

Research and Development Explanatory Meeting

"The Optimal Relationship Between People and Machinery"

June 19, 2019

Kotaro Hirano

Representative Executive Officer, President and CEO

Hideshi Fukumoto

Executive Officer and CTO

 **Hitachi Construction Machinery Co., Ltd.**

- 1. Research and development to realize the corporate principles**
- 2. Research and development strategy for the future**
- 3. Enhancement of safety**
- 4. Improvement of productivity**
- 5. Reduction of life-cycle cost**
- 6. Achieving a sustainable society**
- 7. Summary**

Our vision

To pass on productive environment and prosperous cities to future generations

**Hitachi Construction Machinery Group helps
to create comfortable living spaces**

Our principles

To actively develop machinery to make the relationship between people and work , more comfortable , advanced, and efficient.

To continuously develop and provide our customers with technology, products, and services that generate new value.

To act as a decent corporate citizen maintaining harmony with the environment, contributing to society , participating in cultural activities, and striving for a symbiotic relationship with society, while maintaining profitable operations.

Social challenges

Decreasing birthrate and aging population

Insufficient labor force and shortage of experts

Growth slowdown

Shift from expanding production volume to improving productivity

Sustainable growth (SDGs)

Climate change, gas emission regulations, CO2 reduction

Rapid progress of digitization

IoT technology and big data

All objects connected by data

Fusion of the real and virtual worlds

New paradigm of automation and labor saving

Rise of ventures

Collapse of barriers to entry and competitive rules

Shift from "Tangible Goods" to "Intangible Goods"

Curb CO₂ emissions via new products in FY2030: Reduce by ▲33% (compared to FY2010)

- Set 10 key goals to align our activities with SDG's.
- Established Sustainability Promotion Division (April 2019)



- HCM set a CO₂ reduction target for production and products according to the requirements of an IPCC 2°C scenario (21% to 37%). The target value for product development is a decrease of 33% in FY2030 compared to FY2010.
- This target will be achieved through advanced energy-saving in our major products which are hydraulic excavators, mini excavators, wheel loaders, dump trucks, and compaction equipment. In addition, we will promote IoT and electric solutions to save energy.

1-4. Shifting from New machine Sales to a Value Chain

HITACHI

Reliable solutions

Mega Trend

- Aging, labor shortage
- Tightening of Environmental regulation (SDGs)
- IoT/Digital revolution
- Electrification /Automation

Customer Needs Change

- "Ownership to "Sharing / Rental"
- Tangible goods to intangible goods
 - Operation support / Automation
 - Operation management – from machine to entire construction site
- Safety, Environmental Regulation

Core Competence of OEM

Base

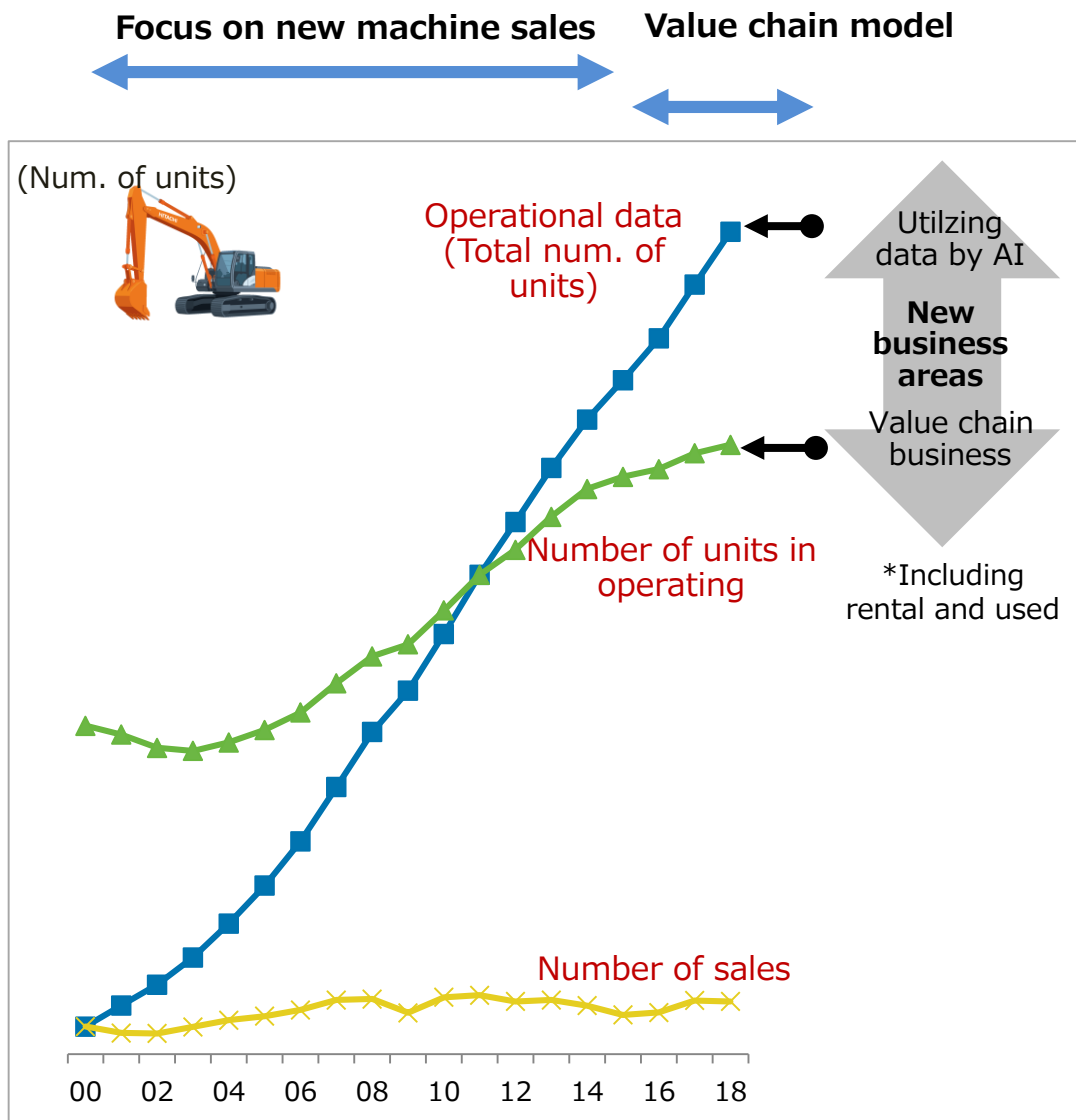
- Digital Technology
- Big Data/AI

Technology

- Engine/EV
- Internal manufacturing of major component

Solution

- Information-oriented construction
- Autonomous operation
- One Stop service
- Preventive maintenance



1-5. New value created by Hitachi Construction Machinery - Solution Linkage

HITACHI

Reliable solutions

Customer's needs

Enhancement
of safety

Improvement
of productivity

Reduction of
life-cycle cost

Solution Linkage[®]



ICT/IoT solutions solving problems together with customers

AHS Solutions
[Autonomous Haulage
System]



