Mitsui Chemicals

NTT Communications
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Mitsui Chemicals, Inc.

Deep learning model predicts gas product quality and identifies quality anomalies in 20 minutes.

Service: Deep learning for time series analysis

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Mitsui Chemicals Inc.
"I was surprised by the highly advanced AI technology from NTT Communications, which I considered a network vendor. We anticipate further support from the company as we expand our business."

Challenges
- To compete globally, production plants required digital innovation
- A 15-year project to apply AI in manufacturing met many obstacles

Solutions
- Use 51 types of sensor data to predict chemical product quality
- Use AI deep learning to automatically process relevant data

Benefits
- Accurate gas concentration prediction (ave. +/-3% deviation)
- Identify faulty sensors that detect and predict plant and product conditions

Customer profile

Name: Mitsui Chemicals Inc.
Revenue: JPY 1,212.3 billion (as of March, 2017)
Business: The company delivers wide-ranging products in markets worldwide, including materials for mobility, ophthalmic lens materials, dental materials and nonwovens for healthcare services; packaging and agrochemicals for the increased production and safety of food products; phenols and polyolefins, and more. The company's portfolio has recently expanded to include new solutions for the energy, agricultural, medical, IoT and other sectors.
URL: https://www.mitsuichem.com/en/

Challenges
Applying AI after 15 years of preparation for revamping the production process

Since its establishment in 1912, Mitsui Chemicals has been developing and delivering various chemical products to meet society's needs. Current areas of business include automobile materials, ophthalmic lens materials, dental materials, nonwovens used in diapers for healthcare, packaging and agrochemicals that ensure the safety of food products, phenols and polyolefins, and more.

Hideki Matsuo from Mitsui Chemicals tells us, "Today's global manufacturers are rapidly innovating their production processes. We urgently needed to digitalize our production using Internet of Things (IoT) technologies and big data to effectively compete in the market."

The company set up a special team to enhance productivity by promoting the use of ICT in production. The most striking new processes use artificial intelligence (AI) technology.

Mr. Matsuo explains, "As our operators age, we need to standardize and share their know-how as 'implicit rules and knowledge' among our production team. It's much easier to hand down these assets to the younger staff through AI".

In fact, Mitsui Chemicals started testing elementary AI technology for neural networks (models based on the brain) over 15 years ago. The resulting system analyzed temperatures, pressures and flow rates in the plant via neural network with the goal of improving production processes and raising product quality. However, considerable labor was required to generate the instructional data that would serve as a model for the neural network. In addition, the need to revise prediction models for every change in the production process was an obstacle to applying the system in actual use.

Recent rapid advances in AI gave Mr. Matsuo hope that the company's deep learning technology, which helps AI learn and solve problems, could finally be implemented. "I assumed the application of recent AI technology could overcome our previous inability to apply our technology," Mr. Matsuo tells us. "Since the conditions for implementing ICT have greatly changed over the years, it was about time to take on the challenge of introducing AI in our production processes".

Solutions
Predict the quality of gas products with deep learning

Reliable solution partners are vital to implementing the latest technologies in business operations. After considering various vendors, Mitsui Chemicals chose NTT Communications (NTT Com) as its partner.
"We felt NTT Group's research organization and extensive expertise in corevo* AI technology offered us real advantages. It was also refreshing to see the company eager to enter our industry despite the relative lack of application of AI among chemical manufacturers. These were some of the reasons we decided to build the partnership," Mr. Matsuo informed us.

Figure: Quality prediction of gas products with deep learning
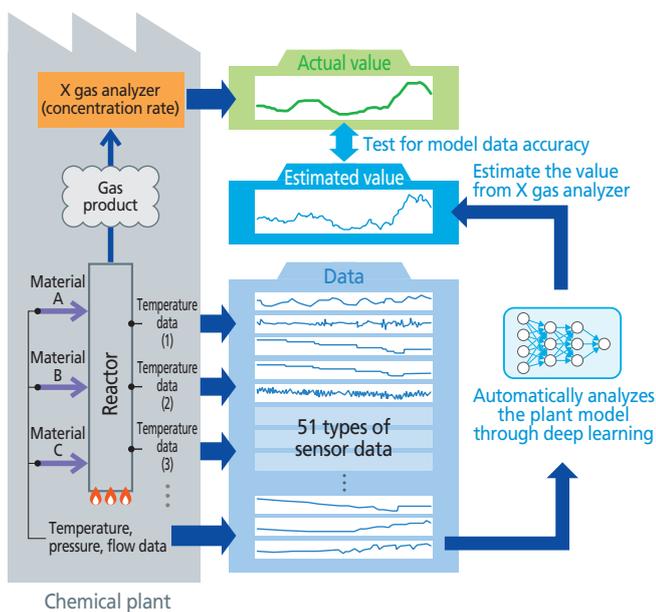
This system uses deep learning to create a model that accurately predicts gas product quality within approximately 20 minutes of receiving 51 types of sensor data.

As a test case, Mitsui Chemicals launched a project to utilize deep learning in the production of gas products. The goal was to predict the quality of chemical products based on sensor data from production processes, such as type of materials and reactor conditions.
"By examining the data for each process, we came to realize that experienced operators are often too busy making necessary adjustments to optimize the quality of the products. We are trying to give AI the know-how to standardize operations and product quality", says Mr. Matsuo.

Benefits
Highly accurate quality prediction (average +/-3% deviation from actual quality)

Mitsui Chemicals has conducted numerous tests since the launch of the project using various prediction models. The concentration of gas after 20 minutes can now be predicted with high accuracy (average +/-3% deviation from actual concentration).
Mitsui Chemicals provided NTT Com with 51 types of sensor data, including data on material temperature, pressure, flow rate, reactor set value and gas product concentration. The data was provided raw without any cleansing or explanation of manufacturing processes, so Mitsui Chemical personnel were quite amazed at the accuracy of the predicted quality.
"Of course, we were able to achieve this with support from NTT Com, which provided data management expertise. We could clearly see how much AI has advanced over the years. Since there is no longer a need to prepare data in advance, we can save operational costs and apply AI more widely. I'm counting on it." recounts Mr. Matsuo.
The company will continue to refine its prediction models with a view to applying the models in actual plant operations.
"We assume that such accurate predictions will enable us to extend our AI project to various other areas. For example, we hope to detect anomalies in sensors and measuring devices, as well as optimize maintenance schedules in the near future," shares Mr. Matsuo. Since malfunctions are extremely infrequent, the AI system will first have to become familiar with normal operation so it can detect deviations from the norm. This is another area in which NTT Com's support will play a vital role.
"We are aiming for next-generation facilities that harmonize relations between humans and machines. We need to implement the latest technologies and educate our process engineers on how to efficiently manage product data. Business proposals from NTT Com will be a major asset in coming years," Mr. Matsuo assures us.

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