The metals industry thinks big and gets practical about digitalisation

In real-world scenarios, converging operational technology (OT), IT and engineering data can be challenging, especially when enterprise information infrastructure includes heterogeneous information systems. Most metals plants also live with incompatible legacy OT systems which can become a massive hurdle to integration. The integration process therefore requires expertise on both the domain and system levels, and specific connectivity solutions. ABB shares insights about metals producers successfully converting from conventional to more modern operations that are safe, smart and sustainable.

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Many potential digital use cases can open up for the metals industry once basic data requirements are fulfilled. The pain points that come first are: How can disparate equipment availability improve and how can processes run at an optimal and profitable level? We agree, because when assets or processes do not run reliably and optimally, you reduce, restrict or stop fulfilling your higher-level business goals.

It is important not to treat assets and processes separately. Real value comes when previously hidden relationships and correlations are revealed. We are helping customers improve interactions in real time so that everybody is working towards common goals. Questions from the operations people that we often help to address include: How can all resources be managed in real time to provide contracted product quantities and qualities faster?

Companies focused on continuous improvement are eager to explore how powerful enterprise-grade industrial analytics and artificial intelligence (AI) can provide them with even deeper insights about their activities, asset or process behavior and reap the benefits of higher productivity, lower energy/emissions, better industry reputation. Leaders with the need for deeper actionable insights are asking: How can we get real-time visibility of our business,

Data gathered by metals companies is essential to reaching digital potential
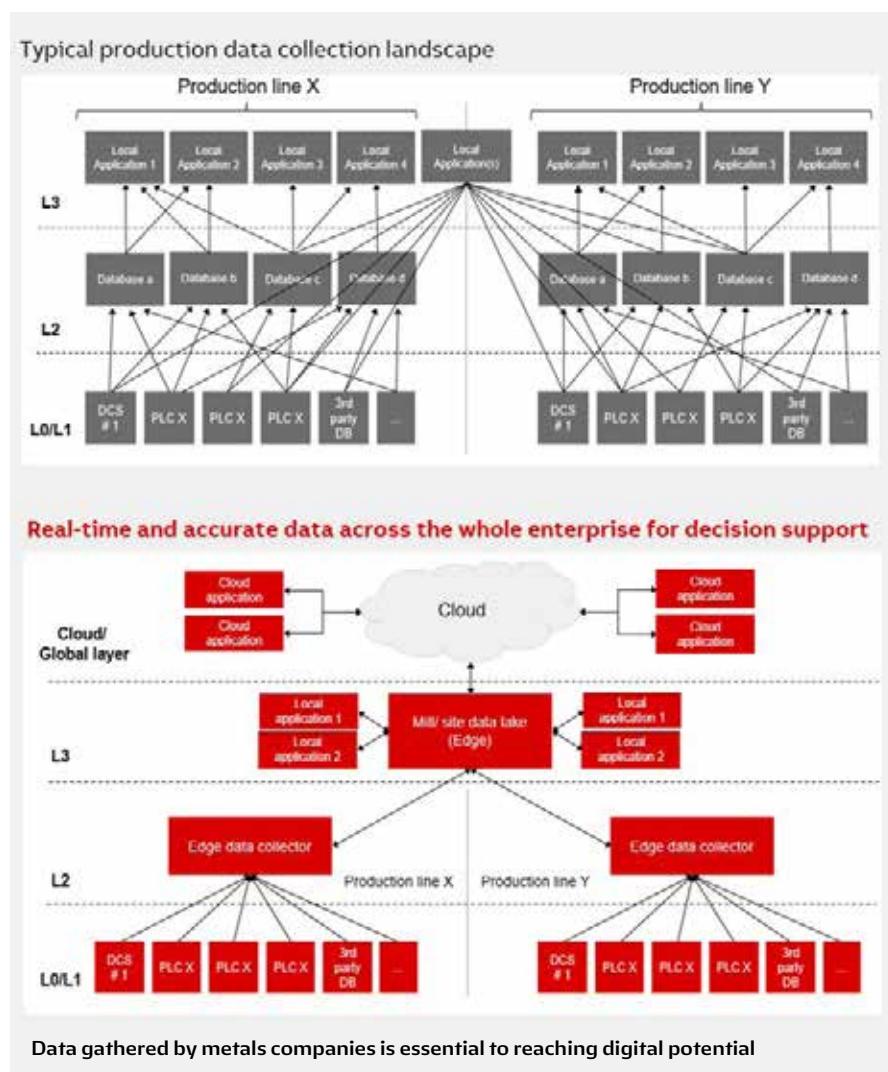
mill, process or equipment - no matter location or time?

