DIGITAL TRANSFORMATION FORUM FOR THE STEEL INDUSTRY

17–20 MAY 2021
Omni William Penn Hotel • Pittsburgh, Pa., USA

UPCOMING EVENTS

Modern Electric Furnace Steelmaking Fundamentals – A Practical Training Seminar
24–28 May 2021
Nashville Marriott at Vanderbilt University
Nashville, Tenn., USA

Maintenance Solutions: Fundamentals and New Frontiers
21–23 September 2021
Embassy Suites San Antonio Riverwalk
San Antonio, Texas, USA

Specialty Alloy and Foundry – A Practical Training Seminar
21–23 September 2021
Sheraton Columbus Hotel at Capitol Square
Columbus, Ohio, USA

Secondary Steelmaking Refractories – A Practical Training Seminar
5–7 October 2021
The DoubleTree Colorado Springs
Colorado Springs, Colo., USA

Association for Iron & Steel Technology
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ABOUT THE PROGRAM

Digital transformation is a critical component for steel companies' future success. It is a broad concept with the potential to influence all aspects of the steelmaking process. Following the success of the inaugural Digital Transformation Forum focusing on an overview of and insight into different components of Industry 4.0, this year's Digital Transformation Forum dives into the specific topics of machine learning (ML) and artificial intelligence (AI). Machine learning and artificial intelligence technology is the heart of nearly every application of Industry 4.0. The 2021 Digital Transformation Forum covers ML/AI applications and use cases from liquid steel (iron- and steelmaking), upstream (casting and hot rolling) and downstream process, to final product. In addition, the Digital Transformation Forum will discuss the essential roles humans play in a successful digital transformation journey. Strategies and methods to efficiently manage the cultural change and human involvement are also explored through the high-quality presentations and panel discussion sessions.

WHO SHOULD ATTEND

Decision-makers and those with a technical background who are interested in learning more about how to make their areas smarter by utilizing digital transformation methods through system integration and ML algorithm deployment.

ATTENTION NON-MEMBERS

Non-member registration fees include membership in AIST through 31 December 2022. Membership is not automatic. A completed membership application must be returned to AIST.

Premier Sponsor: SMS group in partnership with noodle.ai

Event Sponsors: OnPoint, iba, fēro labs

REGISTRATION INCLUDES

In-person event registration includes reception Monday and Tuesday, breakfast and lunch Tuesday and Wednesday, breakfast Thursday and online access to presentations. Virtual event registration includes Zoom link to access live presentations and link to download conference materials.

HOTEL ACCOMMODATIONS

A block of rooms has been reserved at the Omni William Penn Hotel. Please call the hotel at +1.800.843.6664 by 23 April 2021 to secure the AIST discount rate of US$152 per night for single/double occupancy.

AIST MEMBERS	NON-MEMBERS
US$945	US$1,190

PROFESSIONAL DEVELOPMENT HOURS

This course may qualify for up to 15.5 Professional Development Hour (PDH) credits. Each attendee will receive a certificate listing the quantity of PDH credits earned for this course. This course is not approved for PDH credit in New York, Florida, North Carolina and Oklahoma.

ORGANIZED BY

AIST's Electrical Applications/Sensors Subcommittee and Digitalization Applications Technology Committees.

