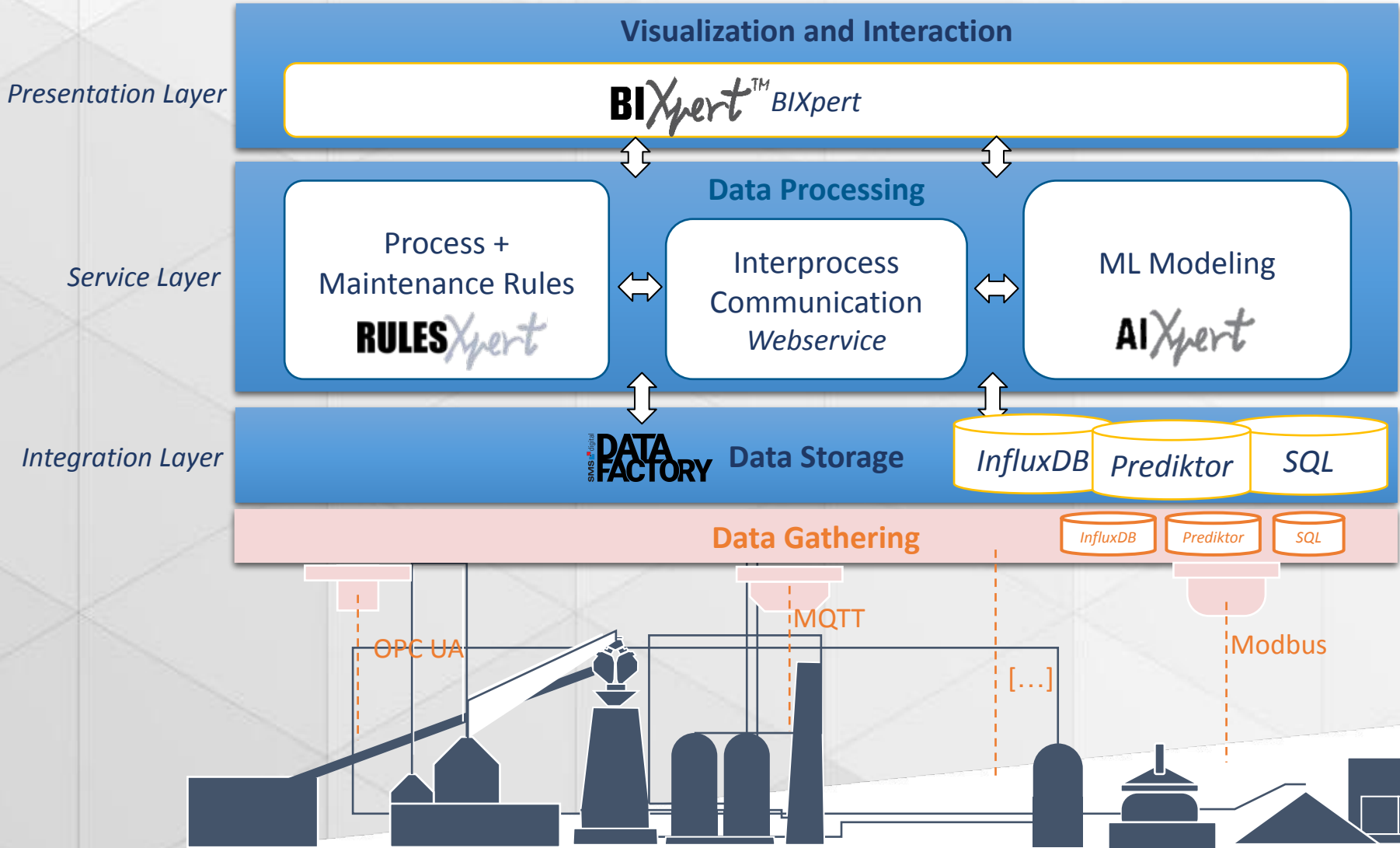
RulesXpert | Engineering Models & Machine Learning Models
Process Optimization

Rules Designer

Start

End
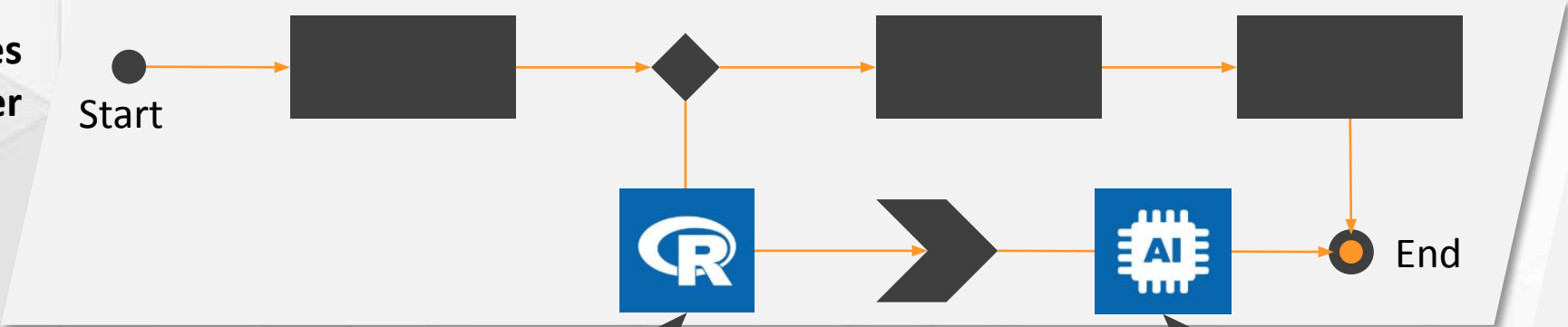
Model generation
- › One-click from research to industrialization

julia python R

- › SMS / customer data scientists

Predictive model
- › Auto ML

- › Process engineer

Pattern recognition
- › Anomaly detection
- › Deviation from normal behavior
  - › Process engineer

