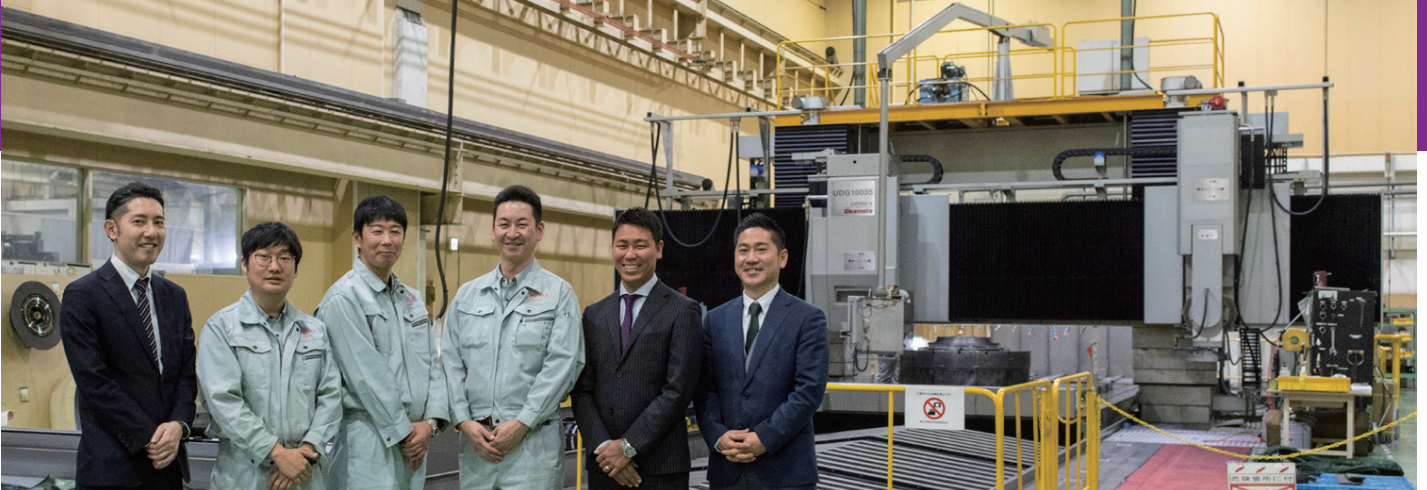


Grinding Machine for Everyone

Behind-the-scenes of how Okamoto Machine Tool Works is building a grinding machine that anyone can use to deliver high grinding accuracy by migrating the "brain" of skilled workers to AI.



Okamoto Machine Tool Works is a 90-year-old manufacturer of machine tools with the largest market share in the Japanese surface grinding machine market. Machine-based grinding is a field that requires highly-skilled workers. However, as more and more of such employees retire, there is a higher chance that the machines are used by less-experienced employees. Okamoto Machine Tool Works has joined hands with Macnica and Core Concept Technologies for a project that aims to build machine tools that are easier to operate and enable anyone to work with high precision. In this article, we asked several project members about their experiences.

THEMES

Assisting factories where experienced workers have retired

Quantifying the grinding knowhow of experienced workers and integrating it into machine tools.

Developing machine tools that achieve high processing accuracy with AI

Developing value-added machine tools that is easy-to-use and enable high processing accuracy.

A 90-year-old established manufacturer of grinding machines

Can you give us a brief overview of your company?

Nishigami: Okamoto Machine Tool Works is a company founded in 1926 under the name Okamoto Sennyō Kikai Seisakusho. After the Second World War, the company started manufacturing surface grinding machines, cylindrical grinding machines, and internal grinding machines for treating surfaces, cylinders, and inside diameters. We are currently the company that holds the number one market share, roughly 40% of the surface grinding machine market in Japan.

MAIN PHOTO

The interviewees in front of the largest grinding machine in Japan.

[From the left]

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KENICHIRO WAKISAKA

Sales Manager, IoT/AI Products
Core Concept Technologies Inc.