Fleet Management
Solutions



ICT Solutions
for i-Construction



Service
Solutions



One Hitachi

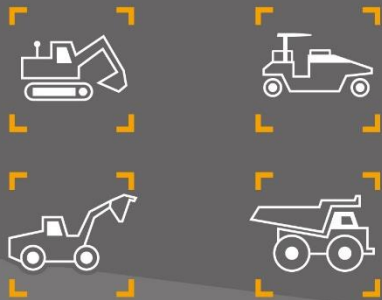
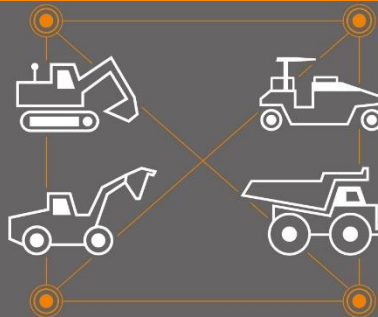
Customer
collaboration

Open innovation

AHS: Autonomous Haulage System
ICT: Information & Communication Technology

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Proposing the optimal relationship between people and machinery to maximize the customer's enterprise value

Current**Site is visible and understood****2 to 5 years****People and machinery are connected and start to move****5 to 15 years****Evolve to make their own on-site decisions and discoveries****Visualization****Site management****Automation**

Equip a platform which presupposes built-in digital features

Open innovation

Big data analysis

Machine status monitoring and predictive diagnostic, work process analysis, AI

New business models

Data-driven businesses
Customer process innovation, shared services

Sensors and new features built-in

Satellite positioning, cameras, LIDAR Inertial measurement devices

Communication and network features built-in

High-speed, high-capacity, and real time Control, construction, and monitoring

Machine foundation

Safety standard measures
Electronics and electrification
Automation and robotization

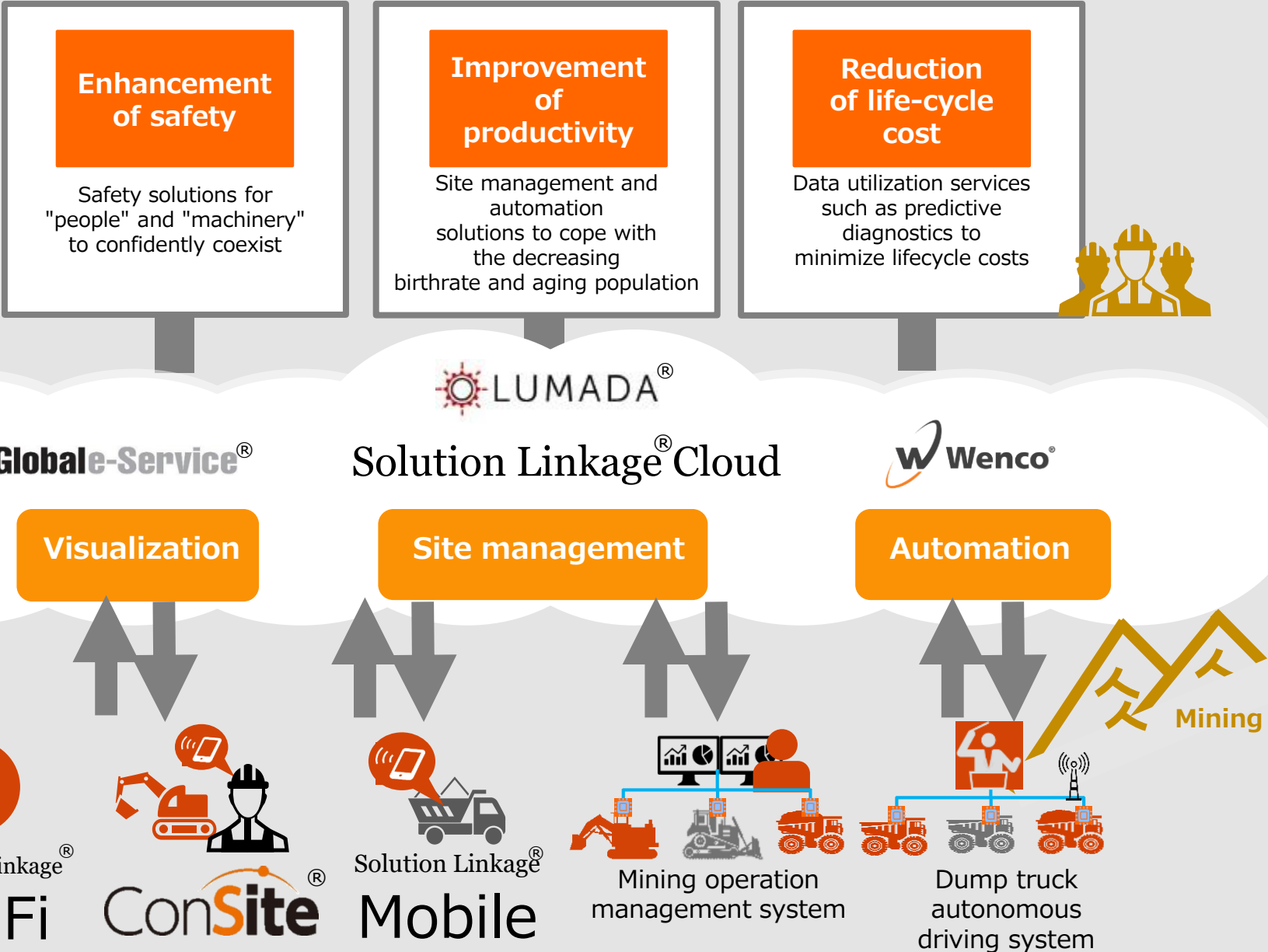
Manufacturing foundation

Components which support electronics and electrification
Easy to build
Can be built by anyone

Platform



2-3. Aims of Solution Linkage



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3-1. Aims of Solution Linkage

Enhancement of safety

Safety solutions for "people" and "machinery" to confidently coexist

Improvement of productivity

Site management and automation solutions to cope with the decreasing birthrate and aging population

Reduction of life-cycle cost

Data utilization services such as predictive diagnostics to minimize lifecycle costs



