

Komatsu IR-Day 2020

The pursuit of safety and productivity at mine sites

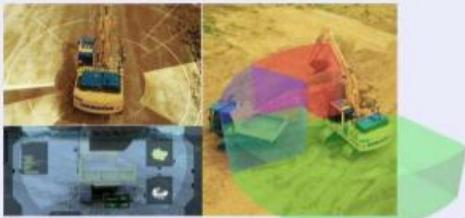
**December 16, 2020
Director, Senior Executive Officer
President, Mining Business Division**

Masayuki (Max) Moriyama

Mid-Term Management Plan (FY2019~FY2021)

We will achieve sustainable growth in the face of changing external environment and challenges by focusing efforts on the following three pillars of growth strategies.

Value creation by means of innovation



- ◆ Optimization platform and solutions business strategies
 - * SMARTCONSTRUCTION, Autonomous Haulage System (AHS), and platforms (LANDLOG and IntelliMine)
- ◆ Automation, autonomous operation, electrification and remote controlling of construction, mining and utility equipment
- ◆ Smart forestry and agriculture

Growth strategies based on business reforms



- ◆ KMC integration synergies and business reinforcement
- ◆ Value chain reforms and redefinition of the aftermarket business
 - * Preventive maintenance by applying IoT and AI, and Lifecycle support under serial number-based management
 - * Logistics reforms * Next-generation key components
- ◆ Next-generation KOMTRAX
- ◆ Stronger focus on aggregate & cement, forestry, agriculture and other segments
- ◆ Efforts for “DANTOTSU NO. 1 in Asia” and in the growing markets of India and Africa
- ◆ Reforms of the industrial machinery business (Expansion of synergy with the construction equipment business and growth by capitalizing on core technologies)

Structural reforms for growth



- ◆ Business reforms by means of ICT and IoT
- ◆ Structural reforms of development operation
 - * Model base development
 - * Open innovation
- ◆ Connected plants with Zero impact on environment and workers
- ◆ Global human resource development

Mid-Term Management Plan (2/2)

We will accelerate the speed of advancing the level of DANTOTSU products, DANTOTSU services and DANTOTSU solutions, and create DANTOTSU Value (ESG solutions through the creation of customer value and improvement of earnings).

DANTOTSU Value (ESG solutions through the creation of customer value and improvement of earnings)

Workplaces of the future: Safe, highly productive, smart and clean

[Advancement of Construction]
Commitment to safety and productivity

- ◆ Optimization platform and solutions business strategies




[Advancement of Machine Operations]
Commitment to "visualization" of machine operations

- ◆ Preventive maintenance by applying IoT and AI
- ◆ Lifecycle support under serial number-based management
- ◆ Next-generation KOMTRAX



