Komatsu IR-Day 2020

The pursuit of safety and productivity at mine sites

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President, Mining Business Division

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Mid-Term Management Plan (FY2019～FY2021)

○ I would like to take a brief look-back at Komatsu's mid-term management plan.

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Mid-Term Management Plan (1/2)

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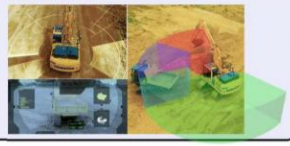
We will achieve sustainable growth in the face of changing external environment and challenges by focusing efforts on the following three pillars of growth strategies.

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

○As the external environment and social values surrounding Komatsu change, we uphold the three pillars of our growth strategy, that is, value creation through innovation, growth strategy through business reform, and structural reform for growth.

○ Regarding value creation through this innovation, we are working on digital transformation by means of an optimization platform and mining machinery, as well as automation, autonomous operation and electrification of mining machinery.

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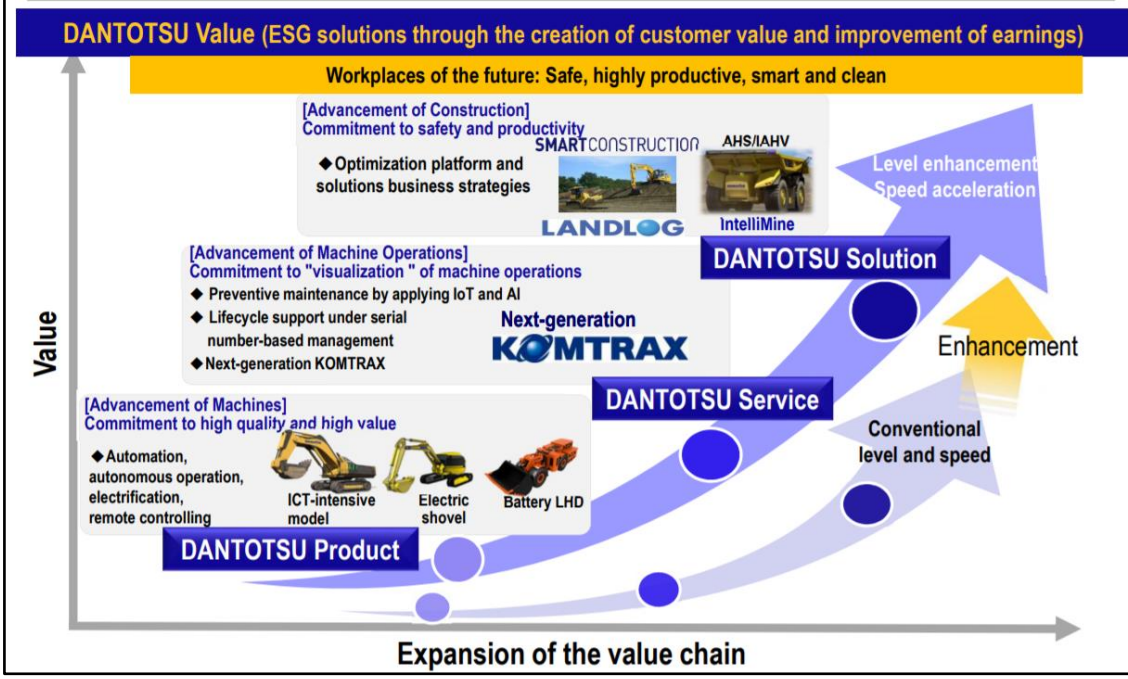
Mid-Term Management Plan (2/2)

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).



○ As a DANTOTSU product, we have achieved the sophistication of individual products through high quality and automation, and as a DANTOTSU service, we have enhanced machine operation and construction by “visualizing” the operation using KOMTRAX.

○ Through the creation of these customer values, we are working to solve ESG issues and improve profits.

○ Today, I would like to explain the pursuit of construction safety and productivity in mining.

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Voice of customer

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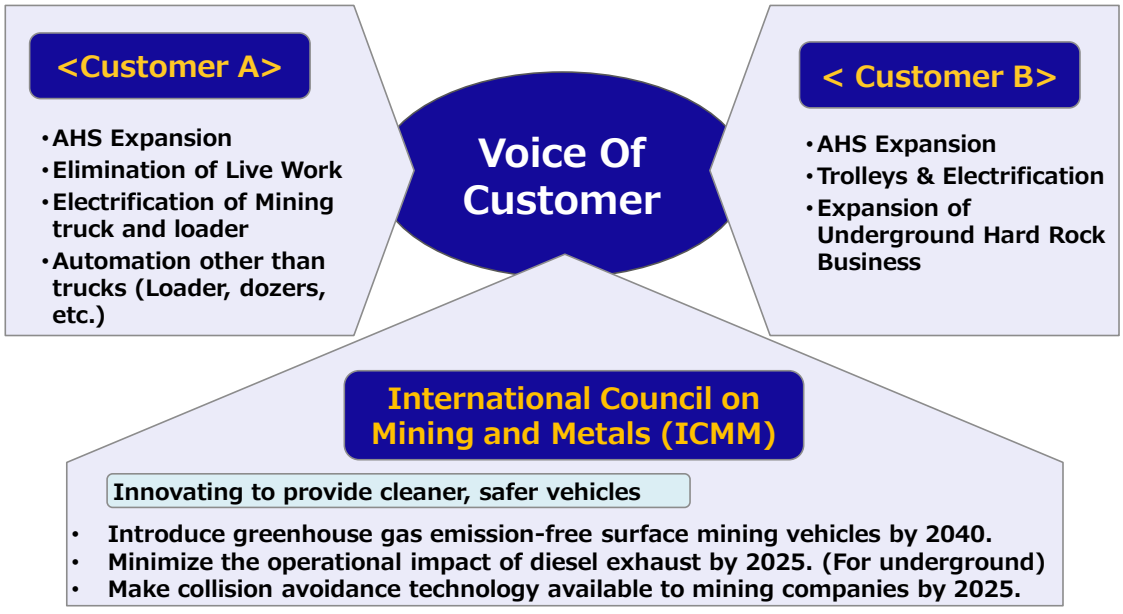
Major mining companies are focused on safety enhancement and productivity increases capable through automation, and greenhouse gas reductions.