Globale-Service®

Solution Linkage® Cloud



Visualization

Site management

Automation



Civil engineering



Solution Linkage®

Wi-Fi



ConSite®



Solution Linkage®

Mobile



Mining operation management system

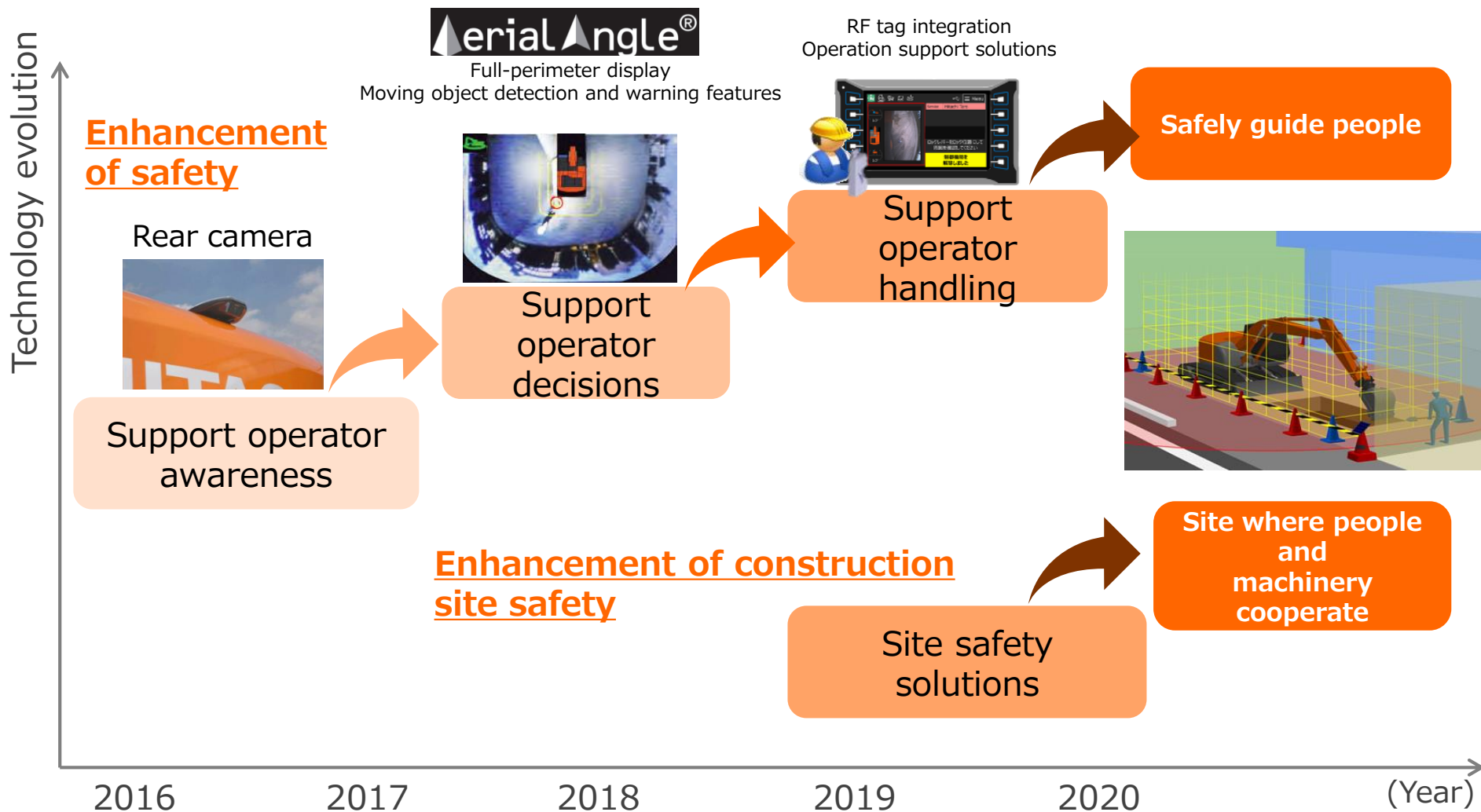


Dump truck autonomous driving system

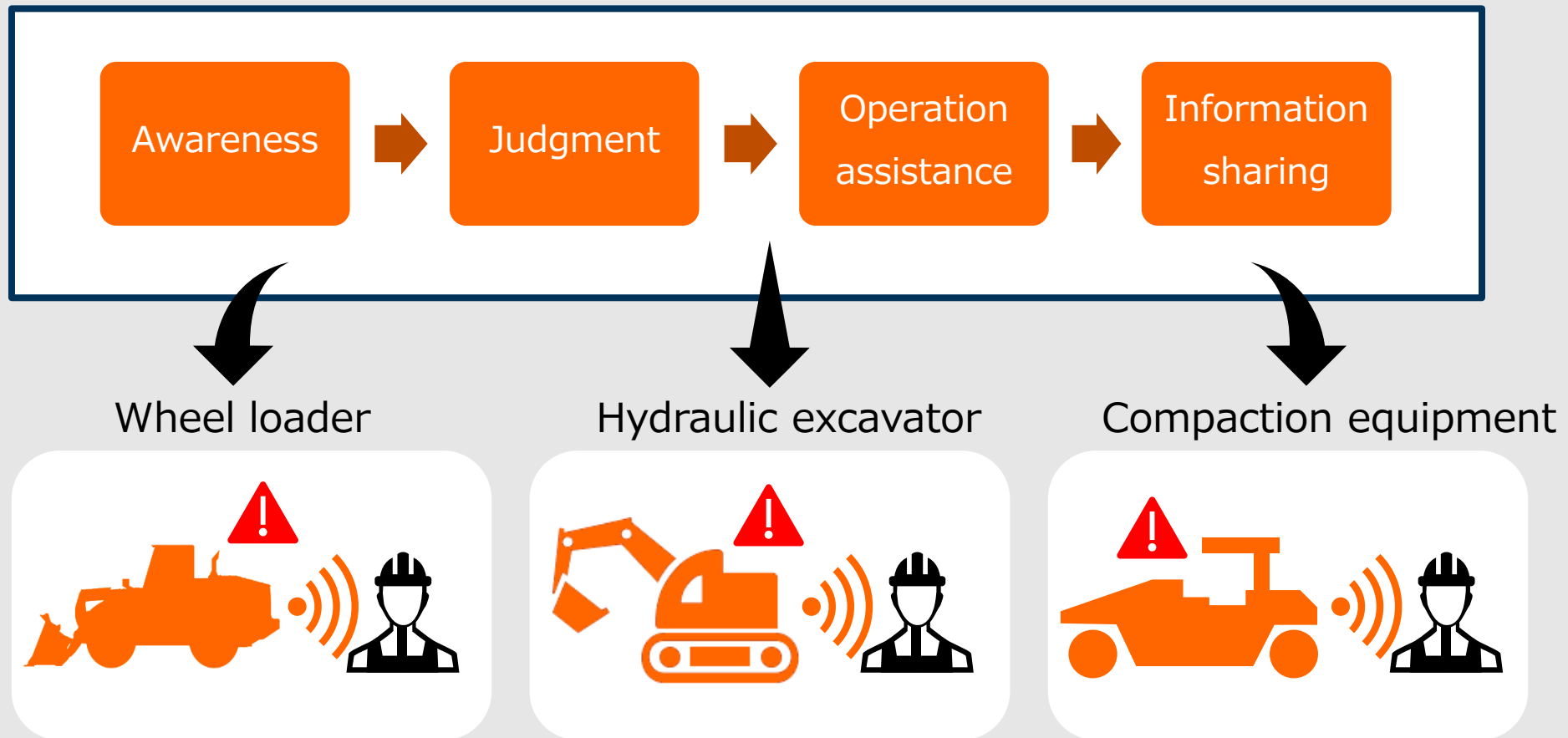


Mining

Realizing a safe site where people and machinery cooperate



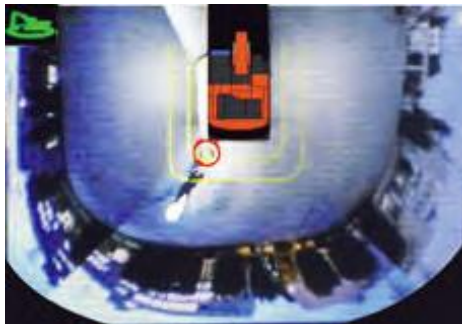
Provide the operation assistance system for enhancement of construction site safety as a common package on major models