Yoshida: Due to our long, 90-year history, the biggest contributor to our number one market share are the assets realized by previous generations. I also think that our sincere dedication to our company policy "Innovative Technology" is a large factor in achieving the number one market share. Our mission is to review the feedback we receive from our customers about previous products, and deliver even better products to the world.

Grinding machine anyone can use with high accuracy

—— What was the reason for starting the current project?

Yoshida: Grinding is a field that requires specialist workers. However, nowadays we see many of these experienced workers leave the industry. We started our current project because we wanted to create a machine that is easier to operate and will allow anyone to produce high-quality results. The development concept was aimed at enabling both specialist workers and younger workers to work with the same level of precision. When using our machine, operators adjust various peripheral attributes, such as whetstones and grinding fluid. Our ultimate goal is to share this information, quantify the grinding knowhow, and use AI to help operate the machine.

When we first thought of introducing AI, we had no team that could do data analysis. We did have a team that could collect data, but we had no people to properly analyze it. So we decided to join forces with Macnica and Core Concept Technologies, who had the knowhow required for analysis, to implement AI technology into our grinding machine as the first step of our development.

—— What was the reason for choosing Macnica and Core Concept Technologies as partners?

Yoshida: A big reason was that there aren't many companies that specialize in both sensing technology and data analysis. After the arrival of IoT in the industry, the leading method was to collect and use vibration data, and we also received such proposals from other companies. However, we found Macnica to be the most advanced when it comes to a more comprehensive approach.

As for the proposals we received regarding AI, we found that Macnica listened to our specific wishes and could translate them into reality, which was appealing to us, while other companies often only suggested specific products or packages. I think that Macnica's strength is their willingness to listen to the issues we are dealing with, visit the factory floor, and come up with a proposal while truly understanding what we want to achieve. Another reason we chose them was the passion they showed in their sales activities. I strongly felt that they were very interested in our ideas. (Laughs)

Matsumoto: Macnica visits manufacturers all over the country to promote the smart factory concept, and so we have a thorough understanding of the manufacturing industry. Although it was the first time we dealt with the abrasive grain of grinding machines, by making the steady effort of visiting the field, collecting end users' feedback and reviewing research papers, we try to come up with proposals that is ready for productization.

COMPANY PROFILE

Okamoto Machine Tool Works, Ltd.
<http://www.okamoto.co.jp/>

"Innovative Technology"

Okamoto Machine Tool Works, Ltd. is a manufacturer of general abrasive machining equipment for machine tools and semiconductor-related equipment, and contributes to next-generation manufacturing by supporting the manufacture of highquality, high-precision products. Under their company policy "Innovative Technology", they accumulate new challenges everyday as they aim to be a one-of-a-kind machine tool manufacturer that can lead their customers one step further than what the customers are expecting.



Quantifying the cognitive process of skilled workers

— Can you describe the outline of the current project?

Yoshida: At Okamoto Machine Tool Works, we wanted to develop a grinding machine with which any worker, regardless of experience, could deliver high-precision results. To achieve that, we joined forces with Macnica and Core Concept Technologies, who could help us implement sensing technology and AI to analyze the current grinding process and map out any issues.

Matsuoka: The first thing we did was to capture the phenomena that are the issues of the current project. To do that, we inspected the structure of the machine, selected the required sensors, developed efficient data collection software, created dedicated jigs, and installed the sensors. We installed sensors at 30 locations. The reason we started with 30 locations was that we thought 30 would be large enough to cover the phenomena when we started out not knowing what areas caused an effect of what degree. We're very grateful for the help of Macnica, who cooperated with us on tedious work that is typical of the manufacturing industry, such as sensor installation and fine schedule adjustments.

Matsumoto: Of course, machine builders are doing manufacturing work of their own, so the time to freely use their machines for this project was limited. That's why we did all sorts of time-consuming tasks together, like spending our weekends installing sensors. Those are great memories. (Laughs)

— What can you tell us about the advantages of using AI technology?

Nishigami: First and foremost, this project allows our employees to get to know our machines better than before. That is a big advantage. What makes machines operate is a combination of three attributes: hardware, software, and people. When we can use the sensing and AI technology to sufficiently control the tasks normally done by people, that is when our final product comes into view. Quantifying the cognitive process that is happening inside the head of skilled workers. I think that if we can achieve that, we are on a level similar to self-driving cars.