[Advancement of Machines]
Commitment to high quality and high value

- ◆ Automation, autonomous operation, electrification, remote controlling



DANTOTSU Product

DANTOTSU Service

DANTOTSU Solution

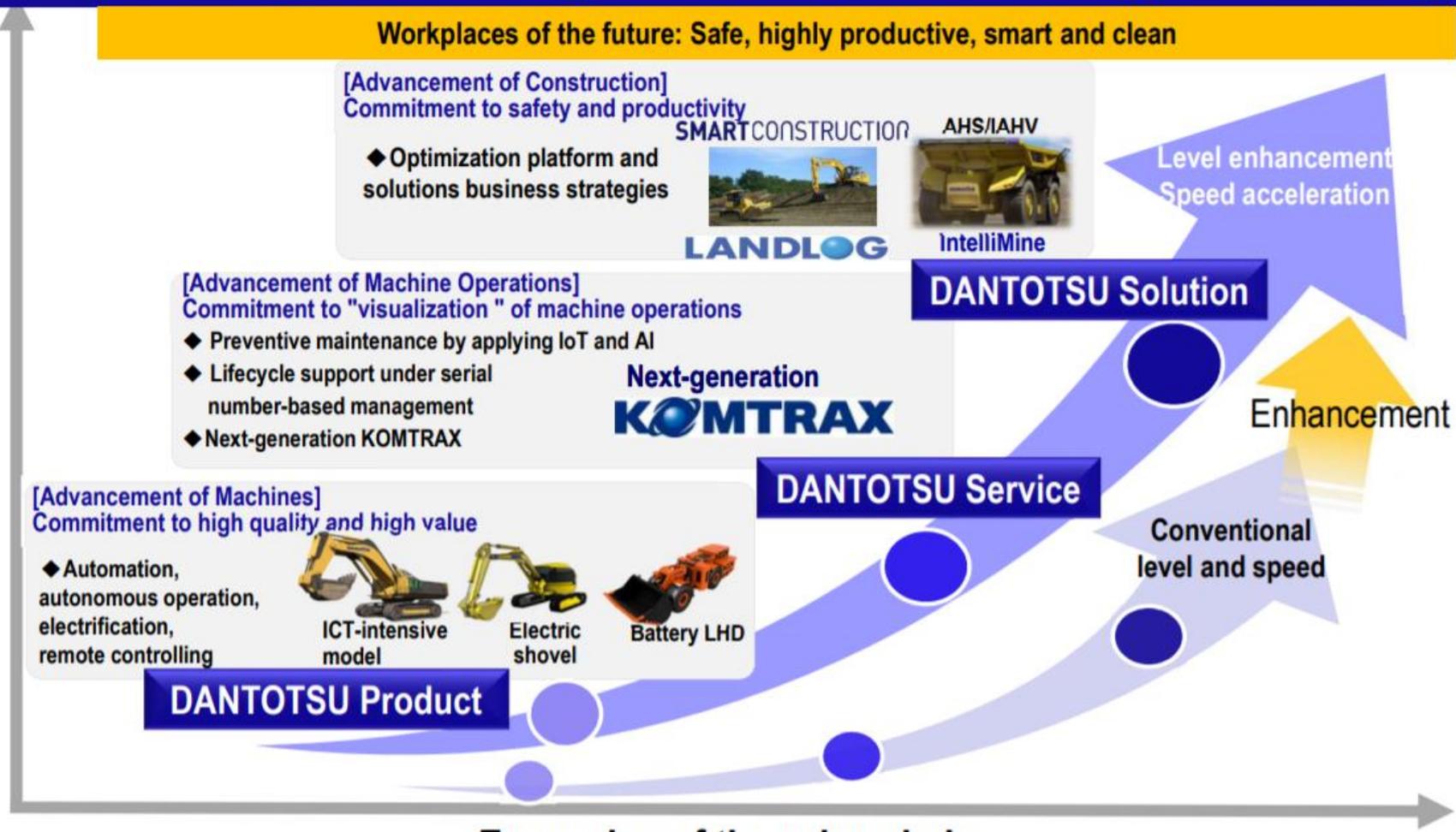
Value

Expansion of the value chain

Level enhancement
Speed acceleration

Enhancement

Conventional level and speed



Major mining companies are focused on safety enhancement and productivity increases capable through automation, and greenhouse gas reductions.

<Customer A>

- AHS Expansion
- Elimination of Live Work
- Electrification of Mining truck and loader
- Automation other than trucks (Loader, dozers, etc.)

Voice Of Customer

< Customer B >

- AHS Expansion
- Trolleys & Electrification
- Expansion of Underground Hard Rock Business

International Council on Mining and Metals (ICMM)

Innovating to provide cleaner, safer vehicles

- Introduce greenhouse gas emission-free surface mining vehicles by 2040.
- Minimize the operational impact of diesel exhaust by 2025. (For underground)
- Make collision avoidance technology available to mining companies by 2025.

By investing in these technologies, Komatsu will expand its capabilities and provide customer value in a form that fits the evolving needs of our customers.

Automation

Operation Centre

Tele-operation

IAHV

Safety

Speed control and CAS

Hawkeye

ProVision & MineAlert

Vehicle Intervention

Future Mining

Digitalization (Data Driven Operation)

Value Chain Integration

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Analytics and prognostics

Sensing (e.g. Real time Ore analysis)

Sustainability (Electrification, etc)

Trolley

SR motor & KESS

Battery drive

Autonomous Haulage System (AHS)

Automation

- Operation Centre
- Tele-operation
- IAHV
- Speed control and CAS
- Hawkeye
- ProVision & MineAlert
- Vehicle Intervention

Safety

Future Mining

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**Digitalization
(Data Driven Operation)**

Analytics and prognostics Sensing (e.g. Real time Ore analysis)

**Sustainability
(Electrification, etc)**

Trolley

SR motor & KESS

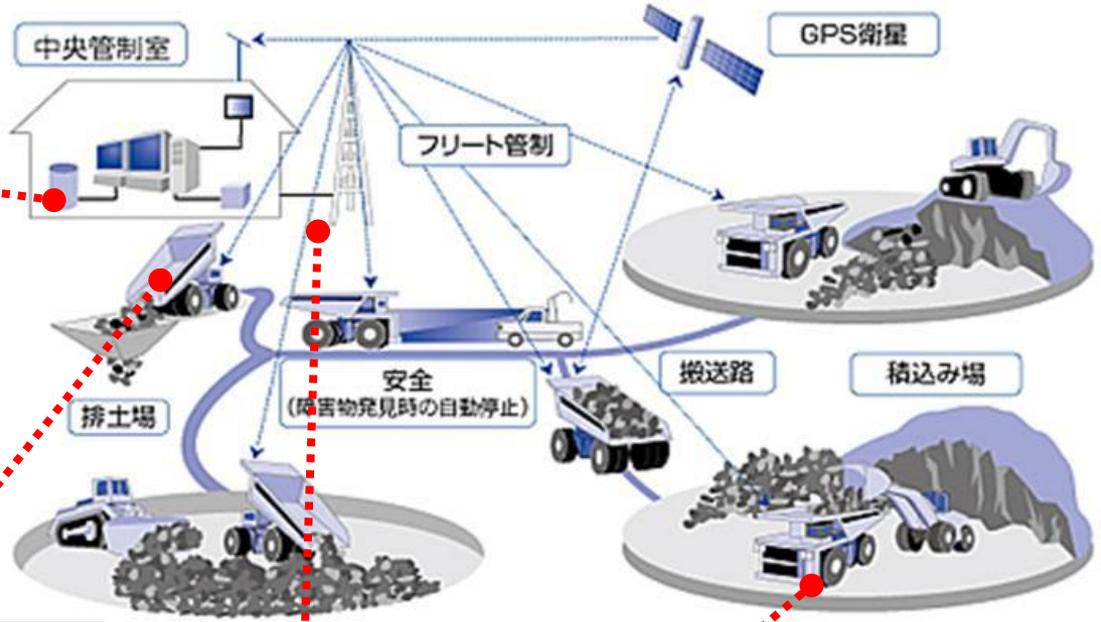
Battery drive

History of Komatsu AHS

- Komatsu started Autonomous Haulage System (AHS) research and development in Japan in 1990 with the 32-ton class dump truck HD325.
- The company launched the world's first commercial application of AHS in 2008 and has been leading the AHS market since.