BIXpert™

AIXpert

AIXpert |Engineering Models & Machine Learning Models
Process Optimization

Configurable web dashboarding for real-time decision support
BIXpert™

**Facilitation of organization and visualization of equipment reliability data**

› Trend views for in-depth analysis and troubleshooting

› Contextual views by combining drawings, sensor positions and their values

› Status view for general overview

› Tabular views for KPIs, equipment and process status

› Notification panels including grouping and Gantt charts

› High-speed queries:

   › Display

   › Aggregates

   › Raw values and filters

› No querying language required

Use Case#1: Hot Metal Temperature Forecast for Blast Furnace Process
Condition and Process Prediction

Machine Learning Use case:

- Predict the temperature of the hot metal up to 3h in advance.
- **Model ensemble approach** with models implemented in AIXpert and R and glued together in RulesXpert.
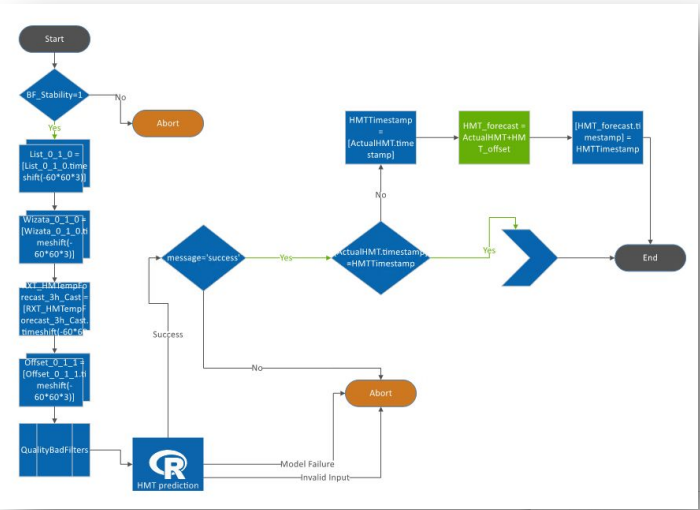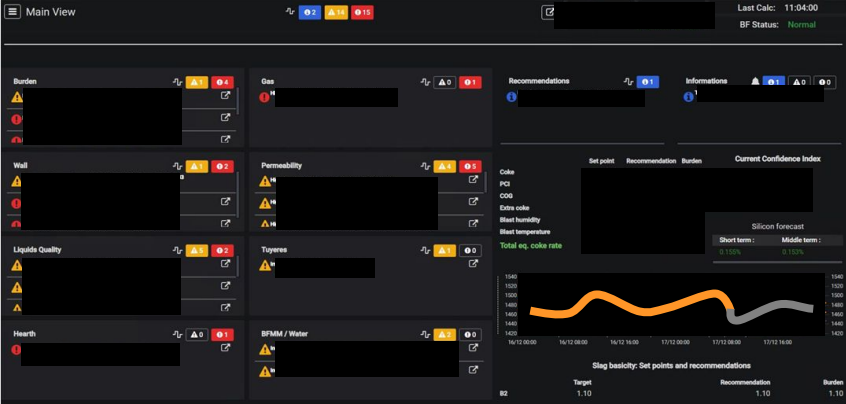
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Use Case#1: Hot Metal Temperature Forecast for Blast Furnace Process
## Condition and Process Prediction

- Selection of 80 potentially influencing variables **(feature selection) by the process engineer**

