Komatsu IR Day in 2019

Komatsu’s Digital Transformation Strategy

Chikashi Shike
Executive Officer and President of Smart Construction Promotion Division
Mid-term Management Plan
(FY2019 – FY2021)
Linking every workplace through excellence

Our world is changing.
So are the challenges of our customers and society. What can we do to help overcome these challenges while remaining sustainable?
Together, we can reach new, unrivaled heights of excellence in our products, services, and solutions to enable a better world. We can link every workplace and generate value with our global teams, customers, distributors, partners and communities.

We can make a difference. We can do it by delivering DANTOTSU Value.
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 of “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 added value
◆ Automation • autonomous operation, electrification and remote controlling

Expansion of the value chain

Level enhancement
Speed acceleration
Enhancement
Conventional level and speed

DANTOTSU Product
DANTOTSU Service
DANTOTSU Solution
SMARTCONSTRUCTION
February 2015 --
Announced our “SMARTCONSTRUCTION” concepts and began service.
We will work together with our customers at their jobsites to achieve safe, highly productive and smart workplaces of the future.

High-precision 3D survey by using drones
Generation of 3D design data
ICT-intensive models (Rental and sales)
As-built data management (SMARTCONSTRUCTION application)
SMARTCONSTRUCTION support (Remote & on-site)

Began successive provision of different services.

April 2016
Japan’s Ministry of Land, Infrastructure, Transport and Tourism designated FY2016 as the first year of productivity revolution and declared to promote “i-Construction”.

September 2016
PM Abe declared the Promotion of Productivity Revolution of Construction Jobsites at the first meeting of Investing for the Future.

We aim at 20% improvement of productivity of construction jobsite operations by 2025. (As expressed by PM Abe)

Expanding application of “i-Construction” from the national government-controlled to prefectural government-ordered construction work.
SMARTCONSTRUCTION

High-precision surveying

Generation of construction plans

Construction

Inspection

3D Design Data

3D of the current situation with high accuracy

Precision of earthwork volume is 99%. (Komatsu data)

3D of the current situation with high accuracy

Construction management

Consultant

Support Center

SMARTCONSTRUCTION

SMARTCONSTRUCTION CLOUD
Since the start of SMARTCONSTRUCTION service in February 2015, we have deployed it at 8,700 jobsites.

(As of August 31, 2019. Limited to Japan)

We have also shared with customers new issues which we must solve together at many jobsites.
Our customers’ voices are introduced in our SMARTCONSTRUCTION website. http://smartconstruction.komatsu
Values of “Things”

“Things”: DANTOTSU products that improve customers’ safety and productivity.

“Service of things”: DANTOTSU service that will not stop machines at jobsites.

“Quality assurance of things”: Our promise to customers reflects Quality and Reliability of products.

Values of “Matters”

Domain: Customers’ operations (civil engineering/construction)

Newly created values: Improved safety and productivity

Conceptual drawing of value creation

Earthwork volume will not change.
Minimum use of machines and workforce
Shortened construction periods
Working to Achieve “Safe, Highly Productive, Smart and Clean Workplaces”
We will accomplish digital transformation of construction with “things” (automation and sophistication of construction equipment) and “matters” (optimization of construction work), thereby achieving safe, highly productive, smart and clean workplaces of the future.

**Digital transformation of construction work**

Daily tasks are generated from daily optimized construction plans. Synchronized automation with on-site equipment.

**Safe, highly productive, smart and clean workplaces of the future**

**“Visualization” of jobsite info**

Emergence of sophisticated models

**“Things” [Automated and autonomous level of machines]**

- Level 1: Limited to machine operation support
- Level 2: Expanded scope of operation support
- Level 3: Sophistication: Automated (solo)
- Level 4: Sophistication: Synchronized autonomous
- Level 5: Sophistication: Decision-making autonomous

**“Matters” [Optimization level of construction operations]**

- Level 1: 3D design data
- Level 2: 3D terrain data
- Level 3: 3D construction plans
- Level 4: Automated planning of construction
- Level 5: Optimized construction

**Conventional construction**

**IT-intensive construction**

ICT-intensive construction & equipment

“Visualization” of progress & use of terrain info

**LANDLOG**

**“Visualization” of jobsite info**

**Visualization** of progress & use of terrain info.
Achievements Made Possible with SMARTCONSTRUCTION since 2015
In all processes of conventional construction, safety and productivity have been improved by leading-edge digital technologies.