○ I will explain recent demands and trends of the mining equipment market.

○ We have had direct dialogues with major mining companies, discussing the challenges facing the mining industry and what future visions they have.

○ As shown here, mining companies commonly list "improvement of safety and productivity by automation" and "reduction of greenhouse gases" as their issues to be solved mainly by deployment of the Autonomous Haulage System (AHS) and electrification.

○ For mining customers, solving these issues is an essential requirement, like a license, to continue mining into the future, and we are working to resolve these issues.

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Future mining technologies

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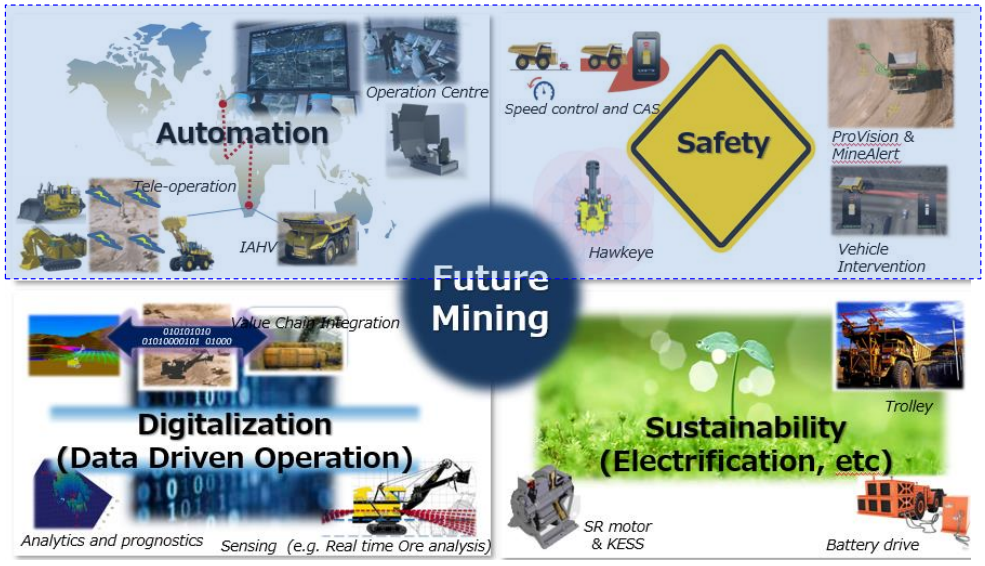
By investing in these technologies, Komatsu will expand its capabilities and provide customer value in a form that fits the evolving needs of our customers.

○ We are continuing to make priority investments in the four areas of Automation, Safety, Digitalization, and Sustainability in order to respond to the common issues of mining customers, that is, "improvement of safety and productivity through automation" and "reduction of greenhouse gases". By providing customer value in a targeted manner, we will increase the degree of their dependence on us as their indispensable partner.

○ Today, I would like to explain our efforts surrounding these four themes.

Autonomous Haulage System（AHS）



○ From here, I am going to explain the pursuit of automation and safety, focusing on AHS.

○ I will explain the history and outline, and then, Komatsu's strengths and development policies in order.

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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.**

