

## Partnership driven Business Growth in Komatsu



Hisashi Asada

ICT Solution division, Komatsu Ltd.

Oct. 22, 2015

## Partnership driven Business Growth in Komatsu

1. Komatsu Overview (Komatsu DNA)
2. Komatsu Business Strategy
3. **KOMTRAX** (Telematics/IoT)
4. **Autonomous Haulage System**
5. **Intelligent MC Construction Machine/  
Smart Construction**
6. Challenge

# 1. Komatsu DNA of “MONOZUKURI”

---

- **Outline of Komatsu and Business History**
- Komatsu Product Line
- Komatsu Way

# 1-1. Outline of Komatsu (FY2014 Business Results)

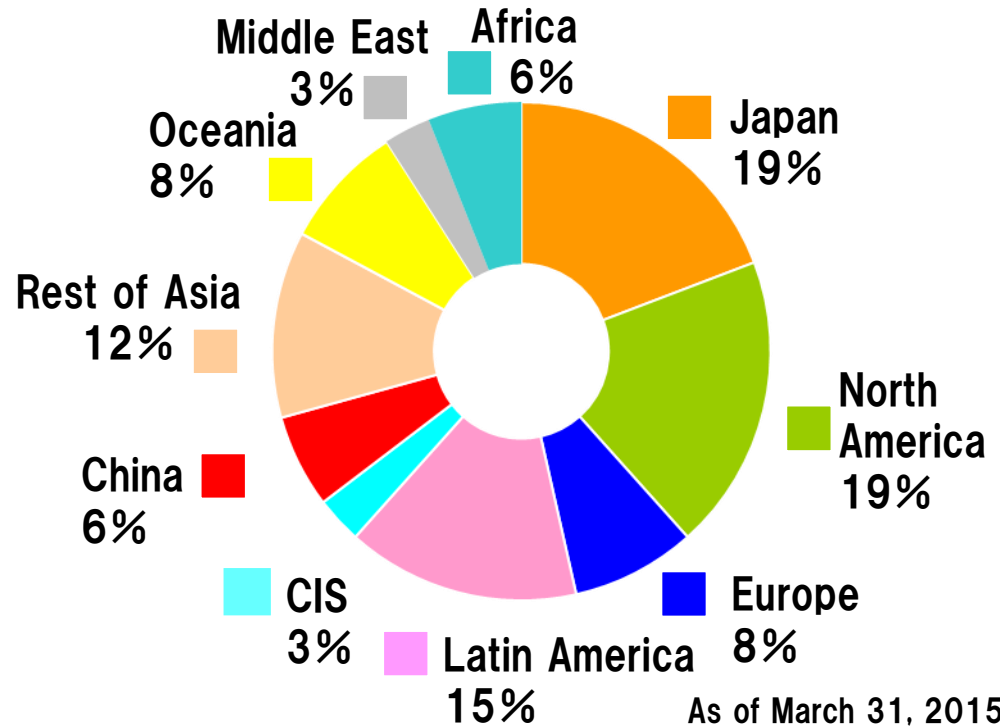
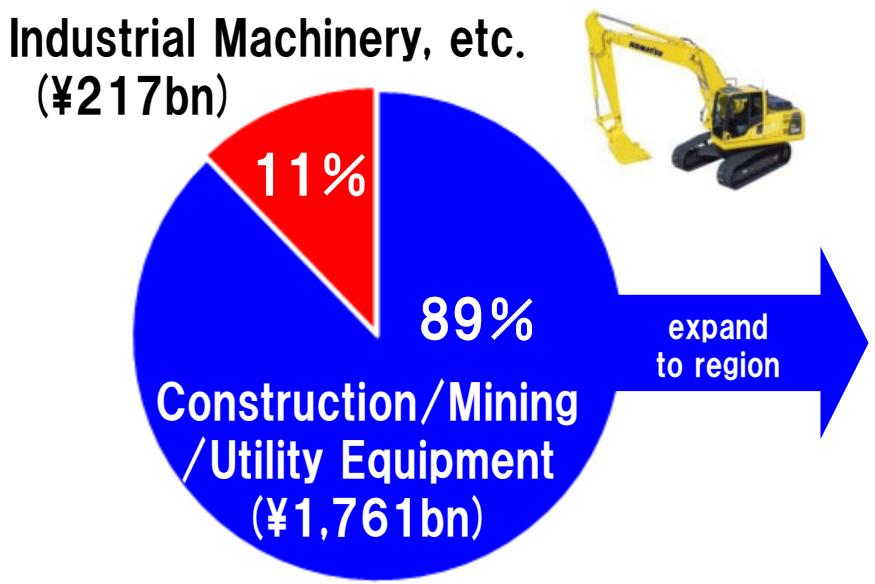
As of March 31, 2015

- **Established** : May 13, 1921
- **Net Sales** : ¥1,978.6bn
- **Opere Income** : ¥242.0bn

- **Affiliated Companies** : 177
- **Employees** : 47,417

Sales\* by Segment

Construction/Mining/Utility Eq. Sales\* by Region



\*by Final Delivery

As of March 31, 2015

As of March 31, 2015



# 1. Komatsu DNA of “MONOZUKURI”

- Outline of Komatsu and Business History
- **Komatsu Product Line**
- Komatsu Way

# 1-3. Komatsu Product Outline (1/4)

## PC01

Bucket capacity 0.008m<sup>3</sup>  
Machine weight 300 kg

## PC8000

Bucket capacity 42m<sup>3</sup>  
Machine weight 752,000 kg



## D21

Blade capacity 0.57m<sup>3</sup>  
Machine weight 3,940 kg

## D575

Blade capacity 69m<sup>3</sup>  
Machine weight 152,600 kg



# 1-4. Komatsu Product Outline (2/4)

## HD255

Loading capacity 25,000 kg



## 960E

Loading capacity 327,000kg



## WA10

Bucket capacity 0.16 m<sup>3</sup>  
Machine weight 1,065 kg



## WA1200

Bucket capacity 20 m<sup>3</sup>  
Machine weight 216,400 kg





# 1-5. Komatsu Product Outline (3/4)

Road work in New York



Pipe-layer working in extreme coldness in Siberia



<Workplace>  
 • Extremely cold  
 • -50°C

Forestry machine valued in Nordic Countries



<Harsh Operating Conditions>

- Operating Hours  
 23hrs/day → 6,000hrs/year  
 → 60,000hrs in 10 years
- Temperature range  
 Extreme cold -50°C ~ +55°C hot
- Altitude Max  
 at 4,600m elevation

Driver-less dump truck operating in Australia



<Workplace>  
 • Dusty, Hot, etc.  
 • +55°C



Utility equipment used in urban area in Europe

# 1-6. Komatsu Product Outline (4/4)

## Construction/Mining Equipment

Hydraulic Excavators



0.3~42m<sup>3</sup>  
(7~770t)

Bulldozers



(4~108t)

Dump Trucks



(37~580t)



(26~34t)

Motor Graders



(17~30t)

Wheel Loaders



(7~216t)

Figure in ( ) is machine weight)

### Sales Ratio to the Overall Sales

	C/M equipment	Ind. Mach. etc.
Share No.1	51%	49%
Share No.1+2	88%	84%

## Industrial Machinery, etc.

Machine Tools for automobile manufacturing: Komatsu NTC

Wire saws  
Crankshaft millers



Transfer machines



Semiconductor manufacturing equipment: Gigaphoton / KELK

Thermoelectric modules



Excimer lasers



Servo presses



Plasma cutting machines



Forklift Trucks

Forklift trucks



Large Presses for automobile manufacturing



Sheet-Metal / Metal Forging Machines: Komatsu Industries Corp.

# 1. Komatsu DNA of “MONOZUKURI”

- Outline of Komatsu and Business History
- Komatsu Product Line
- **Komatsu Way**

# 1-7. Komatsu DNA and Komatsu Way

1921

## <Founder's Philosophy>

- Overseas markets in perspective
- Quality first
- Technical innovation
- Human resource development