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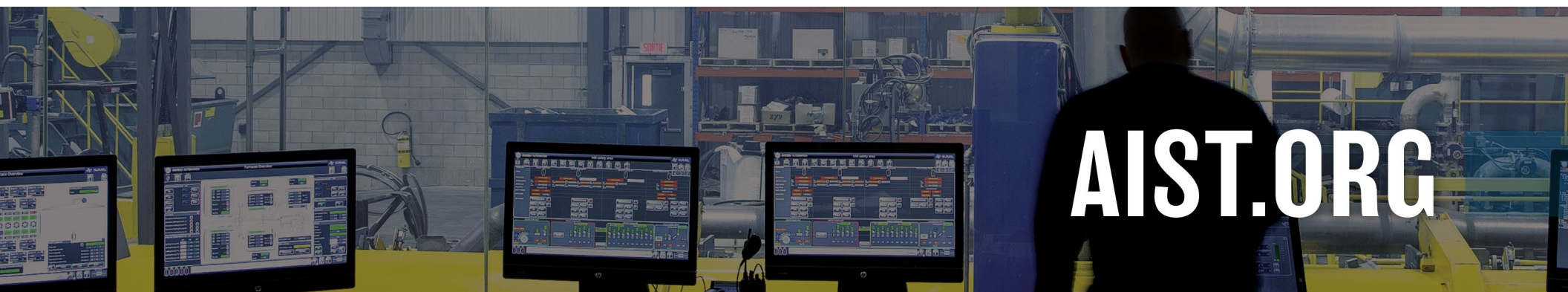
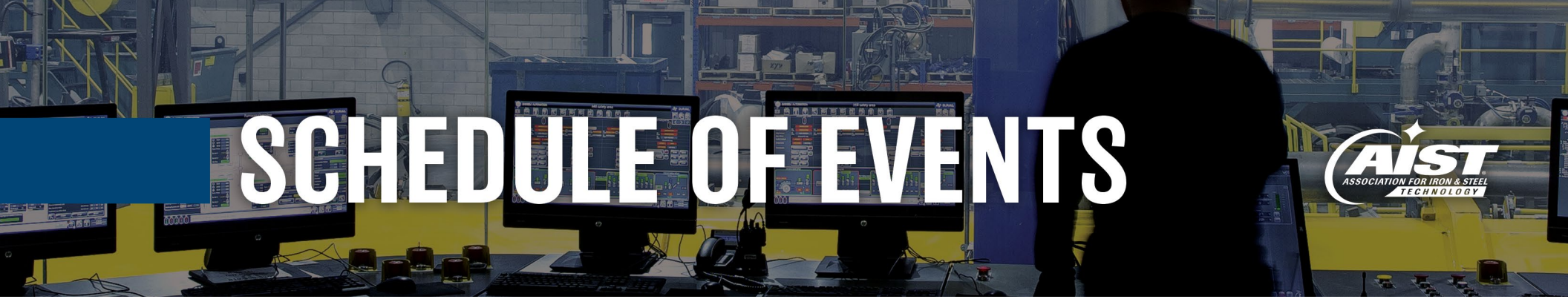




SCHEDULE OF EVENTS

All times are in Eastern Daylight Time (EDT) (GMT -04:00)

Monday, 17 May 2021

4–6 p.m.
Registration

5–6 p.m.
Welcome Reception

Tuesday, 18 May 2021

7 a.m.
Registration and Breakfast

8 a.m.
Opening Remarks
Michael Dudzic, ArcelorMittal Dofasco.

8:10 a.m.
Keynote Lecture: ArcelorMittal Global Approach to Digitalization
Carlos Alba, ArcelorMittal
ArcelorMittal's vision for digitalization is a fully digitalized enterprise where everything is connected. This includes manufacturing (and mining), procurement, commercial, supply chain, logistics, finance, strategy and product development. This presentation introduces the ArcelorMittal global approach to digitalization, mixing in-house developments with strategic partnerships both with giants and startups and showcasing specific success stories in several fields where digitalization really led to additional value not captured in the past with older technology and algorithms. The specific success stories are linked to both digital manufacturing and digital business as procurement or supply chain, among others. While it takes benefit of some very well-known solutions dealing with business processes, ArcelorMittal's scientific approach and knowledge interfaces on artificial intelligence, manufacturing processes, metallurgy, applications, etc., have led to the biggest added value for its customers and for the group.

9 a.m.
Smart Ladle: AI-Based Tool for Optimizing Casting Temperature
Chenn Zhou and Nicholas Walla, CIVS, Purdue University Northwest
The Smart Ladle is a machine-learning tool that uses current and historical process data to predict temperatures in the casting process. The ability to understand, quantify, and respond to the factors affecting steel casting temperature is crucial for achieving consistent casting quality and maximizing productivity and avoiding breakouts or other losses in productivity. Finding quantifiable relationships between the casting temperature and various other factors such as ladle history will improve understanding of the process and provide an ability to find adequate response to issues incurred in the plant. This project leverages the considerable resources, multi-disciplinary and multi-institutional connections, and accumulated research and support infrastructure of Purdue Northwest's Center for Innovation Through Visualization and Simulation (CIVS) and Steel Manufacturing Simulation & Visualization Consortium (SMSVC). Together they have a combined +13-year history of developing and applying advanced technology solutions to improve energy efficiency, production processes, equipment maintenance and reliability, safety, and product quality in the steel industry through research projects performed by students in direct collaboration with industry partners. Methodology and results will be presented, covering approaches to data collection and processing, deep learning network creation, and implementation.

