

# Facing the Game Change

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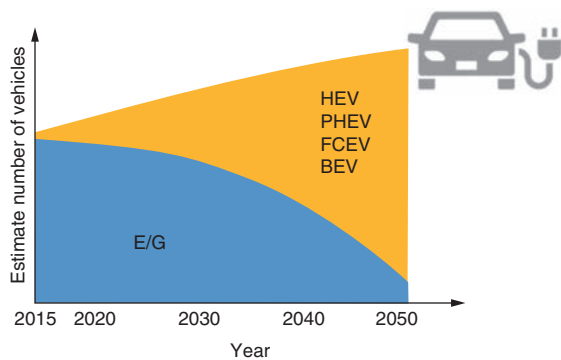
*From engine to motor, automobiles are being electrified are being promoted in the name of achieving a carbon-free society. Various game changes have begun in related industries. The machine tool industry is no exception, and we have promoted prior technology development and product development in efforts to find solutions, as well as begun reforming work styles. This paper covers some of these initiatives.*

**Key Words:** static pressure bearing, intelligent, DX, new normal, carbon neutral

## 1. Introduction

In the media such as newspapers, words such as SDGs, carbon neutral, decarbonized society, hydrogen society, power crisis, food & water crisis, and new normal have been taken up as major social issues.

In addition, the industrial world has been talking about declining working populations, electrification of automobiles, 5G, material innovation, etc., and is facing various issues (Fig. 1).



**Fig. 1** Being electrified of automobiles

The Machine Tools & Manufacturing Systems Business Unit is proceeding with technological and product development for new competitive axes, such as motors and batteries, from our base of conventional machine tools mainly for engines.

As a measure to avoid decreases in the productivity and reliability of manufacturing sites due to decreases in the general working population and that of skilled workers, we are proceeding with technological development for machines which can grasp a situation, analyze, judge, and act, all by itself, so-called "intelligence/autonomy."

Economic activity cannot be stopped even though the movement of people is restricted due to the COVID-19 pandemic. We have actively promoted meetings, presentations and machine inspection using the Web. By solving the problems that arose during these activities, IoE solutions have also evolved.

This report introduces some of the activities that have taken a step toward the new work styles that are being called the new normal, and our technology and product developments for new competitive axes such as electrification of automobiles.

## 2. Toward the Electrification of Automobiles

### 2.1 An Innovation Line That Unites All of the Resources of JTEKT Group

European and American automakers have been announcing BEVs one after another due to the increasing momentum to achieve carbon neutrality by switching from engines to motors. The transition of automobile power sources is now rushing ahead. The new competitive axis is shifting from engines to motors and drive system and battery performance. JTEKT group has various technologies that support production lines, not only machine tools, but also materials, tools, heat treatment, and measuring instruments. Based on these technologies, we will propose an integrated line for motor shaft and gear processing (Fig. 2).

By sharing various information from the front-end process to the back-end process and from the back-end process to the front-end process using IoE (Internet of Everything) solutions, we will also build efficient, highly accurate, and highly reliable manufacturing lines.

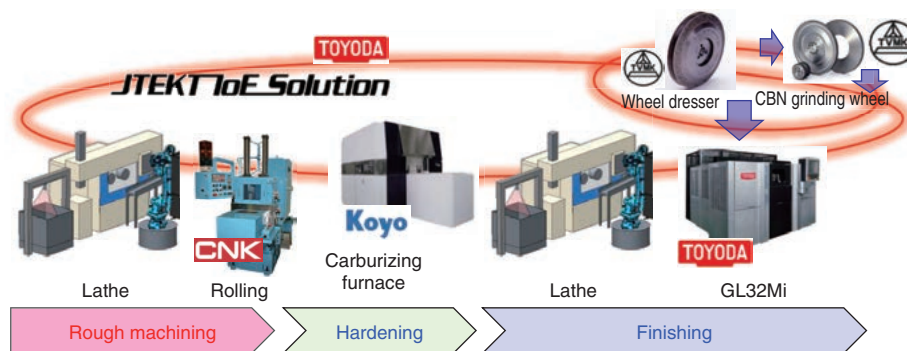


Fig. 2 Line builder

## 2. 2 Developing the High Accuracy Roll Grinder

With the electrification of automobiles and the advent of the 5G era, large rolls used in manufacturing machines for thin film, films for applications such as in-vehicle batteries and laminated capacitors, and for displays, required higher precision as products become more sophisticated.

By grasping these needs of this new era as an opportunity, we have developed the High Accuracy Roll Grinder GR7i by combining our high-precision processing technology cultivated over many years and the craftsmanship of our manufacturing technology.