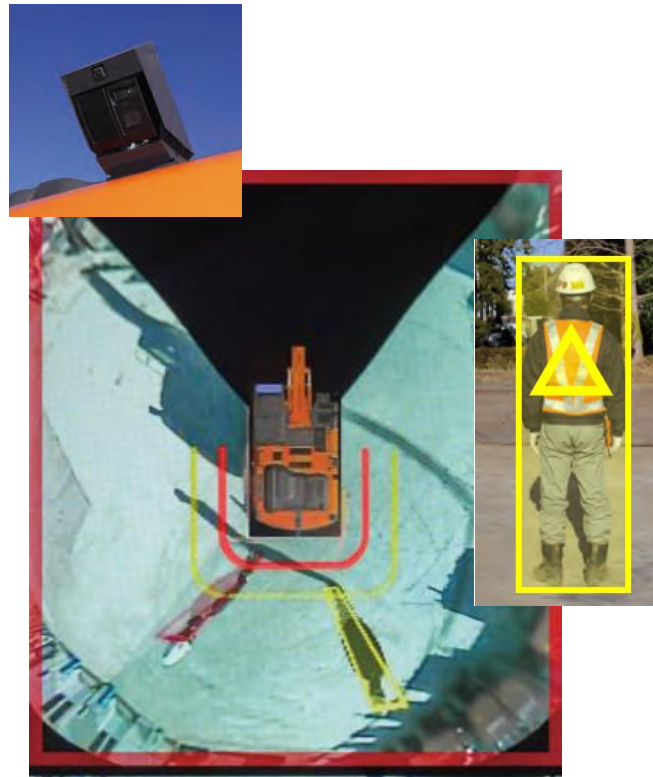
Improve detection features with cameras and sensors to alert operators

[2018] Optional configuration (camera and infrared sensor)

[2018]
Standard equipment
(camera only)



Full-perimeter display
Moving object detection
and warning



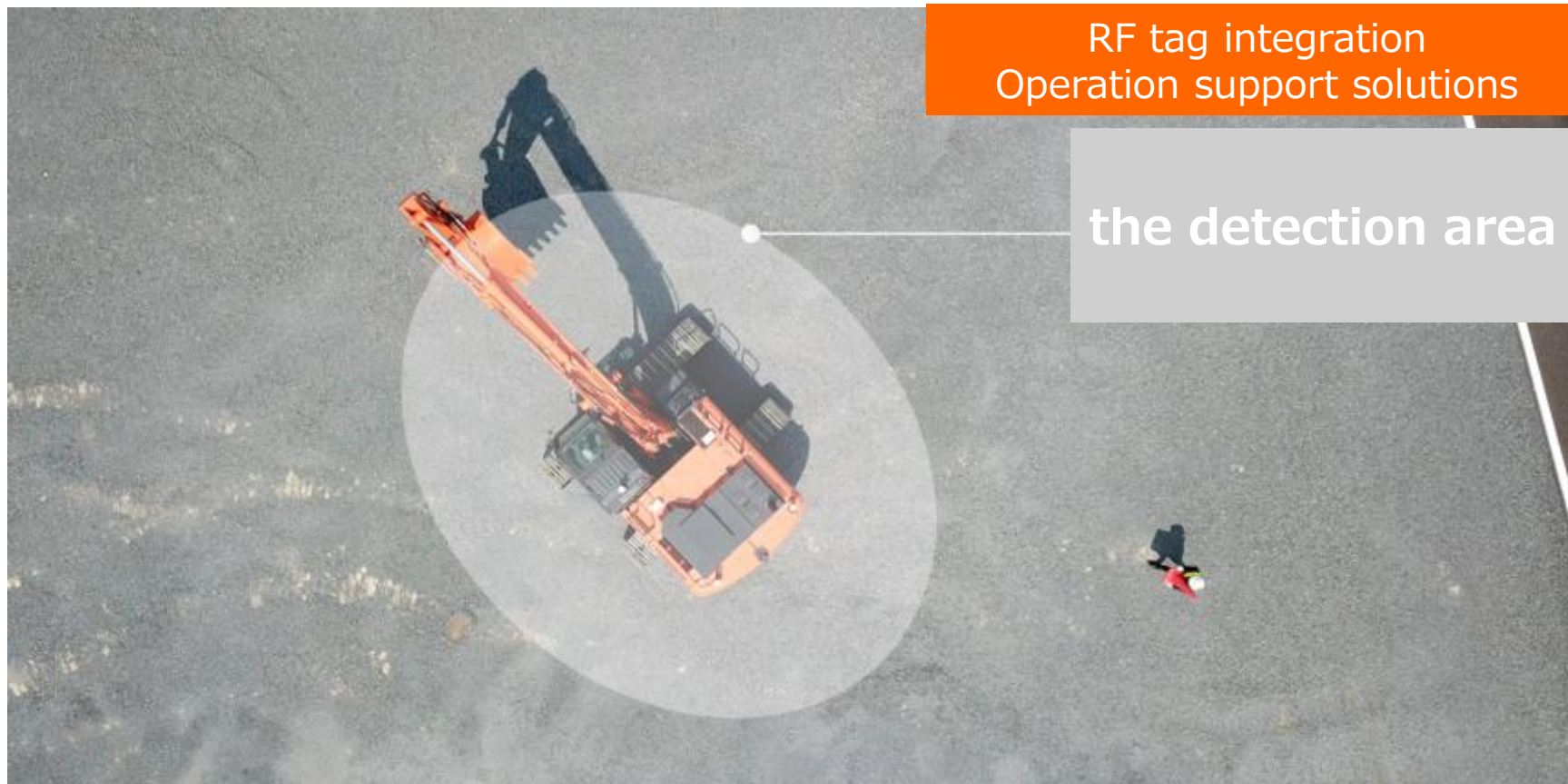
Detect objects



Detect only reflecting materials

Camera and infrared sensor ⇒
easy to confirm detected objects

Hydraulic excavator warns the operator and those nearby when a person enters the detection area



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4-1. Aims of Solution Linkage

Improving safety

Safety solutions for "people" and "machinery" to confidently coexist

Improving productivity

Site management and automation solutions to cope with the decreasing birthrate and aging population

Lifecycle cost reduction

Data utilization services such as predictive diagnostics to minimize lifecycle costs



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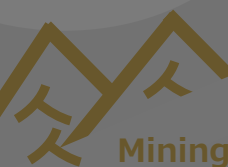
Mobile



Mining operation management system



Dump truck autonomous driving system



Mining

Creating new forms of value through remote operation

HCM's approach

Application of 5G and other next-generation communication technologies
Remote control over typical lines by combining automation technologies

