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Using Advanced Analytics to Meet ESG goals

By: Mike McIntyre, Onto Innovation

With the continued advancement of environmental, social and governance goals, corporations are increasingly focused on reducing their carbon footprints. To accomplish this, these companies are being asked to operate their businesses more efficiently than ever before, whether the matter is reducing waste, water usage or power consumption. This is true for the semiconductor industry as well.

Although semiconductor manufacturing is not a smokestack industry, it is truly amazing just how many resources – from water to materials and electricity – goes into making chips. To better understand the carbon footprint and environmental impact a typical fab has, consider this: based on estimates in a 2021 article in *The Guardian*, a 1% improvement in a factory's production capability could save that factory 450 tons of waste, 37 million gallons of fresh wafer and 22.5 million kilowatt-hours of electricity over the course of a year. That small 1% change is a substantial reduction in resources used, one that not only makes operations managers happy but ESG-minded stockholders as well.

With that in mind, it should come as no surprise that facilities departments and factory managers at semiconductor fabs around the world are exploring multiple methods to reach their environmental social and corporate governance (ESG) goals. The good news here is that, thanks to the internet of things, factory engineers and managers have more real-time data available to them today than they could have imagined just three to five years ago.

Facilities data originate from all facets of the factory, including gasses and chemical management; power consumption; airborne, liquid and solid waste mediation; piping and ducting systems; airflow and more. A consequence of having all of this facilities management data at your fingertips: taking this deluge of information and making sense of it. Then using it to drive a more efficient manufacturing operation without impacting productivity. This challenge is very much like what has transpired with yield and process control for the last two decades.

Here's where it gets particularly interesting. We have found that semiconductor companies can leverage the same systems and methodologies they use for optimizing chip yield and process control to optimize their factories as a whole. In fact, many of the same techniques that are used for identifying chip performance issues can be applied to factory operations.

Just as in manufacturing analytics, the key to analyzing factory performance lies in the ability to organize and relate multiple and disparate data sources from across the factory. A critical first step is building an effective solution. This is something that some existing

software systems are already configured to align and accept. Once these data sources are aligned and related, engineers can produce information using their current box of analysis techniques and tools.

In our experience at Onto Innovation, we have seen how the overall ESG challenges of some facilities can be addressed through run-to-run/advanced process control, fault detection and classification, find relationships, yield mine and artificial intelligence solutions. The following are some examples of how enterprise software can be used to better enable factory operations to meet ESG goals:

- By using fault detection & classification software to monitor the power distribution system in a fab, changes in system performance or temperature, say of a critical breaker, could be flagged. More importantly, a signal could be issued to the manufacturing floor to halt operations in an impacted area ahead of a complete failure.

- An advanced AI model could be used to adjust, balance and otherwise optimize the exhaust systems for the factory based on real-time tool operational status. This could save considerable amounts of money in power consumption.

- With run-to-run systems being used in a feed-forward mode, the wastewater reclaim systems could be made aware of the materials that will be arriving and how they need to be treated in advance of their arrival.

Perhaps the biggest news concerning this new application of analytics software is that this optimization of modern semiconductor facilities does not detract from chip yield and performance while also allowing a company to better address its ESG goals. Today's software solutions are ready to meet many of these environmental challenges.

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Content as published on Semiconductor Engineering blog post, June 2023.

About the author
Mike McIntyre is a director of software product management at Onto Innovation.