AHS system configuration



① Central control room

Fleet Control System (FrontRunner™)

② AHS truck : 980E/930E/830E

前方モード表示機

GPSアンテナ

無線アンテナ

後方モード表示機

障害物検知センサ (後方)

緊急停止ボタン

コントロールパネル

通信装置

ステアリングセンサ

障害物検知センサ (前方)

③ Communication network system

Main Tower

Mobile Repeater

④ AHS device for manned vehicle

GPS Antenna

Control Panel

Emergency Stop Button

Excavator

Motor Grader

Patrol Car

Bulldozer

M/L Hub

Experience Matters



Since our first commercial AHS deployment in 2008, we've been building a steady track record of success.

Zero Harm

Zero system-related injuries involving Komatsu's AHS

0

Footprint

268 Units

FY2019	FY 2020 (FY2Q)	FY2021
221	268	380

West AUS Iron mins

- launch since 2008
- Over 180units operation in 6 site

Canada Oil sand mine

- Launch since 2016,Over 50 units.

Coal mine

- launch since 2020

Chile Copper mine

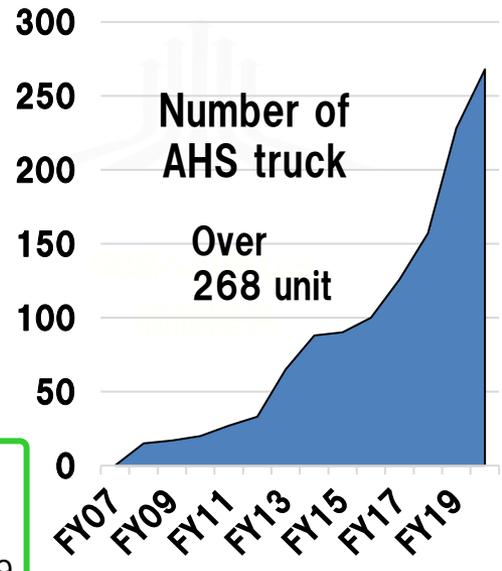
- launch since 2008
- Over 20 units operation

East AUS Coal mine

- launch since 2020

Brazil Iron mine

- launch since 2019



AHS provides Komatsu customers cost and productivity improvements such as:

- Improving machine utilization by reducing operating shift times and truck downtime
- Extending tire life and reducing fuel consumption by optimizing truck operations (reduce sudden steering and acceleration)

Reducing costs

Load and haul unit cost reduced by up to

15%



Extending tire life

Optimized automatic controls reduce sudden acceleration and abrupt steering resulting in up to

40%

Improvement in tire life compared to manned operations



Minimize footprint

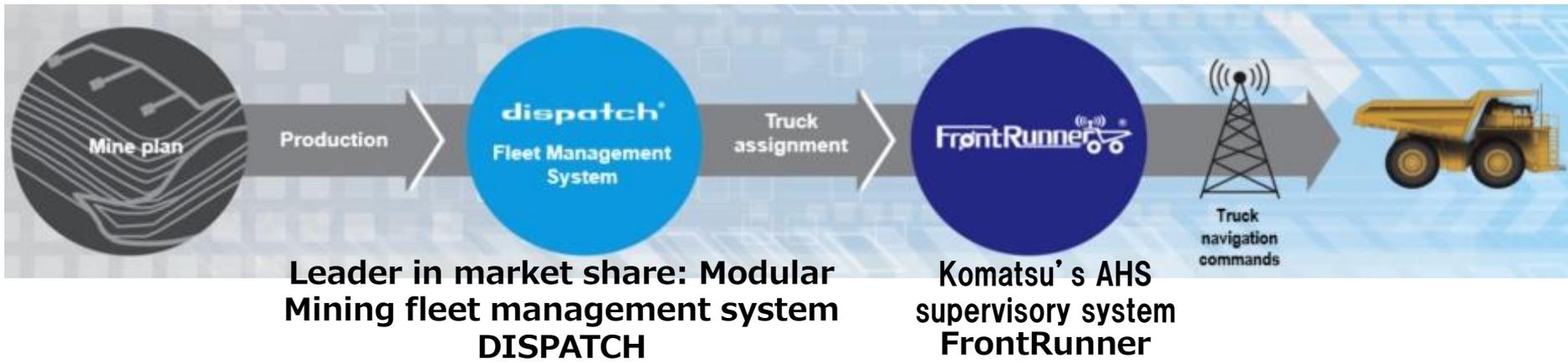
With AHS, operations consume less fuel and emit less CO₂