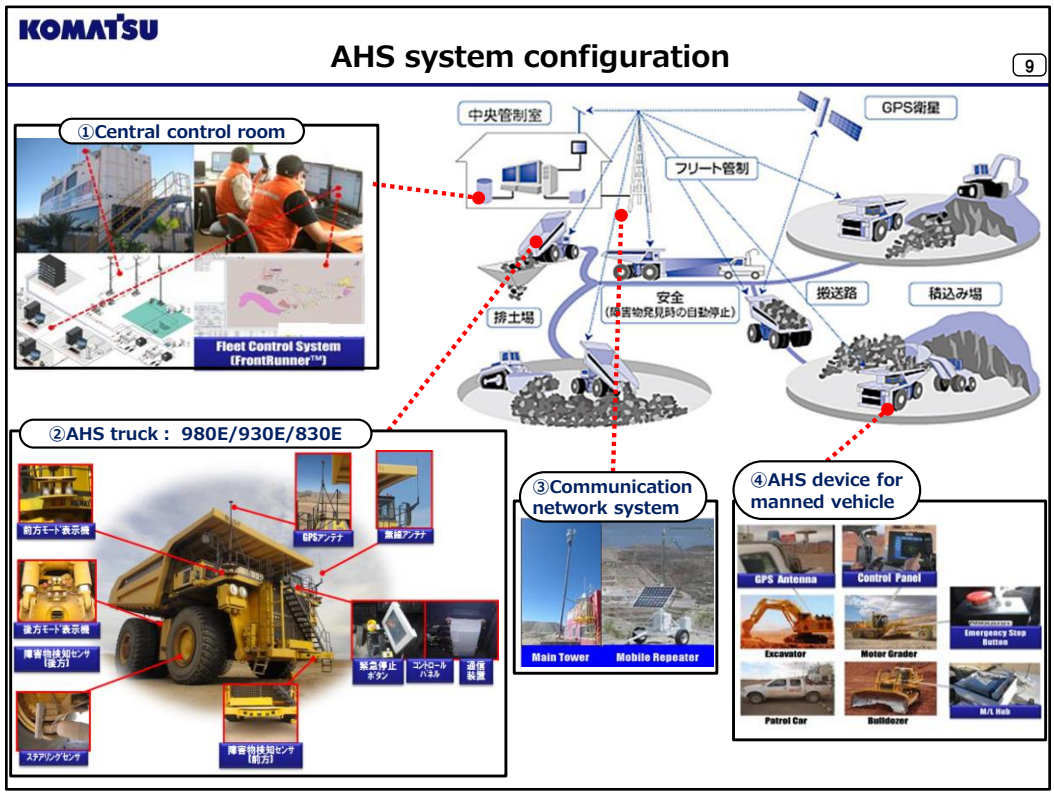
○ First is the history of AHS.

○ I joined Komatsu in 1982, and even then Komatsu was conducting basic research on Autonomous Haulage Systems.

○ In the 1990s, we started full-scale research for practical use and started test operations at mining sites in Japan.

○ In 2005, we began a test operation at a Chilean mine, and Komatsu engineers took turns on a business trip for two months in the harsh environment of the Chilean mine, and repeated test operations locally to improve the degree of perfection. In 2008, we embarked on the world's first commercial operation of AHS at the Chilean mine.

○ Komatsu's AHS has been highly evaluated for its safety and productivity, and has since been introduced to mines in Australia, Canada and Brazil.



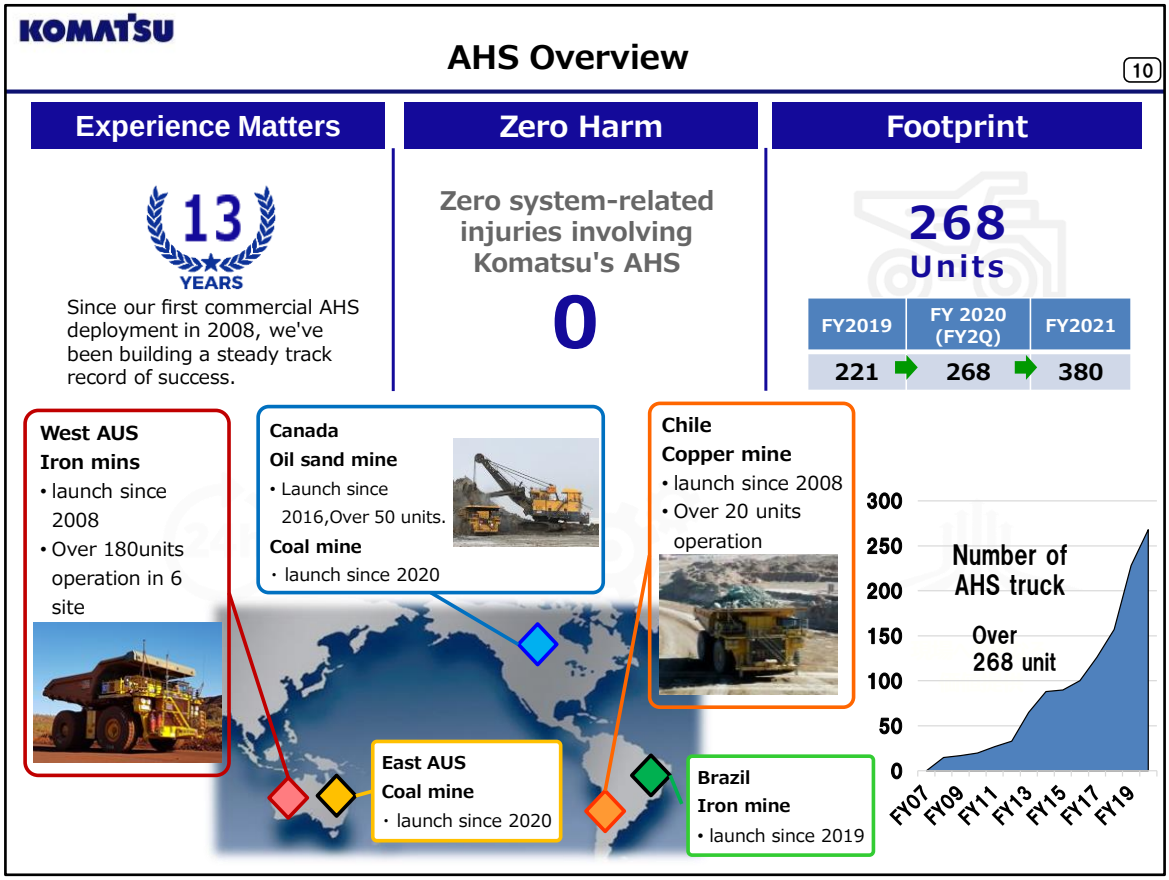
○ AHS is roughly divided into four components..