9:40 a.m.
Break

9:55 a.m.
Toward Optimal Model Retraining in Steelmaking Process Estimation Using Machine-Learning Algorithms
Marco Luccini, Elena Uchiteleva and Vittorio Scipolo, Tenova Goodfellow Inc.
Predictive models trained on data collected by Industrial Internet of Things (IIoT) devices are extensively used for manufacturing process control, optimization and automation. In order to maintain the prediction quality, such models are often required to adapt to changes in the process behavior and learn new process characteristics when those appear. This presentation introduces a machine-learning model adaptation cycle applied to steelmaking processes in an EAF, as a part of the Industry 4.0 solution for remote plant monitoring. The model adaptation cycle aims at providing the best estimation of process values by adjusting to time variant conditions of the EAF process of interest. This contribution highlights the stages necessary to reach that objective, explaining which process indicators trigger the adaptation cycle, the necessary data exchange protocols and machine-learning steps to achieve an accurate and timely model retraining. The solution enables effective maintenance of real-time process prediction accuracy in changing IIoT environments.

10:35 a.m.
AI in Steel Ecosystem – Achieving Measured Scale for Digital Transformation
Pritam Pritu, IBM Corp.
The DiSE™ Model (Digital, Sustainability & Ecosystem) provides an approach to measure the impact of artificial intelligence (AI) aligned to business goals. Accurate and appropriate measurement is the key to valuable projections and hence building the business case for AI initiatives. This presentation covers standardization of metrics that are actually improved by digital interventions, measurements (calibration and aggregation) at the right granularity, benchmarking for innovation and improvement, and alignment with industry imperatives and business strategy. This model helps organizations scope, prioritize and evaluate each AI initiative, objectively taking the right steps in their digital journey. Some examples of digital applications in the steel industry will be given.

11:15 a.m.
Optimizing Heat Chemistry in Real Time Using Explainable Machine Learning
Berk Birand, Fero Labs
Changes to product chemistry boundaries are rare and are made only a few times a year. During the period between chemistry modifications, there are still opportunities to optimize chemistry limits within the boundaries for cost and product performance measures. This includes accounting for process and raw material costs fluctuations, which have a direct impact on operating margins. Machine learning (ML) software optimizes the alloy additions during the refining stage in the meltshop while including real-time process and cost changes in the simulation. Gerdau's engineers and operators have adopted this ML-centered workflow to ensure that the mechanical properties are met while the mills achieve the cost savings opportunities available. The ML software has been deployed to five Gerdau mills in real-time optimization mode. This presentation will discuss the steps taken to implement this new workflow and the share the savings achieved as a result of integrating into the chemistry optimization process.

12 p.m.
Lunch

1 p.m.
AI for Improvement of the LF Slag Conditioning Digital Model for Quality Prediction and Optimization
Nelson Enrique Sanchez Rodriguez, ECON Tech
The slag in the secondary metallurgy furnace plays a fundamental role in the cleaning of the molten steel, and it protects the steel from external agents during the refining of the chemical composition. ECON Tech has developed a predictive and optimization model, based on a machine learning (ML) + slag conditioning ladle furnace (LF) digital model as a solution of LF digital transformation, to predict the slag quality and then calculate and suggest the slag raw material additions adjustment to achieve the slag quality goals, improving the cleaning of the molten steel. The solution is an artificial intelligence (AI) + digital model based on four fundamental modules. The first module is an ML algorithm to calculate an initial approximation of raw materials additions based on the successful experience of slag conditioning operation. The second module calculates the proportion of oxides in the slag and its mass through the LF digital model. The third module is an optimization algorithm that modifies, if necessary, the raw materials additions proposed by the ML model, prioritizing compliance with the target chemical composition. Finally, the fourth module is an off-line DdPM tool where the process engineer can simulate the process to find opportunity areas and operational improvements. The AI/ML model provides higher prediction accuracy, reduces the variability of the final chemical composition of the slag and increasing the quality of the steel product, decreases decision-making time, decreases operational errors, and provides off-line DdPM tools to gain a better understanding of influencing factors.

