Mining Machinery Business

In 1979, Hitachi Construction Machinery launched the world's largest ultra-large hydraulic excavator for mining, the UH50 (sold as the UH801 outside Japan), in North America and entered the mining market in earnest. Since then, our hydraulic excavators and dump trucks have earned high praise from customers for their excellent durability and ease of maintenance, and they continue to be a preferred choice for mining sites around the world.

Enhancing Our Development System for Technologies and Solutions Solving Mining Site Issues

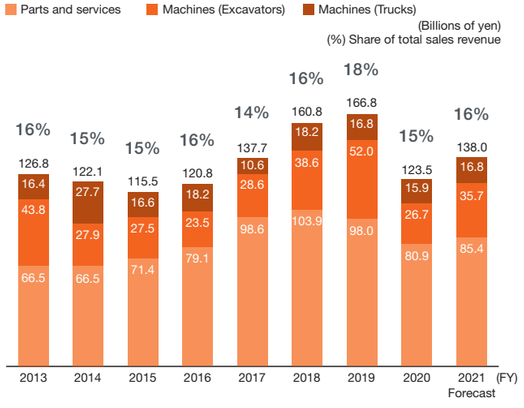
The Hitachi Construction Machinery Group has successively developed and provided a number of elements contributing to the resolution of issues at mining sites, such as skilled labor shortages and safety improvement. These solutions include our Fleet Management System (FMS) for mining operation management and our Advanced Vehicle Stabilization Controls Technologies. We have also taken action to strengthen our solutions business structure, such as bringing US-based machinery and equipment services solutions provider H-E Parts into the Group in 2016, and acquiring Australia-based major manufacturer of cast parts manufacturer Bradken into the Group in 2017. In addition, our ConSite® Mine service, beginning a full-scale rollout in 2021, features a Load Index function that utilizes AI and stress analysis technology to predict cracks in excavator booms and arms. By visualizing the operator's operations, this system helps improve safety and productivity, as well as contributing to the reduction of life-cycle costs. We have utilized Proof of Concept in Australia, Zambia, and Indonesia to conduct a detailed analysis of user needs, reflecting these in our UX/UI*1 improvements.

Much of the world's mining remains energy-intensive, with the challenges to reduce CO_2 emission. Hitachi Construction Machinery has reached an agreement with major Swiss heavy electrical equipment company ABB, establishing collaboration with the aim of achieving net zero emission from mining machinery. ABB has strong capabilities in electrification, automation, and digital technologies for mining machinery. Going forward, our goal is to improve the efficiency and scalability of mining sites through a fusion of solutions from both companies, contributing to the realization of a sustainable society.

*1 UX/UI: User Experience/User Interface

Illustration of the ConSite® Mine dashboard (management screen). Users can check detailed information on excavators via a web browser or tablet device.

Mining Sales Revenue



Focus on Australia

Autonomous Operation, Remote Operation, Decarbonization: Australia's Mining Sites Serve as Near-future Model

Australia is the world's largest coal exporter and boasts ample mineral resources. Its coal and natural gas industries are key parts of its economy, accounting for about a quarter of total exports. It is also rich in hard rock (metal minerals) like iron ore, copper, and nickel, and steel companies are actively working to introduce technologies and automation in order to improve productivity and safety on-site.

In 2009, Hitachi Construction Machinery began research into an Autonomous Haulage System (AHS) for dump trucks used in mining. In FY2020, we delivered six unmanned autonomous rigid dump trucks to the Maules Creek Mine operated by coal giant Whitehaven in FY2020, launching 24-hour autonomous operation. Large-scale mining sites have a wide variety of both manned and unmanned vehicles, requiring stable control of wireless communications in managing operations. Hitachi Construction Machinery's AHS is managed by our FMS, and is scalable to control up to 100 vehicles.

Unmanned rigid dump trucks operating in Australia

Leveraging Collaboration with Australian Startups to Accelerate Self-Driving Development

Beginning in FY2021, we are also launching Proof of Concept for autonomous ultra-large hydraulic excavators. We began by developing an ultra-large hydraulic excavator remote operation system to improve operators' work environments and to ensure safety. Furthermore, in order to ensure the same level of operability as if an operator were in the machine itself, we incorporate the operator support system to provide functions like avoiding collisions with other mining machinery. Next, we will develop a system automating some of the machinery's operation, such as excavation and loading, enabling a single remote operator to operate multiple excavators. Through these steps, we aim to develop autonomous ultra-large hydraulic excavators. Eventually, our goal is to attain high levels of both safety and productivity by exchanging information between ultra-large hydraulic excavators, dump trucks, and other machinery operating on-site.