○ 1)The AHS Central Control Room monitors the operating status of autonomous trucks, manages operations, and responds to abnormalities. By installing this central control away from dangerous sites where large machinery operates, it is possible to keep people working in the mine away from danger. In fact, there is a central control room in a city 1,500km away from mines in Australia.

○ 2) We have already introduced these three models of AHS dump trucks to the market. The AHS equipment installed in the vehicle is standardized among the three models, and is installed according to each vehicle, tuned according to the vehicle characteristics, and optimized for each model.

○ 3) AHS's communication infrastructure supports Wi-Fi and LTE, We are going to keep pace with technology development, such as 5G, to ensure compatibility.

○ 4) In addition, manned vehicles, such as loading machines, operating in the mine are equipped with AHS equipment to transmit their own position information, instruct AHS trucks, and engage in an emergency stop of the system.



○ Next is the operating status.

○ Our AHS has already entered the 13th year since its commercial introduction in 2008, but no system-induced personal injury has occurred to date.

○ Our AHS has been evaluated for its high degree of safety and productivity, and the number of units in operation has expanded. Currently, it has been deployed at 13 sites in four countries, and a total of 268 units are in operation.

○ We plan to start operation of 380 units (medium-term management plan) at the end of 2021, but we also have other major opportunities.

○ While mining customers are rapidly introducing AHS to solve productivity and safety issues through automation, we are also proposing AHS trucks in almost all negotiations of heavy-duty trucks.

○ We believe that the entry of competitors is also a factor in the rapid expansion of the market.

○ Until now, the ratio of AHS trucks in sales of all trucks has been a few percent, but we expect that AHS trucks will exceed 1/4 of the number of all trucks to be delivered.

○ Over 30 years ago, Komatsu embarked on research and development of AHS dump trucks, and has since carefully fostered their full-scale commercialization. They have finally begun to blossom in recent years.

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Customer benefits of AHS

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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 CO_2

○ Here I will explain the customer benefits of AHS.

○ AHS improves operating rates by reducing operating shift times and downtime, such as truck breakdowns. Furthermore, optimized vehicle control, such as reduction of sudden deceleration and sudden steering, can extend tire life and cut down fuel consumption and CO2 emissions.

○ Customers have announced that this has lowered production costs per ton by 15%.

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Strengths of Komatsu's AHS

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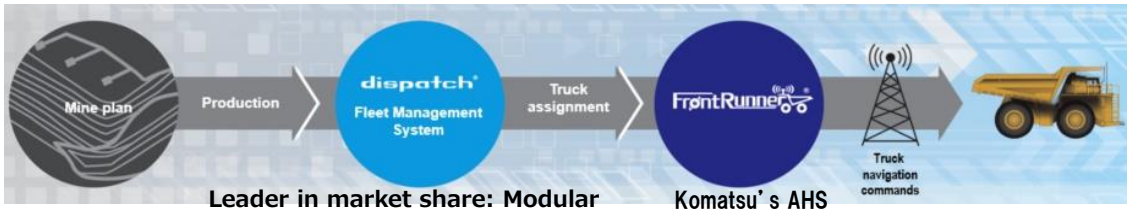
Strength of Komatsu AHS: Technology

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.

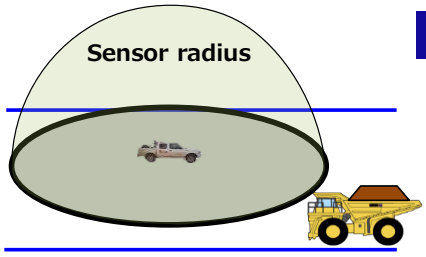


Leader in market share: Modular Mining fleet management system DISPATCH

Komatsu's AHS supervisory system FrontRunner

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

13 YEARS

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

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○ Next, I would like to explain our strengths and points of differentiation from competitors.

○ The first is a combined use with the optimal vehicle allocation management system.

○ 1) Optimal vehicle allocation instructions to AHS trucks are given by the DISPATCH Fleet Management System (FMS) of Modular Mining, our subsidiary and a pioneer in the industry and with the largest share in the mining market. Based on DISPATCH's instructions, the FrontRunner autonomous haulage system automatically drives trucks and achieves safe and efficient operation.

○ 2) Our AHS places top priority on the safety of manned vehicles operating in the AHS area. AHS trucks cannot run unless manned vehicles permit their operation.

○ As a result, we have continued to operate with zero accidents, resulting in no injury or death due to the system.

