

KOMATSU Ltd.

Analyze Big Data of Mining Equipment Detect Signs of Failures from Sensor Signal Aim the Maximum Efficiency of Mining Operations



Mr. Hisashi Asada (Director of ICT Solution Department Division, Business Innovation Department, KOMATSU)

KOMATSU is the top IoT leading company in Japanese industry. The brand of KOMATSU is established by distinct user service based on equipment operation data. KOMATSU has top market share in Japanese construction equipment, and, even in global market, KOMATSU keeps second position after US-based Caterpillar. This year, KOMATSU has gone into high gear on the diagnostics project in a long-term growth business of mining equipment. It realizes prediction of unexpected failures via equipment's sensor signals emitted in the field of mining. This is the solution provided by collaboration of ISID and US-based Predictrics, called Intelligent Maintenance.

But Failure Occurs — The Limit of Condition Monitoring

Copper mine spreads out in the highlands of South America, Chile. Surface of the mountain has been scraped off. 7 meters high, max. load capacity of 327 tons, such huge dump trucks incessantly run back and forth through the path. Most of these mines including the open-pit copper mines are open 365 days a year. Similar to a blast furnace and a chemical plant, mining is continued day and night. If a failure stopped equipment, the downtime shall directly affect to the business loss.

“The productivity is critically reduced if a huge dump truck is just stuck in the middle of the way” said Director Hisashi Asada, a

leader of Business Innovation Promotion Division at KOMATSU. He is responsible for the data science organization, and working to maximize efficiency of mining operation using sensor information from the equipment.

Mr. Asada explains “We provide not only regular maintenance, but we also provide condition monitoring to detect anomalies by machine's vital signs (health index) to reduce life cycle cost of mine construction equipment. For example, there is blow-by gas pressure in the diesel engine (pressure in the crank case), and this value rises if wear of the piston ring begins. We detect anomaly or degradation from that.”

However, Mr. Asada pointed out this approach is not perfect. “Vital sign health monitoring is only effective when you know a part is about to break and where the sensor signal is clear. Since mining equipment is used various ways in the field, there shall be many noises along the sensor data, so then it is difficult to acquire stable data. Unfortunately, not all the failure can be found from the vital sign. You can keep the vehicle healthy by

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increasing the number of regular inspections and cycle of maintenance. However if the dump truck frequently stopped to exchange parts, maintenance cost increases and productivity decreases. As the result, customers become unhappy. We've been looking for a new prescription to reduce the down time".

Data Mines Anomaly — The Advanced Data Science revealed its high potential.

While Mr. Asada was struggling to find a breakthrough to reduction of downtime within R&D at KOMATSU, he asked several IT vendors to examine benchmarking on each method in autumn 2015.

Mr. Asada recalled, "I felt improvement of downtime reduction by condition monitoring reached plateau. Although knowing its difficulty, I stepped into the world of predicting failure which required advanced data analysis".

KOMATSU asked the analysis and anomaly detection to different vendors by providing the past failure data, in which its source or background of values were masked.

"We wanted to see if statistical and mathematical approaches overcome the problem derived only by the solution with purely numerical values, rather than solving structural and equipment mechanisms." Mr. Asada expressed his honest intension.

ISID joined this benchmarking and analyzed using Intelligent Maintenance methods built upon Predictronics extensive past experiences. The Intelligent Maintenance analytic method is to analyze pleiotropically industrial big data collected from machines and equipment sensors. ISID and Predictronics performed to detect hidden anomalies and degradations in moving parts by using defined several parameters and original algorithms. Mr. Asada told, "Analysis of ISID exceeded other competitors in terms of data processing and detection accuracy as well as feasibility, but we were mostly impressed by their distinguished amount of experiences. Their report included some comparison of the past failed analysis results. These evidences showed their methods and techniques were developed by actual experiences. Failure is an option for technology achievements in R&D".

Based on this evaluation, KOMATSU began the validation project of Intelligent Maintenance with ISID at Chile mine on March 2016. Mr. Asada adds, "We opened masked information at benchmarking, and now we verifying validity and effectiveness of Intelligent Maintenance together. A delighted vision, which had never been seen, for future failure detection, which had never been achieved, has positively accepted by site workers".

"Data Driven" — The Key to Dantotsu Service on Era of IoT

"It takes some more time to see actual result." said with this preamble, Mr. Asada still suggests the benefit of applying predicting failure based on Intelligent Maintenance technique to



Our mission is to provide absolute No.1 Dantotsu service to our users in ahead of any other competitors, and to let customers recognize KOMATSU as essential. In such case, ISID is reliable.

KOMATSU business. "Construction and mining equipment business is not ended when products delivered to customers. It always comes along with services such as spare parts supplying, parts repairing, and operational improvements. Of course, competitors will attempt to enter here so it is necessary to differentiate from them. KOMATSU advantage is that we can expand data driven services in the world of ICT, and take actions based on data. This failure prediction technique becomes one of the tools."

KOMATSU is known its brand as IoT manufacturing company by selling data driven user service and solution such as "KOMTRAX," "KOMTRAX Plus", "Autonomous Haulage System", "smart construction", etc.

Mr. Asada recalls his feeling, "Glad to start together with ISID in the era of IoT. Our mission is to provide absolute No.1 Dantotsu service to our users in ahead of any other competitors, and to let customers recognize KOMATSU as essential. In such case, ISID is reliable. Their technology and wisdom based on their experience will prove their strength in such rapid competition."

KOMATSU

Corporate Profile (For Fiscal Year ended March 31, 2016)

Company Name: KOMATSU Ltd.

Head Office: 2-3-6, Akasaka, Minato-ku, Tokyo 107-8414, Japan

Established: May 13, 1921

Common Stock: Consolidated 67,870 million yen

Net Sales: Consolidated 1,854,964 million yen

Number of Employees: Consolidated 47,017

Main Businesses: Manufacture and sale of construction and mining equipment, utilities, forest machines and industrial machinery.

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