1:40 p.m.
Machine-Learning Model Development for BOF Process Optimization With Respect to Dephosphorization
Kinnor Chattopadhyay, University of Toronto
Controlling endpoint phosphorus in basic oxygen furnace (BOF) steelmaking plays a significant role in enhancing the quality of liquid steel. With recent advances in machine-learning methods and improved computational capacities, data captured during dynamic physicochemical process in the BOF can be easily utilized to study the underlying mechanism of phosphorus removal. Herein, a principal component analysis (PCA)-based twin support vector machines (TWSVM) algorithm is proposed to predict categories of phosphorus partition based on slag chemistries, slag basicities, O_2 blowing time and tapping temperature. Data collected from approximately 15,000 heats from two steel plants on slag chemistries and tapping temperatures were assigned to four categories of l_p based on unsupervised K-means clustering method. An efficient decision tree-based twin support vector machines (TWSVM) algorithm was implemented for the purpose of classification of l_p categories. Highest accuracy (≥97%) was observed for GMM-TWSVM model implying that by manipulating the slag chemistries appropriately using the structure of the model, a greater degree of P-partition can be achieved in the BOF.

2:20 p.m.
Use of Machine Learning to Improve Surface Quality of Peritectic Steels
Andrew Doll, OnPoint, and Heitor Soldatti, Gerdau Special Steel North America
A machine-learning model that can accurately predict surface quality in several problematic grades has been developed at Gerdau. This presentation will discuss the results of a project intended to reduce surface quality defects on continuously casted billets with limited surface quality data. An overview of the project will be given from ideation to implementation, and discussion will include the method of applying machine learning to develop and maintain models, as well as tracking performance. The presentation will also focus on the decision-making process around model deployment options and monitoring as well as the results achieved.

3 p.m.
Break

3:15 p.m.
Automated Reduction of Surface Defects in Production of Ultralow-Carbon Grades for Automotive Exposed Applications Through AI
Falk-Florian Henrich, Smart Steel Technologies GmbH
For the first time in the industry, a data-driven approach based on artificial intelligence and machine learning fully automates the optimization of continuous casting operations and thus eliminates the root causes of surface defects. The result is a permanent reduction of surface defect rates by 50% and more without modification of the casting equipment. Ultralow-carbon (ULC) and interstitial-free (IF) steel grades for automotive exposed applications require highly accurate processing. In many cases, defects are detected only after galvanizing and downgrading takes place after high processing costs have been invested into the coil. Therefore, all quality data from hot rolling, pickling and galvanizing is mapped automatically onto the corresponding casting and meltshop data for each segment of cast strand. Proprietary ML models extract knowledge from historic production data and compute optimal configurations plus live recommendations for the caster and for relevant meltshop processes. Smart Steel Technologies' solution for continuous casting optimization leads to a substantial and permanent reduction of defect rates, downgrading rates and quality costs. At the same time, yield increases for high-quality grades and lead time is reduced.

3:55 p.m.
Producer Panel
Panelists:
- Carlos Alba, ArcelorMittal;
- Jena Kreuzer, Gerdau Long Steel North America Cartersville Mill;
- Yury Krotov, Steel Dynamics Inc. – Flat Roll Group Butler Division; and
- Sabyasachi Bandyopadhyay, Big River Steel