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Truck interoperability standard

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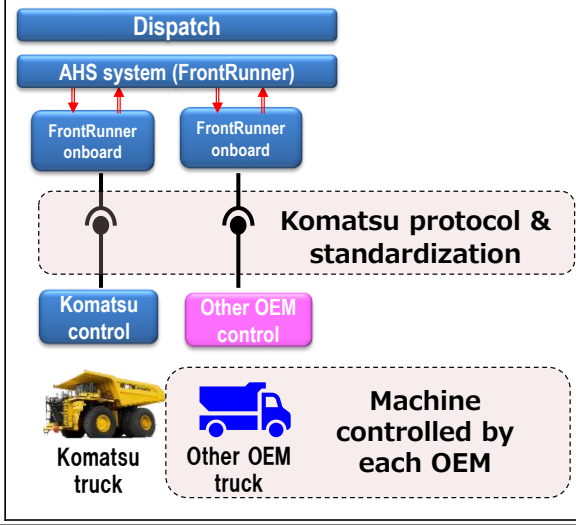
Komatsu's interoperability capability enables other OEM's trucks to be operated in Komatsu's AHS system through FrontRunner. Komatsu is working to standardize related protocol as the industry standard. Komatsu's AHS system provides an open protocol and allows other OEM's trucks to work within the system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

Komatsu system



Komatsu system strengths

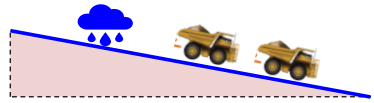
① Open protocol
Komatsu's open protocol released to other OEMs to enable automation.

light vehicle　bus　fuel car

② No Komatsu AHS kit development / installation is required

Utilize OEM's truck control system

③ Utilize machine control by various OEMs
Can utilize other OEM's vehicle within the system for safe and optimized machine control.



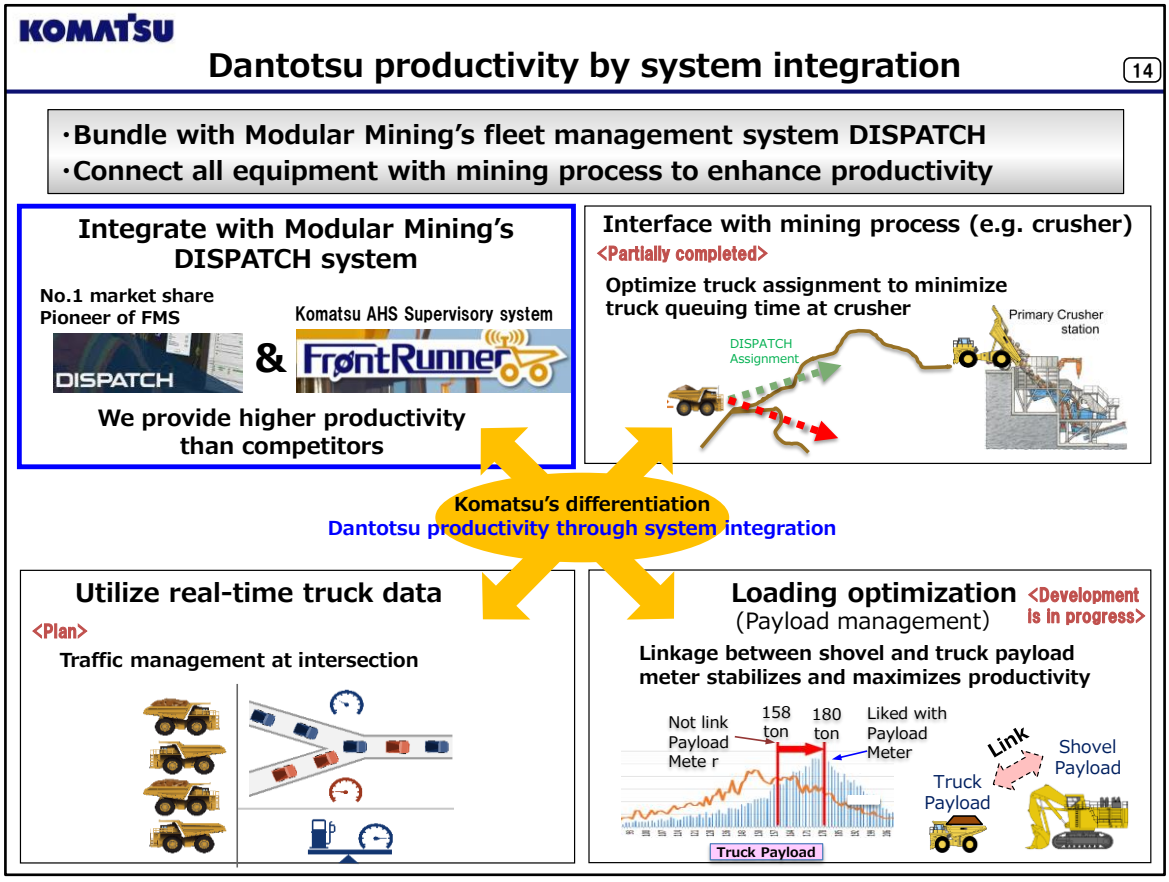
○ Next, I will explain Komatsu's interoperability policy.

○ In the mine, not only Komatsu trucks but also trucks made by other companies are in operation, but mine customers want to automate all the vehicles in the mine.