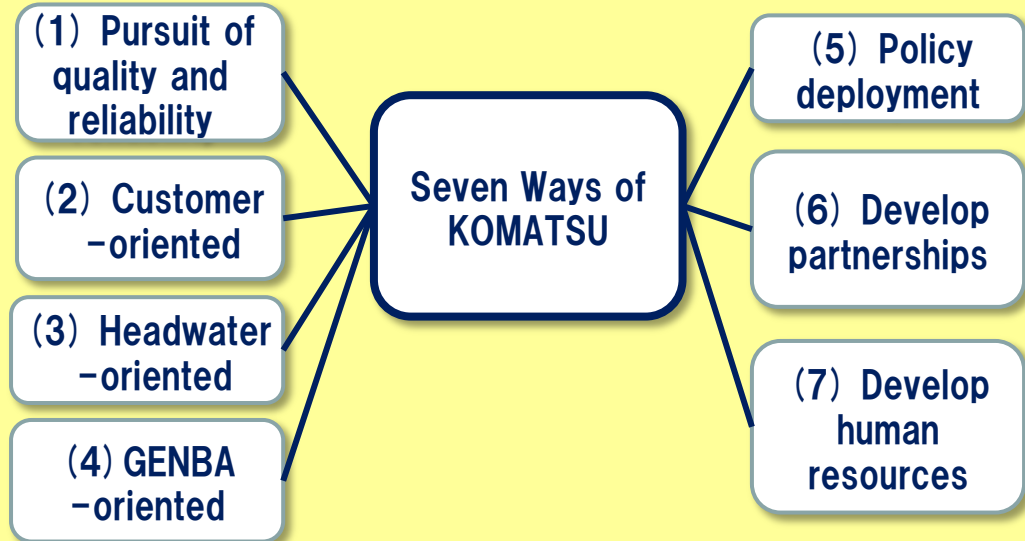


Founder:  
Meitarou Takeuchi

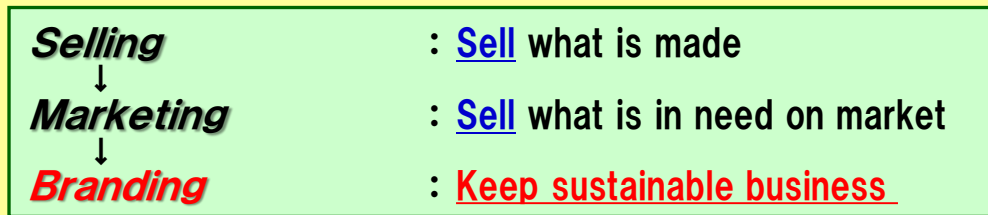


## Komatsu Way

1. Corporate governance
2. Enhancement of "MONOZUKURI"



3. Customer-oriented mind (Brand Management)



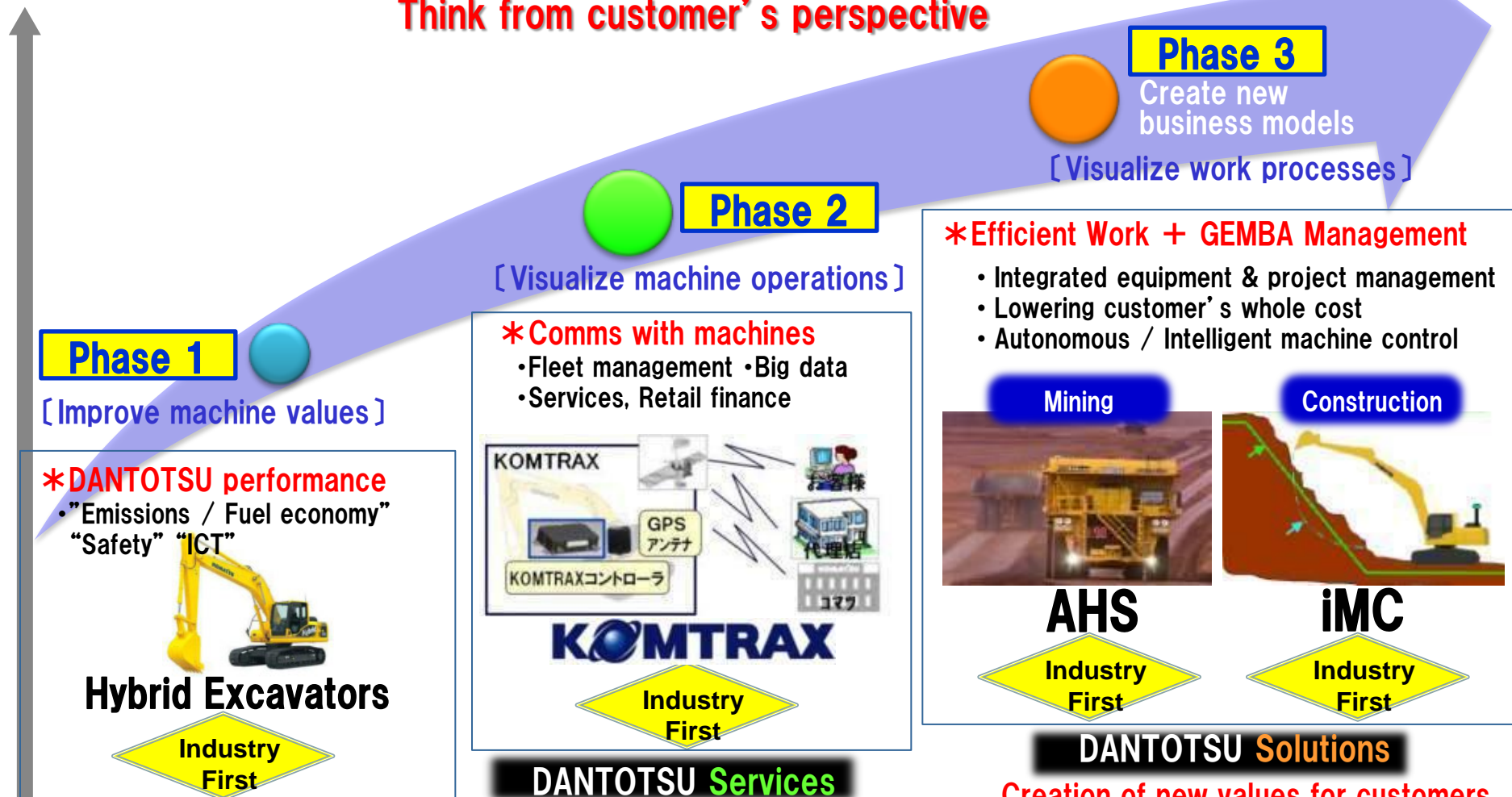
Emphasis in marketing shifting  
 from **“Deal”** to **“Relationship”**  
 (Sell products) (Keep sustainable business)

## **2. Komatsu Business Strategy**

# 2-1. Komatsu Strategy and Products

Customer Value

Think from customer's perspective



Revenue increase over the values chain

Creation of new values for customers

High price enabled by added values

**Growth Strategy**

# 2-2. Definition of DANTOTSU Product & Examples

## ● Definition of DANTOTSU Product

Must satisfy the following 2 criteria.

Must excel in more than one aspect of **safety, environment & economy**, by **ICT** with a several-year lead.

+

Must enable **raising retail prices** (Substantial margin increased)

=

**DANTOTSU Product**

## ● Examples



*Safety*

**DANTOTSU operator sight:  
40% improved**

**Bulldozer D51PX-22**



*Environment, ICT*

**DANTOTSU fuel economy:  
30 to 40% improved**

**Hybrid Excavator HB205-1**



*Economy*

**DANTOTSU fuel economy:  
30% improved**

**Forklift Truck FH40/45-1**

# 2-3. Product Strategy in view of Customer Field Jobs

Customer Value

Think from customer's perspective

**Phase 1**

**Phase 2**

**Phase 3**

Customer's GEMBA

[Improve machine values]

\*DANTOTSU performance

- Fuel economy, emissions, vibration/noise,
- Usability, functions, durability
- Ergonomics, easy operation, safety

[Visualize machine operations]

\*Communications with machines

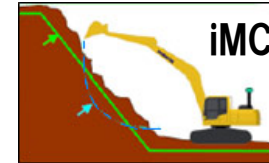
- Fleet management, Big data
- Services, Retail finance
- Lowering machine's life cycle cost

**KOMTRAX**  
**KOMTRAX Plus**

[Visualize work processes]

\*Efficient Work + GEMBA Management

- Integrated equipment & project management
- Lowering customer's whole cost
- Autonomous / Intelligent machine control



...

**DANTOTSU Products**

**DANTOTSU Services**

**DANTOTSU Solutions**

Use of M2M comms transforms manufacturer to service provider.

R&D

Production

Sales

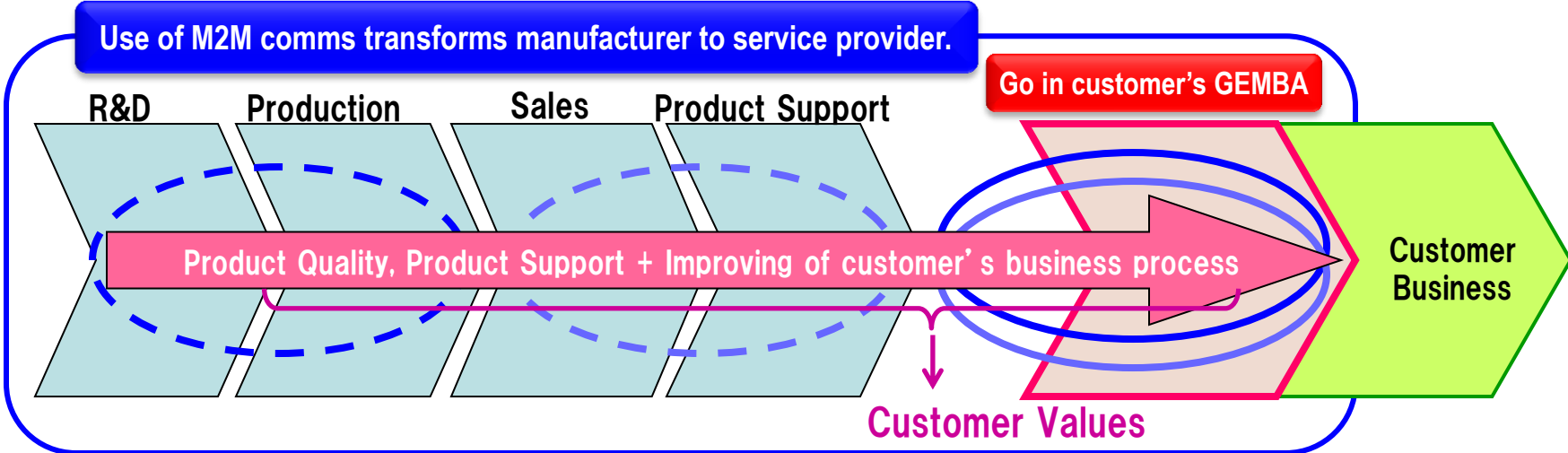
Product Support

Go in customer's GEMBA

Product Quality, Product Support + Improving of customer's business process

Customer Business

Customer Values





# 2-4. KOMATSU Strategy

## Together We Innovate GEMBA Worldwide

KOMATSU medium-term management plan

### Provide new Value to Customers

We should provide **the best service** to customers. The best service should **match customer earnings structure**.



Once we understand **customer environment and their concern**, we can create New Values customer has not noticed yet.

**Dantotsu Solution**

**Dantotsu Service**

**Dantotsu Product**



### Improve Quality of Product

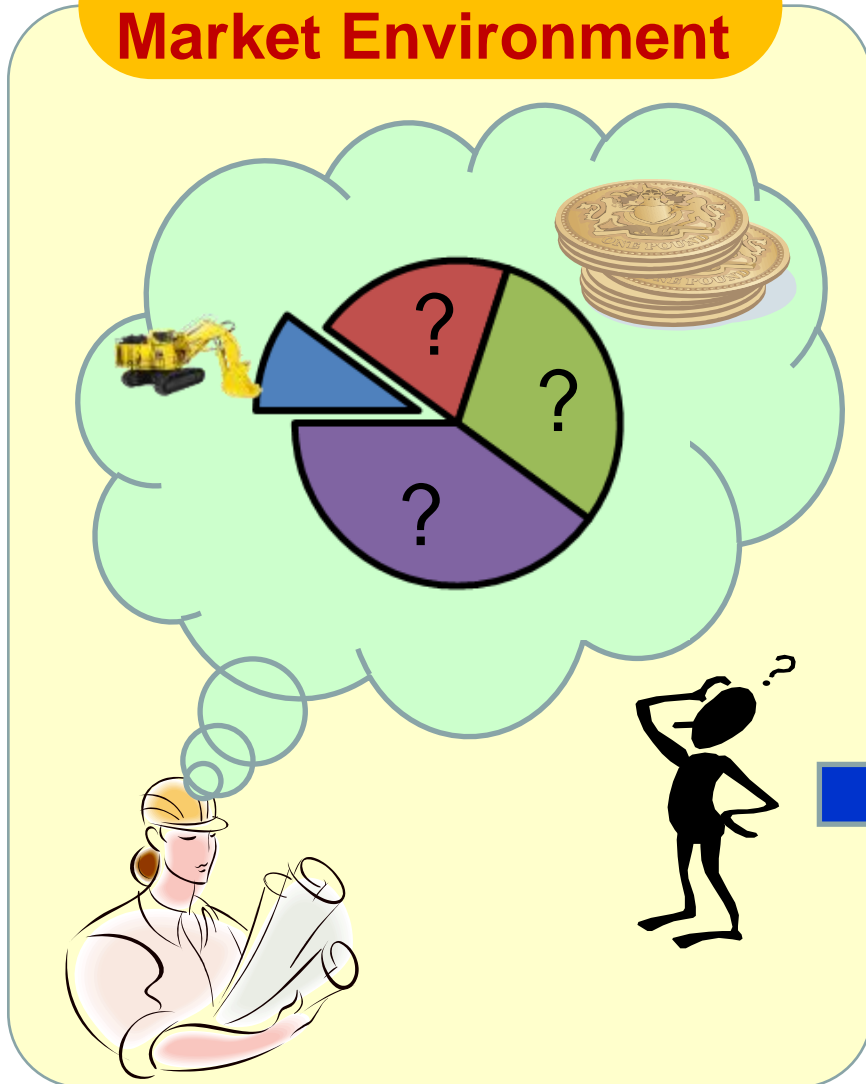
We provide **the best products** to customers **continuously**.

- ✓ High Quality
- ✓ High Performance
- ✓ High Reliability
- ✓ Safety

These are competitive.

## 2-5. Create a new Value by DANTOTSU Service

### Customer's concern Market Environment



### What is Dantotsu service?

- Timely parts delivery
- Quick repair and maintenance
- Reasonable service contract
- ...