We recently supported a steelmaker to establish a data platform delivering exhaustive plant data collection and smooth data flow upwards, enabling

meta-data – structure and information within data itself and a site data lake – with cloud connectivity. Further options could be: cloud data lake, data integration for specific customer's digital use cases, edge computation service

environment – key performance indicators (KPIs), calculations, applications, visualization services, training and support. The data platform will be used by this steelmaker for better production knowledge and continuous improvement (like speed, quantity and price), equipment condition monitoring (for availability) and more. We also ensured the reliability of sensors (avoiding temperature drift) and opened production data to customers (for direct sales).

Five pillars of digital solutions

Technology leaders obviously wish to see plants adopt new solutions to benefit operations, but sometimes the digital landscape can seem quite intimidating. We have selected real-life examples providing evidence that digital transformation strategies are working and demonstrating value in the metals industry. There are five digital solution areas in our portfolio, representing the following value pillars.

• Operational excellence
Flexible manufacturing execution, improved insights from operations by integrating different areas – from production to upper-level systems – and optimizing costs across distributed plants makes for operational excellence and includes KPI monitoring, analytics and remote operations capability.

One of the largest manufacturers of metal and flat steel products in the Middle East and North Africa region Al Ezz Dekheila Steel Company Alexandria S.A.E. (EZDK), implemented ABB's Manufacturing Operations Management (MOM) system tailored to metals processes — including complete tracking from furnace charging area to C hook conveyor. It provides EZDK with 24/7 and year-round access to production management system dashboards from any mobile device, making it even easi-

Fig. 4: The shop-floor and top-floor can be more connected, with greater visibility than ever before

er for them to visualize their processes and utilize the information provided to further optimize operations.

Meanwhile, JSW Steel Ltd, India's leading steel company, adopted a complete smart factory solution for energy-efficient, safe and productive melt shop operation - which is unique in the industry. This digital solution connects steel melt shop operations with ladle and crane tracking and thermal loss prediction for higher casting speeds and additional output. It addresses one of the major challenges facing steelmakers today, which is to maintain the optimal temperatures required to make molten steel while balancing high electrical energy costs. Ensuring the right temperature at the right time, together with other parameters in the molten steel, directly determines steel quality and productivity.

JSW Steel expects to increase the company's EBITDA profit by around 2 million USD per annum through four

percent higher casting speeds, time savings of one working day per month and additional output equating to 24,000 tons a year. The lower energy consumption means fewer consumables used per batch and a lower carbon footprint with less CO_2 per ton of steel. Automatic tracking and scheduling enable better maintenance planning and increases personnel safety as they are removed from the production area during crane and ladle movements. Scheduling results in reducing tapping delays by ensuring movements are synchronized with process requirements.

Based on advanced digital algorithms and mathematical modeling, ABB Ability™ Smart Melt Shop is a true example of technology convergence as it utilizes cameras and image-processing, weighing systems, radar, laser and wireless-based technologies to ensure steel melt shops operate at optimum levels where crane and ladle tracking and
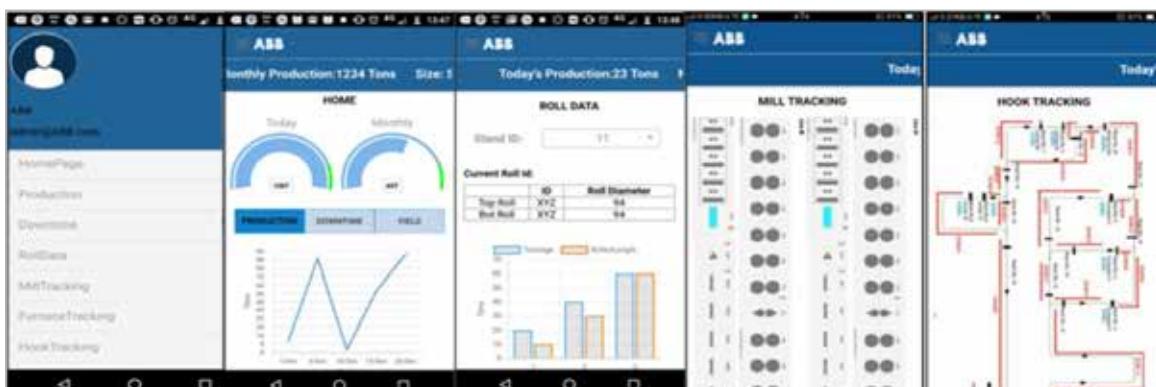
ABB recommends user-friendly dashboards via web page or mobile
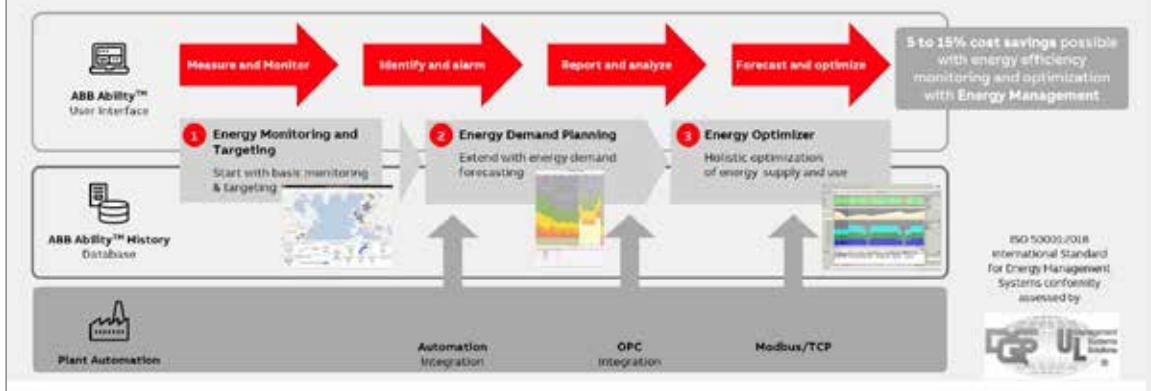
their availability are critical to the entire steelmaking process.