- Multiple Models trained in **AIXpert and R**

- Output of the models **combined in the rule engine**

- Time-delayed influence on the target variable
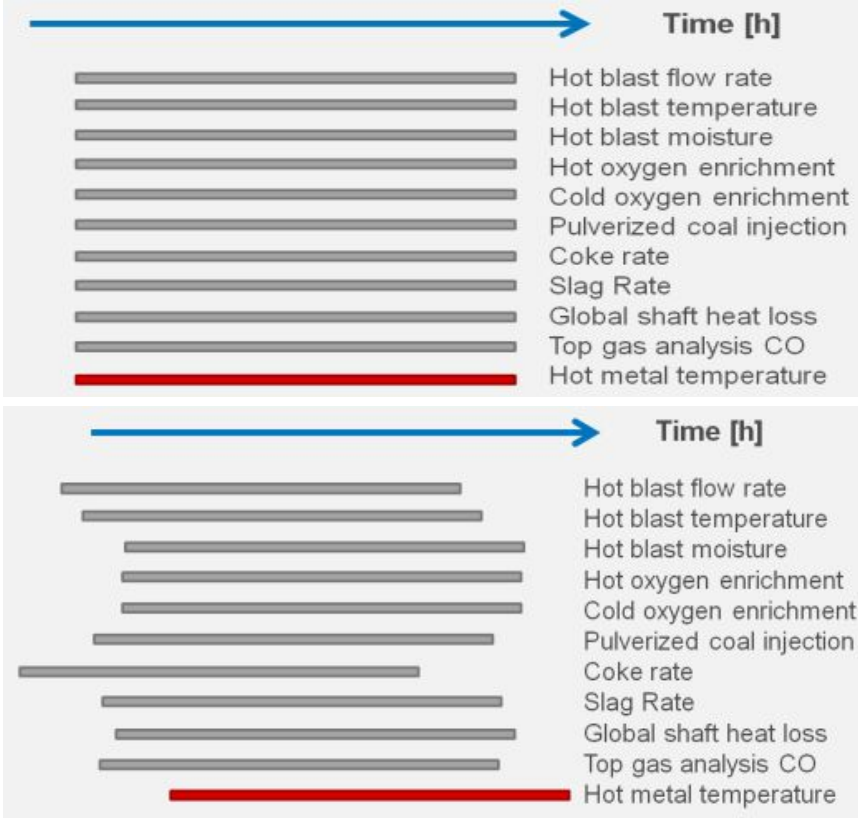
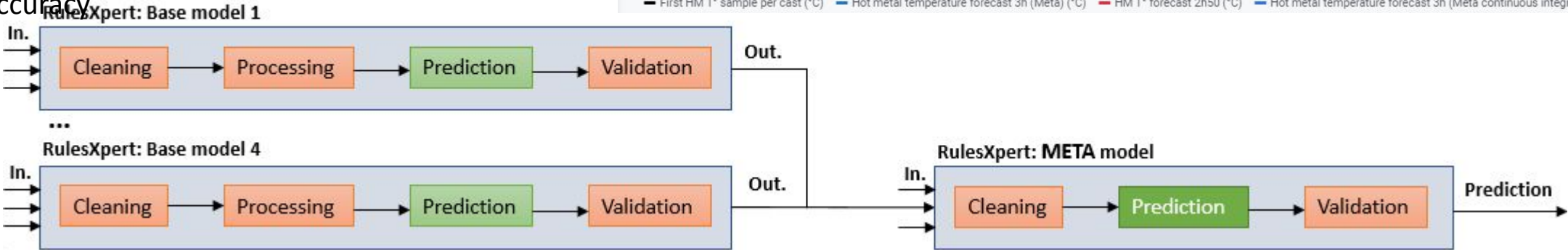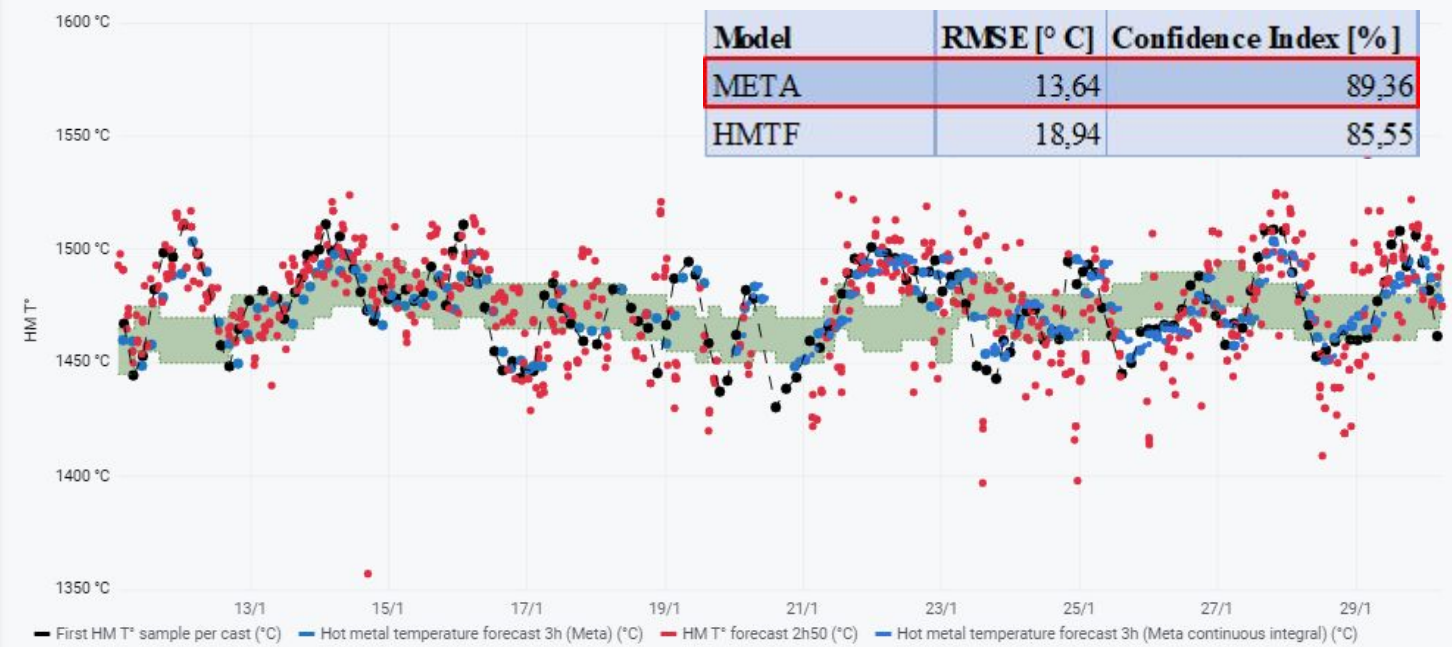# Use Case#1: Hot Metal Temperature Forecast for Blast Furnace Process