Common Sense Service



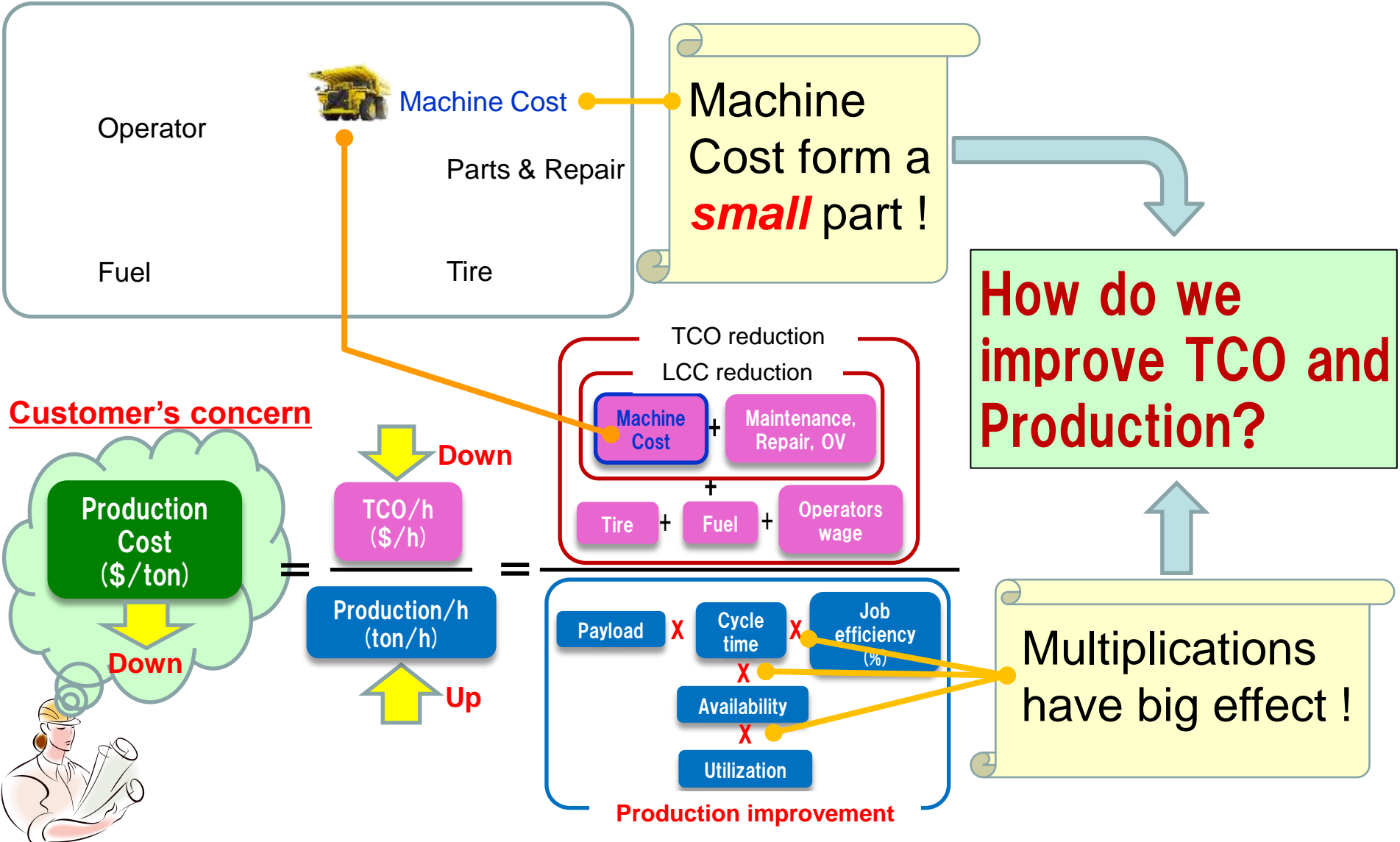
### Shift the view point to Customer oriented

To create new values for customer, it has become essential that we review **customer earnings structure**. After understanding it, we should approach with the most effective way. **Even a customer has not noticed it's value.**

## Meet customer's expectation?

# 2-6. Customer View point in the Production Cost

Get strong competitiveness through customers' \$/Ton cost down by not only TCO reduction but also production improvement.



# 2-7. Telematics and Big data Analysis in DANTOSU Service

Predict and enhance component life  
 <Monitoring severity, trend of characteristic value>

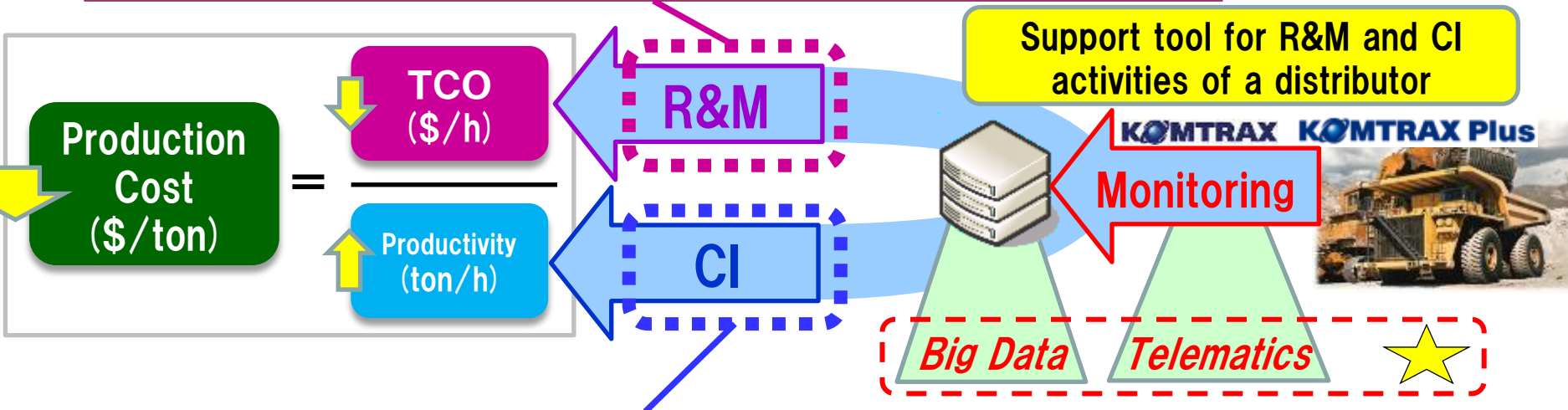
Condition based maintenance  
 <Planning maintenance schedule>

Monitoring availability & MTBF



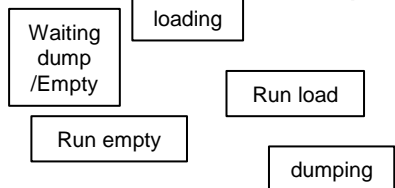
Enhance capability to reduce machine down and break through daily monitoring  
 Enhance component life by condition based maintenance to make more money

**Reduce Operation Cost: Repair & Maintenance activities**



**Proposals for production improvement: Continuous Improvement activities**

Payload analysis    Operation analysis    Course analysis    Time efficiency analysis    Operation analysis by operator



**Propose operation improvement, reduction wasted time and training**

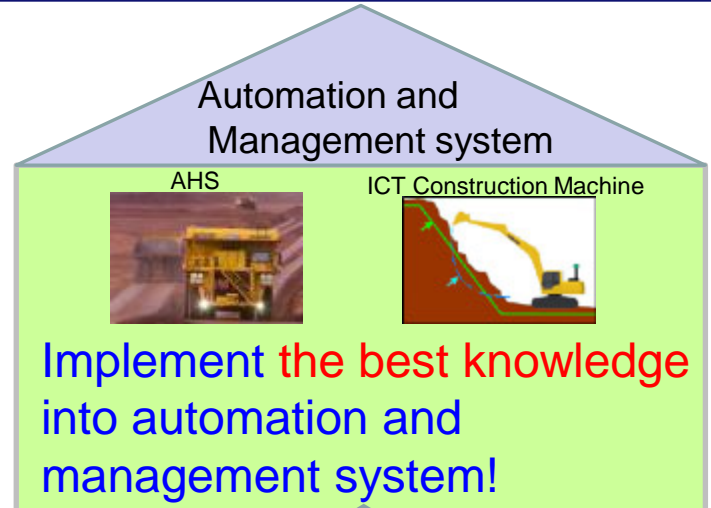
# 2-8. DANTOTSU Solution

## Strategy

### Dantotsu Solution

### Dantotsu Service

### Dantotsu Product



*"The Best Usage" of machines*

*Big Data Analysis*

*Telematics*

The Best Products



## 2-9. Autonomous Haulage System “DANTOTSU Solution”

*“For production – what we get from our best day in a manned operation we get everyday from an autonomous operation”*

- Anonymous customer quote



# 2-10. Enhancing Customer Value Added by ICT Service

## Customer's Goal



**No Harm  
Safety First**



**Increase  
Production**



**Save  
Cost**



**Protect  
Environment**



**Semi & Full  
Automated  
Operation**

## KOMATSU's Possible Value

**Safe Product** *linked with*  
**Safety Management**

**High Machine Performance**  
*with* **Better Operation**

**Robust Product**  
*with* **Health Monitoring  
& Management**

**Competitive Initial Cost**  
*and* **Low Maintenance Cost**

**Efficient Machine Performance**  
*with* **Economic Operation**

**Innovative Technology**  
**for Job-site Automation**

**High Quality  
Machines**  
can be more  
valuable with  
better usage.



**Practical use  
of ICT**



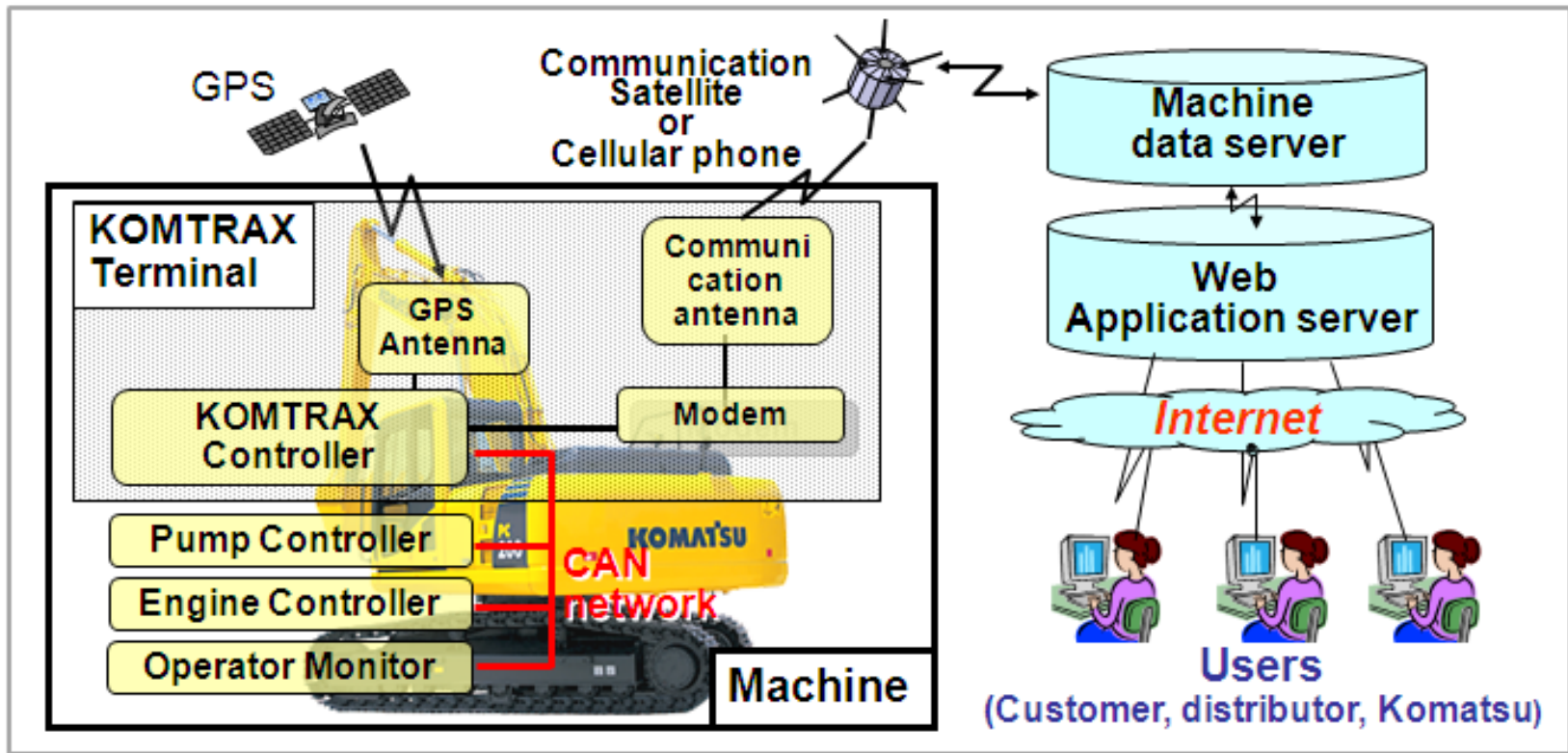
### 3. KOMTRAX

# KOMTRAX





## 3-1. KOMTRAX System Overview



By utilizing this system...