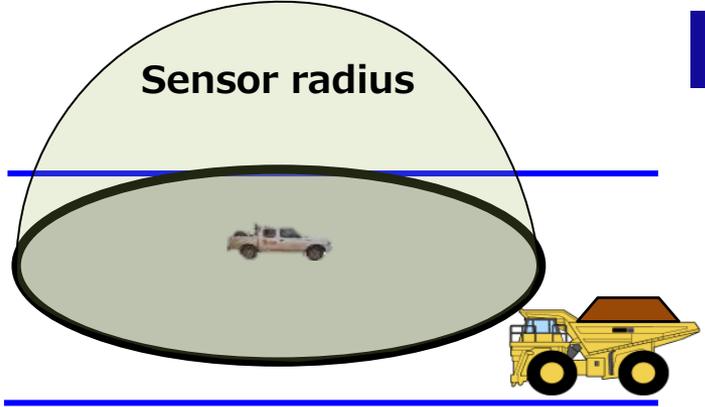
Productivity increases of up to **15%**



Strength of Komatsu AHS: Technology
Bundled with the company's Modular Mining DISPATCH fleet management system to optimize mine operation, and enable safe and efficient truck operation within the AHS area.



Strength of Komatsu AHS : Safety
Komatsu puts the highest priority on safety. With AHS, manned vehicles (e.g. light vehicles) are protected by a sensor radius that provides permission to the AHS truck. There have been no system-related injuries reported since our first AHS commercial deployment in 2008.



Experience Matters



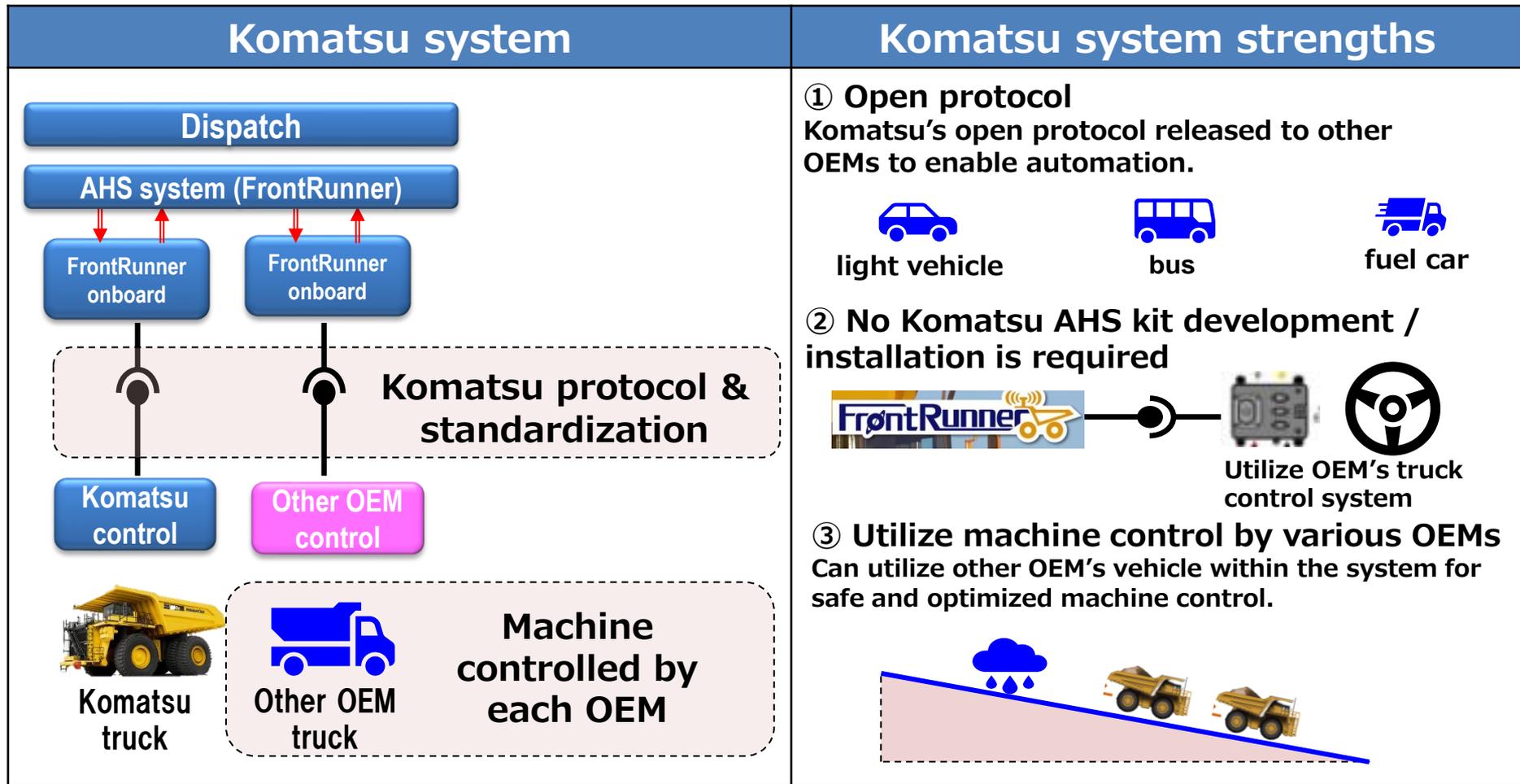
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Komatsu's interoperability capability enables other OEM's trucks to be operated in Komatsu's AHS system through FrontRunner. Komatsu is working to standardize related protocol as the industry standard. Komatsu's AHS system provides an open protocol and allows other OEM's trucks to work within the system for safe and optimized machine control.