• **Process performance**
This includes solutions around advanced process control (APC), optimization and related services. It lets the industry achieve sintering and pelletizing process stability, improve quality and output, reduce costs by employing Model Predictive Control that acts as an 'autopilot' and sustains benefits over time.

At an Indian steel plant, the task was to maintain the outlet temperature at a desired setpoint. APC was implemented with dryer outlet temperature as the controlled variable and fuel flow as the manipulated variable. A model of dryer outlet temperature was developed based on plant data to include the fuel flow control valve and disturbance variables, such as feed rate. The model was used to predict the upcoming control performance, calculating setpoint corrections, which were then downloaded to Level-1 proportional–integral–derivative (PID) controllers. APC maintained the dryer temperature even with changes in feed rate and process delays, achieving a 10 percent reduction in the standard deviation of the temperature. The implementation of APC stabilized temperature conditions within the dryer, improving overall performance and productivity.

Across any of the digital solution areas, there is always the opportunity to make enhancements with industrial analytics, AI and machine learning (ML).

Cold rolling mills have opportunities to optimize their performance and profitability through continuous performance monitoring and real-time expert

insights. ABB's data analytics solution for cold rolling mills helps carry out benchmark analysis comparing productivity, quality and yield for golden coil and actual coil. It lets you find out which process steps (threading, reversing, unthreading, acceleration, deceleration, minimal speed, operation speed and slowdown) are having a negative impact on your productivity. You can investigate your thickness deviations including related sensors, actuators and control loops or find the root causes of your exit flatness quality issues. If you want to know the state of your mechanics, motors, drives, and automation platform or if you are simply unsure about which issues to prioritize in terms of potential performance improvement, our analytics engine specific to cold rolling will help you focus on the right goal, attain optimum rolling setpoints and achieve world class strip quality and uniformity at the highest rolling speeds.

For bar mill or wire rod mills with large amounts of plant and process data it is also not realistic to manually monitor all the important KPIs – due to a large number of data sources and process variables. Operators need more advanced tools to help them better understand the trends and inter-relations between the process parameters that cause faults and failures. ABB's data analytics solution for long product mills is increasingly used for this purpose, but success in digital depends on the availability of process expertise in both implementation, operation and maintenance of such tools. Combining data analytics, process-specific algorithms, real-time continuous monitoring and remote sup-

port from ABB experts allows our customers to access a much higher level of process insight, preventing cobbles and continuously improving yield, quality, productivity and margin.

• **Asset performance**
Asset performance is about increasing the uptime of the plant through asset monitoring and failure prediction, prolonging the life of an asset and achieving the best performance from it. Asset-intensive industries, including metals, have a focus on reducing maintenance costs.

One of Europe's largest steel producers CELSA Barcelona deployed ABB's asset condition monitoring solution. The application monitors the health of a variety of production assets, including automation, instrumentation, electrical, mechanical and process equipment. It has meant a complete overview of production assets' health, avoiding unnecessary maintenance and unplanned shutdowns, reducing exposure to hazardous areas and speeding up repairs. According to ARC Advisory Group, 18 percent of assets have age-related failure patterns, and 82 percent of asset failures happen at random intervals. Switching from time-based equipment inspections, without any sensors on assets, to checking equipment health status online, with real-time predictive notifications means faster decisions, easy root-cause analysis for quick failure detection, faster corrective actions thanks to the recommendations and continuous improvement culture.

The next generation of Asset Performance Management (APM) solutions will be enhanced by AI and ML. At ABB, this is underway with ABB Ability™

Genix APM suite. APM means different things to different people, who have varying degrees of difficulty to locate and analyze data across an organization. Some assets do not last their originally predicted design and service life. It is also common for assets to operate past their design life, and that might result in performance problems and safety risks. Genix APM, based on the industrial analytics and AI platform, helps you get the most from disparate data sources. It automates data integration, lets you identify previously hidden relationships, correlations with processes, analyze performance trends, make timely predictions and accurate asset life assessments. The business value from the holistic view and tighter control over assets is tailored to specific roles in your organization and enables cross-enterprise actions.