- Where the machine is located,
- When and how often the machine is working,
- How the machine is used,
- Which machines need maintenance, etc. can be known at the office.

# 3-2. Telematics in KOMATSU

## KOMTRAX

**Telematics System for construction machine**

Statistic operation analysis by DBs, Countries, models, etc.



D275  
 ≦ PC850  
 HD405  
 WA500

## KOMTRAX Plus

**Machine Health Monitoring System for Mining machine**

In-depth analysis focused on a machine.

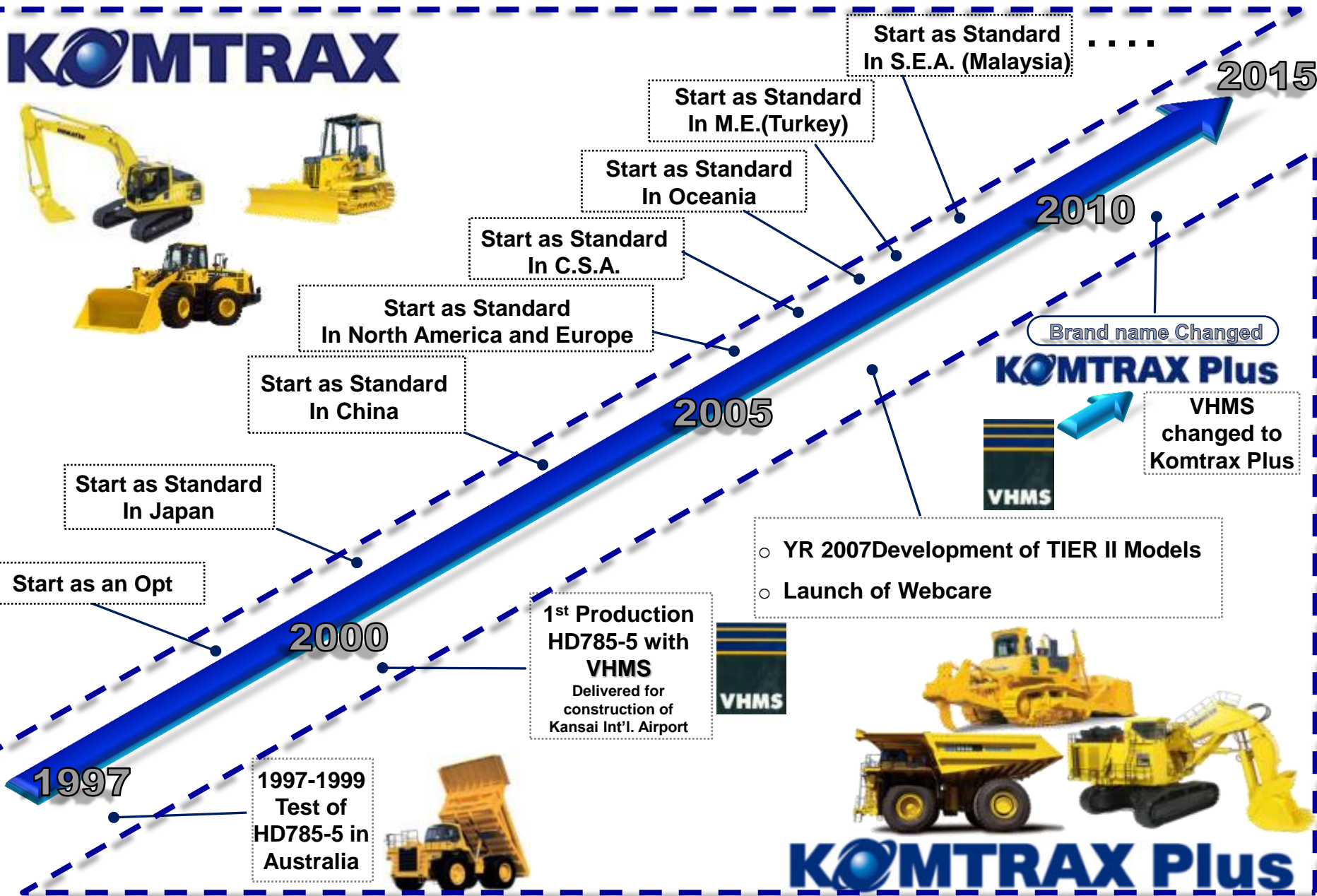


D375  
 ≦ PC1250  
 HD465  
 WA600



# 3-3. Timeline and Machine Models Equipped

## KOMTRAX



### KOMTRAX Plus

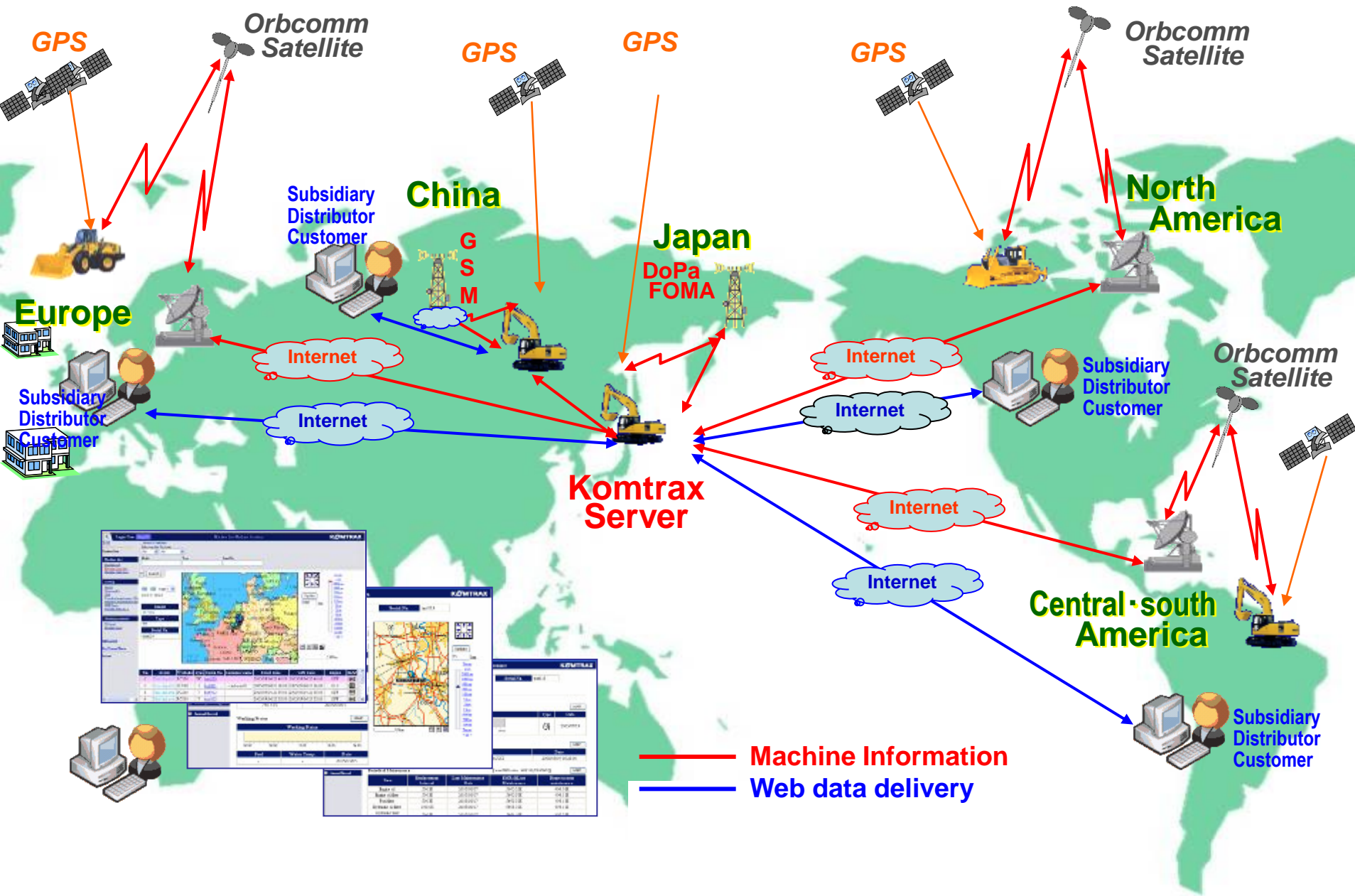


VHMS changed to Komtrax Plus

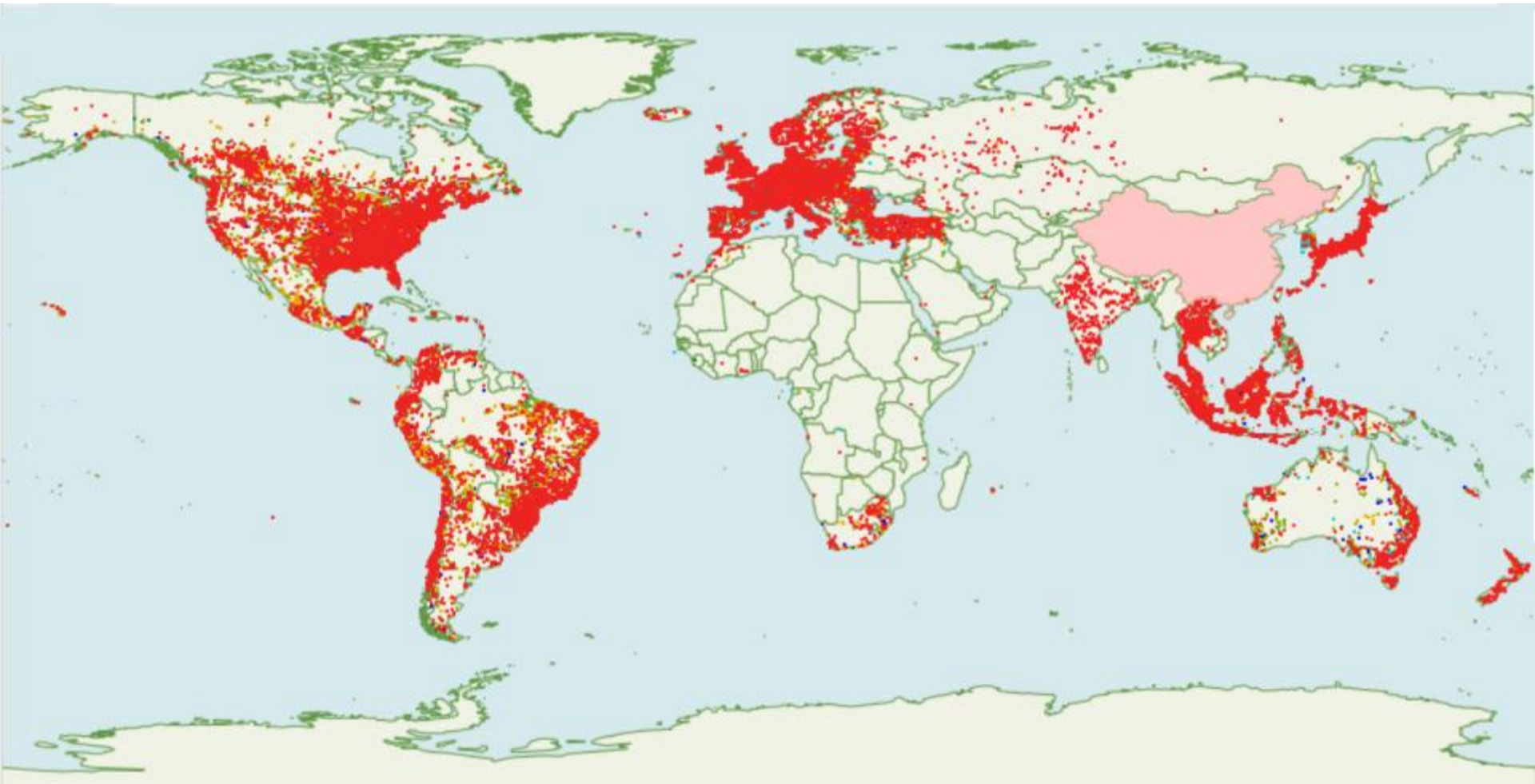


## KOMTRAX Plus

# 3-4. KOMTRAX System Overview



## 3-5. KOMTRAX World Population



**More than 388,000 machines are working with KOMTRAX.**

Confidential

# 3-6. KOMTRAX Screen Example (1/2)

**Location**

**Latest SMR**

Model: 8, Serial No.: C60172

Machine Location:  
 LAT: 1725 50 39.61, LONG: W80 20 15.184  
 Event Time: 18/11/2008 01:23:00, GPS Time: 18/11/2008 01:34:00

Location export: 25.844233, -80.3377

SMR:  
 SMR Value: 6521.6 H, Date: 18/11/2008

Working Status:  
 Working Status: [Bar chart]  
 Fuel: [Bar chart], Water Temp.: [Bar chart], Date: 17/11/2008

**Location History**

No.	Date	Event Date	GPS Date	LK1	LK2	LK3
1	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
2	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
3	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
4	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
5	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
6	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
7	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
8	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
9	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
10	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
11	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
12	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
13	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
