Faster, smarter, smaller:

Digital technologies push new frontier for metals industry

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American Metal Market

At first glance, many parts of the metals, mining and manufacturing industry may not seem the most obvious candidates for digital technology-driven efficiency gains. For one, many of the manufacturing processes are generations old. Steelmakers have been using electric arc furnaces and Linz-Donawitz processes since shortly after World War II, while aluminium producers have been smelting the light metal using the Hall–Héroult process since its discovery late in the nineteenth century. And it is difficult to apply modern, industrial data-driven pricing methods to markets where one's own prices are not in one's own control, are commonly set on exchanges, and have themselves become speculative financial instruments for lightning fast algorithmic traders.

But advances in digital technology, and the falling prices thereof, are now offering miners and metal producers significant advantages when it comes to even the oldest production processes and the longest standing production challenges. More affordable and, crucially, smaller sensing equipment allows producers to retro-fit older equipment with the new sensing hardware, while more advanced software networks with total connectivity between various systems allows one to leverage existing automation and control systems to offer new ways of approaching asset lifecycle and maintenance, productivity, and energy optimisation.

Processing data and digitally monitoring production equipment are not new concepts to metals manufacturers, any more so than automation. But smart analytics is still a nascent industry, and being able to process all of that data for multiple variables and run it all through advanced analytic software almost instantaneously to provide floor operators with real-time visual representations is something that is only now becoming possible and affordable for many manufacturing companies operating on thin margins.

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"At a really high level, it's about sensors becoming affordable to allow pervasive sensing," Perry Zalevsky, senior director of industry at OSIsoft, said. "At the same time, networks and connectivity make it possible to relay data from sensors in real time to better monitor and optimise operations. Once the data is there, increased compute power is making more analytics available both at the edge and in the cloud."

Many are still reluctant to invest in that sphere where the return on investment is uncertain, but they won't be able to ignore it forever. Last year Accenture Strategy estimated, based on modelling it had done at several metal production facilities, that companies could expect to see 11-15% in efficiency improvements with the embrace of new digital technologies. Management consultants at McKinsey have estimated that EBITDA gains of 6-8% are available to metals producers that embrace digital technologies.

For a steel mill, there will be any number of processes that are monitored and data sets that are provided. Temperature, pressure, vibration, and many other things that will affect the lifecycle of an asset, the amount of product it turns out, and the amount of energy it uses. Traditional methods of managing a production asset do not take into account the small changes in such factors and therefore surrender efficiency.

In managing the maintenance strategy for a hot rolling mill, for example, a steelmaker might traditionally operate on a system that pulls an asset out of operation for maintenance work based on a regularly timed schedule. But a more efficient approach would be to determine when best to do so based on all the data available from those processes. To collect data from all available sources and determine when an asset is most likely

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to require maintenance. Condition-based maintenance like this, also called predictive maintenance, is hugely time-consuming when someone has to collate all manner of data spreadsheets to formulate sufficiently accurate models, but not so using modern analytical software. And modern sensing tech allows for ever more comprehensive data sets.

"Condition-based maintenance can improve the uptime by 5-10% depending on previous strategies," OSIsoft's Zalevsky said. "In a similar manner, the energy consumed can be monitored to, for example, find furnaces that might be using large amounts of heat but are not occupied. Again, with the data, one could look at the best way to run the equipment."

PwC has identified four levels of maturity in current predictive maintenance practices, and last year surveyed 280 manufacturing companies from Belgium, Germany and the Netherlands that were using some form of predictive maintenance. For companies that had reached the fourth and highest level, or predictive maintenance 4.0, where big data analytics starts to drive decision-making, it found cost reductions of up to 17%.

The data-driven approach can also help predict when an asset may experience equipment failure. Take a large, multinational aluminium producer with multiple facilities, all with numerous processes churning out digital reams of data that can now be centrally compiled and analysed. If one piece of equipment fails, the company can now see exactly what happened with each process that affects that asset. Now it can look out for that combination of data again in any of its assets, to hopefully recognise and anticipate any reoccurrence.

This could be crucial, as unplanned stoppages are hugely damaging to metals producers' balance sheets. US steelmaker Nucor saw its net income fall by 12.1% year-on-year in the third quarter of 2017, due in part to a series of unplanned stoppages blamed on equipment failures at its direct reduced iron (DRI) plant in St James, Louisiana. Nucor had to make repairs to the plant's process gas heater and its furnace.

Tellingly, Nucor ceo John Ferriola said at the time that the

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company would look to take lessons learned from its DRI facility in Trinidad, which has long been meeting quality targets is reaching world-class productivity levels as well. One of the tenets of advanced digital data analytics is not only to predict equipment failure ahead of time, but to more easily bring all of a company' assets and facilities up to its own best practice.

And in a time of increasingly stringent environmental policy such systems can not only better enable regulatory compliance but also massively simplify the otherwise arduous reporting process. Many production facilities have complex regulatory requirements requiring thousands of data points over multiple assets. Barrick Gold's Goldstrike mine in Nevada is one example, which holds a permit under title 5 of the clean air act in the USA that requires monthly compliance reports with input from over 140 systems monitoring coal and gas consumption,voltage, temperature and pressure, among other things over multiple time periods.

Such a task has until recently filled a full-time position managing masses of spreadsheets, but using modern, centralised data infrastructure the reports can now be compiled using a single database that makes all necessary calculations across an entire asset portfolio, and can be changed at any time by altering even one of the many inputs.

"We're able to enter all of the permit line items in one centralised location and use that to populate the rest of the model. We can change and grow with the permit," Felicia Douglas, environmental analyst at Barrick Gold, told delegates at a software conference in San Francisco last year.

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Being able to evaluate one's compliance in a moment also offers huge advantages in production facilities where assets commonly run at variable operational rates. When certain assets are running at full or limited capacity, that can change a company's compliance position if it alters things like power and raw material consumption. But a centralised data infrastructure can automate the whole process, providing on-the-go compliance alerts and populating monthly compliance reports.

"We needed a more efficient way to generate compliance reports, as the existing framework was complex, redundant and time-consuming," Douglas said. "The solution was to leverage the software to automate the reports and create a centralised database that stores advanced analytics and allows for decisions to be made faster and with more precision."

Other companies have also tasted the benefits of recent advances in both sensing hardware and analytical software. The production of tungsten concentrates at Wolf Minerals' Drakelands mine in the UK increased 22% in the fourth quarter of 2017 from the previous quarter, with the company attributing the improvement in part to higher run times due to new performance data analytics.

The metals companies included in PwC's survey last year said they plan to invest 4% of their annual revenue in digital operations tools over the next five years, with 62% of those surveyed saying that they expect to reach an advanced level of digitisation, potentially predictive maintenance 4.0, within the next five years.

Miners and metals manufacturers around the world are facing numerous challenges, from rising capital costs and regulatory burdens to community relations challenges and the spectre of international trade action, quite apart from all the difficulties associated with massive energy use and sustained volatility in prices. The digital revolution offers real scope to dramatically improve a production asset's performance without changes to the underlying production technology.

The future for metals mining and manufacturing is one of an interconnected data universe where automated machines talk to each other and respond to the slightest fluctuations to all manner of inputs, while companies are able to share and leverage highly analytical data with customers and suppliers in a vast digital community. And the journey to that future has begun.