

## **Construction Business, Electrification**

Q1: I understand that there are four problems that Komatsu is working on to electrify construction equipment. How are you planning to solve each of them?

A1: Compared to automobiles, our development of solutions for all four challenges will be very tough because construction and mining equipment are used under very demanding conditions.

- 1) With respect to machine performance, while we will not engage in in-house development of battery cells to meet lowering energy density, we are going to develop battery modules, packages, and management systems in-house to a certain degree, manufacture optimal ones, and mount them on our equipment. Concerning the charging cycle of our mining equipment, we will need to extend to over 10,000 cycles, whereas automobiles require about 3,000 cycles. We will have to install batteries capable of meeting such a cycle, as we proceed to discuss with our suppliers.
- 2) In the area of durability, we have accumulated technological expertise against severe vibrations. We believe we can handle this problem by innovating the ways to install fuel cells or batteries.
- 3) Concerning environmental performance, we will design our machines to meet required quality and reliability. With respect to mining, our customers use a lot of chemical substances. Accordingly, it's very important to include our suppliers and customers in developing innovative ways to filter them.
- 4) In terms of costs, we must decide which areas of the machine we will design and make strategic and steady efforts to reduce production costs. We expect the costs will double or triple those of conventional machines, so it's important for us to develop the ways to curtail them.

Construction and mining equipment are used for a long time, so we should be able to help our customers reduce their costs often along the machine lifecycle. We want to offer value through which our customers will feel our machines are cost effective in light of their lifecycle even though initial investment is expensive.

Q2: Will electrification efforts lead to your superior competitive edge in the future?

A2: When we develop components of electric equipment, we will always keep efficiency and compactness in mind. We also believe we need to design, develop, and manufacture components based on the approach called "integration of machines and electrification" which anticipates digitalized machine control. Furthermore, we will build virtual sensors to create and apply digital twins. As we are equipped with design data, bench test data, production data, and machine operating data, we will develop our business by utilizing these data. Thanks to this superiority, we believe it's virtually impossible for any unexpected newcomer, who might have technologies either to manufacture or to electrify construction equipment. to catch up with us.

Q3: What power source are you planning for 20-ton or larger construction equipment?

A3: In light of efficiency and other requirements, we are thinking about batteries for hydraulic excavator models smaller than 20-ton, and fuel cells for 20-ton and larger models mainly in light of fuel efficiency. These will be our basic roadmaps. However, depending on product types, for example, bulldozers, we believe internal combustion is better than other power sources. The use of fuel cells requires getting clean oxygen from the air. As bulldozers characteristically generate a massive amount of dust while in operation, it's very difficult technologically to apply fuel cells to them. They also vibrate very much. In this regard, we believe hydrogen engines will be appropriate for them.

For our large dump trucks, we are developing power-agnostic models. We believe the power source will be changed according to customers' jobsite infrastructure, environmental restrictions, and the like, as represented by hydrogen in regions where the power generation environment is established for renewable energies, as well as trolleys and batteries in other regions. By making reference to hydrogen, unlike automobiles, we will face surmounting tasks of developing mobile hydrogen stations for construction equipment. By taking this aspect into consideration, we must think about using hydrogen.

Q4: Can you expect to increase your market shares, as electrification progresses for construction equipment? You develop components in-house and have hybrid technologies. Will you be able to demonstrate your strengths of components in tandem with electrification? What kind of technologies do you lack for electrification?

A4: In terms of components, we have designed and manufactured all kinds of electric motors in the course of 13 years since launching our first hybrid hydraulic excavator. Having accumulated in-house technological know-how, we have also developed original power-storage systems. In the United States, KMC incorporates the SR electric drive into mining wheel loaders. As we have our own manufacturing and design technologies for large electric motors, we believe we have some degree of advantage and electrification offers good business chances for us. As we look ahead, we believe it's important for us to contribute to creating customer value in our processes business, which combines electrification and automation. Nevertheless, electrified models are inevitably more expensive than conventional ones. So, in addition to delivering value to customers along the product lifecycle, we are also considering offering additional customer value in automation by using digital technologies and further promoting efficiency. We are ready to go forward in this direction.

Q5: Concerning medium-sized and small hybrid hydraulic and mini electric excavators, please tell us about their machine population and market sizes.

A5: When we launched hybrid models in Japan and China, we found many issues then, and have not increased their machine population as much as conventional models. However, we

believe the current trend for carbon neutrality will work for our hybrid models. We also offer 30-ton models in our hybrid hydraulic excavator line-up, which account for over 40% of our total unit sales of 30-ton excavators in Europe. The sales volume of our 30-ton excavators is growing, increasing our market share in Europe. Sales of hybrid models is helping increase our market share, rather than replacing conventional models. We believe 40-ton hybrid models are worthy of trying.

We have had a hard time with 20-ton hybrid hydraulic excavators. The 20-ton class is highly volatile in competitive pricing, especially in Asia, largely because of high initial costs. Concerning 30-ton and 40-ton models, customers strongly expect production efficiency from them. In terms of work volume against the purchase prices and CO2 reduction, we are enjoying very positive customer evaluations, especially in Europe. We are also getting ready to launch 30-ton hybrid models in Asia. With regard to mini electric excavators, we have just launched them and are working hard to develop succeeding models for full-scale commercialization in order to increase our market share.

Q6: What are Komatsu's strategies to launch electrified models of over 20 tons, in relation to regulations?

A6: We need to organize recycling/reuse of batteries. How to manage them is critically important, especially in Europe, where they are traded across the border. To develop new schemes, we are having discussions with different organizations and companies. Besides electrification, we are working on fuel cells, but the regulations concerning hydrogen in fuel cells are relatively stringent. The concerned industries therefore need to engage in joint discussions concerning the establishment and clarification of industrial rules and supply channels, while consulting with the concerned authorities.

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