14	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
15	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
16	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
17	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
18	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
19	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---
20	18/11/2008 01:23:00	18/11/2008 01:23:00	18/11/2008 01:23:00	1725 50 39.61	W80 20 15.184	---

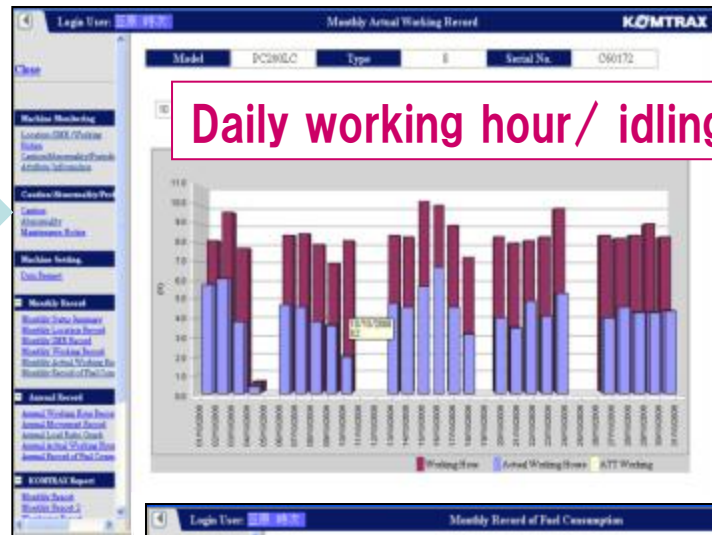
**Location on Google Map**

**SMR Trend**

**Daily working status Record**

Date	Working Status	Working Hour	Actual Working Hours	ATT Working	Fuel	Water Temp.
17/11/2008	[Bar chart]	7.9 H	4.0 H	0.0 H	[Bar chart]	[Bar chart]
16/11/2008	[Bar chart]	0.0 H	0.0 H	0.0 H	---	---
15/11/2008	[Bar chart]	0.0 H	0.0 H	0.0 H	---	---
14/11/2008	[Bar chart]	7.8 H	3.5 H	0.0 H	[Bar chart]	[Bar chart]
13/11/2008	[Bar chart]	7.9 H	4.0 H	0.0 H	[Bar chart]	[Bar chart]
12/11/2008	[Bar chart]	10.2 H	6.4 H	0.0 H	[Bar chart]	[Bar chart]
11/11/2008	[Bar chart]	7.9 H	4.4 H	0.0 H	[Bar chart]	[Bar chart]
10/11/2008	[Bar chart]	10.2 H	5.5 H	0.0 H	[Bar chart]	[Bar chart]

# 3-7. KOMTRAX Screen Example (2/2)

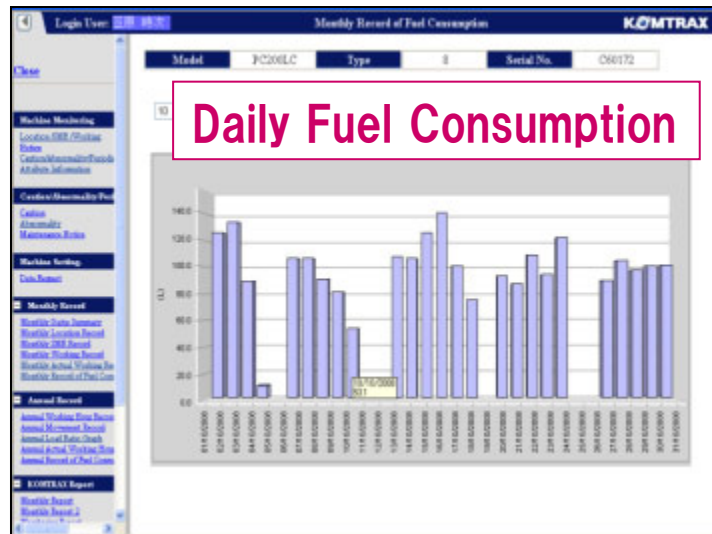


Cautions Record



Load History

Oil/Filter/exchange timing management



Daily Fuel Consumption

## 3-8. Benefits from KOMTRAX

### Customer

*Visualization*



- Minimize machine stoppage
- Lowering machine life cycle cost
- Efficient administrative work

### Distributor

*Higher work quality,  
efficiency*



- Services : Minimize downtime
- Parts : Just in time delivery
- Lowering financial risks

### Komatsu

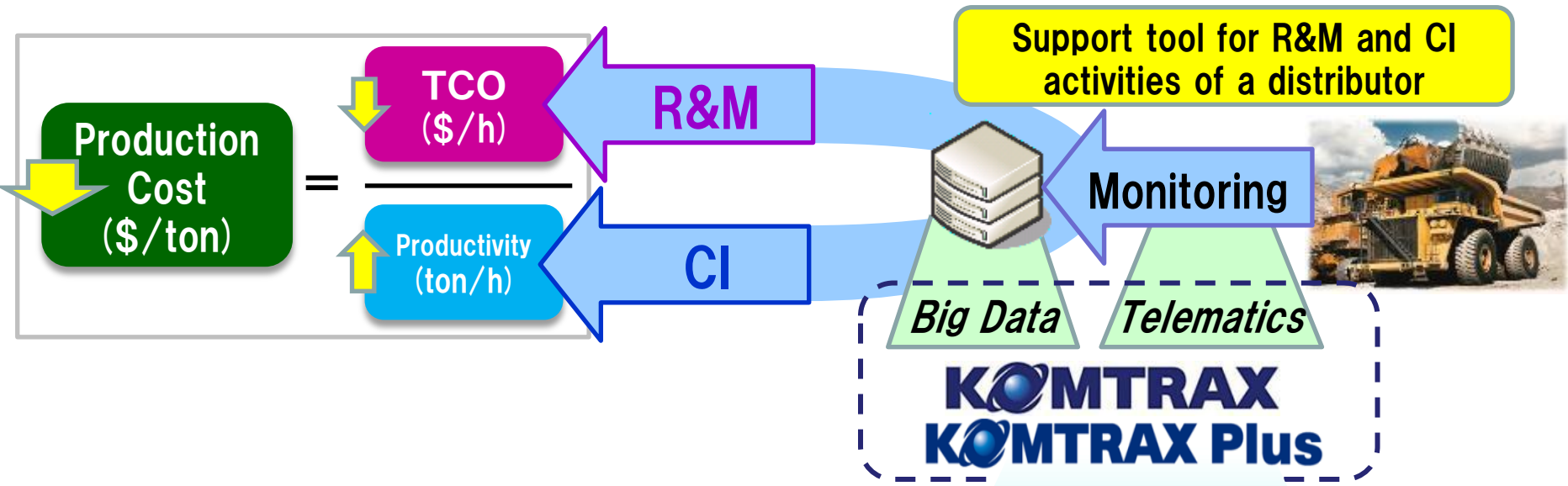
*Flexibility  
lean management*



- Analysis of machine abnormality trends
- Product Development
- Demand forecasting / Production planning

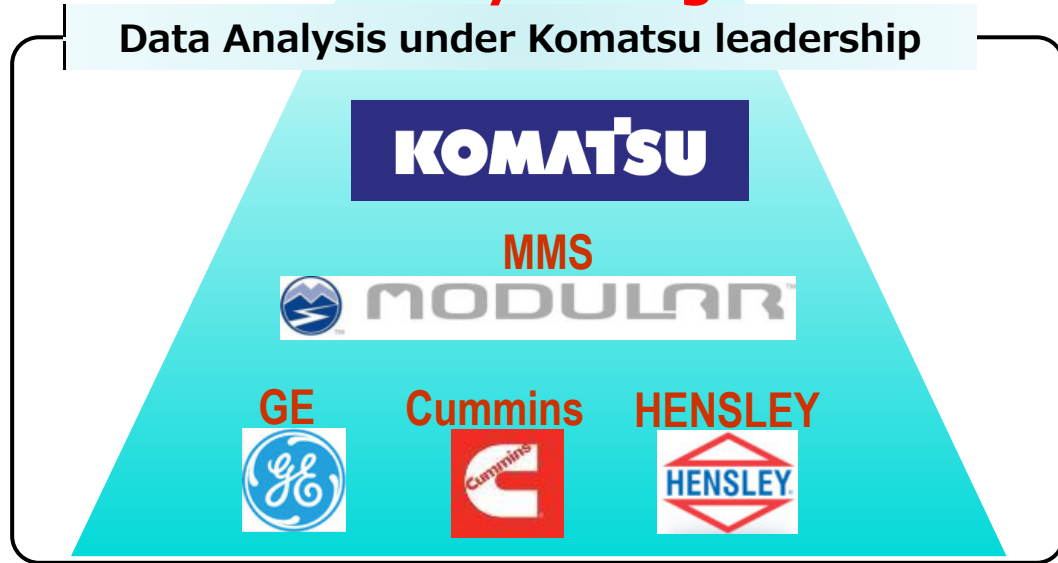


# 3-9. Partnerships in DANTOSU Service



## Data Analysis Engine

Data Analysis under Komatsu leadership



By incorporating *Partners Knowledge* with Komtrax, Komatsu can provide better information more timely and efficiently.