- Bundle with Modular Mining's fleet management system DISPATCH
- Connect all equipment with mining process to enhance productivity

Integrate with Modular Mining's DISPATCH system

No.1 market share
Pioneer of FMS



&

Komatsu AHS Supervisory system

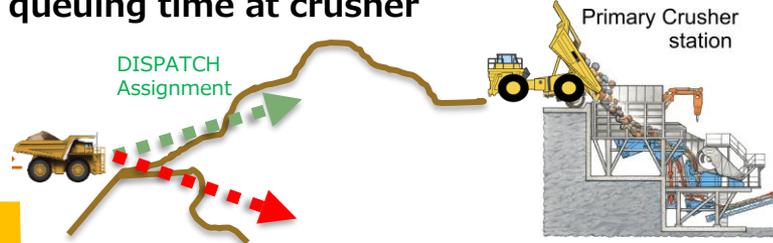
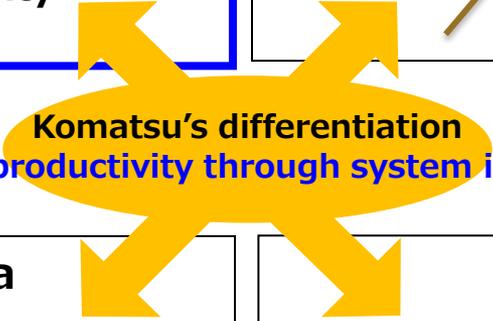


We provide higher productivity than competitors

Interface with mining process (e.g. crusher)

<Partially completed>

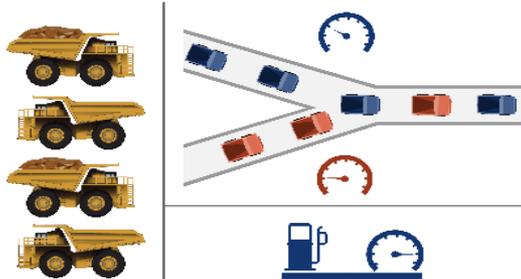
Optimize truck assignment to minimize truck queuing time at crusher

Utilize real-time truck data

<Plan>

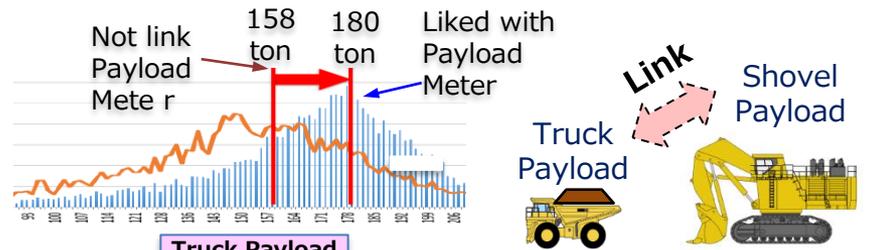
Traffic management at intersection



Loading optimization

(Payload management) <Development is in progress>

Linkage between shovel and truck payload meter stabilizes and maximizes productivity

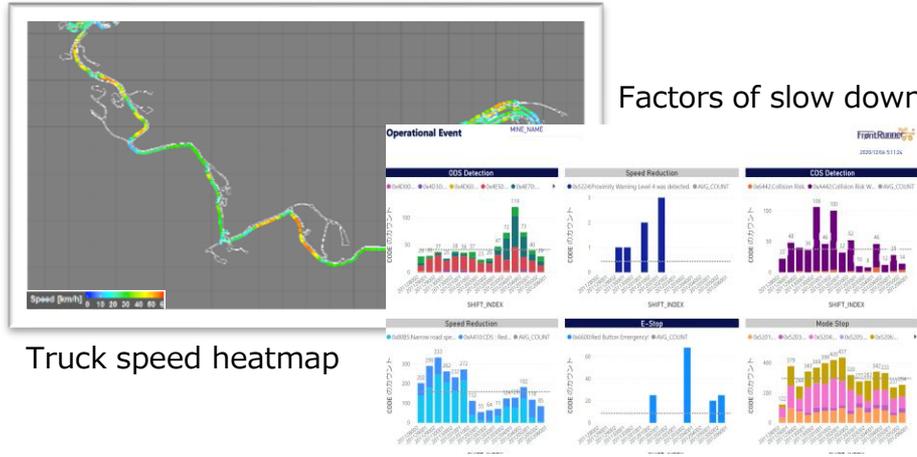


AHS is advancing mine operation visualization since AHS is rich in data. Enhancing data analytics to accelerate mine productivity Kaizen (improvement) activity to strengthen customer value.