In order to strengthen technologies for solutions targeting mining operation, Hitachi Construction Machinery has invested in Baraja, an Australian startup offering LiDAR*2 technology, which is essential for advanced autonomous driving. Our plan is to use this to further accelerate development for evolving our AHS and greater autonomous function for ultra-large hydraulic excavators.

*2 LiDAR: Light Detection and Ranging. A technology that irradiates an object with laser light, captures the reflected light with a sensor, and detects the shape of and distance to the object.

Stakeholder's Voices

Our Quality Gives Confidence, Even at Harsh Mining Sites

The Roy Hill Mine in Australia's Pilbara region is one of the world's largest iron ore mines. We have 24 EH5000AC-3 (rigid dump truck) from Hitachi Construction Machinery in operation at our site. EH5000AC-3 is an ideal match for the scale of our business, including matching with EX8000-6 ultra-large hydraulic excavator. And EH5000AC-3 provides us with various advantages. Hitachi Construction Machinery dump trucks run in harsh environments. The fact that they have passed Japan's rigorous performance tests gives us confidence.

Ian Wallace
Head of Mining, Roy Hill

Construction Business

Since the 1990s, Hitachi Construction Machinery has shifted its overseas business, which was previously focused on exports, to a local production, sales, and service model, and has expanded its business around the world. Fiscal 2020 overseas sales for the Group will account for 75% of total sales, and in order that we can provide customers worldwide with various options other than for new machines, we are entering the rental business in major developed countries as well as expanding sales of certified used equipment worldwide.

Global Deployment of Value Chains and Digital Solutions

The fiscal 2020 impact of COVID-19 on markets led to a decrease in new machines sales. Rental machines, however, saw heightened demand even during the pandemic, and so the Group started to expand its rental construction equipment business in India and Russia, in addition to North America, Europe, China, and Australia. We will work to differentiate ourselves in the market by maximizing our advantages in providing high-quality rentals of construction equipment through the use of ConSite® and other products. In addition, as a response to growing demand for used equipment especially in emerging countries, we have systemized the distribution and expansion of sales of certified used machines under warranty as PREMIUM USED, for which we can control quality in-house. In the medium to long term, we aim to establish a high-quality used machine business so that we can provide customers around the world with used machines and services that suit local needs.

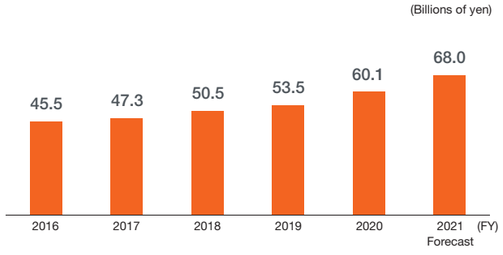
We will also accelerate technical innovation in response to the on-site challenges of advanced markets including ICT construction equipment incorporating autonomous driving and remote control functionality which is seeing increased demand in Europe and other areas. We will also work using open innovation in order to develop next-generation construction equipment including the usage of fuel cells and hydrogen engines as a way to contribute to carbon neutrality.

Hitachi Construction Machinery
PREMIUM USED

PREMIUM USED certified used machines under warranty

After meeting our own inspection and maintenance standards, used machines under warranty are sold with a power train warranty.

Trends in Rental Business Sales Revenue



No. of Used Machines Auctions

Approx. **4,000** (FY2020 results)

Focus on China

Aiming to be a High-quality Presence in the Chinese Construction Market

The COVID-19 pandemic has resulted in China's economy being in turmoil, however the government's strict quarantine policy was successful, and since March 2020 the economy has been recovering rapidly. The increase in infrastructure construction means the demand for construction equipment has rebounded, and the pronouncement by the National People's Congress that it will aim for 6% growth in GDP in 2021 has further spurred activity.

To ride this wave of demand, Hitachi Construction Machinery launched three new specialized models of earth-moving equipment for the Chinese market in the fall of 2020—the ZX60C-5A, ZX120-5A, and ZX195-5A. Many local manufacturers have entered the Chinese market and are driving price competition. We are at a disadvantage as regards price here given that we are a foreign manufacturer, but the operability and durability of our products are highly regarded.