## 4. Driver-less Truck Haulage

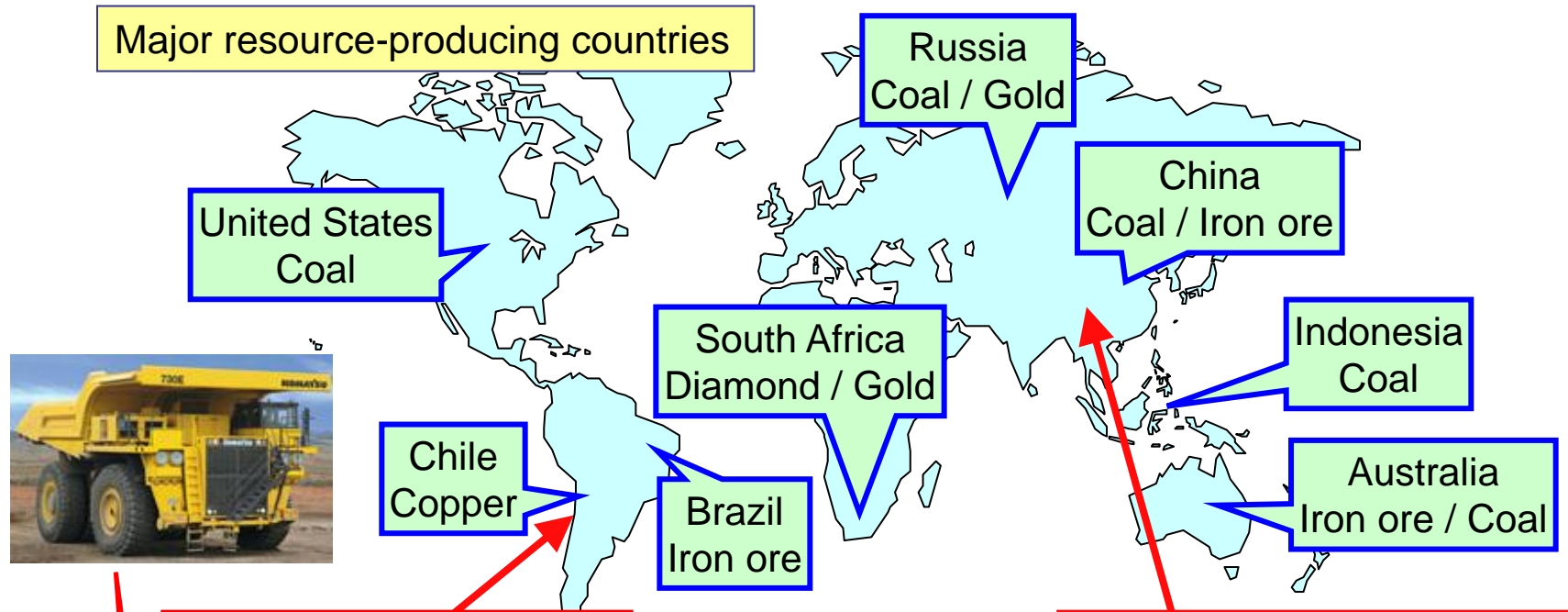
# Autonomous Haulage System : AHS



**World-Largest Copper Mine** (Length×Breadth×Depth: 2km×4km× about 1km)



# 4-2. Introduction of use cases of mining equipment



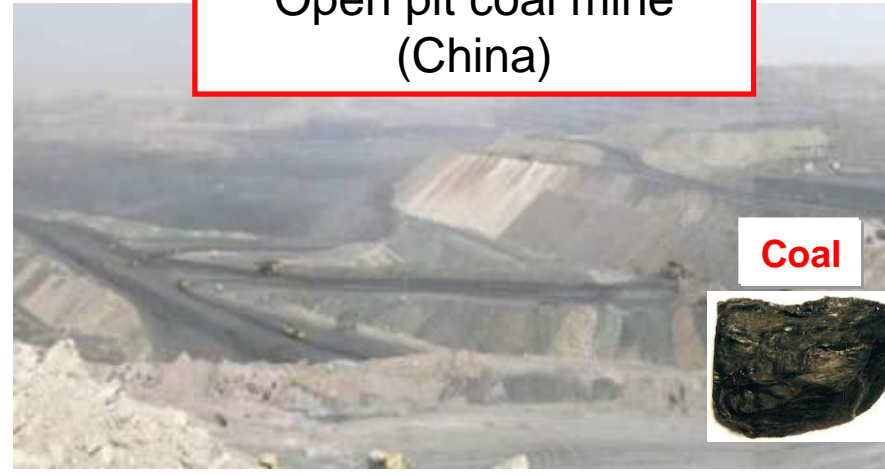
Open pit copper mine (Chile)

Altitude: 4,000m



Copper ore

Open pit coal mine (China)



Coal

# 4-3. Examples of open pit mines



# 4-4. Customer Benefit by AHS Operation

## AHS at Mines



※ *Autonomous Haulage System*  
(Haulage by driver-less trucks)

Driver  
Onboard

無人車  
(AHS)

# 4-5. System configuration



Controller of autonomous haulage system (Upper : exterior, Lower : interior)



GPS antenna



Radio antenna



Side strip guidance laser



Obstacle detection sensor



Operation mode light (backward)



Steering sensor

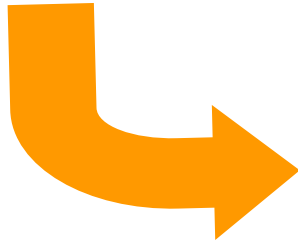


Operation mode light (forward)

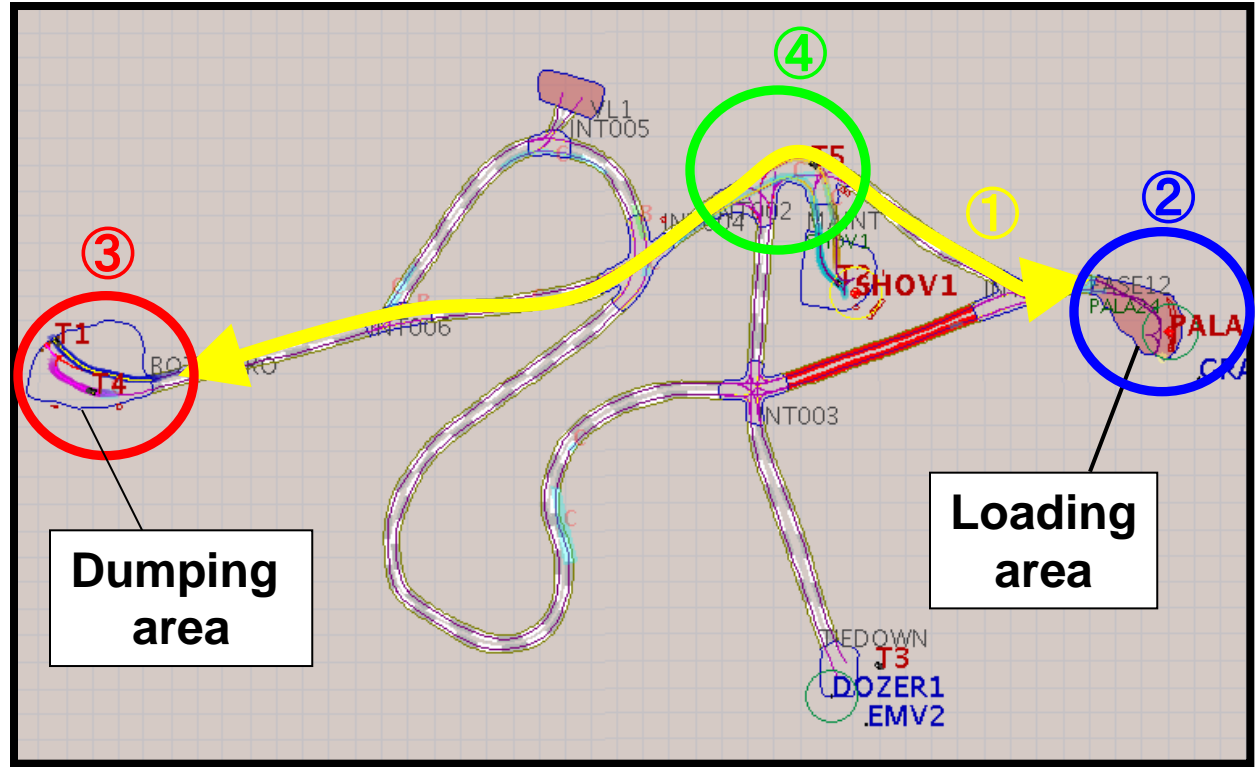
# 4-6. AHS Overview



Full view of mine site



AHS basic operations



Mine site map displayed on monitor in operation control room (Image view)

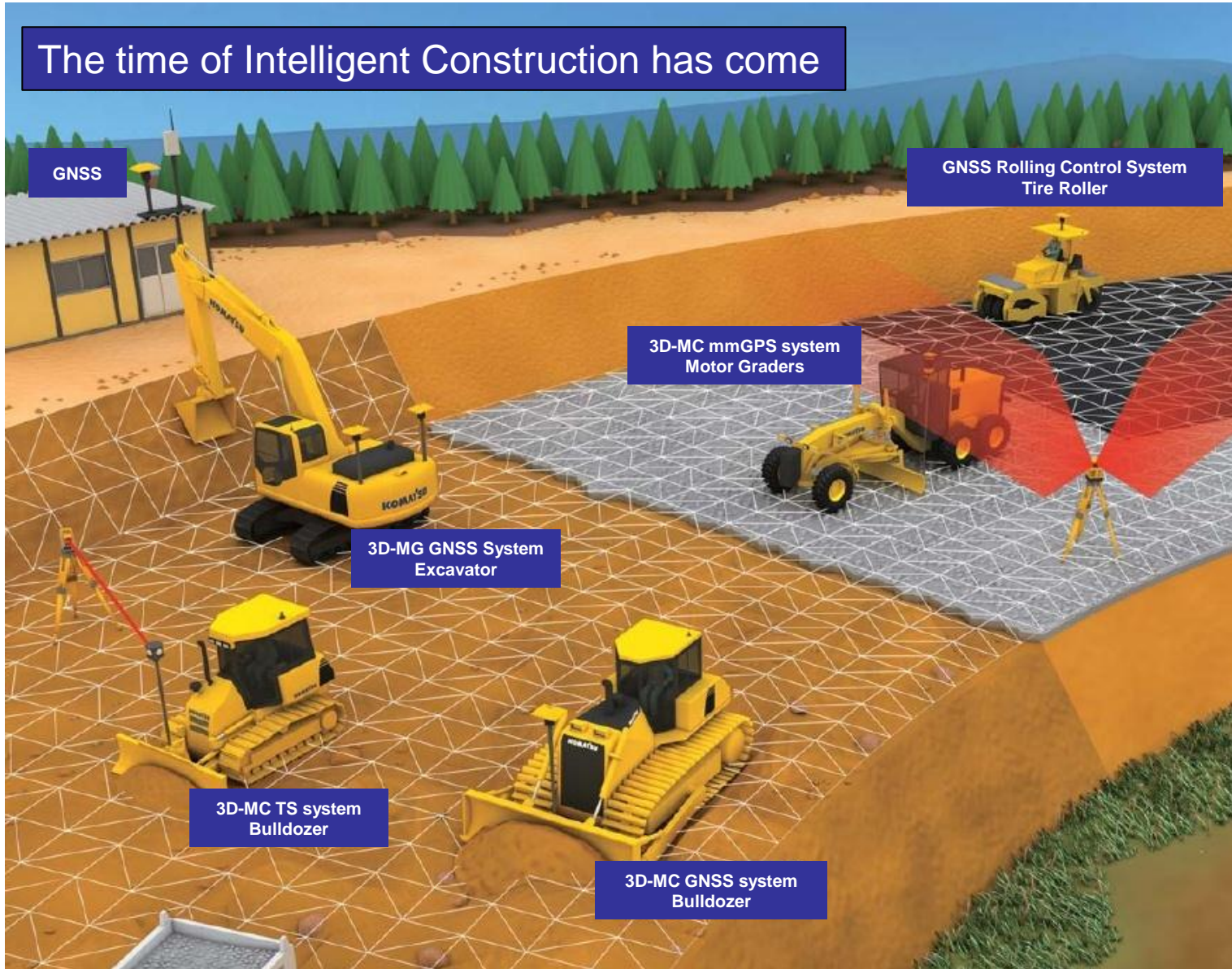
- ① Autonomous haulage
- ② Loading
- ③ Dumping
- ④ Traffic control