5:15 p.m.
Reception

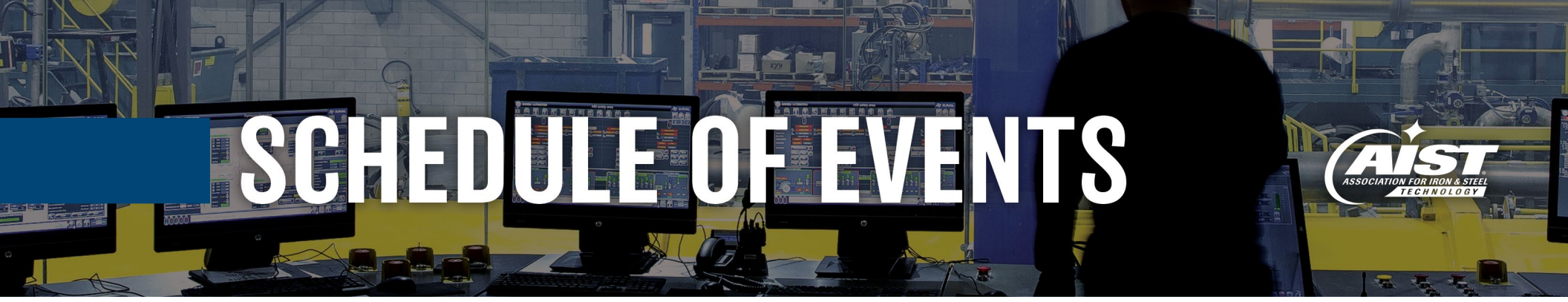
Wednesday, 19 May 2021

7 a.m.
Breakfast

8 a.m.
Keynote Lecture: Big River Steel Digitalization Journey
Sabyasachi Bandyopadhyay, Big River Steel
Big River Steel is a technology company that has transformed the conventional steelmaking process through its pioneering vision and cutting-edge technologies and equipment. The automation throughout the mill keeps our headcount low (approximately 5,000 tons to be produced per employee per year) and yield high with a best-in-class productivity for our employees. Also, Big River Steel is the world's first "Flex Mill" to produce niche products, especially in the energy sector and advanced high-strength steel (AHSS) through the utilization of technological prowess and capabilities. The company embraced the philosophy of not only putting thousands of sensors across the mill but also provisions for storing the data forever. Big River Steel has several initiatives on the horizon in the data science space that include energy optimization, product quality monitoring, supply chain management, metallics consumption and product mix selection. Big River Steel is at the forefront of the effort to provide steel consumers with "green steel" with an industry-leading carbon emissions factor of only 0.125.

8:50 a.m.
Democratizing Production-Ready Edge-Based AI Solutions for Frontline Steel SMEs
AJ Alexander, SORBOTICS, and Leonardo Rosa Lemos, Gerdau Long Steel North America
This presentation will showcase several edge-based artificial intelligence (AI) smart asset health and process control optimization use cases that span across rolling mill and reheating furnace. Key performance indicators achieved include reducing overall unplanned maintenance hours and a real-time reduction in total fuel/gas consumption. Gerdau will also touch on value-added implementation ownership lessons learned from deployed AI/ machine learning (ML) applications. There will be further takeaways on how to accurately calculate the true total cost of ownership for steel producers that seek to democratize AI/ML solutions internally and empower their frontline workers to become citizen data scientists without having to write complex code or acquire a Ph.D. in data science.

9:30 a.m.
How to Eliminate Missed Problems and False Alarms Using Machine Learning for Vibration Monitoring and Analysis
Brad Kintner and Borui Li, ITR, and Klaus Stohl, Primetals Technologies Austria GmbH
Vibration anomaly detection can already be considered as state of the art, but problem identification, determination of the required maintenance activity and estimation of the remaining lifetime are still often based on human expertise. This is true especially for the steel industry where continually changing operating conditions are common. This presentation discusses the use of both supervised and unsupervised machine learning methods to identify the root cause of potential failure modes. Using machine vibration data collected on-line and off-line for more than 35 years in hundreds of different plants, models were built and tuned to assure any detectable faults



SCHEDULE OF EVENTS

were detected and clearly identified. Knowing what is occurring in a timely manner and how severe it is enables operators and maintenance personnel to react in time with the right course of action. The presentation will explain why certain machine learning (ML) methods were preferred over others. Practical examples will show results from real applications applied in the steel industry. The outlook for future developments in this area will also be discussed.

10:10 a.m.
Break

10:30 a.m.
Predict to Prevent: Transforming Metal Production and Maximizing Revenue Creation With Operational AI
Nikunj Mehta and Crick Waters, Falkonry Inc.
This presentation will show how a major steelmaker uses data already being collected from thousands of sensors within their continuous casting and hot rolling mills to predict impending equipment issues before they cause production losses due to unscheduled downtime. In particular, the presentation will look at how they used operational artificial intelligence (AI) to empower their existing operations teams to increase annual production output. Use cases and outcomes in several areas of a continuous caster are explored, from segment rollers and pinch rollers to cooling tables. The presentation concludes with some lessons learned about integrating the operational AI solution to existing decision-making systems and about scaling operations to additional forming equipment.