○ As shown in the figure on the left, Komatsu gives instructions to each vehicle for automatic driving through the FrontRunner in-vehicle system, but Komatsu standardizes the communication protocol between the control system and the vehicle, and we are developing interoperability to realize automatic driving of vehicles made by other companies with our AHS system.

○ As shown on the right, by standardizing this communication agreement and opening it to other companies, we will promote the automation of mine operating vehicles such as trucks made by other companies and service vehicles in the mine.

○ In addition, regarding vehicle control, we ask each vehicle manufacturer to control the vehicle, so we believe that safety can be improved by optimal control according to the vehicle characteristics of each manufacturer, even on slippery downhills, for example. ..



○ We are striving to optimize mining by connecting the equipment and pre- and post-processes in the mine through a system centered on Modular Mining's DISPATCH.

○ In the example on the upper right, DISPATCH connects to the crusher production control system so that the arrival time of the truck to the crusher can be accurately predicted and the waiting time for the truck can be predicted automatically. The destination is automatically changed to a temporary storage site (stock pile).

○ Furthermore, we will maximize the loading capacity by arbitrating at intersections by using real-time truck information, connecting the loading machine and truck with DISPATCH, and transmitting the loading status to the loading machine in real–time.

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Customer value enhancement

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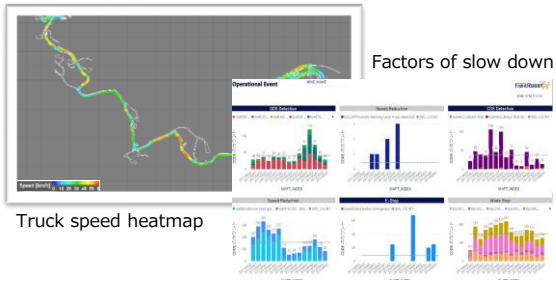
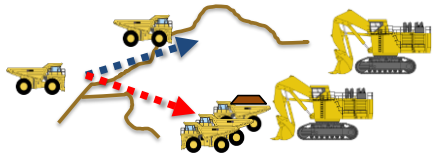
AHS is advancing mine operation visualization since AHS is rich in data. Enhancing data analytics to accelerate mine productivity Kaizen (improvement) activity to strengthen customer value.

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)

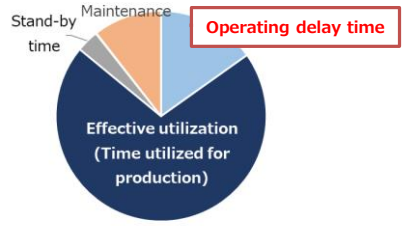


② **Optimize truck assignment by DISPATCH system**
Optimize truck assignment to avoid congestion

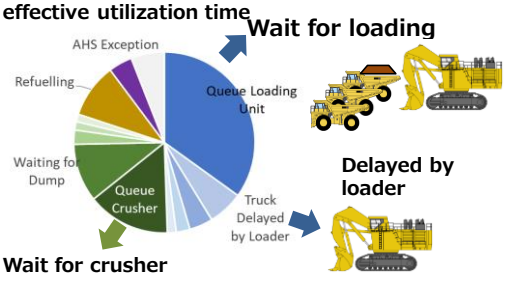


Example of analytics

Truck operating time: Productivity improvement opportunity by maximizing effective utilization



Operating delay breakdown: Factor of lowering effective utilization time



○ However, customers do not maximize productivity by simply deploying an AHS system. They can maximize productivity by performing operations that match the characteristics of AHS.

○ Since AHS can acquire a lot of data, the operating status is becoming more visible. As an example given here, customers can improve their operations with each use, by understanding where the AHS truck is slowing down and what is causing it.

○ On the right is an example of truck uptime analysis. To increase truck production, it is necessary to maximize the actual effective operating time. Further analysis of this waiting time revealed that the loading wait time for trucks was large.

○ In this way, using the data, it is possible to quantitatively grasp the issues and the degree of impact, prioritize them, and proceed with improvement activities.

○ On the next page I will talk about improving the productivity of loading machines.

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Loading Optimization

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

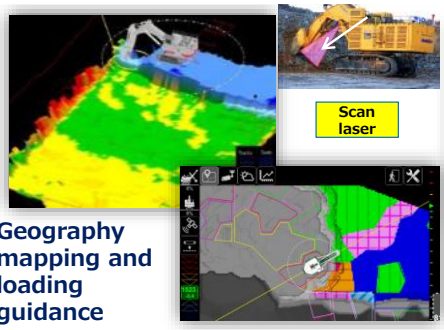
Loading optimization (Payload management)

Truck payload

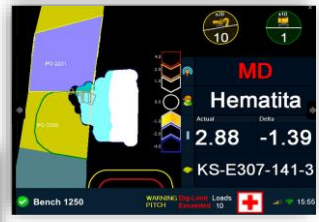
Reduction of volatility through real-time monitoring

Increase truck payload

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



Geography mapping and loading guidance



Loading guidance of material display

Simulator Training

○ The productivity of trucks is affected by the productivity of the loading machine, which is used in the prior stage of the work process.

○ The payload of the truck is provided to the loading machine operator in real time to reduce the variation in the load capacity and increase the load capacity. Furthermore, by providing excavation guidance, real-time coaching, and offline coaching through the use of a simulator to the loading machine operator, the efficiency and productivity of loading work will be improved.