**5G high-speed,
high-capacity
remote operation**

**Low bandwidth
support
remote +
autonomous and
automatic**

Remote operation in
an Internet
environment

Remote operation in
a specific radio
environment

Visual remote
operation



Special low-power remote
control unit



ASTACO-Sora for the
Fukushima Daiichi
Nuclear Power Plant

Unmanned
construction at
Mount Unzen
Fugen-dake
and Mount Usu



Ultra high-speed compression and expansion technology
Low delay remote control technology

Developed in 2013
ahead of the
industry

1990

2000

2010

2020

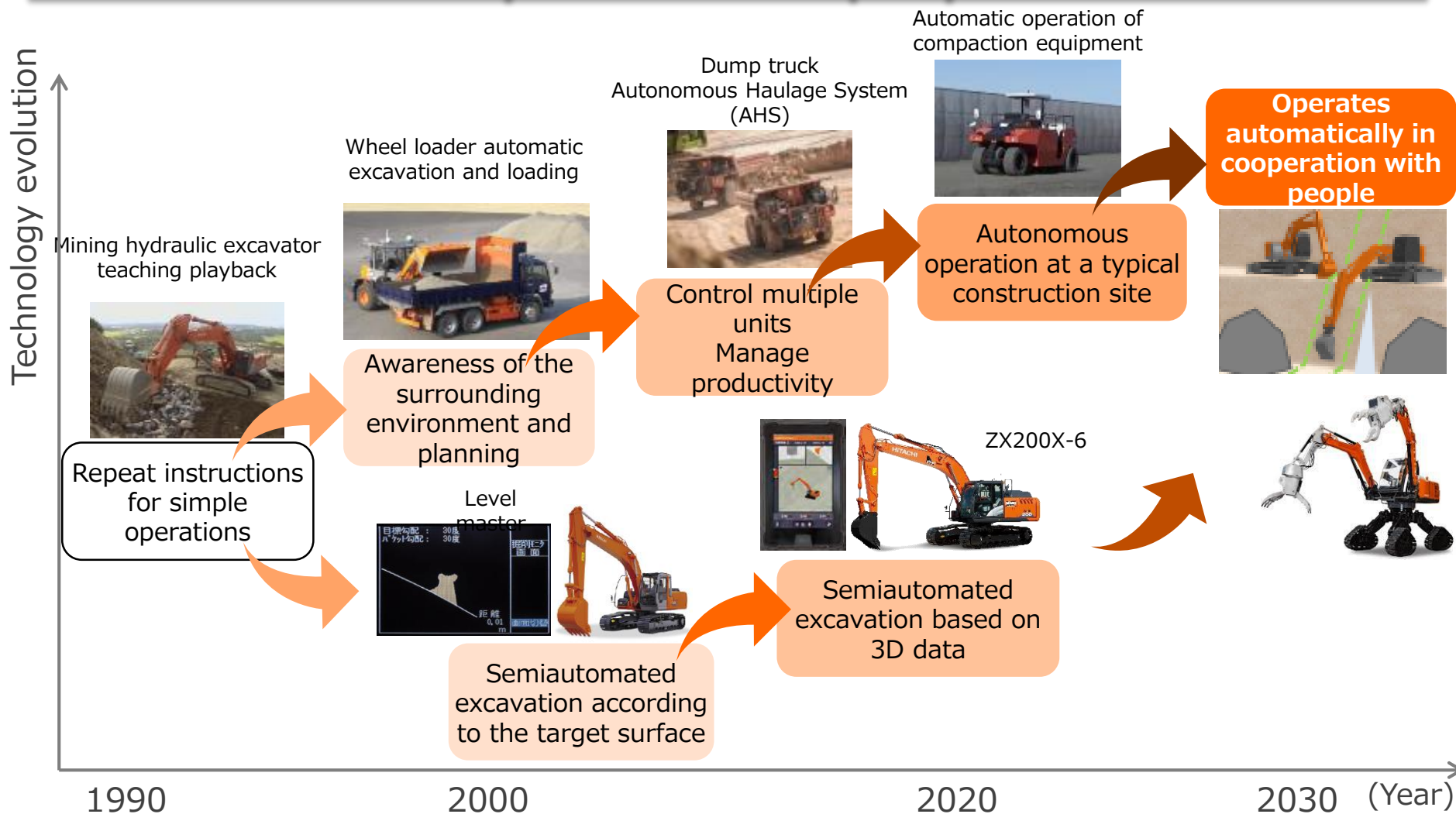
2030 (Year)

4-3. Improvement of productivity (Future of Automation)

HITACHI

Reliable solutions

Automation solutions realized by "machinery that cooperates with people"



Proven Wenco® FMS x HCM AHS moving to commercial operation

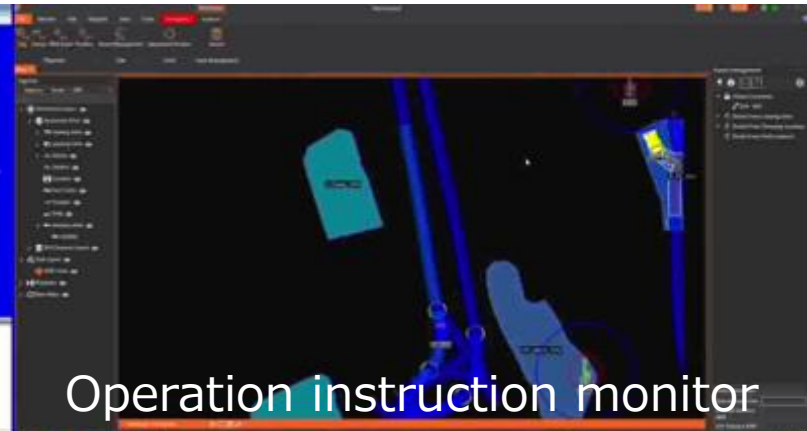
Commercial operation scheduled to start in FY2019

FMS: Fleet Management System

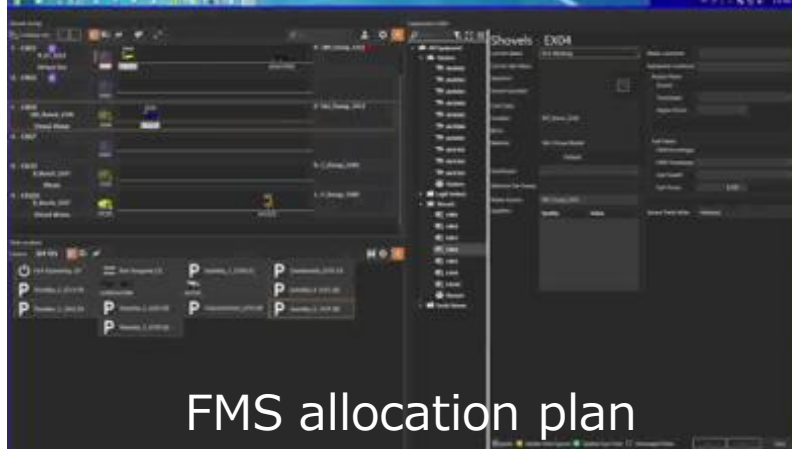
Carrying out user tests for a full-scale rollout at an actual site in cooperation with Whitehaven Coal