11:10 a.m.
Building Data-Driven Predictive Maintenance Operations in a Steel Mill: Challenges and Lessons Learned
Hyungi Ahn, Noodle.ai
With rapid instrumentation and collection of heterogeneous data in manufacturing systems, machine-learning techniques can be leveraged to generate actionable insights at scale. This is valuable for performing predictive maintenance operations across multiple failure modes in asset-intensive steel manufacturing processes. Specifically, these insights include critical alerts to the maintenance teams with relevant sensor contributions that support interpretation of a particular failure mode. The alerts are augmented with corresponding predictions regarding the time to next breakdown, which serve as input to schedule maintenance operations. This talk will highlight the inherent complexities of building such an integrated system and will present real use cases that have been implemented and running live in a steel mill spanning across several subsystems in the continuous caster including segments, mold and turret.

11:55 a.m.
Lunch

1 p.m.
A Systematic Guideline of AI/ML Application in the Metal industry
Franck Adjogble, SMS group Inc.
The purpose of this presentation is to illustrate the process of pre-processing time series data in the production process, as well as summarize and extract favorable features and information. This framework will guide the metals manufacturing industry on successfully operating artificial intelligence/machine learning. In this context, the scope of the paper provides an explanatory example for product quality assessment such as mechanical properties variability. For asset health and reliability, it covers both dynamic data-driven forensics and failure prediction.

1:40 p.m.
AI Tools in the Steel Industry
Edgardo La Bruna, Janus Automation
In this presentation, the goal is to present some real cases where artificial intelligence (AI) has been successfully used to improve performance, quality or safety or a combination of them. The main sections of the presentation will be:

- Introduction to AI technologies and tools and a brief history of some key events and technology evolution to provide attendants with less knowledge.
- Real case application of machine learning applied to a hot rolling mill mechanical prediction system, presenting also the entire process, challenges and benefits.
- Real case application using AI for detecting, classification and alarming of environmental events for stacks in a steel mill.
- Brief descriptions of new areas and trends where AI is changing the steel industry.
- The presentation is supported by years of experience and work in the AI and digital transformation field, partnering with customers to get traction in real applications with real benefits to them, improving performance, operation, safety and costs.

2:20 p.m.
Understanding Advanced Analytics – Concepts and Potential Applications for the Steel Industry
Michael Tay, Rockwell Automation
Advanced analytics consists of predictive and prescriptive analytics — leveraging machine learning. Common applications include:

- Anomaly detection (e.g., blast furnace).
- Predictive maintenance (e.g., arc furnace electrode or refractory).
- Predictive key performance indicators (e.g., arc furnace tap temperature or reheat billet temperature).
- Model predictive control (e.g., furnace heat optimization).
- Utility optimization (e.g., integrated mill utility system management).

This session will dive into predictive maintenance, specifically how this application of advanced analytics can be combined with condition-based monitoring, machine-learning techniques, and smart sensing technology to enable asset performance management. The benefits include increased machine availability, reduced maintenance spend per ton products and reduced unplanned downtime.

3 p.m.
Break

3:15 p.m.
How a Steel Plant Successfully Launched and Scaled AI
John Devins, Canvass Analytics
The potential of artificial intelligence (AI) and machine learning (ML) is an exciting development for the steel industry. However, machine learning isn't the best solution for every challenge. In fact, it is estimated that by 2022, 85% of machine learning projects will fail, showing the need to have a clear understanding of ML and its suitability for your use case. Therefore, it's important to check five important criteria for selecting a use case to ensure a company starts its AI strategy on the right foot. Scaling AI across multiple processes brings new complexities that must be mitigated to achieve true automation. This session will introduce the key considerations and requirements to scaling an AI strategy, including how to connect the different sources of data; managing dozens of models concurrently; and monitoring AI for success. Learn how a North American steel plant successfully scaled its first AI implementation across four different parts of the plant as part of its AI journey toward automation.