The static pressure bearing technology developed in 1955 through a technical tie-up between Jeandle of France and our company has evolved to meet the needs of the so-called high-growth era. A major change in recent years was our development of technology to control the oil flow rate of static pressure bearings. Applying this technology for all moving devices such as the grinding wheel spindle and each feed slide, we developed a high-accuracy grinding machine with no metal contact and a processing accuracy of 0.5 μm in cylindricity.

In March of this year, we exhibited the GR7i at Grinding Technology Japan 2021, an in-person exhibition held at Makuhari Messe for the first time in a long time, attracting the attention of discerning customers (Fig. 3).

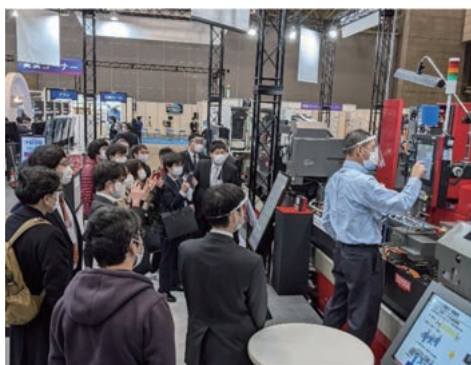


Fig. 3 Grinding Technology Japan 2021

## 3. Bringing the Wisdom of Skilled Workers to Everyone

### 3. 1 Intelligence/Autonomy

At the production site, productivity and quality are guaranteed by advanced adjusting technology such as processing, measurement, analysis, and correction (Fig. 4). Skilled workers familiar with the equipment and processing are indispensable, which makes generalization and sharing of production technology difficult. However, the situation changes if the equipment itself can be made to grasp the conditions, judge the situation, and take the best measures to guarantee productivity and quality. Aiming to create such a system, we are proceeding with technological development for autonomy of equipment and lines.

There are three elements of autonomy that we are working toward: situation recognition, autonomous judgment, and autonomous action (Fig. 5). The key of our strategy is to create autonomy that makes the best use of our technological advantages in areas such as jigs, tools, and machining. The knowledge and know-how of peripheral devices such as coolant tanks and hydraulic units that we possess in the JTEKT group can also be utilized.

The autonomy of our customers' equipment and manufacturing lines can be promoted through machining simulation technology, predictive analysis technology, and digital twin technology utilizing this knowledge. We will make production possible and help to improve the competitiveness of our customers by offering flexible solutions that do not rely on adjustments by skilled workers and that are not affected by fluctuations in quantity or type.