AHS command execution



Operation instruction monitor



FMS allocation plan



Operation status monitor

AHS system operation screens

4-5. Automatic Operation (Automatic Operation Tests of Compaction Equipment)

HITACHI

Reliable solutions



Automatic operation tests of compaction equipment (tire roller)



4-6. Automatic Operation (Mini Excavator Automatic Excavation and Loading Tests)

HITACHI

Reliable solutions



**Mini excavator automatic excavation
and loading tests**

4-7. Aims of Solution Linkage

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Reliable solutions

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Site management and automation solutions to cope with the decreasing birthrate and aging population

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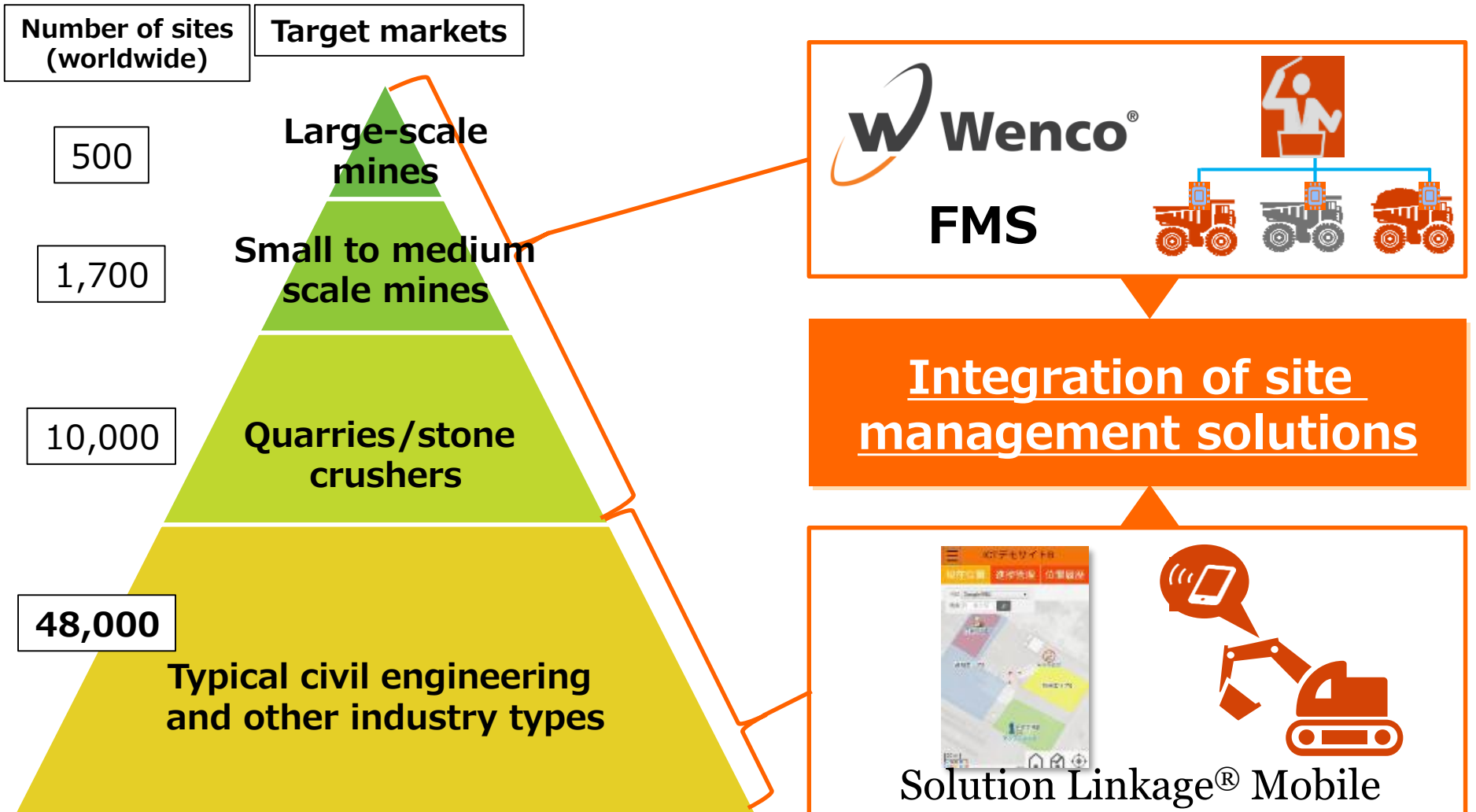


Dump truck autonomous driving system



Mining

Development of site management solutions which integrate the knowledge and technologies cultivated on typical civil engineering sites with the Wenco FMS



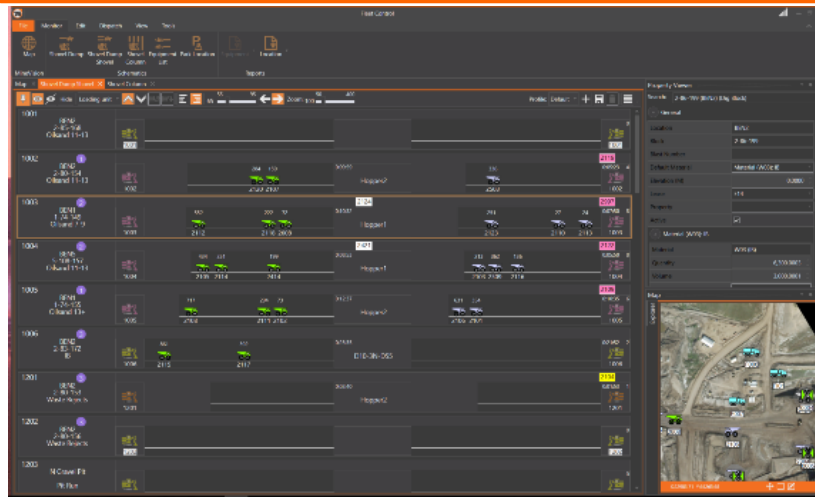
Implements allocation, safety, and asset management of dump trucks and heavy machinery at mines and quarries

Wencomine

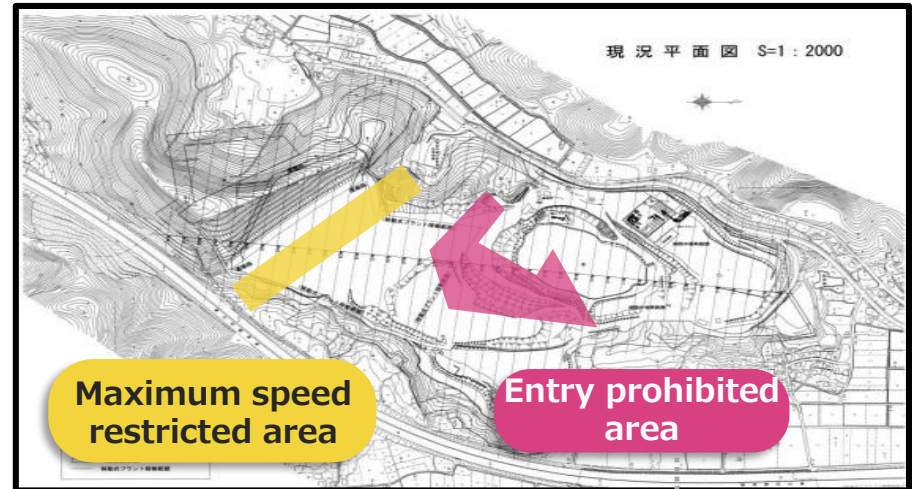
- Dump truck allocation management system for large-scale mines
- World's second largest number of (Wenco® survey)