› Main information:

  › Consists out of 4 base ML models scheduled in RulesXpert™

  › Training period 2 years

  › Cleaning and filtering of training period

  › Suitable for different blast furnace operations
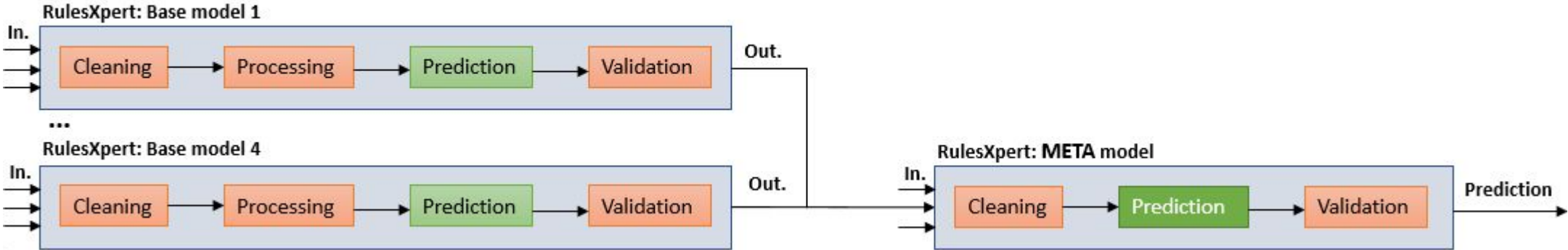
Use Case#1: Hot Metal Temperature Forecast for Blast Furnace Process

› Main information:

  › Consists out of 4 base ML models scheduled in RulesXpert™

  › Training period 2 years

  › Cleaning and filtering of training period

  › Suitable for different blast furnace operations

  › Significant improvement of prediction accuracy

Model	RMSE [° C]	Confidence Index [%]
META	13,64	89,36
HMTF	18,94	85,55

ProcessXpert™: Hot metal temperature forecast and fuel recommendations
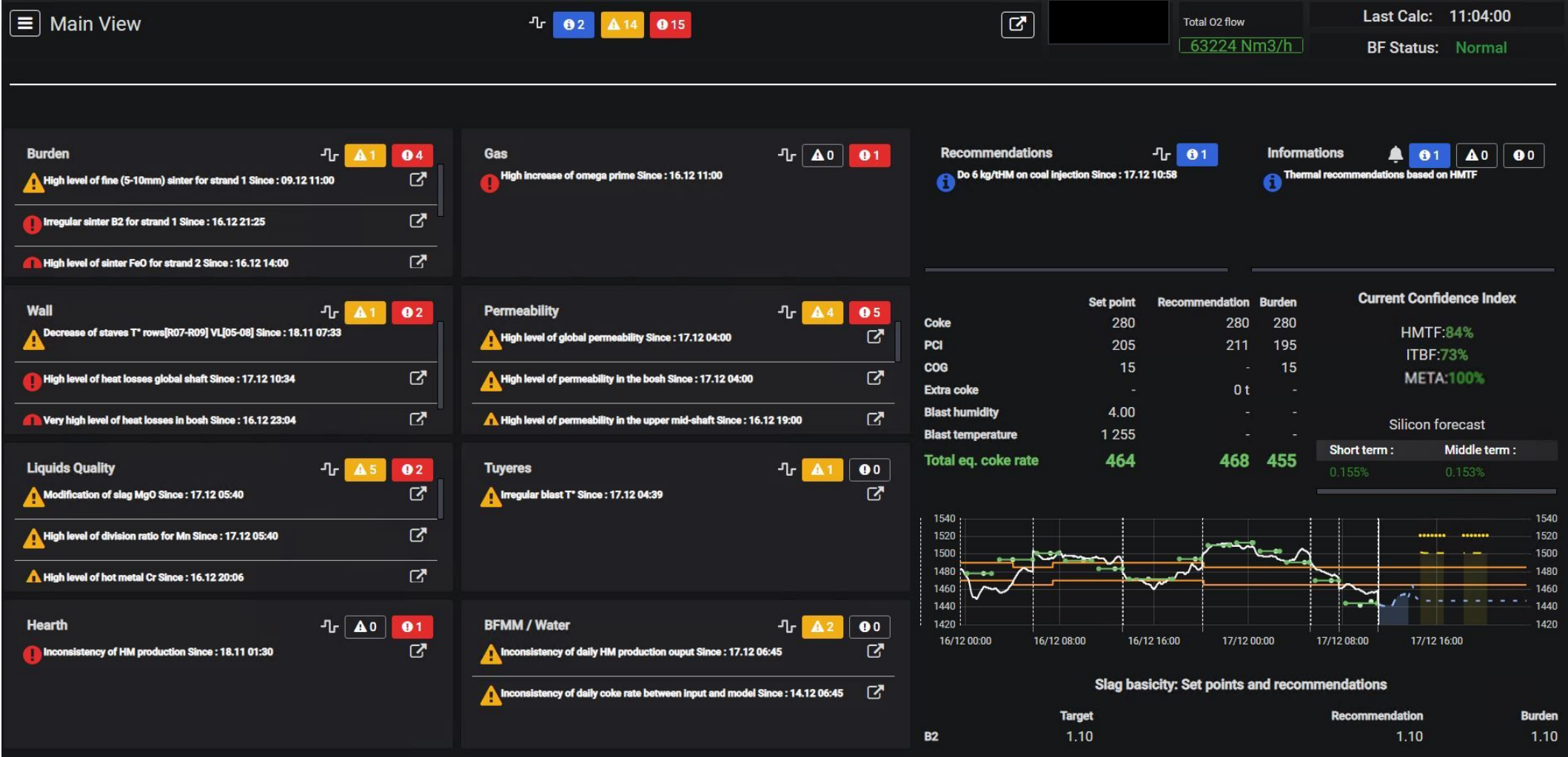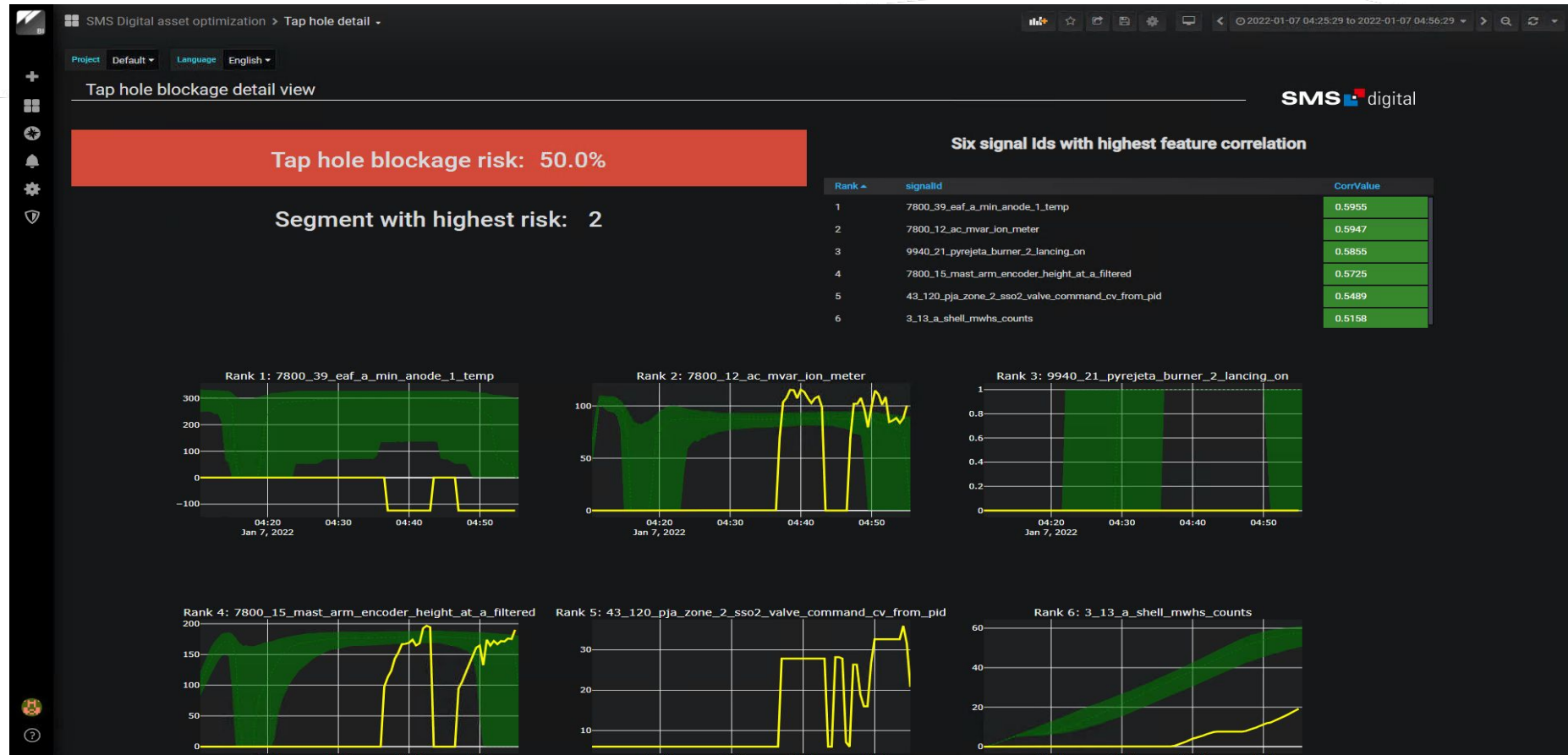
Use Case#2: Electrical Arc Furnace- Prediction of Tap-hole blockage

› Main information:

  › EAFs have tap hole to pass said molten steel.