Example of Kaizen activity

① Visualization of truck slow down factor

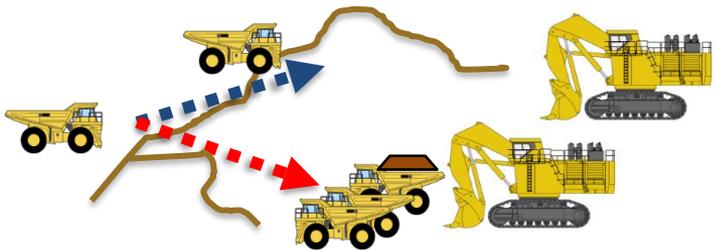
Visualize hot spot of truck slow down and its factor for improvement (Haul road improvement)



Truck speed heatmap

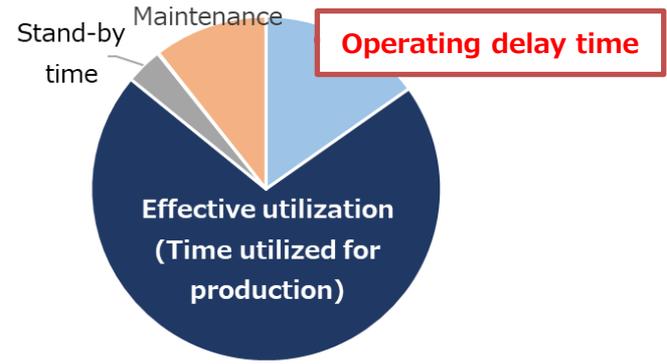
② Optimize truck assignment by DISPATCH system

Optimize truck assignment to avoid congestion

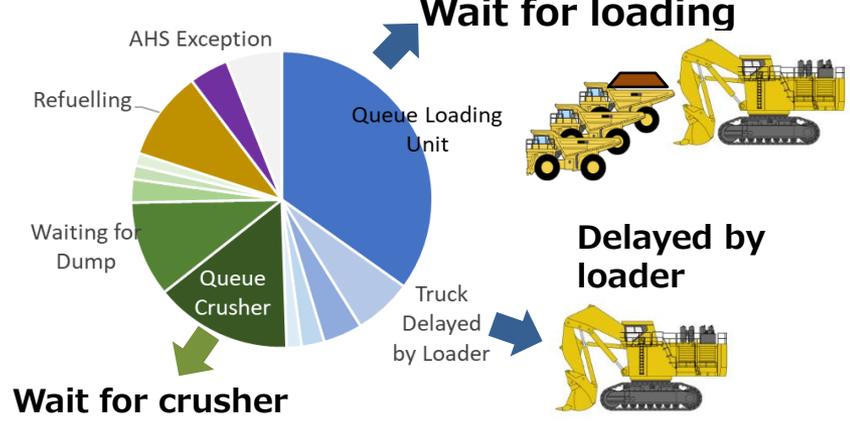


Example of analytics

Truck operating time: Productivity improvement opportunity by maximizing effective utilization



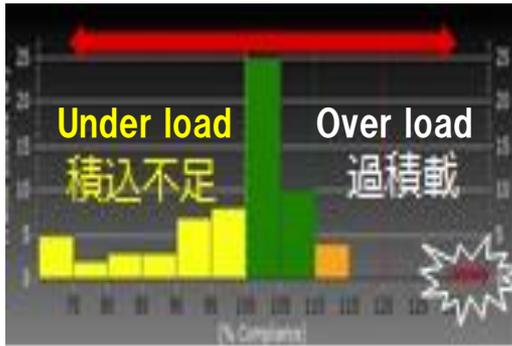
Operating delay breakdown: Factor of lowering effective utilization time



Optimization (matching) with preceding process (loading) is important to improve truck productivity

Loading optimization (Payload management)

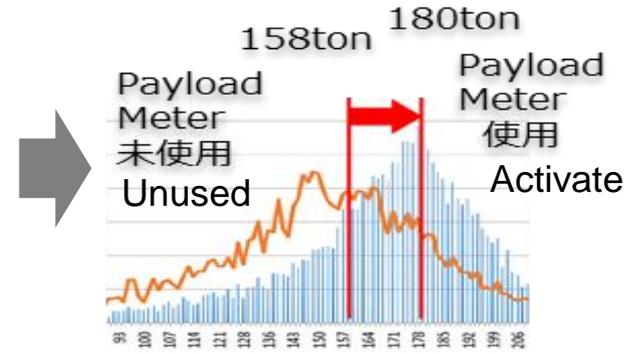
Truck payload



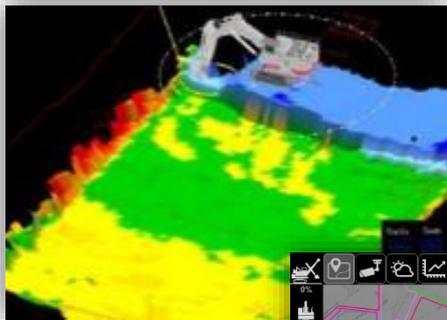
Reduction of volatility through real-time monitoring



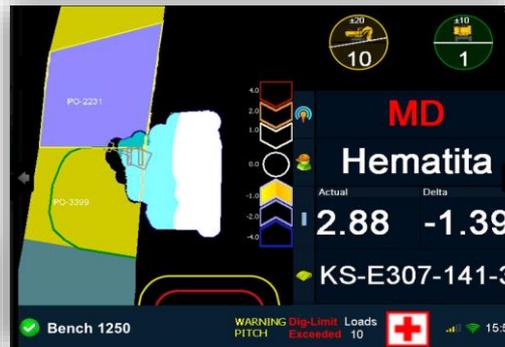
Increase truck payload



Efficient loading (operator guidance, online coaching/offline coaching)