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Automation initiatives for other equipment

- **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.

○ So far, I have explained truck automation, so I would now like to explain our efforts for automation of equipment other than trucks.

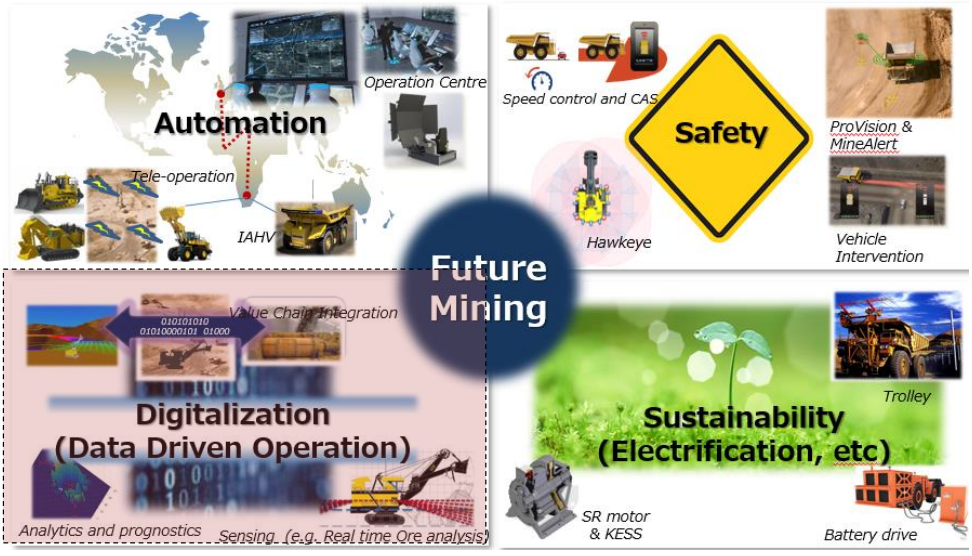
○ We are striving to automate the entire mining operations in order to improve the safety and productivity of the mine, so we would like to introduce one of our efforts, the tele-remote operation system for mining hydraulic excavators.

○ This system not only keeps operators away from the dangerous environment of mining sites, but also is designed to improve productivity beyond manned operation by utilizing automation and AR technology.

○ We have also completed the development of a remote control system for our large mining bulldozers, and are proceeding with the development of automatic operation.

○ We are planning to test both excavators and bulldozers at customer sites, separately, by the end of next fiscal year.

Mine-wide optimization



○ Next, I will explain the optimization of the entire mining operation by means of digitization.

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Open Technology Mining Platform

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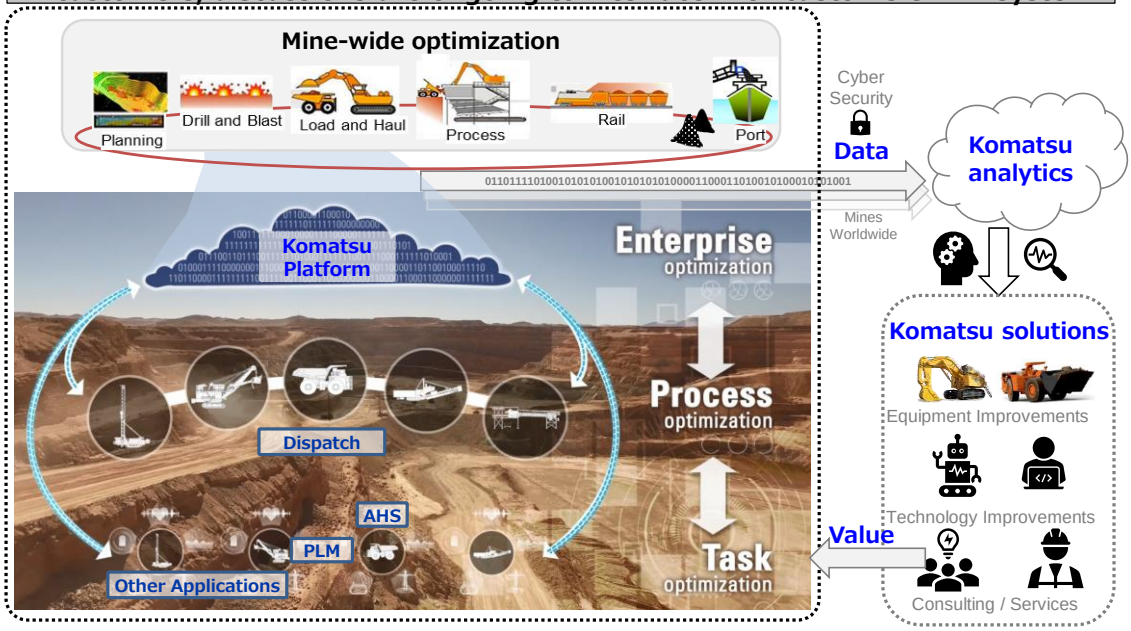
- **Major mining companies are pursuing continuous improvement by targeting zero wait time between processes for mine wide optimization**
- **Komatsu is developing an open technology mining platform to support customers, discussions are ongoing to interface with customers ERP system**

