

Report on visit to Bauma 2016

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1. Introduction

Bauma is a combination of the German words Bau (construction) and Maschinerie (machinery), and is one of the three largest construction machinery exhibitions in the world, along with Intermat (France) and Conexpo (USA). It is held in Munich every three years. The exhibition is switched every year among Bauma, Intermat, and Conexpo.

Development of automatic driving technology and various sensing technologies for construction machinery has progressed in recent years to save on man power. In particular, the technology called Information-Oriented Construction has been making construction work more effective and automated using GPS (global positioning system) and drones (unmanned aircraft). This technology is also studied by the automobile industry. So different industries share the technology. Also, we can see in Bauma numerous concrete mixer vehicles and related technologies of large companies throughout the world. We are from two departments: the Basic Technology R&D Center and the Special Purpose Vehicles Div. One of us from the former visited the site for three days and the other from the latter visited the site for two days. In this report, we introduce some trends in sensing technologies, concrete mixer vehicles, and related technologies in the global construction industry.

2. Exhibition site and overview of exhibition

Bauma is held in Messe Munich. About 40 international exhibitions are held every year in this site. More than 30,000 companies from more than 100 countries attend the exhibitions and more than two million people from more than 200 countries visit the site every year. The site was established in 1998, before which it was Riem International Airport. As we noticed afterwards, the airport was the one where a chartered plane used by England soccer team Manchester United crashed on February 6, 1958. This famous accident was called the “Munich air disaster” and 23 people including eight players died.

Although we have visited exhibitions held at Pacifico

Yokohama and Tokyo Big Sight, Messe Munich was unbelievably large; larger than the ones we have seen in Japan. The site size was almost equivalent to the distance between two subway stations.

It was much bigger than Tokyo Big Sight, one of the largest exhibitions sites in Japan (Table 1).

The outdoor exhibition space is about 47 times larger than Tokyo Big Sight and there were many large heavy machines and cranes exhibited. Since there were no tall buildings around the site, the outdoor exhibition space attracted our attention from a train approaching the site (Photo 1). It was more like a festival than a business site.

Table 1 Comparison of exhibition sites

	Tokyo Big Sight	Messe Munich	Area ratio
Total area	243,419 m ²	605,000 m ²	2.5
Indoor exhibition area	80,660 m ²	180,000 m ²	2.25
Number of exhibition halls	10 halls (total of west and east areas)	17 halls	—
Area of each hall	4,680–8,880 m ²	3,500–11,000 m ²	—
Outdoor exhibition area	About 9,000 m ²	425,000 m ²	47



Photo 1 Bauma view from train

Bauma was held on April 11 (Mon) to 17 (Sun) in 2016. A total of 3,423 companies from 58 countries participated in Bauma and about 0.58 million people from 200

countries visited it. One of the authors (Hasebe) visited the exhibition from April 11 to 13 and the other (Niijima) from April 14 to 15. Since visiting a large exhibition like Bauma was our first experience, we were not sure if we could see everything in two or three days. In fact, it took a whole day to look around the entire exhibition area and we needed to visit target booths in an efficient manner. In particular, there were many heavy vehicles in the outdoor exhibition area (Photo 2) and demonstrations of the vehicles were performed, which we often stopped at.



Photo 2 Large cranes and other heavy machines

There were large and small booths in the exhibition hall. We could see many parts including large parts such as excavators' buckets, cylinders, and crawlers, and small parts such as bolts, valves, and connectors. A construction machine manufacturer even used a whole hall for their exhibition. We could see their extraordinary interest in Bauma.

3. Trend of construction machinery sensing technology

There are many kinds of sensors such as an ordinary pressure sensor or a sensing system using a stroke sensor or camera. The sensing technologies that attracted our attention are introduced here.

3.1 Stroke sensing technology

The stroke of a cylinder is measured and the bucket position is estimated. There were various sensing methods such as a magnetic one and an optical one (Photo 3) (Table 2).

