Artificial Intelligence at ArcelorMittal Dofasco GP

McMaster Manufacturing Research Institute (MMRI)

2019 Manufacturing Forum and Industry Open House

Industry 4.0

Thursday, May 2, 2019
• Founded in 1912 as Dominion Steel Castings Co.
• Our focus is on Continuous Improvement with a target to be World Class

• Hamilton region’s largest private employer, with 5,000 non-unionized employees and supporting an additional 20,000 indirect jobs.
• 100 different steel grades and ~4.5 million tonnes of steel each year.

• 199,000 employees in 60 countries.
• Leader in all major global steel markets including automotive, construction, household appliances and packaging.
Evolution of Steel Manufacturing

Open Hearth Furnaces

Oxygen and Electric Furnaces

Poured Ingots

Continuous Slab Casting

Small Scale Rolling

Large Continuous Rolling Processes

The steelmaking industry is continuously evolving.
Steel Manufacturing: Large Scale & Highly Complex

Computational decision-making enables stable operations and continuous improvement.
Computational decision-making solutions have evolved as computing technology has evolved.
AI is part of a Digitalization / Industry 4.0 Strategy.
Two Machine Learning Project Examples, at AMD’s #2 Continuous Pickling and Cold Mill (#2CPCM)

#2 CPCM is an example of a large and complex manufacturing process, with many localized improvement opportunities that traditional analytical techniques have not been able to fully address.
Machine Learning Project: Weld Quality Prediction

A new Machine Learning function is being developed to determine the weld quality in real-time.

Project #1 - Weld Quality:
- Steel coils are laser-welded, end-to-end, allowing the pickling and rolling process to be continuous.
- Poor welds can cause ‘strip breaks’ and downtime.
- Manual weld inspection lowers productivity.
- The relationships between weld quality and measured data aren’t well understood, and it isn’t possible to directly measure the weld quality.
Project #2 – Rolling Forces: The rolling forces required for a new product type are hard to calculate prior to the new product type actually entering the rolling mill. This results in the lead end of the new product becoming ‘out-of-spec’ until the controllers stabilize forces.

A new Machine Learning function is being developed to improve the calculated forces.
AI Project: AMD’s Ladle Metallurgy Facility

- The LMF *refines the chemistry and temperature of liquid steel* that arrives in ladles from the BOF.
- After the LMF, the liquid steel is converted to slabs at the #1 Continuous Caster.
- *The quality of slabs is highly dependent on high quality steel from the LMF.*

**Project #3. Ladle Metallurgy Facility:** Digital transformation of an existing #1 Ladle Metallurgy Facility (LMF), to improve productivity and steel quality – proposed project for the Next Generation *Manufacturing* Supercluster.

New ML functions will be used at the LMF to address technical challenges that traditional automation techniques cannot address alone, e.g. steel quality prediction.
AI and other I4.0 Technologies in ArcelorMittal

• Machine Learning functions to predict the optimal time when production equipment should have maintenance work.

• Big data and advanced analytics functions to better understand steel markets.

• Big data and advanced analytics functions to assist in the negotiation of raw material pricing.

• Advanced algorithms to optimize scrap steel purchases.

• Blockchain to sell open transportation capacity, without an intermediary.

ArcelorMittal is expanding its use of AI and other I4.0 technologies.
There are many opportunities for AI and other I4.0 technologies in steel manufacturing.