ZX120-5A excavator for civil construction use for the Chinese market

Accelerating Development of Products That Meet Customer Needs, Such as Electric Construction Machinery

In recent years, demands for infrastructure development such as for cities and farmland has seen an increase in numbers of private chartered construction contractors working on an hourly basis. These three models of excavators were developed based upon a new product strategy from the Marketing Strategy Group established by Hitachi Construction Machinery in April 2019. They are the result of a swift response to ever-changing customer needs and the business environment. The ZX60C-5A in particular has been well received because of both the change in body shape from its predecessor the ZX55, and its reduced pricing. Sales of the ZX120-5A and ZX195-5A have also exceeded initial targets.

China has announced a policy of making all cars eco-friendly by 2035, and there is accelerated development of EVs with replaceable batteries, and of charging stations. Such an environment also requires that construction equipment be eco-friendly, and so local Chinese manufacturers are leveraging electrification technologies used in cars and buses in developing hydraulic excavators and wheel loaders, and have begun introduction of these on a trial basis. Foreign manufacturers have also focused development efforts on commercializing electric small and medium-sized equipment, and in areas in which the environment is of concern such as indoor work, tunnel construction, and ports, demand for this is expected to grow.

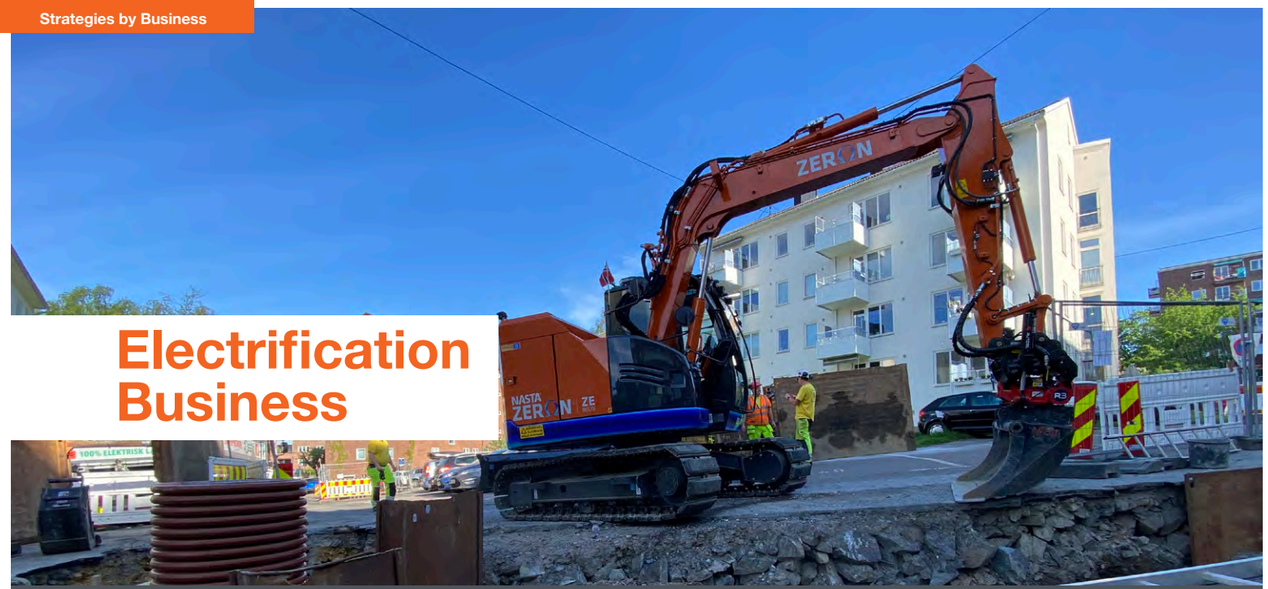
The Group aims to gain a foothold in the global market by accelerating development of electric construction machinery.

Stakeholder's Voices

High Overall Opinion of the ZX120-5A

We have been working with Hitachi Construction Machinery for a while now, and purchased the ZX130-5ABP in 2017 and 2018. We used other manufacturers in 2019 and 2020, but in March 2021, we tested the ZX120-5A in a demonstration, and found it very easy to operate, in particular its speed of combined operations. Its fuel efficiency and overall high rating were key factors in our deciding to purchase this model. We do a lot of crushing work at our site in south-west Chonqing, and so we had the seat screw fitted at the time of delivery, and find it convenient on the work site.