Improved safety and productivity are limited, when each process is partially optimized.
What to Achieve with SMARTCONSTRUCTION from 2019
Dynamic improvement in safety and productivity will be achieved by optimization of all processes when each process, which is partially optimized by digital technologies, is linked.

Conventional construction

Digitalization of each process: “Vertical”

All processes are digitalized and linked: “Horizontal”

Digital transformation of construction resulting from optimization of the entire process.
Verification of Digital Transformation of Construction at Actual Jobsites
Analyses of Digitalization in Construction Processes in Europe

As a result of verifying operational processes with European customers, we have found that the majority of construction processes is in analogue and have confirmed that each step is not connected digitally.

Most processes is not digitalized, so the site foremen check visually and perform other tasks in analogue.

Even when digitalized, digitalization stops at individual processes in analogue. Pre and post processes are continuous, resulting in merely chopped solutions.

Colored process are individually digitalized.
Concerning individual operational process, we have verified pros and cons of digitalization by applying cutting-edge technologies. We have verified that we should be able to achieve digital transformation in the entire construction process, when almost all processes are digitalized.

Customers can develop high-precision plans before bidding, thereby eliminating a process after winning.

By advancing the “visualization” level of jobsite operations, they can replace weekly and monthly processes with daily ones, thereby becoming able to turn the high-speed, real-time PDCA cycle.
As a result of turning the high-speed, real-time PDCA cycle, customers can change the processes per se, which lead to shorten the processes and reduce manpower related to the processes.

**Changes in construction processes by digitalization**

**Before construction**
- Bidding – winning
- Preparation

**Under construction**
- Daily
- Weekly
- Monthly

**Before – Under – After Construction**
- Survey
- Budget/actual analysis
- Operational plans
- Purchase of materials
- Execution

“Real-time PDCA”

By creating an advanced and continuous PDCA cycle, customers can **shorten** complicated **processes** and **reduce** necessary manpower.

**Resulting improvements** (for illustration purposes only)

- By achieving targeted terrain with minimum amounts of time, machines and workers, customers can **minimize construction costs**.
- By deploying surplus time, machines and workers, they can **improve earnings of their total business**.

Source: Material for MLIT’s i-Construction promotion consortium
Digital Transformation Emerging in a Diverse Range of Industries
Providers of new digital-based value are capturing the pool of earnings and causing irreversible industrial transformation. As we look into the future of technology innovation, we inevitably need to maintain our lead in the digitalization of construction.

**Examples of capturing the pool of earnings by digital players**

<table>
<thead>
<tr>
<th>Conventional players</th>
<th>Digital players</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information terminals</td>
<td><strong>BlackBerry</strong></td>
</tr>
<tr>
<td>Electric appliances</td>
<td><strong>Nokia</strong></td>
</tr>
<tr>
<td>Mobility</td>
<td><strong>Samsung</strong></td>
</tr>
<tr>
<td>Settlement</td>
<td><strong>Sony</strong></td>
</tr>
</tbody>
</table>

**Further technology innovation into the future**

- **IoT**: Expansion of business and information which can be transacted on networks
- **Big data**: Creation of new values through analysis of a massive amount of data
- **AI**: Sophistication of decision making based on machine learning
- **Robots**: Automation of diverse and complicated work
As the maturity of digital technologies is approaching a “critical point”, the scope of applications is beginning to expand greatly through combination of technologies which have advanced and become inexpensive.

### Examples of advances of digital technology

<table>
<thead>
<tr>
<th></th>
<th>Past</th>
<th>Today</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data rate¹</td>
<td>384kbps (Rising speed) (3G)</td>
<td>1Gbps (4G)</td>
<td>20Gbps (5G) ...</td>
</tr>
<tr>
<td>LiDAR price²</td>
<td>About USD8,000/piece (2007)</td>
<td>Abut USD375/piece (2017)</td>
<td>...</td>
</tr>
<tr>
<td>No. of IoT connections³</td>
<td>500 million (2003)</td>
<td>18 billion (2019)</td>
<td>35 billion (2021) ...</td>
</tr>
<tr>
<td>Processing speed⁴</td>
<td>10TFLOPS (2002)</td>
<td>100 EFLOPS (10,000 times from 2002) (2017)</td>
<td>10ZFLOPS (100 times from 2017) (2025)</td>
</tr>
</tbody>
</table>

### Expanding applications into the future

- Autonomous driving
- Remote medicine
- Genome analysis
- Space exploitation
- Hologram
- Replacement of intellectual work by robots (teachers, secretaries, etc.)