3:55 p.m.
Digital Transformation Expert Panel

5:15 p.m.
Adjourn Conference

Thursday, 20 May 2021

7 a.m.
Breakfast

8 a.m.
Keynote Lecture

8:50 a.m.
Progress and Key Success Factors of Digital Transformation in Metals Industry
Thomas Pfatschbacher, Primetals Technologies Austria GmbH
Digital transformation is ongoing and will significantly change the steel industry. In recent years, widely accepted tools and strategies have been implemented to enable a "smart metals factory" and finally a more efficient and flexible "smart metals business." This presentation analyzes the most important key success factors that significantly contribute to the digital transformation of a "conventional" steel plant. All presented factors are underlined by selected examples in upstream and downstream, which show real-life "smart factory" case studies.

- Fully integrated robotic systems improve occupational safety and the quality of measurement under the severe operating conditions encountered in the iron and steel industry.
- Intelligent digital assistant solutions permanently monitor the health condition of a plant, process and evaluate alarms and warnings, and provide recommended corrective as well as compensational actions.
- On the single plant level, state-of-the-art automation is an important basis for the entire digitalization of the whole factory, and digital twins support operators and engineers in, e.g., simulating production scenarios as well as developing new steel grades.
- Data analytics solutions create business-relevant insights from structured validated information stored in a data warehouse as, e.g., property predictions.
- The data structure in steel industry is totally different to all B2C applications and different to other industries. Therefore, it is crucial to know what limitations must be considered to successfully implement data-driven methods (e.g., artificial intelligence, statistical methods) for the control and optimization of steel production.
- The entire production should be organized and operated "through-process," no matter if this is production, planning, maintenance or quality. No silos must survive, such that the through-process quality and efficiency of all included processes is maximized.
- To ensure the profitability of a steel plant, the "right" business decisions must be taken based on information and knowledge of the steel production. Connected (digital) services are a proper solution to significantly accelerate the availability of such insights and provide a platform to interconnect operational objectives with production data.

9:30 a.m.
Data Acquisition in Steelmaking – Where to Go With the Data?
Andreas Quick, Eric Snyder and David Kober, IBA America LLC
This presentation outlines a method of leveraging an open ecosystem for data acquisition and data analysis on an edge device. This approach provides consistent data to all stakeholders interested (maintenance, quality, production, technology, R&D, data scientists, etc.) in transforming an immense amount of data into useful and actionable information. The discussion will focus on a novel approach for on-line anomaly detection running autonomously on an edge device while simultaneously allowing for the export of key performance indicators as well as storage of raw data. This will be demonstrated by a real-world example from within the steel industry.

10:10 a.m.
Break

10:30 a.m.
Novel Use Cases of Augmented Reality in the Steel Industry
Philip Woodward, Danieli Taranis LLC
Many companies are rethinking how to provide commissioning and maintenance safely and effectively during the current global pandemic. With a reduced on-site team, engineers will often find themselves in situations that require a certain level of expertise. Using the latest wearables and back-end infrastructure, they can easily augment their reality with remote personnel. The technology enables the remote engineers to "drop in" to handle different mill circumstances. The presentation explores Microsoft and Android applications for augmented collaboration with compatible head-mounted displays. The presentation discusses the pros and cons of the back-end server hosted as on-premises versus cloud-based Software as a Service. Real use-cases will be presented for specific systems deployed, providing augmented reality applications to the global steel industry.

11:10 a.m.
Safe Digitization With Operational Resilience Management
Daniel Bren, OTORIO
By enabling supply chain providers to support inner processes and systems, organizations expand their attack surface beyond their perimeter. As a result, they are exposing their production floor to cyberattacks that originate deep in their supply chain. This thought-provoking session will present the opportunities and challenges that digitalization brings to the steel industry. Discussion will include an explanation of why the current digital and cybersecurity paradigms — that are based on securing data rather than physical safety and business continuity — fail to provide sufficient protection to the industry. Lastly, a new concept called Operational Resilience Management will be presented. This novel approach to digital and cybersecurity was designed and developed to preserve operational resilience and business continuity. It allows organizations to proactively bridge gaps in their security posture long before they turn into breaches. The presentation will provide useful insights and actionable suggestions, including real-life examples of how manufacturers can benefit from digitalization without compromising safety or security. Attendees will also learn how to achieve better and more accurate asset discovery and inventory management, prioritizing cybersecurity resources and actions based on the unique requirements of every site, and in full alignment with business objectives. While automating compliance processes, it is important to ensure that safety and regulatory compliance are maintained at their highest level at all times.

Noon
Wrap-Up and Conference Adjourn