Yue Zong Construction Equipment Leasing Co., Ltd at Beibei District of Chongqing (photo, at right)



Electrification Business

Hitachi Construction Machinery was one of the first companies to develop and manufacture electric construction machinery. We developed the first electric hydraulic excavators in 1971. Wired electric excavators based on small- and medium-sized equipment for work inside factory buildings were launched in the 1990s, and have sold well since then. Experience gained through the development in 2006 of battery type hydraulic excavators incorporating lithium-ion batteries has given the Group a major competitive advantage in this field.

Line-up That Meets the Needs of Customers Aiming to Achieve Carbon Neutrality

The Hitachi Construction Machinery Group has put forth a goal to reduce by 33% CO_2 emissions (over 2010 levels) from production through to disposal, and is working to achieve carbon neutrality. Electrification of construction machinery is key to achieving this. National and regional governments around the world are announcing their intention to go carbon neutral, and we are seeing a move towards the complete electrification of automobiles, with this trend also impacting construction equipment. Construction work in narrow and enclosed areas, as well as at night is increasing particularly in urban areas worldwide, and we are seeing heightened demand for operationally and environmentally functional electric mini excavators with compact bodies, no exhaust, and low emitted sound. Hitachi Construction Machinery developed the battery-powered mini excavators ZX-50UB-2 and ZX70B in 2006, and the ZX35B in 2010, releasing these to market. Leveraging our long experience and expertise in electric equipment, in 2011 we launched the 20-ton class ZH200-A hybrid hydraulic excavator. Furthermore, in the European market which is driving demand for electric construction machinery, in 2018 we established the European Application Center GmbH (EAC) in collaboration with German company Kiesel Technologie Entwicklung GmbH (KTEG) as a development base for electric products. Centered around this, the company is rapidly conducting development near the sites of environmentally conscious clients, and is expanding its development to other models in Japan.

Electric machinery drive components are currently still expensive with major hurdles to cross in order to bring these to prices acceptable for customers, but there is still a need to expand the product line-up in readiness for a rapid expansion in the market. If future advances in cost-competitive electric drive component technologies in conjunction with the move to electric cars and trucks can be achieved, this will let us offer a wide range of electric products from mini- through to ultra-large excavators and loaders, allowing the group to fully demonstrate its strengths.

Stakeholder's Voices

Together, Technologies from Both Companies Will Speed the Development of Electrification

KTEG has a wealth of knowledge regarding regulatory trends and productization for electrification in the European market. Having entered the market in partnership with SUNCAR HK AG, which has extensive experience in electrification, KTEG is very familiar with actual site processes, and has earned a good reputation and high customer satisfaction in Europe. Bringing Hitachi Construction Machinery and KTEG technical know-how together will let us more rapidly provide customers with electric construction machinery that better meets their needs. We feel this type of cooperation will be particularly beneficial not only in achieving zero emissions, but also in the fields of demolition products and digital services.

KTEG GmbH / EAC European Application Center GmbH
Managing Director
Harald Thum

Focus on Norway

Investment Promotion Activities in European Countries to Promote Usage of Electric Construction Machinery

Under the framework of the Paris Agreement with the aim of achieving carbon neutrality by 2050, the EU and other European countries are pushing investment promotion policies aimed at decarbonization. For example, Norway is seeing a more rapid increase in demand for electric construction machinery than in other countries because of a wide range of incentives, such as a 40% subsidy covering the price difference with a standard engine-powered model. Also, Germany has introduced a financial aid program aimed at promoting investment towards reducing carbon emissions, and the Netherlands is also considering a subsidy program for the purchase of electric construction machinery. Major European cities are also increasing numbers of low- and zero-emissions zones, and numbers of gasoline-powered vehicles are gradually decreasing. In view of this, customers in European countries are showing an ever-increasing interest in electric construction machinery.

Norway, the country that has made the biggest move to EVs, has strong requirements for electrification on worksites as well.

Selection of ZE85 Electric Excavator for Pilot Business Project Using Only Electric Construction Machinery

In 2019, Hitachi Construction Machinery (Europe) participated in the bauma2019 international construction machinery trade fair held in Munich, Germany, where it exhibited the ZE85 battery-powered excavator (8-ton class, KTEG brand). The ZE85 was developed in collaboration with EAC, and features a lithium-ion battery that provides 3–4 hours operation on a full charge, and that can be charged in under an hour.