Wencolite

- Vehicle asset management system for small to medium scale mines and quarries
- Limited features to control implementation and maintenance costs



Wencomine allocation management system



Wencolite safety zone setting screen

Implement site management by linkage with the smart devices of construction workers

Solution Linkage® Mobile

IoT solution has (three or standard) features for position identification, understanding work volume and progress, and approach notification



Construction managers understand the position of heavy machinery and workers



*Map data ©2018 Google, ZENRIN

Efficient site management and operation

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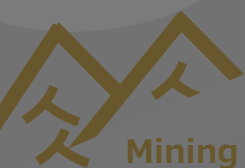
Mobile



Mining operation management system



Dump truck autonomous driving system

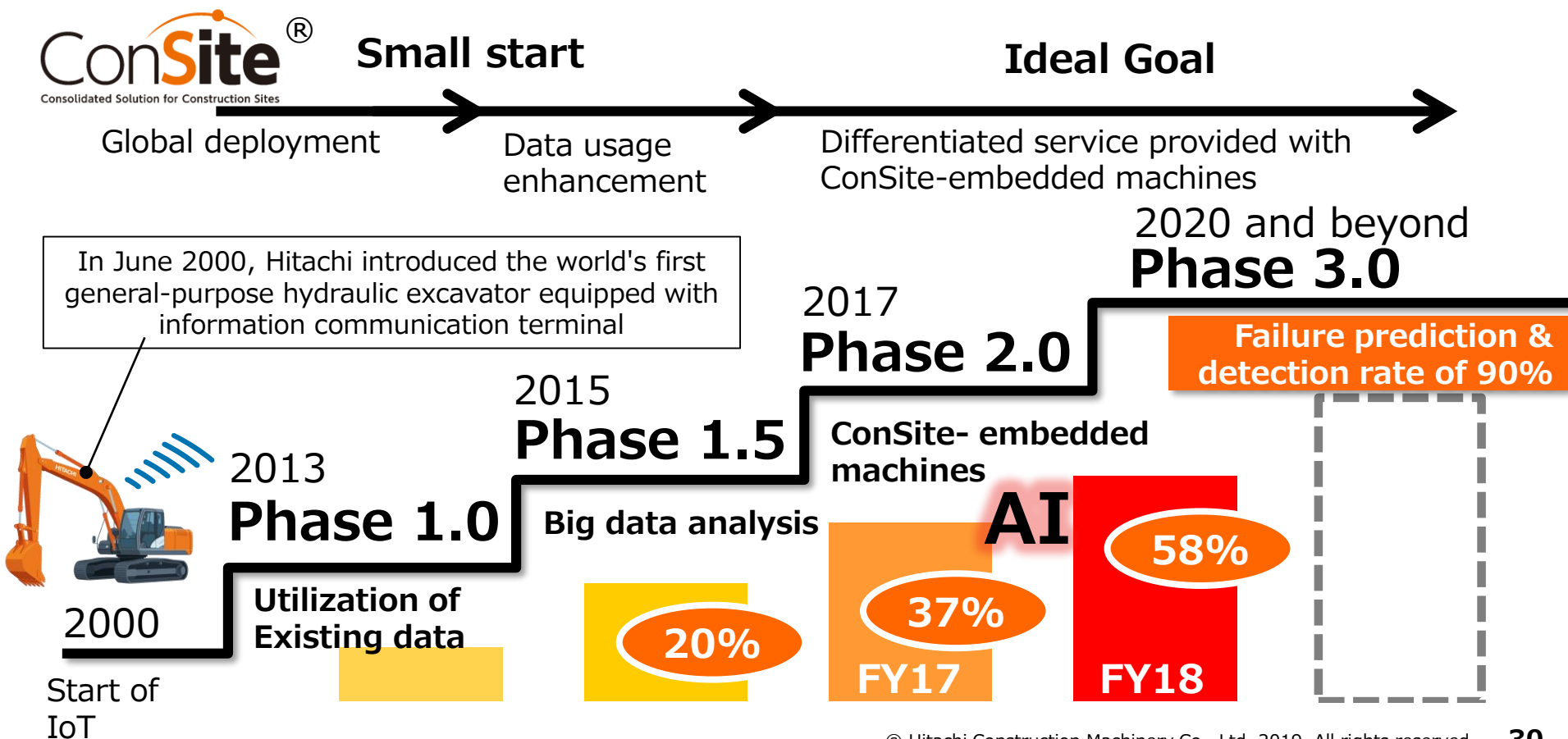


Mining

Target to achieve 90% of major components failure detection & prediction after 2020

■ KPI: major component fairer to be covered by sensing data

The remote failure prediction & detection rate indicate the coverage rate of major components failure



Global start from December 2018

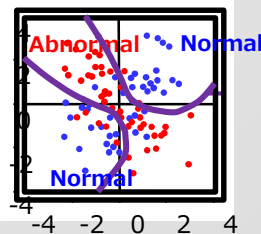
POINTS

- Don't expect AI to provide 100% accuracy in risk calculation.
- Do use the result of risk calculation to conduct the Digitalized "health check" inspection to prevent the major incident. (fix before it brakes.)
- AI DO continuously monitoring with the result data gained through Digitalized "health check". The result data enhance the accuracy of risk calculation.

(1) Risk calculation (AI)

Calculate the risk according to the use of each machine

- Use data obtained via IoT
- Extract high-risk machinery



ConSite[®] AI
Consolidated Solution for Construction Sites

(2) Health check (mechanic)

Conduct Digitalized "health check" inspection

- Check the health of high-risk machinery
- Standardized accuracy can be provided by the smartphone app



(3) Retrain (automatic)

Use the results data to retrain the AI and continue the condition monitoring

Implement failure prediction & detection of the main pump (heart of the hydraulic excavator)

POINTS

- Failure in main pump may cause the damage for the entire hydraulic system.
- In the machine down situation, considerable time & cost will be required.
- Low failure rate. Extremely difficult to predict the failure.