3.2 Circumference recognition technology

In addition to safe driving support functions of automobiles, many safety check devices using a millimeter wave radar or camera were displayed. In particular, there were many circumference monitoring camera systems, including a surroundings-view system with multiple cameras and object detection systems with monocular or stereo cameras. Currently, these technologies have been

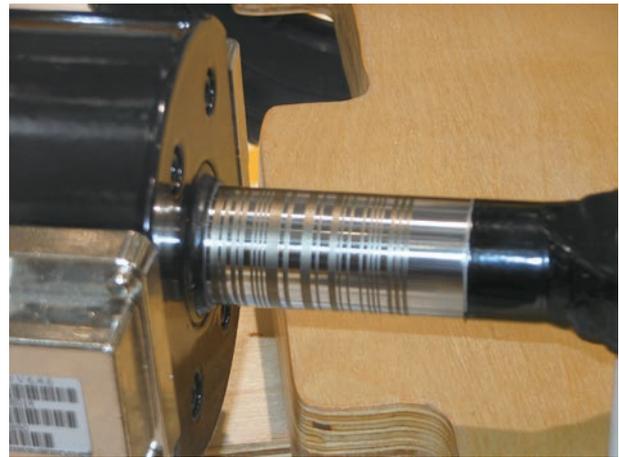


Photo 3 Optical stroke sensor

Table 2 Comparison of stroke sensor types

Type	Features
Magnetic pattern type	A magnetic sensor reads a pattern engraved on the rod to detect the position of a cylinder.
Magnetostriction type	Strain arises through the application of a magnetic field. This magnetostriction curve is used to detect the position of a cylinder.
Hall device type	A Hall device detects an electromotive force generated when a magnetic field is applied to an electric current. The Hall device and a magnet are used to detect the position of a cylinder.
Optical type (Photo 3)	The position of a cylinder is detected by applying a laser to the rod with a pattern engraved.
Wire type	A wire is attached at the tip of the cylinder head and the position of the cylinder is detected based on the extracted wire length.
Radio wave type	A radio wave is applied to the piston. The position of a cylinder is detected by measuring the time from when the radio wave is emitted to when the reflected wave is received.

actively developed in the automobile industry but are expected to also develop in the construction machine industry in future.

3.3 Surveying technology

We found some systems for measuring a work site using a camera-mounted drone (unmanned aircraft), which was getting very popular. One of them was a unique one that did not use a dedicated camera but a commercially available digital single-lens reflex camera (Photo 4).



Photo 4 Drone for measurement



Photo 5 Pump mixer vehicle

4. Trend of concrete mixer vehicles

On the visiting days of April 15 and 16, the weather changed repeatedly between being cold with heavy rain and being warm with a clear sky. Since Niijima had only two days, he decided to spend most of the time observing concrete mixer vehicles and related technologies.

In the outdoor exhibition booths, there were concrete mixer vehicles displayed by automobile companies and several large-sized world-leading manufacturers not only from Europe but also from other areas. Every company displayed vehicles that integrated a concrete mixer vehicle and a concrete pump vehicle^{Note 1)} (hereinafter referred to as a pump mixer vehicle: Photo 5). In Japan, a concrete mixer vehicle delivers fresh concrete to a concrete pump vehicle then a concrete pump vehicle places concrete throughout a construction site. So we do not find pump mixer vehicles in Japan. In addition to the pump mixer vehicles, there were many concrete mixer vehicles with belt conveyors (hereinafter referred to as conveyor mixer vehicles). According to staff from a manufacturer, there was a certain demand in Europe to save on manpower in narrow areas in cities or mountainous areas, and the market for pump mixer vehicles and conveyor mixer vehicles occupied about 10% of the entire concrete mixer vehicle market.

Actually, the urban area in Munich had many buildings of similar design, which was probably due to landscape control, and the roads were narrow and not always straight. The area was so complicated that we happened to walk into the backyard of a neighboring house of our hotel when we left the hotel (Photo 6). We have the same situation in cities in Japan, but those vehicles are not popular because of the severe vehicle weight standard. If the vehicles can meet the Japanese standard, there should be a high demand for the pump mixer vehicles and conveyor mixer vehicles against the background of a labor shortage in the construction industry.