In fiscal 2020, the ZE85 was selected for a zero emissions construction site pilot project in Norway's capital Oslo. This test project using only electric construction machinery was carried out in an area in front of Oslo's city hall. The test showed that power and operating duration performance of the ZE85 were comparable to engine-powered models, and these have been introduced on zero-emissions worksites. Moving forward, Hitachi Construction Machinery will continue to seize such opportunities to meet the needs of Europe which has high environmental standards and strict regulations.

Demonstration of ZE85 exhibited at international construction machinery trade fair

Stakeholder's Voices

ZE85 Showed off its Superiority in Oslo

PA Entreprenør AS has been engaged in construction in and around Oslo for around 30 years. We are very mindful of the environment, and more than half of our construction equipment is emissions free. In a project in Oslo, emissions-free machinery alone completed renewals of water and sewerage systems. The ZE85 has operability, productivity, and safety characteristics similar to the ZX85, and yet is quiet enough that workers nearby can converse. This benefit also showed its advantages in Oslo. We currently own two of these machines, and plan to purchase more this year. We hope to see the ZE85 manufactured in larger quantities to bring its price down.

PA Entreprenør AS
Department Manager (CEO)
Lars Fredrik Moe-Helgesen

Parts Remanufacturing Business

Hitachi Construction Machinery started our parts remanufacturing business in 1998 as one of our efforts towards achieving a recycling-oriented society. Since then, our accumulated unique reconstruction technologies let us rapidly provide high-quality, low-cost remanufactured parts, and these have gained the trust of customers around the world, while also contributing to a reduced environmental impact.

Parts Remanufacturing That Maximizes the Value of Resources, Providing High Value to Customers Around the World

Hitachi Construction Machinery manufactures the major components of its main products such as 20-ton hydraulic excavators, and in this the company has accumulated around 70 years of technology. Accordingly, we are able to remanufacture parts such as hydraulic pumps, hydraulic cylinders, and travel devices to have the same performance as new parts in-house. We currently have three production locations within Japan and eight overseas, providing remanufactured components to customers in over 170 countries and regions around the world. As an example, our equipment is in operation almost around the clock at large mines in Africa, Australia, Indonesia, and other areas. These are often located far from urban areas, meaning that ordering parts after a problem occurs can result in significant down-time. However, Hitachi can provide remanufactured parts from the closest plants to the mines, meaning equipment can be returned to operation quickly.

Society's needs are changing from an owning to a usage paradigm, and this trend is seeing different manufacturers entering the parts remanufacturing business, with intensified price competition. In this, Hitachi Construction Machinery has established our REMANUFACTURED brand of remanufactured parts. As well as providing parts with quality guarantees, ConSite® is used to monitor customer machinery by providing high-quality service by predicting failures and supplying parts, thereby improving our competitive advantage. We are also working to develop the specialist knowledge and skills of our service engineers, continuously enhancing our ability to provide support and proposals to customers.

Hitachi Construction Machinery REMANUFACTURED

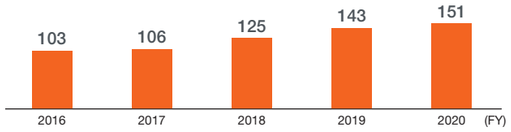
REMANUFACTURED brand of remanufactured parts

Parts Remanufacturing Flow

1. Recover core products
2. Clean at parts remanufacturing plant
3. Determine if parts can be reused
4. Modify and assemble
5. Carry out inspection and performance testing
6. Paint
7. Ship

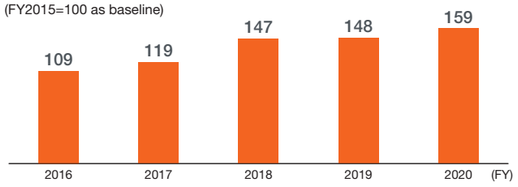
Trends in Remanufactured Parts Sales

(FY2015=100 as baseline)



Trends in Remanufactured Parts Production

(FY2015=100 as baseline)



Focus on Zambia

Providing Dependable Service to Mining Customers in Southern Africa, Where Parts Wear Out Rapidly

Hitachi Construction Machinery Zambia's parts remanufacturing plant is the first such parts refurbishment location established by a Japanese construction machinery manufacturer in Africa, and this started operation in 2012. In 2016, the production line was approximately doubled in size to handle key components used in mining equipment, and it is increasing production capacity targeting an expansion of supply to all of Africa.