  › Due to multiple reasons, after continued operations, there is a phenomenon called 'Tap hole blockage' or Tap hole jamming.

  › Operators need to clean the taphole to resume normal operation

  › Due to complexity in metallurgy, it is very difficult to predict such tap holes blockages in advance.
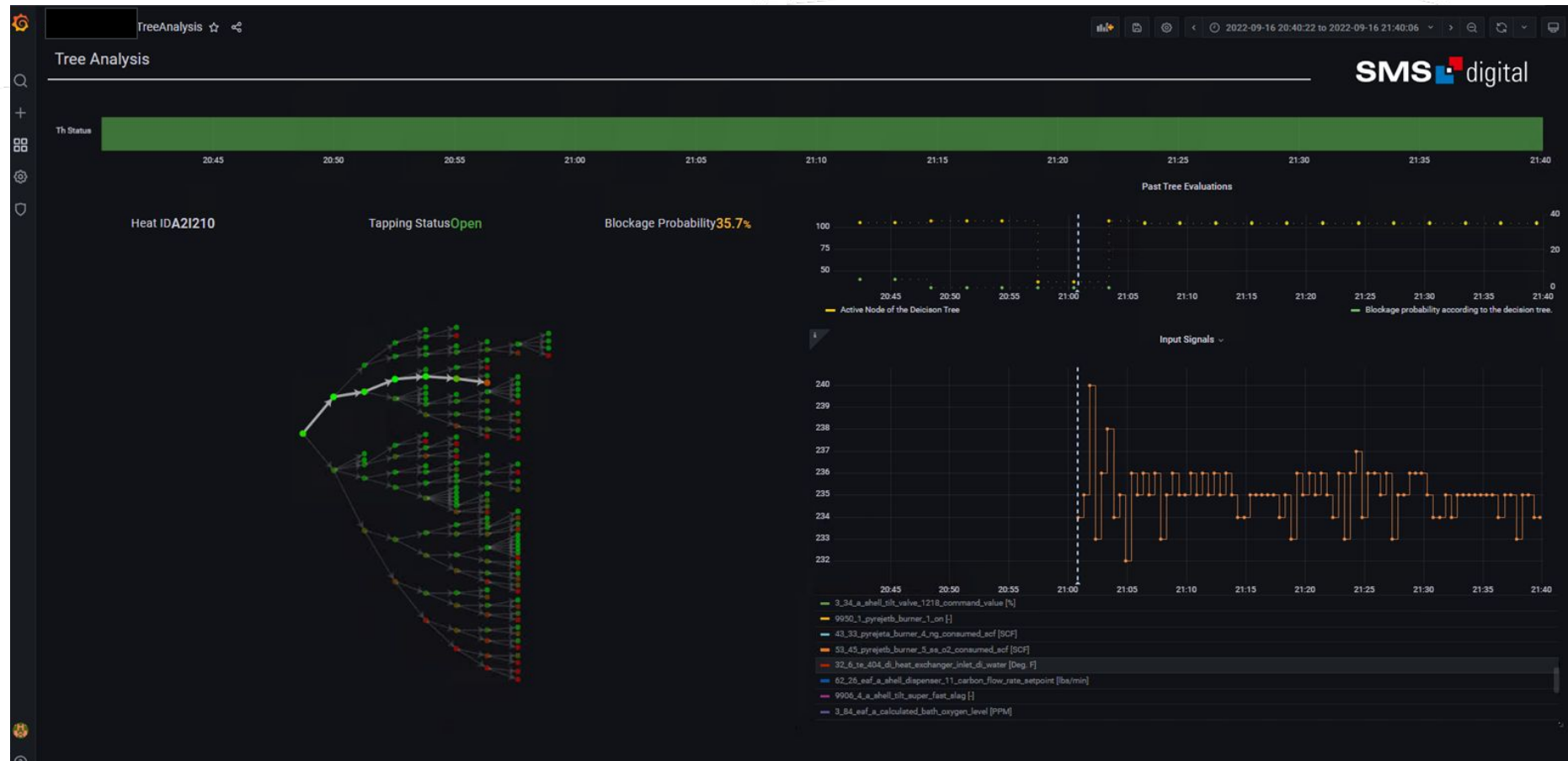
Use Case#2: Electrical Arc Furnace- Prediction of Tap-hole blockage – Tree Analysis

› **Objective:** Which process factors lead to such blockage.