# 5. Intelligent MC Construction Machine

The time of Intelligent Construction has come



GNSS

GNSS Rolling Control System  
Tire Roller

3D-MC mmGPS system  
Motor Graders

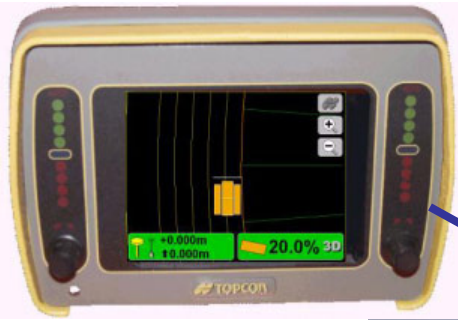
3D-MG GNSS System  
Excavator

3D-MC TS system  
Bulldozer

3D-MC GNSS system  
Bulldozer

# 5-1. System Configuration

**Control Box**



**GPS Box**



**Radio Antenna**



**GPS Antenna**



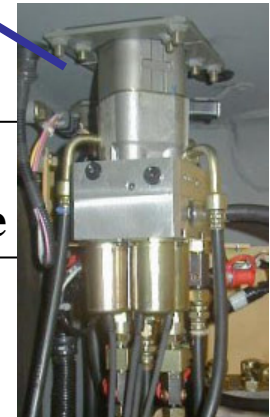
**Tilt Sensor**



**Automatic/Manual SW**



**Electronic Control Valve**



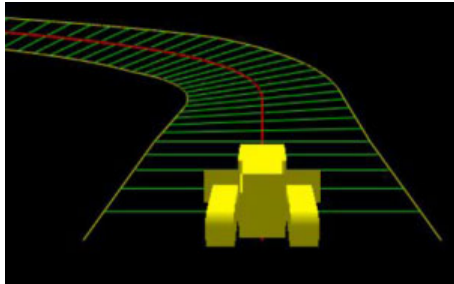
**Radio Unit**



# 5-2. Control Diagram



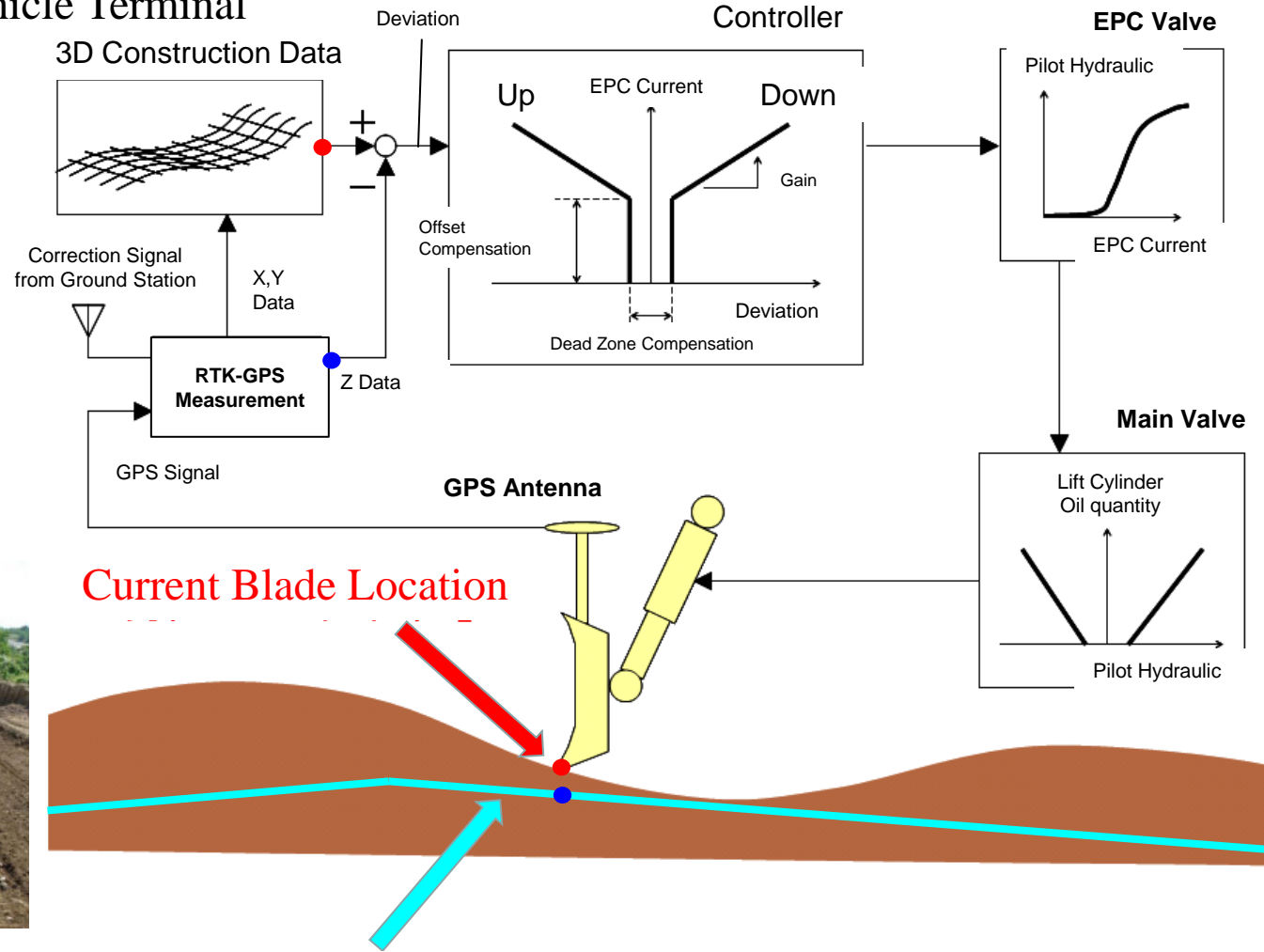
Vehicle Terminal



Construction Drawing



Finished Shape



**Finished Surface** that indicates the construction surface which made and memorized beforehand

## **5-3. Customer Benefit by Intelligent MC Machine Operation**

---

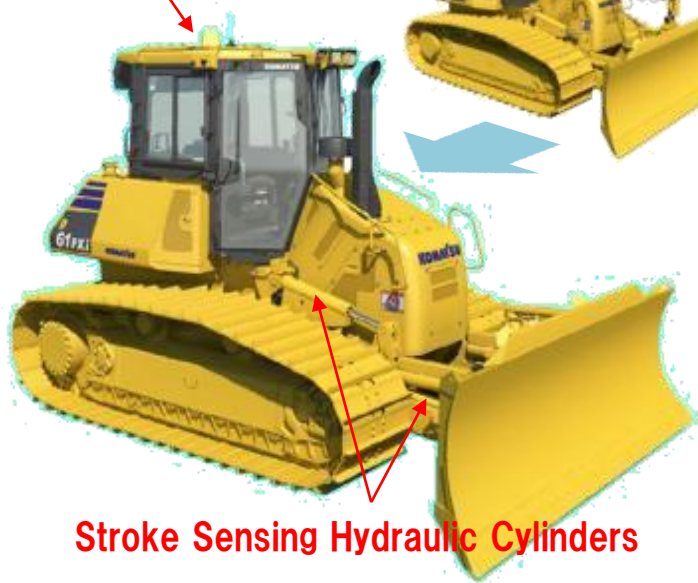
# 5-4. Komatsu Intelligent Machine Control (Dozer)

Typical Aftermarket Machine Control System



Standard factory installed Intelligent Machine Control System

Cab Top GNSS Antenna



Stroke Sensing Hydraulic Cylinders

- ◆ Factory Integrated Sensor Package  
Komatsu durability & quality with factory installation, integration.

- ◆ Operator Selectable Load Settings  
Machine control load settings can be adjusted between presets to tailor response to material conditions.

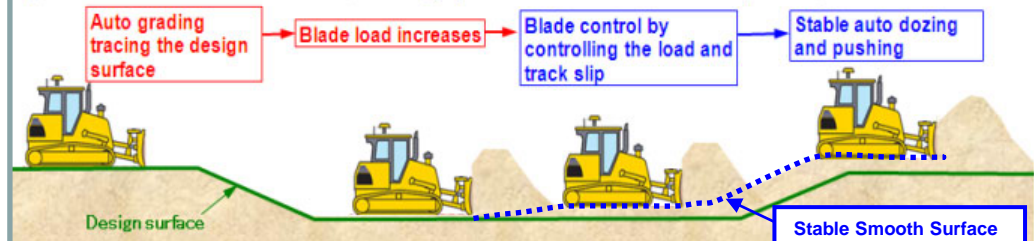
## ◆ Automated operation only for finish grade

Issues with the Conventional iB (Blade control only by blade edge position)



## ◆ Automated operation from rough dozing to finish grade

Improvement on the Dantostu Control (Blade edge position + load control + track slip control)



## ◆ Progress can be measured in real time

### As-Built Surface Track Mapping



Cab top GNSS antenna provides for accurate as-built surface data collection by measuring actual elevations as machine continuously tracks in operation.