Harsh on-site conditions mean that mining equipment operating in southern Africa is subject to severe wear and tear, and reducing running costs is a major issue for customers. So that it can ensure a rapid and reliable supply of parts to mining sites, Hitachi Construction Machinery Zambia conducts exacting performance testing on these remanufactured parts, delivering only those parts that have passed this rigorous testing. The company also provides customer-centric support that includes a manufacturer warrantee as well as prompt replacement in the event of trouble.

Zambia parts remanufacturing plant

High-quality Training Program for Local Personnel, Aiming for Locally Based Management

Since the establishment of its base, Hitachi Construction Machinery Zambia has been actively recruiting local human resources, expanding employment along with improved technical capabilities. Out of 171 employees, 159 are Zambian, including 29 women (as of April 2021). The company is expanding its training programs by job category and level, such as factory, administrative, and management divisions, and has recently introduced a program from the Zambian Ministry of Higher Education to support the early acquisition of skills and growth.

In the factory division, the company is working with the KAIZEN Institute of Zambia to communicate the concept of kaizen to a wide range of employees, and so that it can strengthen activities to solve issues concerning quality and work efficiency. At the 45th International QC Circle Conference held in December 2020, the "Parts Centralization" kaizen initiative for improving the work flow for shelving parts from the EXCAVATOR team from Hitachi Construction Machinery Zambia's parts reclamation plant won the highest award, the Platinum Award. This both shortened working hours, as well as ensuring safety and reducing worker fatigue.

Recipient team members with Hitachi Construction Machinery Zambia Company President Hideki Hattori (2nd from right)

Stakeholder's Voices

High-level Support for Mining Equipment Operating 24hrs a Day 7 Days a Week

Having the option available to use remanufactured component on our machines provides us a cost-effective solution while minimizing the downtime on our machines. Hitachi keeps critical component stock available close to our operations to ensure same shift availability of critical components. Our fleet runs 24hrs a day 7 days a week so this type of support is critical. The fact that the Reman center is available in Zambia adding that high level of support was a positive contributor towards our decision to purchase our Hitachi fleet. We look forward to continue to working with the Remanufactured product going forward.

Avantech Ltd. Avantech Plant General Manager Joseph Kapira

ICT Construction Business

In 2000, Hitachi Construction Machinery launched the ZAXIS series, the world's first hydraulic excavators incorporating satellite communication functionality, and since then has been promoting development to support customer ICT construction. In 2017, we launched Solution Linkage® Cloud which is central to ICT construction solutions, and are providing a series of new solutions to support the whole process from initial surveying through to delivery.

Providing Wide-ranging, High-quality ICT Solutions to Respond to the Diverse Challenges of Differing Sites

There are a wide range of solutions in achieving ICT construction, requiring expert technologies and advanced solutions. These include 3D surveying using unmanned aerial vehicles (UAVs) and lasers, creating point clouds and 3D design data, autonomous operation and remote control of ICT construction equipment, as well as quality control and inspections using this equipment. To meet these demands, Hitachi Construction Machinery provides Solution Linkage® as a platform for providing value, and while utilizing advanced technologies using open innovation, provides high-quality solutions that address a range of challenges faced by worksites.

Given this, requirements for ICT construction vary dramatically between countries and regions. For example, in Scandinavia the introduction of ICT construction equipment has reached 80 to 90%, while in Japan the number of construction projects commissioned by the Ministry of Land, Infrastructure, Transport and Tourism is only now starting to increase. In spite of this, the increase in reconstruction work due to frequent natural disasters along with serious labor shortages due to declining birthrate and an aging population mean that we expect to see an accelerating introduction of ICT construction solutions that enable high safety and productivity while requiring fewer workers. Increased adoption of 5G communications networks will enable the introduction of these solutions to major construction projects even in mountainous areas in which communication environments were hitherto unavailable. Hitachi Construction Machinery is rapidly developing new solutions that can use this high-capacity communications infrastructure, and in FY2020 started providing Solution Linkage® Survey, Solution Linkage® Work Viewer, and ConSite® Navi. In July 2021, we have started providing Solution Linkage® Point Cloud.