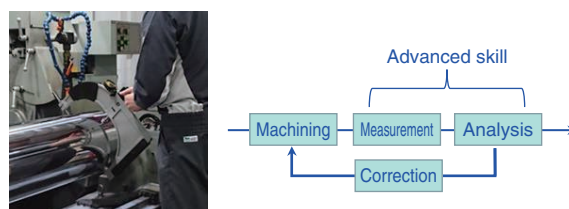


Fig. 4 Quality assurance by adjustment technology

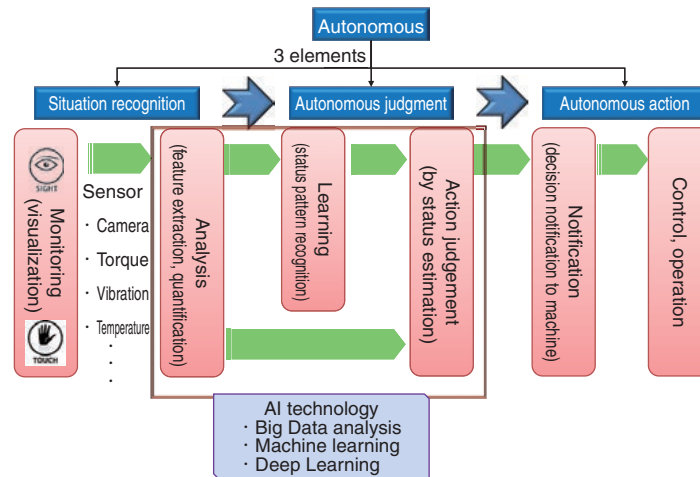


Fig. 5 3 elements of autonomy

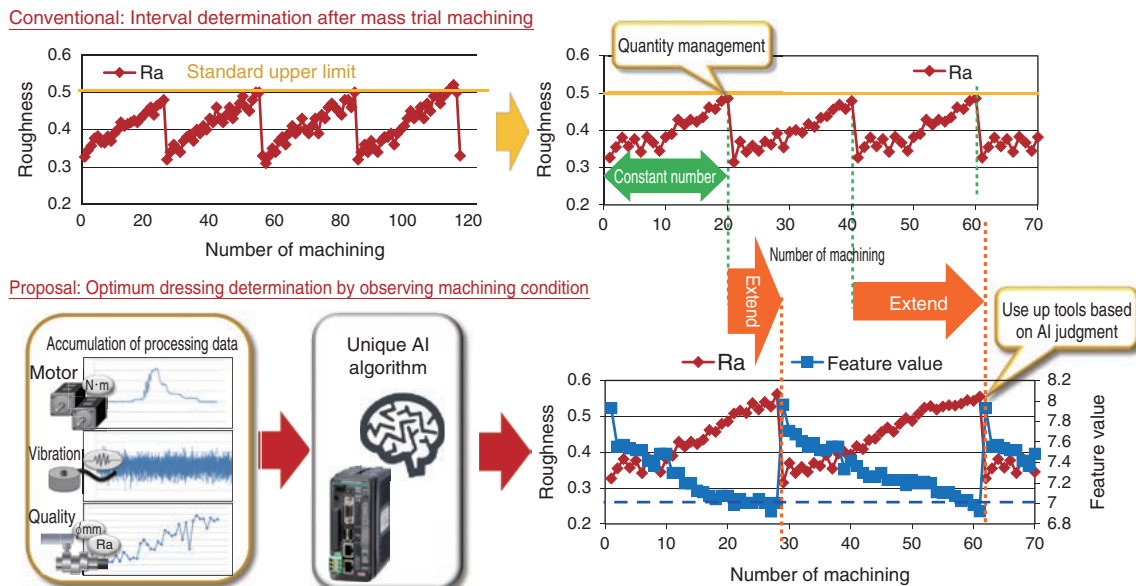


Fig. 6 Grinding wheel dressing condition by AI judgment

### 3. 2 Optimization of Machining Conditions

As an example, we will look at extending the life of the grinding wheel of a grinding machine using condition monitoring and predictive analysis technologies.

As grinding is carried out, the sharpness of the grinding wheel decreases. Accuracy will be poor if the process continues as is, so an operation called wheel dressing is performed to restore sharpness.

Normally, wheel dressing is performed at intervals of grinding a set number pieces as determined by test machining. In the case of Fig. 6 as an example, wheel dressing is performed after grinding 20 pieces.

This preset interval tends to be set shorter than strictly necessary to ensure that no defective products are produced.

We have developed logic that allows the equipment to autonomously determine the machining status and then

determine the timing of wheel dressing.

As a result, in the case of Fig. 6, the interval was extended to 30, or by 1.5 times, and tool costs could be reduced.

We will continue to evolve this technology with the aim of building machines that can keep track of cutting tools and machining conditions, ensure that their processes are carried out in the optimum state, and continue to produce good products.

## 4. New Normal

### 4. 1 Reform the Production Process

In Japan, the term IoT (Internet of Things) began to be used around 2016, but it was first used by Kevin Ashton of the Massachusetts Institute of Technology in 1991.

Recently, the term DX (Digital Transformation) has

taken its place, meaning not only everything is connected to the Internet, but also enhanced with AI, 5G, and cloud functions. The possibilities are expanding rapidly.

"How can we deliver products to our customers as quickly as possible?"

No answers have been revealed by our previous work style no matter how we stretched it. Face-to-face meetings with customers while looking at specifications written in paper, bringing back remaining issues, and having more meetings again later to bring internal meeting discussion results. A completely new business negotiation method that capitalizes on 3D and simulation technology to examine and verify in the virtual world will change this style of working. By inputting the specifications of the customer's workpieces, optimum tool shapes, jigs, and tooling are automatically designed, and the machining time and machining accuracy can be verified at once by machining simulation (Fig. 7).

With the gear skiving center, it is possible to carry out business negotiations with customers in this style. Application of this new style of working to other models such as grinding machines is in progress.

In many cases, face-to-face business negotiations with customers were difficult due to the COVID-19 pandemic,

and as a result, we were able to proceed with business negotiations using remote technology. It has become possible to conduct machine inspections remotely, and products such as RemoteTalk and ShareBoard that we developed for this new style of working have become useful, which was a great opportunity to introduce these products. This new working style is one part of what we call the New Normal.

### 4.2 Better Products with Digital Twins

Figure 8 is a model of the battery production line. AI connects material information to production equipment and finished products, contributing to production preparation and line operation.

It also helps improve the added value of the final product by optimizing the product conditions from quality and performance starting from production and materials through to the final product.

We will promote the development of AI, digital twins, and autonomous technologies while drafting this kind of ideal figure.