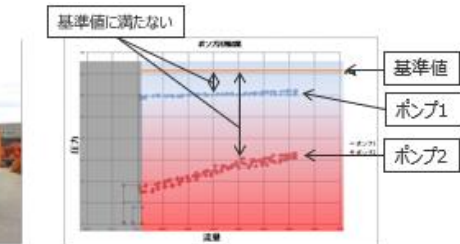
Main pump



The actual picture of Inner parts of a damaged (scratch) main pump



[Aichi Prefecture]

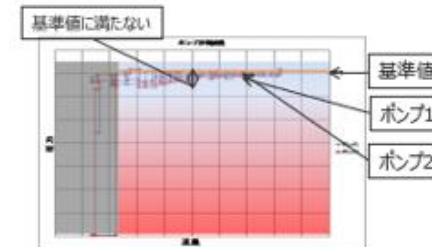


Machine shows signs of a clear pump performance decrease

D Rank
(Warning)
Requires repair or replacement



[Okinawa Prefecture]

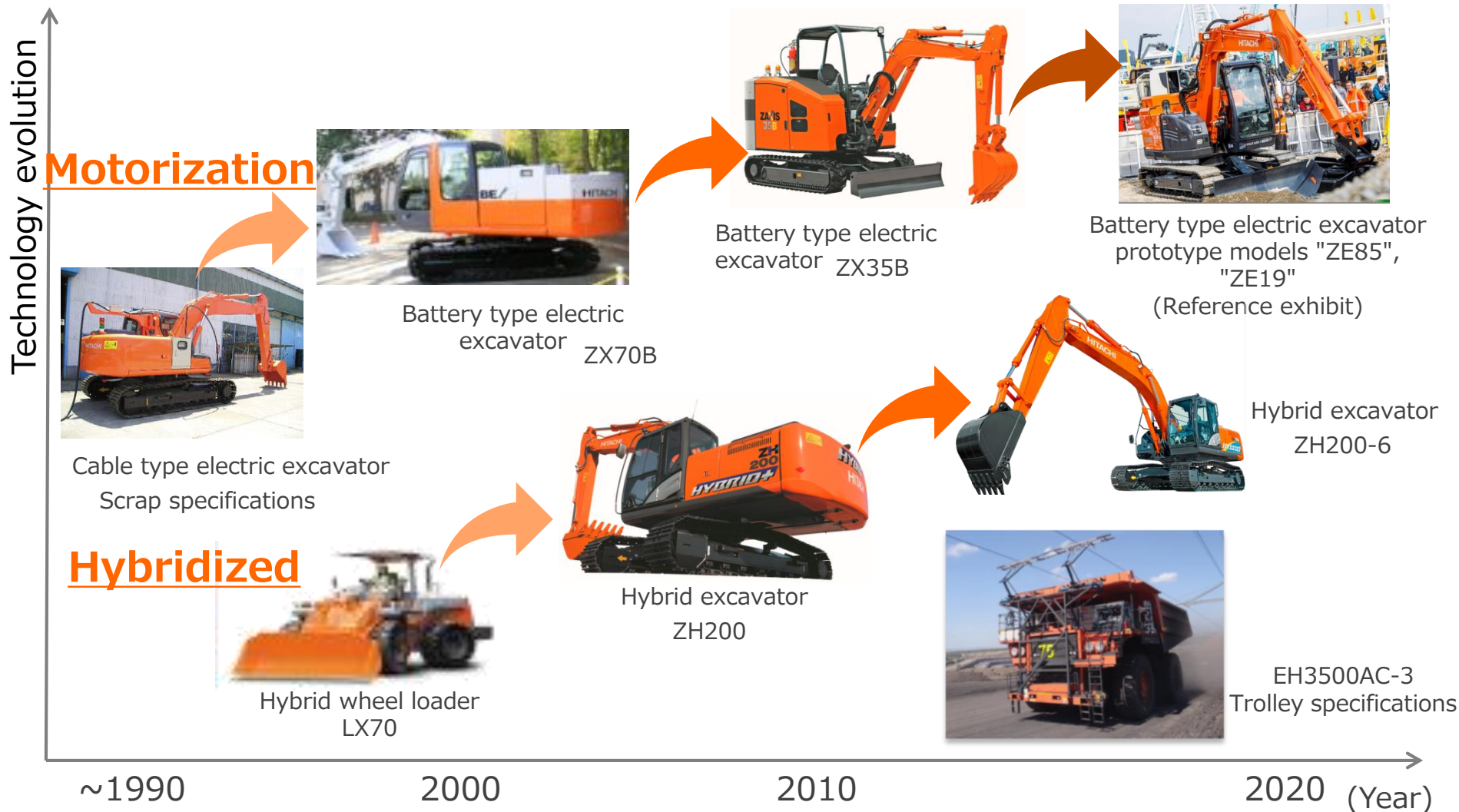


Machine shows signs of a slight performance decrease

B Rank
(Notice)
continuous Follow-up

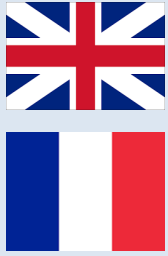
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Contributing to various social issues through electric and hybrid development since the 1990s



Full-scale shift to EVs expected to start from mini excavators in each country and region

- More European countries will ban internal combustion in the future
- Alternative fuels are also advancing in China

Automobile trends	2020	2025	2030	2035	2040
Europe (internal combustion ban)					
			Increasing 		
China (shift to alternative fuels)	▽ 20% NEV shift ^{*1}		▽ EV, PHEV ^{*2}		
		Accelerating 			

*1 New Energy Vehicles

*2 Plug-In Hybrid Electric Vehicles

*1 NEV: New Energy Vehicles

*2 PHEV: Plug-In Hybrid Electric Vehicles

Promoting the development of electric construction machinery through "EAC*", a new company established with the German distributor KTEG who understands the trends at European sites



Toni Kiesel (left), President of KTEG, and Hideshi Fukumoto (right), Executive Officer and CTO of Hitachi Construction Machinery, shake hands at the contract signing ceremony

*: "European Application Center" established in October 2018

6-4. Reference Exhibit of Two Jointly Developed Prototype Models at bauma2019

HITACHI

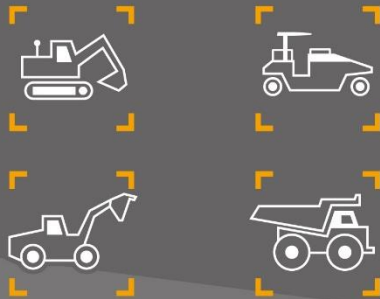
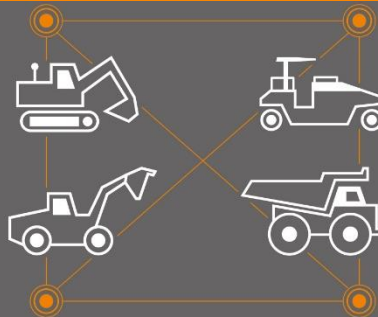
Reliable solutions



Reference exhibit of 2t and 8t class electric mini excavator models at bauma2019

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[Cautionary Statement]

This material contains forward-looking statements that reflect management's views and assumptions in the light of information currently available with respect to certain future events, including expected financial position, operating results, and business strategies. Actual results may differ materially from those projected, and the events and results of such forward-looking assumptions cannot be assured.

Factors that may cause actual results to differ materially from those predicted by such forward-looking statements include, but are not limited to, changes in the economic conditions in the Company's principal markets; changes in demand for the Company's products, changes in exchange rates, and the impact of regulatory changes and accounting principles and practices.

[Cautionary Statement]

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END

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