Yoshida: To create an AI that can calculate how to make corrections according to the movements of a machine in real time, we are now in a stage of the development where we teach AI how the values change.

Kayata: The most important step is to understand physical phenomena by thoroughly analyzing collected data using methods such as simulations. After that, we use the expertise of Macnica and Core Concept Technologies to proceed with the construction of an AI model.

Wakisaka: Core Concept Technologies has long worked together with Macnica. As a partner, we help Macnica make proposals and provide technical support supplementing technical expertise.

WHY MACNICA ?

01

Sensing technology × AI

We have deep knowledge of both sensing technology and AI, and can provide comprehensive proposals.

02

Proposals based on deep understanding of the field

We visit the customer's factory floor, listen to the actual issues, and create an optimal proposal from the ground up.

03

Supporting partnership until productization

We are a reliable supporting partner that not only provides data analysis, but shares the same goal of applying the analysis result to the customer's business.

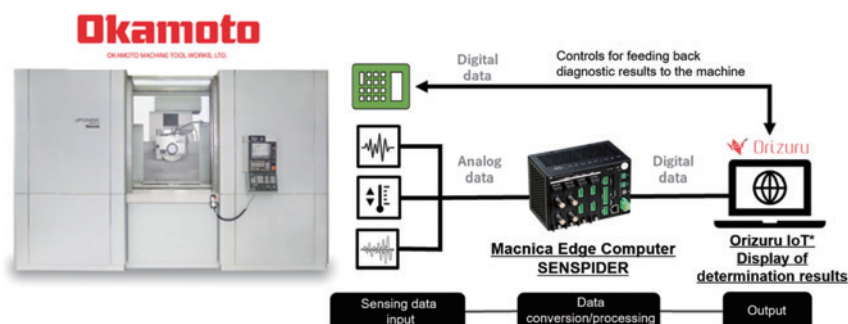


Figure: System configuration diagram



Imagining a machine that helps human development

—— What is the current status of the project?

Yoshida: We're currently using sensing to discover machine movements that we couldn't see before. Our ultimate goal is to have our machine deliver precision regardless of the way it's being used.

However, at a seminar organized by Macnica, I heard a university professor stress how we should "stimulate human development", and in some ways, I think we are doing the opposite. I do think that professor was correct. Even if our machine is usable by almost anyone, I believe we must never forget that people should be at the core of what we do. Therefore, I aim to keep the phrase "a machine that helps people develop" in mind as we continue developing our project.

I think that together with Macnica and Core Concept Technologies, we must think about what kind of product we want to bring to the market, as we consider the kind of business we want to develop for our customers in the future. This is what we always focus on during our conversations in which we exchange various opinions, so I think we are headed in the right direction.

Future challenges

—— Can you tell us about any future steps?

Yoshida: A tough new step involves operating mode compatibility. When our product is released to the market, it's going to be used in various ways, and in various operating modes. I think it will be crucial to see whether the AI model we created will be able to make the correct decisions in such situations. More immediate goals are the improvement of the model precision and the systematization of the controls for exhibition at JIMTOF 2020. After that, we plan to finalize the product.

—— What requests and expectations do you have for Macnica?

Yoshida: We would like Core Concept Technologies and Macnica to provide us with the technology that we lack. We should cooperate with them for that, and we should also work hard to make sure we can keep up with their expertise. I have to admit that our concept of what makes a grinding machine is pretty much fixed. We're hoping that Macnica and Core Concept Technologies will continue to complement our ideas with their innovative points of view.

POINTS

01 Introduction

- Shortage of grinding machine operators
- Introduction of AI to grinding machine
- Partner selection

02 Steps

- Selection and installation of 30 sensors
- Development of AI optimized for grinding machines

03 Current status

- Detection of previously undetectable machine movements
- Investigation of using developed technology for business

04 Future

- Evaluation of AI on a real factory floor
- Improvement of AI model precision
- Presentation of results at JIMTOF 2020