› Solution: Data driven prediction models help operators to predict such a blockage with screen view as the one shown here

› **With this tool not only next blockage is predicted but with expert knowhow counter measures can also be made to reduce such blockages.**
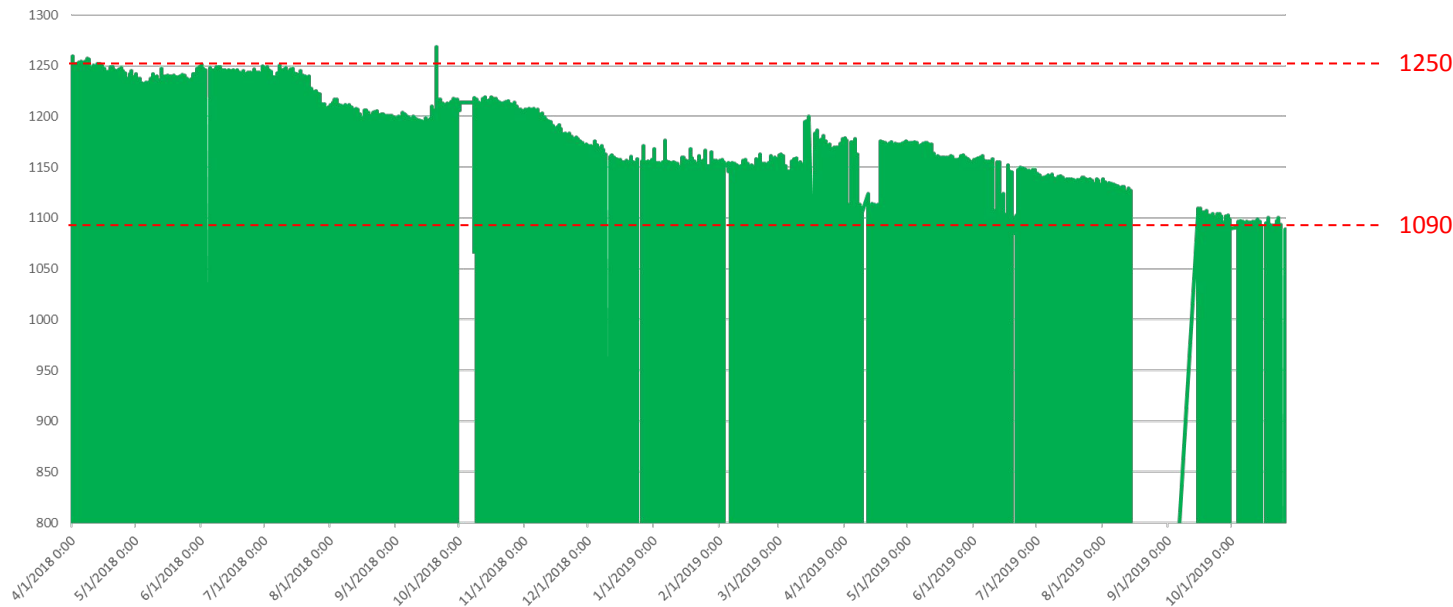
Use Case#2: Electrical Arc Furnace- Prediction of Tap-hole blockage

› Consistent use of the DataXpert will lead to tap-hole blockage free operation.

Use Case#3: Laminar cooling water flow valves monitoring in Hot Strip Mill

› Evaluate flow of laminar cooling group when there is strip in laminar cooling and all valves are open

› Within 1.5 years total flow has decreased by about 13%

› Reason - probably water nozzles are going to clog slowly

› **Benefits:**

- Long term predictive indication on the clogging trend of the valves.

- When flow is reduced, recommendations can be given to the maintenance team to check, investigate, and exchange the cooling header and valve when necessary.

- Avoid unexpected products cooling quality problems due to reduced amount of water.

Use Case#4: Roll Change Optimizer for Hot Strip Mill

Tailor made solutions for Hot Strip Mill

Looper models | HSG models | Roll change models | Descaler models | Bending system models | Roll Shop Optimizer
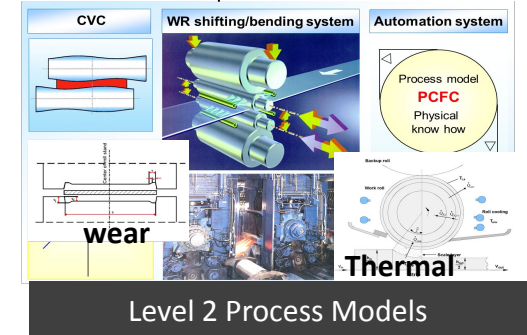
dataXpert Platform

System Visualization

› Prediction of expected roll life

› Display of operation results and recommendation

› System operational Interaction

Data interface and control

› Data Interface to Level 1 and Level 2

› Operational and control data

› Data Streaming

Roll Shop Management System

Level 2 Process Models
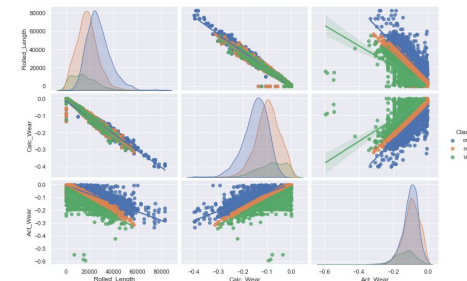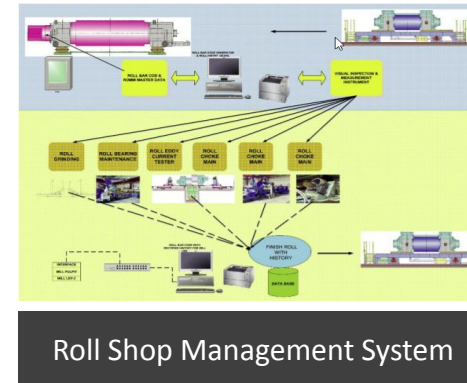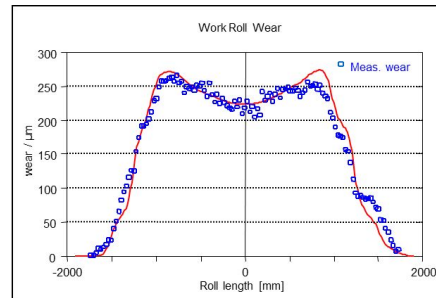
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Conclusion