Solution Linkage® Survey that enables rapid, approximate measurement of soil volume just by taking a smartphone video

Use of ICT demonstration site

Hitachi Construction Machinery is developing ICT demonstration sites in Japan and Europe to let visitors experience ICT construction, and as a first step to its introduction. At these, demonstrations and test rides are carried out using the ZX200X-6 ICT hydraulic excavator that incorporates a 3D machine control function.

Sites currently open

- Hitachinaka ICT Demonstration Site (Hitachinaka City, Ibaraki Prefecture, 2016)
- Kagawa ICT Demonstration Site (Zentsuji City, Kagawa Prefecture, 2018)
- Europe ICT Demonstration Site (Amsterdam, Netherlands, 2018)

Kagawa ICT Demonstration Site

Focus on Japan

High Expectations for Remote Control of ICT Construction Machinery in Response to Challenges Facing the Civil Engineering and Construction Industries

Against the backdrop of labor shortages from declining birthrates and an aging population, a 44% drop in numbers of construction workers in Japan is expected by 2030 (compared to 2005 figures*1), and the civil engineering and construction industries are facing significant issues in passing on specialized skills and securing new workers. To solve these problems, the "i-Construction" initiative is being promoted by the Ministry of Land, Infrastructure, Transport and Tourism. This aims to improve productivity and make construction sites more attractive by introducing innovative technologies such as IoT and AI, and we have high hopes for the spread of ICT construction. Furthermore, we have high expectations for the role of remote operation of ICT construction machinery, in terms of ensuring construction machinery operator safety at sites of natural disasters which have become more frequent in recent years.

Remote operation of equipment requires communications networks that can rapidly transfer large amounts of data such as high-resolution images of worksites and construction management information of projects, and this requires the use of 5G, a 5th generation mobile communications system.

One operator remotely operates three machines

Successful Verification Testing of Remote Operation Using 5G and AR

In February 2021, Hitachi Construction Machinery in cooperation with Kato Construction Co., Ltd. (Hiroshima Prefecture) and Nishio Rent All Co., Ltd. (Osaka) carried out verification testing*2 of remote operation of three types of construction machinery over 5G. The site for this was the Ota River spillway in Nishi-ku, Hiroshima Prefecture, and a single operator remotely operated different construction machinery for each process. This compared and verified the ease of viewing images, operability, safety, and productivity in remote construction carried out using wireless LAN in January 2021, and when using the 5G system. This was assessed as being at a level for practical use in every regard.

*1 Source: Ministry of Land, Infrastructure, Transport and Tourism, "Situation Regarding Skilled Construction Workers."
*2 Implemented as part of an initiative selected by the Cabinet Office's "Public/Private R&D Investment Strategic Expansion PrograM" (PRISM), and the Ministry of Land, Infrastructure, Transport and Tourism's "Project for the Introduction and Adoption of Innovative Technologies to Dramatically Improve Construction Site Productivity."

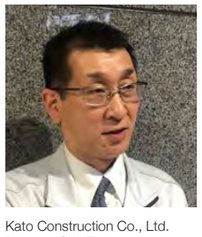
Overview of verification

- Three construction machines—a hydraulic excavator, a bulldozer, and a vibratory roller for earthworks are equipped with a camera for front view, one for interior view, and one for an omni-directional view. Camera images and remote operation signal data for each of these machines are transmitted between the work site and the remote operator over 5G.
- Image data for operational assistance is also transmitted to improve operability. Augmented reality (AR) technologies superimpose ground and bucket claw positions over the camera image as a grid, providing depth information not obtainable from the camera image alone. 3D design data AR images are displayed on the remote operation monitor
- Report submitted to Ministry of Land, Infrastructure, Transport and Tourism at the end of March 2021. Labor-savings of 33% of conventional construction were achieved (target of 40%). Reductions in worker-hours of 61% of conventional construction were achieved (target of 80%).

Stakeholder's Voices

Remote Operation Aims to Solve a Range of Issues

There are fewer new workers being hired, and bringing multiple new operators in is difficult, and so we hope to solve this problem using remote operation technologies. This verification testing also took into account portability, anticipating usage in disaster zones. As a result, we overcame a range of technical issues, and feel that this is at a level suitable for practical use. Developing technologies from scratch is a major hurdle, but utilizing technologies already in the marketplace will speed adoption of the technology. We will provide results of this testing to other companies as well, hoping to make them of value to society as a whole.



Kato Construction Co., Ltd.
Director, Civil Engineering Department Chief
Eiji Harada