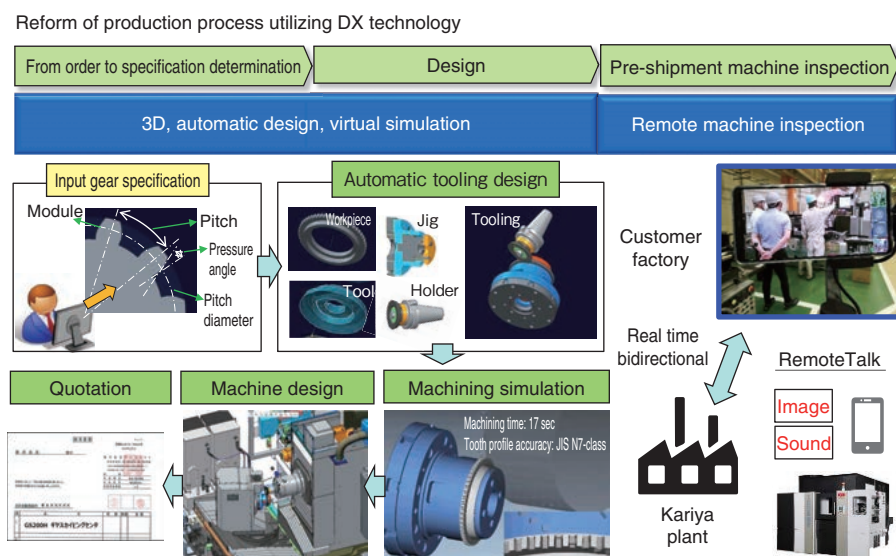


Fig. 7 Utilization of DX technology

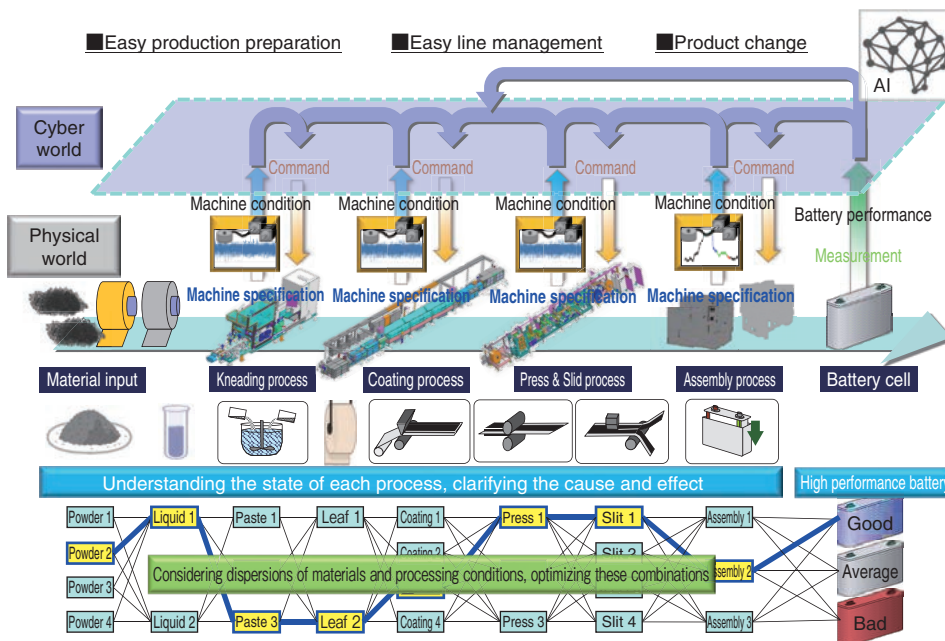


Fig. 8 Better products with connection via AI

### 5. Toward the Future

In the midst of this once-in-a-century revolutionary era in the automobile industry, it is difficult to predict the future. While we maintain the competitiveness of our existing products, we will also promote the development of prior art to expand the range of products and technologies we offer to continue to be a solid business even when a game change like this occurs.

Environmental problems such as global warming are serious and top priority issues for all of humanity. Toward the "realization of a carbon-neutral, carbon-free society in 2050" declared by the government last year, all companies have a responsibility to continue their economic activities and global environmental conservation, and to continue product development with the SDGs in mind. In particular, we expect that the energy-saving technologies and products cultivated in the development of Japan, which is poor in natural resources, can contribute to environmental conservation on a global scale across national borders, and so we will continue to work on further technological development in this field as well.

Through technological development and product development with an eye on the future, we will always take on the challenge of becoming a machine tool and system business that can be relied on as a valuable member of society.

### References

- 1) Kevin Ashton: That 'Internet of Things' Thing, RFID Journal, 22 June 2009 (2009).



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