Geography mapping and loading guidance



Loading guidance of material display



Simulator Training

- Komatsu is developing a tele-remote operation system to remove operators from harm's way to further enhance mine safety
- The system aims to improve productivity beyond manned operation supported by automation and AR technology

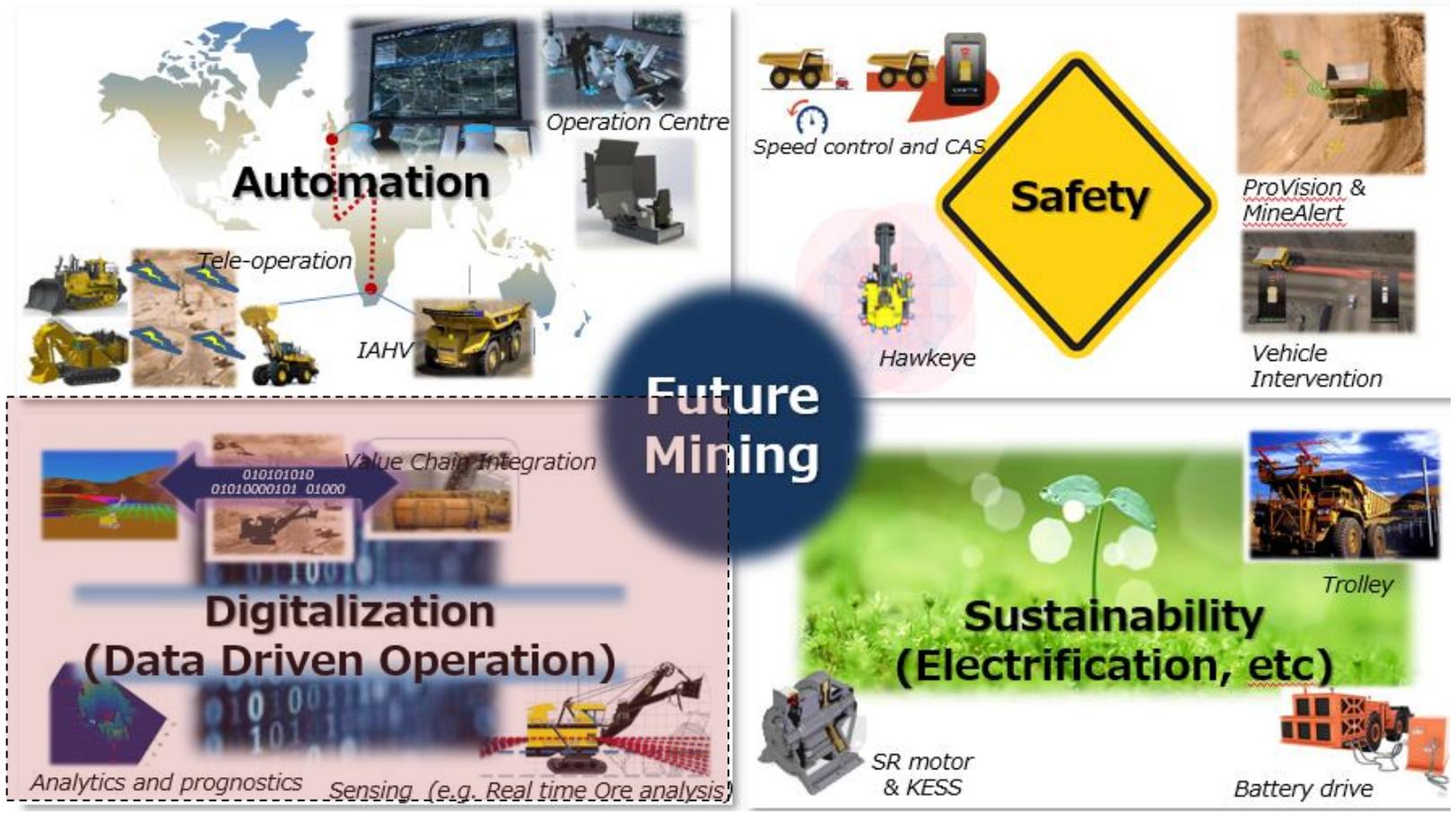


AHS truck with excavator
(Tele-remote operating system is in progress of development)