• **Sustainability and connected worker**
Alongside the recurring challenges of optimizing efficiency, maintaining throughput and quality control during high-volume production, metals producers must comply with strict environmental legislation aimed at reducing emissions. Iron ore reduction is where most carbon emissions come from in steelmaking. Transforming the ways to make steel depends on the energy sources available, but the world will continue to rely on iron ore until around 2100. The carbon challenge for the industry is to transition to alternative sources of energy and to optimize their use for iron ore reduction.

Digital energy management in steel industry returns short payback times and long-term benefits. It not only optimizes costs, throughput and quality, but also energy-related costs, raw material usage, carbon, greenhouse gases and waste emissions. It relies on decades of experience in the process industries, and steelmaking in particular, captured in predictive energy management algorithms.

ABB's energy management software is successfully used by a European steelmaker for site-wide optimization: managing energy purchase and production. It assists gas dispatching, calculates optimal power production based on real-time data and is adapted to power market. It also optimizes energy consumption and secures energy availability considering steam yield, consumption of by-product gases, energy purchase and production including site power plants and turbines. We helped this customer achieve 10 percent less flaring of gases thanks to data and optimiza-

tion model and 15 percent accuracy improvement of electricity procurement forecasts. 15k€ per month are saved on average every year.

Waste gas utilization in metals production can be greatly improved by monitoring generation and consumption across plant facilities. Data is collected from multiple systems to compare allocation with actual consumption, provide real-time demand and supply calculations, balancing, benchmark and optimal distribution as well as forecasts based on production plans and historical data modeling. Root cause analysis is also applied to the data whenever a gap occurs between supply and demand.

Complementing digital energy management systems with data contextualization and digital twins can further optimize energy consumption through load profiling and balancing, process parameters (such as air temperature at compressor intake). The latest possibilities from an enterprise-grade platform and suite of AI and ML tools will let you deploy and monitor advanced controllers, data analytics and optimization solutions at the edge, to and from an industrial cloud/multi-cloud or on-premise.

Safety, productivity, compliance and training of your workforce in these areas can also be more effective through software solutions, where knowledge retention is an issue for companies. The industry rarely has key experts in the same role for 25-30 years as was the case in the past, so there is an opportunity to retain and speed up knowledge transfer through simulators and technology advances from the augmented reality (AR) and virtual reality (VR) space. We are working on helping companies move towards an immersive workspace with mixed reality (XR) helping people master necessary skills more effectively and faster, establishing a foundation of consistency no matter the personnel.

• **Supply chain optimization**
Supply chain optimization goes along with planning and scheduling, with steelmakers looking for decision-making and end-to-end material tracking. A compelling example is ABB's Stockyard Management System, which enables real-time supervision, planning, automated reporting and simulation of bulk stockyards. It opens the door to fully automated and autonomous operation of material handling chain and stockyards. It gives users a high level of situational awareness showing utilization of material, available

quantities and qualities. It is also a formidable job scheduling, optimization, reporting and forecasting tool, and can include full-site automation for major handling machinery, increasing stockyard productivity by 5-10 percent.

ABB recently concluded a successful project for a German steelmaker seeking a quick digital solution for material batch planning and quarterly yard inventory validation. Thanks to the ABB solution including 3D stockpile visualization, quality allocation and automated inventory estimation modules, the customer gained a much higher degree of transparency, resulting in better blend quality, optimization of material sourcing and trading, and overall production planning. Capacity utilization got improved by stacking multiple ores in a single pile. Barge and train waiting time was reduced as yard planning and optimization became faster and more efficient.

Bringing it together
Digital transformation discussions will continue between the many process industries leaders, technology implementors and innovators. The increased complexity requires the ability to master very different technologies, industry-specific processes, cyber security and provide ongoing consultancy and assistance to end users. The reward for metals plant owners adopting digital solutions will be better performances at a reduced capital cost, overall standardization of operational, process, maintenance, environmental and supply chain management practices.

Today we are able to establish a single source of truth system for all information related to all the five solution areas. By combining perspectives between the shop-floor and top-floor, it directly contributes to strengthening your continuous improvement cycle. With energy cost, efficiency and environmental implications gaining top priority globally - particularly for heavy energy consumers - new digital tools are being developed at a much faster pace than ever before, in collaboration with customers, universities, and other ecosystem players. Let's join forces, co-develop and collaborate to set new standards for the metals industry!

Sources:

[1] *The future of metals and steel industry | ABB*

[2] *Digital transformation in the metals industry | ABB Ability*