In addition to the pump mixer vehicles and conveyor mixer vehicles, we also found electronically controlled concrete mixer vehicles displayed by various manufacturers. The operation of the vehicles was



Photo 6 Near hotel (in Munich)

simplified and the engine speed and drum rpm and direction could be controlled gradually by operating a lever on the backside of the vehicles. The conventional mechanical lever operation is being replaced with an electronic one.

On the other hand, the electronically controlled concrete mixer vehicle (hereinafter referred to as an e-mixer) that KYB began selling in October 2004 has a dial-type controller on the driver's compartment and the backside of the vehicle to continuously vary the rpm of the engine and drum. Also, the e-mixer's control is optimized to eliminate unnecessary energy loss by using a two-speed-step hydraulic motor to suppress the engine speed by half. Although we should not forget that the region dependence of the operation form is an important factor in the development, I honestly think that KYB leads the other companies in concrete mixer vehicle control technology.

Note 1) Vehicle that deposits fresh concrete delivered by a concrete mixer vehicle into a concrete formwork.

5. Trend of concrete mixer vehicle-related technology

In the exhibition site, we found not only the concrete mixer vehicles that we often saw in cities but also other vehicles. For example, there were integrated vehicles of a concrete mixer vehicle with a small wheel loader (hereinafter referred to as self-placement mixer vehicle). Also, there were vehicles with large material tanks that allowed production of the appropriate amount of concrete

at construction sites (hereinafter referred to as mobile batcher plants).

Self-placement mixer vehicles have a wheel-loader-like bucket and driving system and can measure and deposit, using the bucket, concrete materials into the mixer to make concrete. Ordinary concrete mixer vehicles mix an appropriate amount of concrete made at batcher plants (hereinafter referred to as plants) and transport it to construction sites. However, it is difficult to construct a plant or deliver concrete with a concrete mixer vehicle in a remote island or in a country with poor road conditions. Self-placement mixer vehicles would be useful in such areas. In Bauma, two Italian companies exhibited self-placement mixer vehicles. Their vehicles were almost the same size but used different methods to measure materials with a bucket. One of them attached a pressure sensor on a hydraulic cylinder that moved the bucket up and down and the weight of materials scooped by the bucket was displayed on an LCD in the driver's compartment. On the other hand, the other company did not use a pressure sensor but extended a hydraulic pipe to the driver's compartment and used a pressure gauge that had conversion tick marks between pressure and weight for analog display of the pressure. According to the company staff, analog-type operation was preferable from a viewpoint of after-sales service or training because the self-placement mixer vehicles were mostly for developing countries.

KYB manufactures mobile batcher plants, but the ones in the exhibition were of a different type. The mobile batcher plants of KYB are the so-called batch type where measurement, mixing, and discharging of materials are made in a single process. On the other hand, the exhibited vehicles are of a continuous type where the measurement, mixing, and discharging of materials are conducted in parallel. An advantage of the batch type is that the processing time can be controlled in each process step to maintain output at a constant level. A disadvantage of the

batch type is the small output. The continuous type can produce large amounts as all the processes run in parallel, but process control to respond to a change of material properties is difficult. Since the concept and way of using the vehicles change depending on regions, it would be very important to understand customers in future overseas development.

6. In Closing

My visit to Bauma was a precious experience, as I could understand the state-of-the-art construction machines that we could not have otherwise seen. I am an employee of a hydraulic products company, but I have no opportunity to directly see construction machines or hydraulic products in my everyday work. Therefore, I was inspired by seeing a variety of small product parts, including bolts, seals, and other small parts and extraordinarily large heavy machines. I had to use English to communicate with exhibitors. Sometimes I could get information without any problems and sometimes I had a hard time understanding when I asked a question. I thought that I would need to improve my English ability for the next visit as I would like to participate in exhibitions like Bauma. (Basic Technology R&D Center: Hasebe)

In the two-day visit to Bauma, I could see products from various manufacturers and have a profitable time. I was overwhelmed by the large scale of the exhibition and the excitement of the exhibitors. As I looked at various exhibition booths, I felt that every company had a clear target. I thought that we would need more effort to understand customers' thoughts and culture and clarify targets in future overseas development. (Special Purpose Vehicles Div: NIIJIMA)

Lastly, the authors would like to thank those who provided us with the opportunity for this precious experience.

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