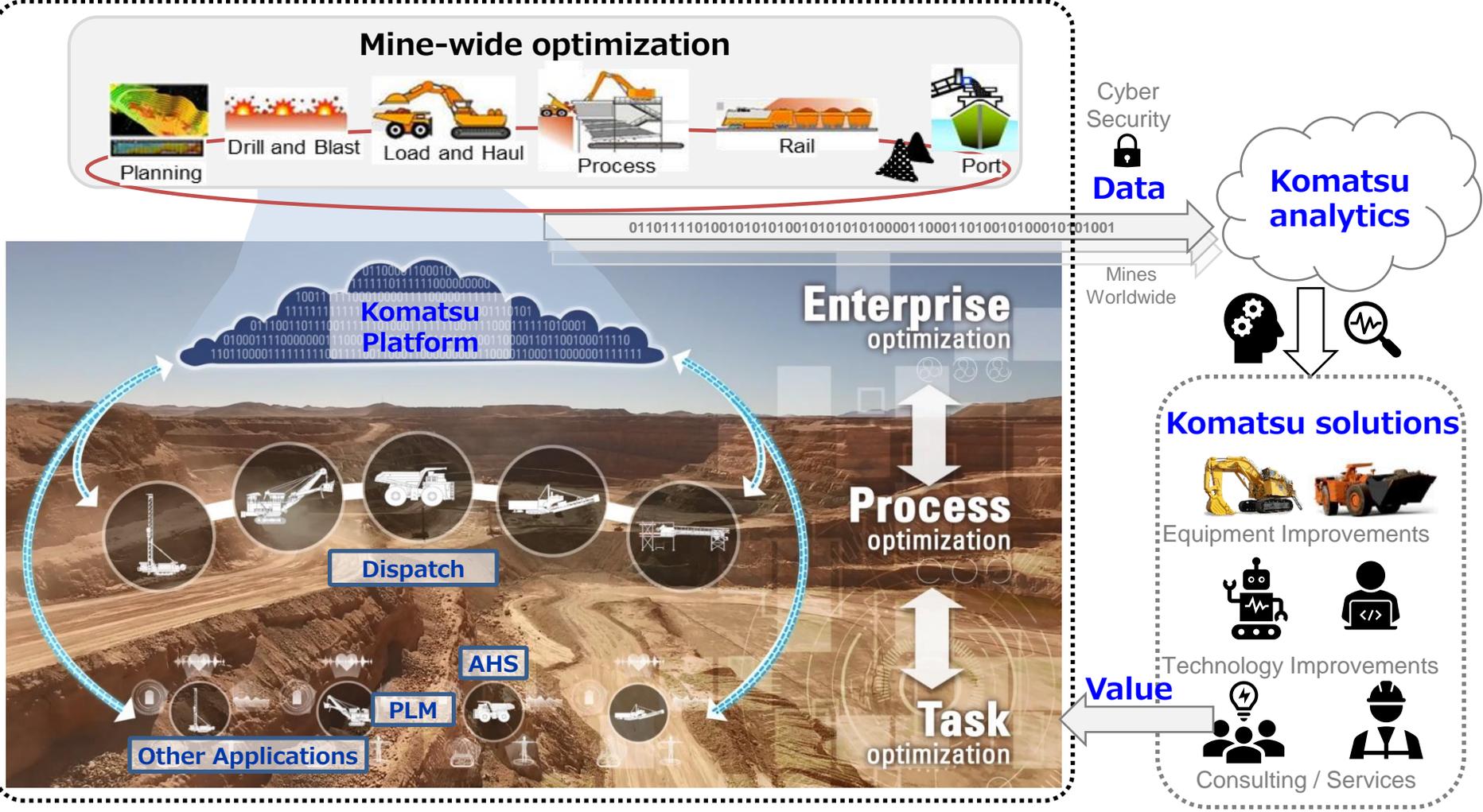
Tele-remote operation console utilizes technologies of Komatsu companies including Immersive Technologies, MineWare and Modular Mining.



Mine-wide optimization



- Major mining companies are pursuing continuous improvement by targeting zero wait time between processes for mine wide optimization
- Komatsu is developing an open technology mining platform to support customers, discussions are ongoing to interface with customers ERP system



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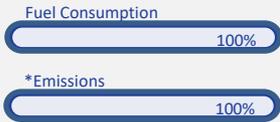
- Major mining companies are committed to obtaining zero (or significant reduction of) greenhouse gas emissions
- Komatsu prioritizing work on trucks with high GHG emissions, and will deploy trolley assist system, followed by full electrification

Electrification and Greenhouse Gas Reduction Timeline

Tier 1
MCRS
Advantage



Pre-Electrification



Today

Stage I Electrification + Tier 4

- Removed Drive System Cooling Fan
- Electric On-Demand Cooling
- Optimized Resister Grid Cooling Fan

Fuel Consumption (Stage I + Tier 4): 98%

Emissions (Stage I + Tier 4): 1.9

Stage II

Stage II Electrification + Trolley

Potential for:

- Electric Driven Hydraulic Pumps
- Electric HVAC System
- Electric Engine Cooling

Progression to Stage III requires a common power interface.

Fuel Consumption (Stage II + Trolley): 48%-68%

Emissions (Stage II + Trolley): .17%-.46%

Stage III

Stage III Electrification + Battery/Hybrid

- Selectable Option Power Systems
- Continued use of Power Module for field power system changes
- Choose from:
 - Diesel
 - Trolley
 - Electric Hybrid
 - Fully electric

Diesel/Trolley

Fuel Consumption: 48%-68%

Emissions: .17%-

Electric

Fuel Consumption: 0

Emissions: 0

*Emissions reduction includes; NOx, Hydrocarbons, and Particulate Matter

*Emissions reductions are a result of improvements made in Fuel Consumption and Engine Design including the addition of SCRs and DEF

Thank you for your attention



[Picture : Cabless truck prototype (Arizona, USA)]