IBM

Business challenge

KIST Europe aims to help Korean and European organizations cooperate on industrial research and innovation. Exploring the potential of harnessing AI for smarter manufacturing is a key focus area.

Transformation

KIST Europe worked with IBM on a project to demonstrate how smart factories can use machine learning to detect quality management issues automatically, without the need for expert human intervention.

Dr. Jongwoon Hwang,
Group Leader,
KIST Europe

Business benefits:

Saves weeks
of development by using pre-built models in IBM® Watson® Studio

5 minutes
to train each iteration of the model, delivering useful results quickly

98%
accuracy rate shows the value of machine learning for industrial use cases

KIST Europe
Making factories smarter by harnessing machine learning for quality management

KIST Europe was established in 1996 in Saarland, Germany, as the first overseas branch of the Korea Institute of Science and Technology (KIST). The organization's main objective is to contribute to the globalization of Korean research and innovation activities by building open innovation platforms with leading Korean and European research institutions and industry partners.

Marco Hüster,
Business Lead AI
Implementation,
KIST Europe

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Investing in Industrie 4.0

As data science and artificial intelligence (AI) move into the mainstream, the manufacturing sector needs to prepare for disruption. The adoption of AI could lead to a fundamental shift in business models, creating new relationships between manufacturers, suppliers and customers—and between humans and machines. This may pose a threat to traditional-minded businesses, but it also presents opportunities for innovators to seize competitive advantage.

KIST Europe works with prominent Korean and European research institutions and industry partners to explore these opportunities. One of its major branches of research focuses on the concept of "Industrie 4.0"—the technological evolution from centralized systems governed by human intelligence, to decentralized machines that can control, optimize and coordinate themselves independently.

Dr. Jongwoon Hwang, Group Leader at KIST Europe, explains: "In a manufacturing context, Industrie 4.0 means that the production-line machinery no longer just blindly processes the product; the product and the machinery communicate with each other to shape the process. There is less need to monitor and control everything centrally, because each part of the production line is intelligent enough to monitor its own performance and make decisions about how to handle problems."

To test and demonstrate the value of Industrie 4.0 principles for real-world manufacturing use cases, KIST Europe partners with SmartFactory^{KL}, an innovative manufacturing facility built with modular production and control components that can be composed in different configurations for different manufacturing tasks. IBM Watson IoT™ technology is used to integrate and instrument these components, allowing them to share data and communicate.

IBM technology also provides SmartFactoryKL with a "digital twin"—a complete digital replica of all its physical assets, processes and systems, which runs in the IBM Cloud™. The digital twin is used to capture data about every event that occurs in the factory, enabling constant monitoring and analysis via an intuitive dashboard.

Marco Hüster, Business Lead AI Implementation at KIST Europe, comments: "The technology behind SmartFactory^{KL} is impressive, but manufacturers are not interested in technology for its own sake. To prove the value of the Industrie 4.0 approach, we need to show how the factory can solve real-world manufacturing problems."

KIST Europe began working with IBM on a project to use AI to improve weight measurement, which is an important part of quality management in many industrial processes. Even the smallest deviation from the expected weight can indicate a fault in a component or product, or even a problem with the calibration of the production-line machinery.

However, reliable weight measurements are not always easy to achieve in a busy factory. High-precision industrial scales are extremely sensitive, and can be disturbed by vibrations from nearby activity. If a heavy forklift drives past the scales, for example, then the measurements taken at that time may be inaccurate. In a worst-case scenario, this could lead to faulty components passing the quality check—potentially resulting in product failures, customer dissatisfaction, and expensive warranty claims.

Dr. Hwang comments: "Imagine if your scales were smart enough to know when their own readings were inaccurate, and automatically decide whether to take a second measurement. We wanted to show how AI can make this possible."

"Watson Studio makes it easy to get an AI initiative into production quickly—it helps data scientists focus on solving business problems rather than writing code."

Marco Hüster, Business Lead AI Implementation, KIST Europe

Putting machine learning in the balance

IBM and KIST Europe built a solution that combined the existing SmartFactory^KL technology stack with cutting-edge data science solutions to apply machine learning to the weight measurement problem.

During everyday operations at the factory, data from high-precision scales and other equipment is converted into MQTT format, and transferred via IBM App Connect Enterprise to an IBM Cloudant® database. Cloudant acts as a "data historian", rapidly ingesting data from hundreds of sensors across the factory, and creating a complete historical record of events.

For this project, the team extracted relevant weight measurement data from Cloudant and loaded it into IBM Watson Studio®. Data scientists used SPSS® Modeler in Watson Studio to design a model that can assess the reliability of each measurement. They then used IBM Watson Machine Learning to train the model against a data set of over 1,000 real-world measurements, and then test it and deploy it into production.

"We used the CRISP-DM methodology to guide the model building process, and it was very successful," says Marco Hüster. "Each iteration of training the model only took three to five minutes, so we were able to improve the results quickly."

He adds: "Watson Studio gave us access to a wide range of machine learning models out-of-the-box. This enabled us to start analyzing the data immediately, instead of spending weeks implementing all the models ourselves."

The model can now predict whether a measurement is reliable with 98.1 percent accuracy, and KIST Europe is working on refining it further. For example, the team is now using the Jupyter Notebook within IBM Watson Studio to explore prototypes that use additive learning techniques to help the model continue to improve as the number of measurements increases.

Weighing the benefits

The success of the project is helping KIST Europe demonstrate the real-world benefits of an Industrie 4.0 approach to manufacturing—and ultimately advancing its mission to help Korean and European manufacturers maintain their competitive advantage as the industry continues to evolve.

Dr. Hwang comments: "Weight measurement is a very simple example, but it proves that integrating AI and smart factory technology can have a genuine impact on production-line efficiency and quality management."

For manufacturers who are interested in adopting such solutions in their own factories, KIST Europe believes that IBM technology offers a viable and cost-effective roadmap.

Marco Hüster says: "Watson Studio makes it easy to get an AI initiative into production quickly. The ability to design models by combining components in a graphical user interface helps data scientists focus on solving business problems rather than writing code."

By using AI to solve the weight measurement problem, manufacturers could gain much more accurate insight into whether a given product is sound or faulty. This would reduce the chance of mistakenly scrapping good products, saving money on production. More importantly, it would also reduce the risk of faulty products passing quality management checks and being released into the market.

Dr. Hwang says: "Modern manufacturing processes are already extremely good at minimizing defects, but manufacturers are always looking for ways to get better. For example, one of our partners has a goal of reducing their defect rate from 1.5 parts per million to 1.2 parts per million. It may seem like a tiny difference, but on an industrial scale, the impact on production costs, warranty claims and customer satisfaction can be significant."

He concludes: "With IBM's help, we are showing the industry how decentralized AI can help to deliver greater flexibility, optimize process management and predict the performance of production resources. As we continue to move towards a fourth industrial revolution, these capabilities will help pioneering manufacturers transform the industry and create new value for themselves and their customers."

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Dr. Jongwoon Hwang, Group Leader, KIST Europe

Solution components

- IBM® App Connect Enterprise
- IBM Cloudant®
- IBM Watson IoT™
- IBM Watson® Machine Learning
- IBM Watson Studio®

Take the next step

To learn more about IBM Cloud and IBM Watson technologies for data science and machine learning, please contact your IBM representative or IBM Business Partner, or visit ibm.com/cloud/watson-studio

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