- The described predictive asset optimization applications shows that SMS group enables steel producers to draw better conclusions in data-rich decision areas and helps to assess equipment health and detect complex anomalies from real-time sensor data. Thanks to machine learning, equipment failures can be predicted or, at the very least, a probability of failure assessed days in advance.

- Data-driven condition monitoring does the groundwork for the **learning steel plant**.

- SMS Tailored solutions are being developed and being implemented for measurable results backed by proven techniques and domain known-how

- **DataXpert** can be used as a **low code platform for machine learning solutions**

- Models can be created in **AIXpert, Python, Julia or R**

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Realizing hidden potentials for maximum business impact

Unique Capabilities for unique consulting services

"We combine 150 years of metallurgical knowhow with digitalization expertise"

Superior expertise in metallurgical processes, operations, equipment and technologies

Process & Operations Expertise

+

Management & Technology Consulting

Digitalization Know-how
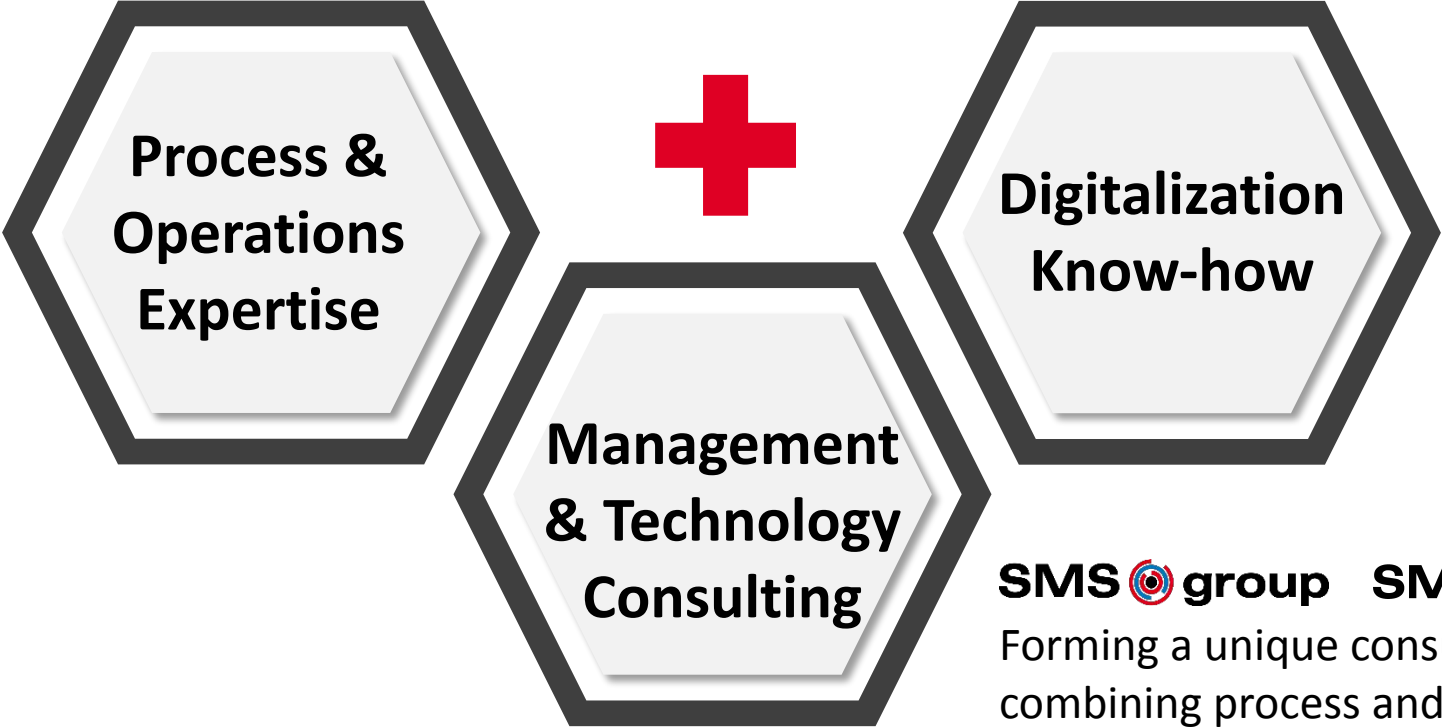
Digitalization experts in digital strategy, data science, digital product development & data architecture

SMS group **SMS digital**

Forming a unique consulting approach, combining process and operations excellence with digitalization to deliver lasting business impact in the metals industry

Thank you

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