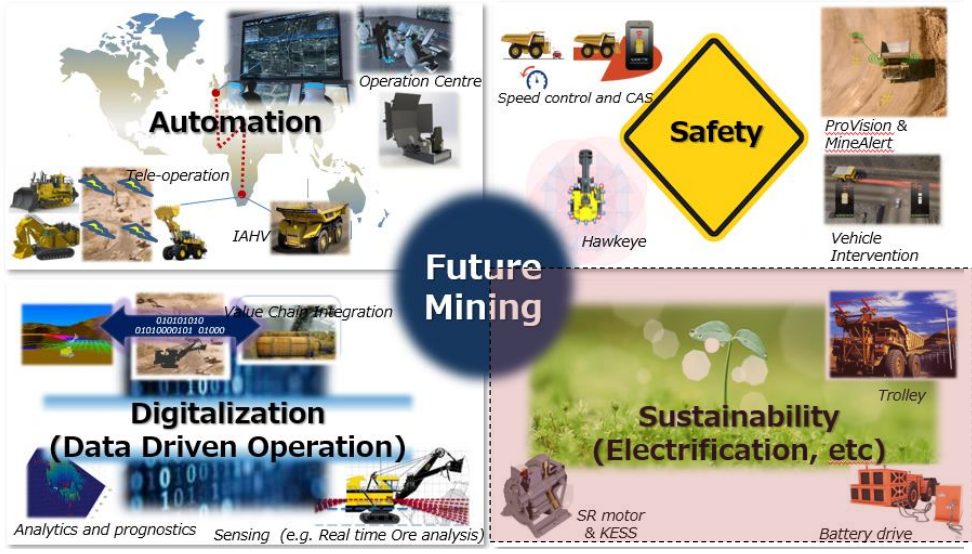


○ Mining customers are working to optimize the entire mining operation with a continuous process that eliminates waiting time between tasks and stock.

○ In addition to improving the productivity of each task, as explained earlier in this presentation, we also reduce the waiting time between tasks by connecting all tasks. By connecting with the customer's business system, we optimize the entire mine production process and improve throughput.

○ Furthermore, we will analyze the data accumulated on the platform, strengthen and improve individual products, and provide consulting services to improve customer value.

Sustainability



○ Before ending my presentation, I am going to explain about sustainability (electrification).

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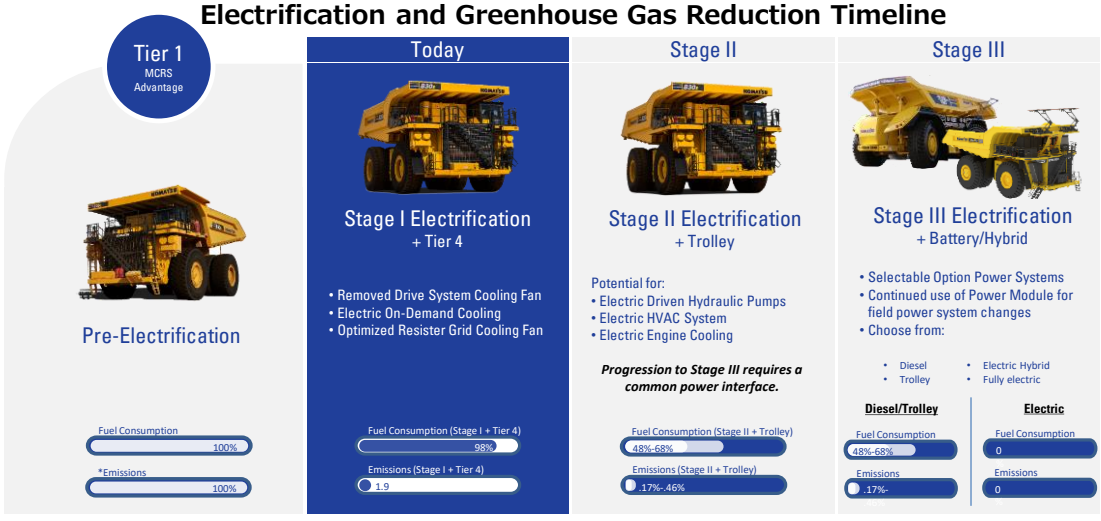
GHG Reduction Initiatives - Electrification of Mining Equipment

- **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



*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

○ Major customers are commonly committed to zero (or significant reductions of) greenhouse gas emissions and are seeking help from us to achieve this.

○ Currently, along with automation, all major customers are demanding electrification of mining machinery.

○ We have already introduced to the market, products equipped with diesel engines of low emission. , In the future, however, we will expand the model range of the trolley assist system powered by electricity taken from the overhead wire, make it hybrid, and introduce full electrification. We will give priority to dump trucks, which have a large number of units in operation.

○ We will also develop Power Agnostic vehicles that allow customers to select the optimal solution, such as diesel, trolley, hybrid, or battery.

○ We are focusing our investment on automation and electrification so that we can provide vehicles that meet the needs of our customers and society as a whole.

Thank you for your attention

【 Picture : Cabless truck prototype (Arizona, USA) 】

○ That is all for my presentation today. Thank you for your interest in Komatsu.