# 5-5. Komatsu Intelligent Machine Control (Excavator)

Typical Aftermarket Machine Control System



Standard factory installed Intelligent Machine Control System

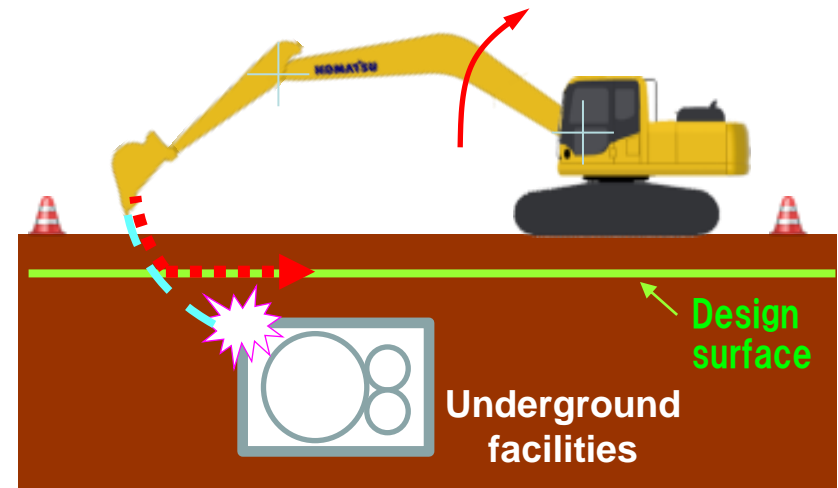
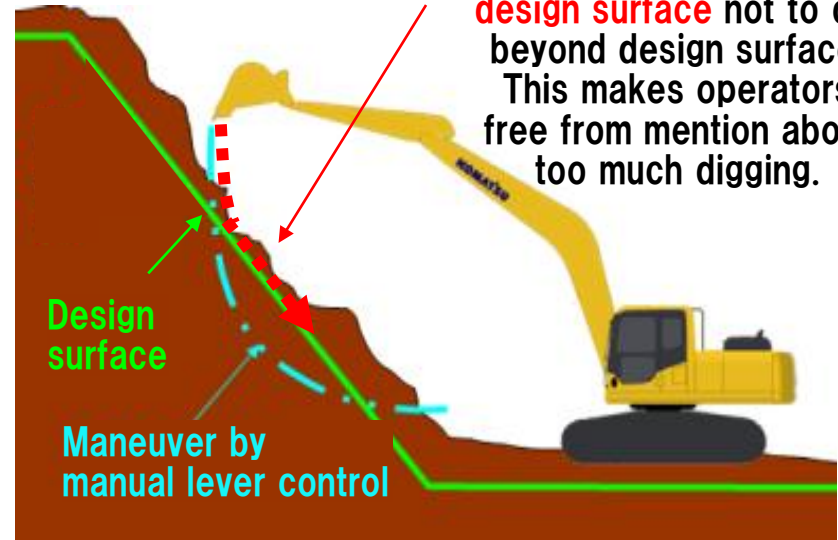
Stroke Sensing Hydraulic Cylinders



12 inch large monitor

◆ **Intelligent machine control** that realizes efficient construction

Automatic control keeps bucket following design surface not to dig beyond design surface. This makes operators free from mention about too much digging.



# 5-6. Partnerships in Intelligent MC Dozer

**KOMATSU Machine  
and Technology**

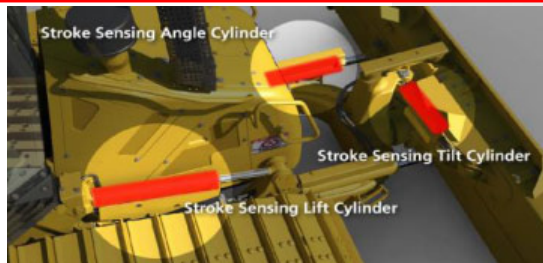
**Electronic  
Control Lever**



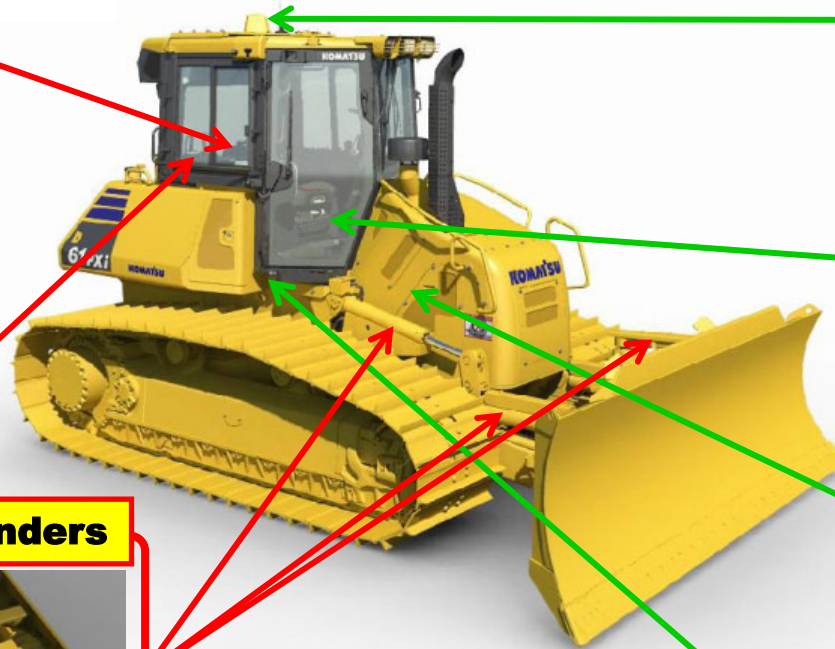
**KMT Sensor  
Controller**



**Stroke sensing cylinders**



**intelligent  
MC Dozer  
D61PXi-23**



**Topcon Component  
and Technology**

**Cab-top  
GNSS Antenna**



**Control box**



**GNSS Receiver**



**Enhanced Inertial  
Measurement Unit**



■ Full Integration of Komatsu Components (Stroke Sensing Cylinder etc.) and Topcon Components to ensure Komatsu Quality and Accuracy.

# 5-7. Smart Construction

ICT solution for construction site named "Smart Construction" has been started.



## SMART CONSTRUCTION

Put all the processes on ICT and link them organically

**① High precision site measurement**

3D map generation (utilization of drone)

**② Making 3D model by plan drawings**

3D data generation from 2D drawings

**③ Analysis on soil, underground water / facilities**

Survey & Analysis for Risks

<Under researching>

**④ Simulation for construction plan**

Optimized proposal for cost / period priority

**⑤ Intelligent construction / management**

Transfer 3D data to ICT machine -> safe / efficient construction

Design change

Support center of smart construction will accommodate

**⑥ Completion**

Utilize data for review / inspection

Fast recovery from damage of natural hazard in case



Visualization of site, Continuous improvement (Plan/Do/Check/Act)

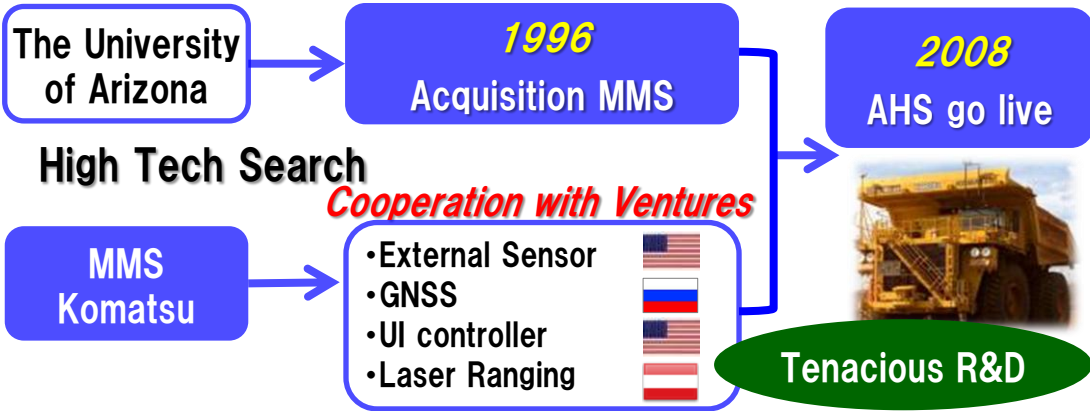


## 6. Challenge

6-1. Open Innovation and Fostering of Global Human Resource for development

(1) Open Innovation ( the case of AHS )

- MMS (Modular Mining Systems Inc.) M&A

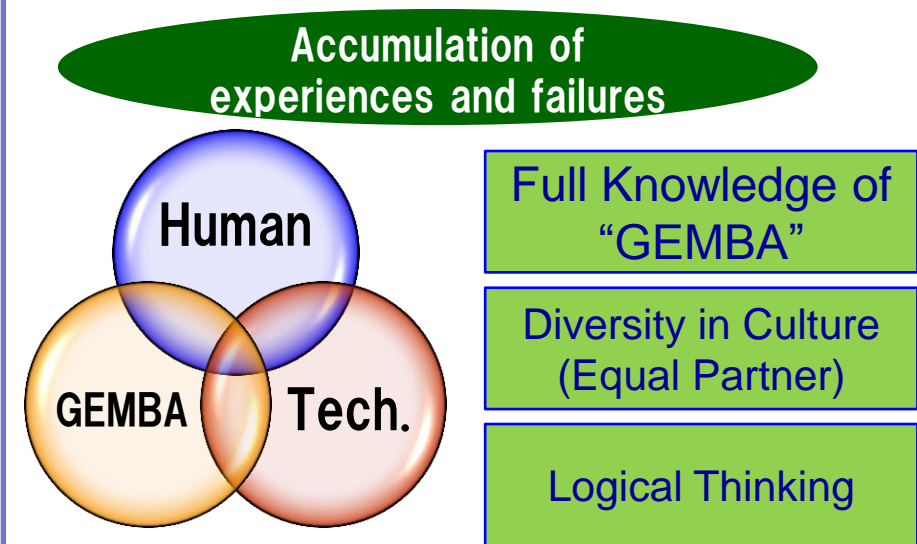


(2) Creating CTO division

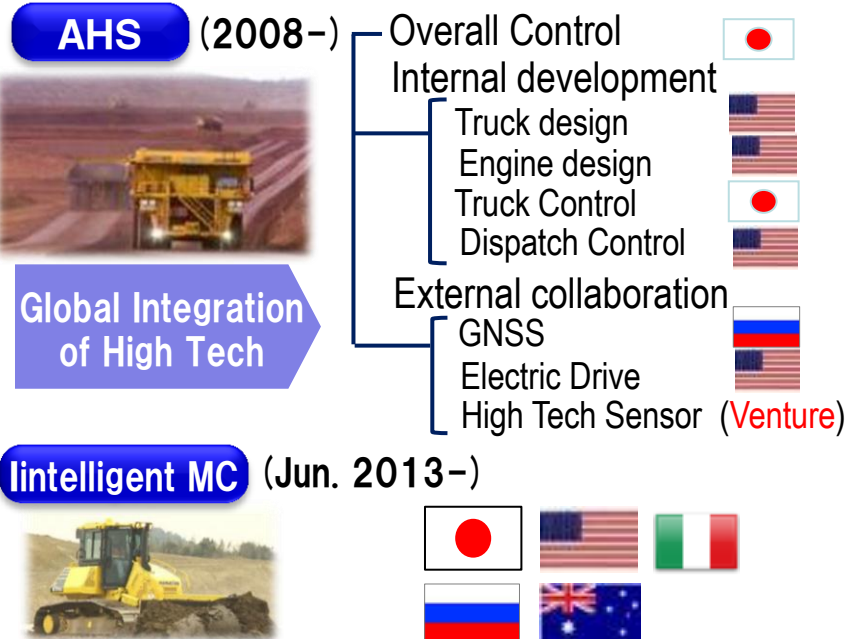
(Apr. 2014 -)



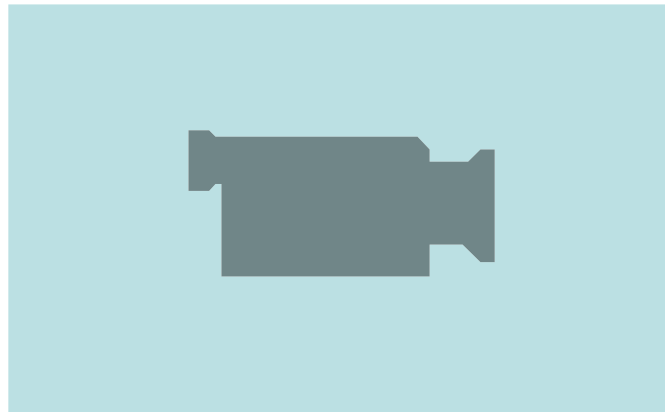
(3) Globally competitive human resource for development



(4) Global Integration of Technology



## 6-2. KOMATSU in the Future





Thank you for your attention



HB215LC-1 the Antarctic Site (Jan. 2014 -)