NIPPON STEEL & SUMITOMO METAL CORPORATION

Analyzing Big Data from Steel Plants to Diagnose Subtle Signals from Equipment and Detect Hidden Signs of Failure Before it Occurs

From left: Manabu Inoue (Monozukuri Planning Development Manager, Technical Administration & Planning Div., NSSMC), Makoto Tanaka (Advisor, same department)

NIPPON STEEL & SUMITOMO METAL CORPORATION (NSSMC) was formed in 2012 with the merger of two of Japan's iron and steel industry leaders, Nippon Steel and Sumitomo Metal. NSSMC has the distinction of holding the largest market share in domestic steel sales, and has prevailed over fierce competition by drawing on its strengths in sales and site operation to meet customer needs globally. In 2015 the company brought in a new method to detect failures before they occur, which aims to drastically improve facilities maintenance at its steel plant. At the core of this method is an Intelligent Maintenance solution offered through a collaborative effort between Japan's ISID and US-based Predictronics.

Even Veterans Miss the Mark — The Difficulty of Predicting Failures

The temperature inside a blast furnace or converter reaches as high as 2,000°C, and casting and rolling equipment transport molten hot steel weighing several tons at high speeds. The production equipment at steel plants operates under extremely harsh conditions. Breakdown and failure is unavoidable given the demands placed on each component. These failures not only impact the production schedule and product cost, but also the business strategy of reliably providing high-quality steel to customers.

The job of facilities maintenance is to prevent failures before they happen and minimize the risk of production delays. Manabu Inoue, Monozukuri Planning Development Manager at NSSMC points out, "This is one of the most difficult jobs there is. Problems are a daily occurrence and breakdowns often occur at times you would never expect."

According to Mr. Inoue, who has been involved in facility design and maintenance as a professional for years, the most difficult part of the job is predicting when a failure might occur. He explains, "Failure is less likely to occur if you orderly produce just a single product using a single process, and even when they do occur in such cases, they are easy to predict. In the past few years, however, a diverse range of steel plates are being produced using several different processes. This makes it much more difficult to predict failure. It's very hard to ascertain what equipment is on the verge of breakdown."

Until now, veteran technicians with extensive experience were put in charge of predicting failure, and plants relied on their experience and intuition. But there are increasingly more situations that are not covered by past experience due to the diversification of production processes, making it progressively more difficult to make useful predictions. Mr. Inoue felt a heightened sense of crisis, he explains, "We needed new ways to detect degrading parts empirically and based on science."

Data Analysis is the Key to Science-Based Facilities Maintenance

The 'scientific method' describes a method to detect degrading parts in advance based on operational data acquired from the equipment itself. To do this, however, requires highly-specialized

Problems are solved all at once
by covering every possible analytic method.
This is totally different approach from previous methods.
Introducing these new techniques made me I feel like
I can finally see light at the end of the tunnel. — *Manabu Inoue*

expertise to process and analyze the massive amounts of data—an overwhelming task for plants to handle alone.
Just as Mr. Inoue was struggling with this dilemma, he happened to spot an article on Intelligent Maintenance solutions provided by ISID and Predictronics that use big data analysis to predict failure in products and equipment with high accuracy. US-based Predictronics Corp. is a venture company spun off from an industry-academic program ("IMS Center") of the National Science Foundation (US). The company has broad experience and expertise in data analysis methods for Intelligent Maintenance.
Mr. Inoue, who had also established a Monozukuri Planning Development Office to rebuild the operational capacity of plants, decided to attend a case-study presentation organized by the IMS Center to assess the expertise and effectiveness of Predictronics. The presentation gathered together researchers from several well-known U.S. universities such as the University of Cincinnati, University of Michigan, and University of Missouri, as well as maintenance technicians from renowned U.S. companies whose names included Bowing, GE, GM, Ford, and P&G. "I was surprised by the heated debates and passion of the people there," recalls Mr. Inoue, "They openly shared their ideas and know-how, and were driven by a common goal to improve the state of technology in this field."
He signed a contract with ISID immediately after returning to Japan, resolving to test out Intelligent Maintenance solutions at his former steel plant.

Immediately Detects Hidden Signs with More than Twice the Detection Results

Makoto Tanaka, an advisor who worked with Mr. Inoue on the problem of how to make production more reliable recalls, "It was an eye-opening experience. The detection process was like a doctor correctly guessing an illness just by putting a stethoscope on a patient's chest and asking a couple questions."
At the plant, ISID and Predictronics staff decided use vibration diagnosis, which is the conventionally used inspection method. They solved problems of noise and low signal strength associated with early stage degradation by combining a number of algorithms, including envelope analysis, cepstrum analysis and frequency band energy analysis. They also used a relative comparison method known as "peer-to-peer" to assess the overall condition of each part. These methods make it possible to detect hidden abnormalities and degradation. While conventional detection methods were only able to find four locations of degradation, this series of processes was able to discover an additional 10 locations.
Mr. Inoue was completely taken aback by the results. He notes, "It's hard to believe how much they could find just using data. Predictronics has a huge arsenal of analytical algorithms for identifying failure. These tools consistently figure out the best approach to take based on the data type or mechanism of the equipment being analyzed." He further praised the company, saying, "They offer a unique advantage over other vendors who provide packages with limited solutions. Problems are solved all at once by covering every possible analytic method. This is totally different approach from previous methods, and I feel like I can finally see light at the end of the tunnel."

The amount of data generated from equipment is overwhelming. ISID's Intelligent Maintenance solutions are powerful tools that are indispensable to keep from being overwhelmed by the deluge of data. — Makoto Tanaka

There is a growing interest in big data, not only in the steel industry, but at production floors across the manufacturing industry. Mr. Tanaka points out that whether data becomes a 'boon' or 'stumbling block' to companies depends on their ability to analyze it. He adds, "The amount of data generated from equipment is overwhelming. Well-developed analysis methods and processes are needed to keep from being overwhelmed by the deluge of data. ISID's Intelligent Maintenance solutions are powerful tools that are indispensable for dealing with these situations."
Mr. Inoue had this to say about the most recent results: "Intelligent Maintenance solutions augment the abilities of skilled technicians. Its diagnostics results free technicians from extra work so they can focus on the equipment that needs their attention. By taking advantage of science, these solutions let technicians draw more value from their human ability to perceive subtle changes in sound and vibration.

Production equipment at steel plants operate under harsh conditions

新日鐵住金株式会社
NIPPON STEEL & SUMITOMO METAL

Company Name: NIPPON STEEL & SUMITOMO METAL CORPORATION (NSSMC)
Head Office: 2-6-1 Marunouchi, Chiyoda-ku, Tokyo 100-8071, Japan
Established: April 1, 1950
Capital: 419.524 billion yen
Sales: 5,610.03 billion yen (year ended March 2015/consolidated)
Number of employees: 84,447 (as of March 31, 2015/consolidated)
Business: Steelmaking and steel fabrication / Engineering / Chemicals / New materials / System solutions
http://www.nssmc.com/

INFORMATION SERVICES INTERNATIONAL-DENTSU,LTD.
2-17-1, Konan, Minato-ku,Tokyo108-0075, Japan