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1: Ministry of Internal Affairs and Communications (MIC), 2: Technavio, 3: MIC, 4: Super computer’s floating point computation capability per one second (Source: Top500)
As the construction industry has big tasks related to safety and productivity, it has more opportunities than other industries to create digital technology-deployed solutions for these tasks.

Safety and productivity-related tasks

- **More dangerous than other industries**
  - No. of deaths per 10,000 employees

<table>
<thead>
<tr>
<th>Industry</th>
<th>Deaths per 10,000 employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic, medical</td>
<td>1</td>
</tr>
<tr>
<td>Financial</td>
<td>1</td>
</tr>
<tr>
<td>Retail</td>
<td>2</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>2</td>
</tr>
<tr>
<td>Service</td>
<td>3</td>
</tr>
<tr>
<td>Energy</td>
<td>4</td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td>9</td>
</tr>
<tr>
<td>Mining</td>
<td>16</td>
</tr>
</tbody>
</table>

- **Lower than other industries**
  - Nominal productivity by industry (JPY1,000/hr)

<table>
<thead>
<tr>
<th>Industry</th>
<th>Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utility</td>
<td>13</td>
</tr>
<tr>
<td>Information &amp; communications</td>
<td>8</td>
</tr>
<tr>
<td>Finance &amp; insurance</td>
<td>7</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>6</td>
</tr>
<tr>
<td>Service</td>
<td>4</td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td>3</td>
</tr>
<tr>
<td>Agriculture, forestry and fisheries</td>
<td>1</td>
</tr>
</tbody>
</table>

Use of digital technologies

- **Very small ratio of investment in IT areas compared to other industries**

<table>
<thead>
<tr>
<th>Industry</th>
<th>IT expenditures per earnings by industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finance</td>
<td>7%</td>
</tr>
<tr>
<td>Service</td>
<td>6%</td>
</tr>
<tr>
<td>Academic</td>
<td>6%</td>
</tr>
<tr>
<td>Travel &amp; media</td>
<td>4%</td>
</tr>
<tr>
<td>Telecommunication</td>
<td>4%</td>
</tr>
<tr>
<td>Insurance</td>
<td>4%</td>
</tr>
<tr>
<td>Medical</td>
<td>3%</td>
</tr>
<tr>
<td>Energy</td>
<td>3%</td>
</tr>
<tr>
<td>Retail</td>
<td>2%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>2%</td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td>2%</td>
</tr>
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</table>

Overall View of LANDLOG Platform and SMARTCONSTRUCTION
Making ‘Things data’ accurately, quickly, easily and cheaply

All kinds of workers, machines and materials involved in construction site
Strategies for “Things”
Advanced Construction (Automated・Self-controlled)

Promote the ICT mechanization* of existing machine

ICT machines* Approx. 2%

To expand and promote ICT function*

Add ICT functions to existing machines

Conventional machines Apptox. 98%

All Excavators working in Japan

*ICT mechanization, ICT machines, ICT functions are, each items of the 3D machine guidance (3D-MG) and 3D machine control (3D-MC) stipulated in “i-Construction” by MLIT, Japan.
Sophistication of construction machinery
(Automated, Autonomy)
Construction by bulldozer by remote control by 5G

Unmanned hydraulic excavators are drilled and loaded

Unmanned crawler dump staked dirt

Demonstration at CEATEC last year
Scheduled to operate at the Government ordering construction site in FY2019
Promotion of ICT for existing construction machinery
We will Develop and launch the Smart Construction Retrofit Kit.

All hydraulic excavators operating on site will be made functions as if they were the latest ICT CONSTRUCTION equipment.

High-precision 3D construction is possible with 3D design data

- No leveling, No auxiliary workers improves safety and productivity
- Can get 3D construction results, ‘things data’, digitally in real time
- Cheap kits, easy to use

<table>
<thead>
<tr>
<th>Feature</th>
<th>Non ICT Machinery</th>
<th>ICT Machinery Retrofit Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3D construction with 3D data</td>
<td>Impossible</td>
<td>Possible</td>
</tr>
<tr>
<td>3D Control</td>
<td>Impossible</td>
<td>Possible</td>
</tr>
<tr>
<td>Leveling · auxiliary workers</td>
<td>Necessary</td>
<td>Unnecessary</td>
</tr>
<tr>
<td>3D Construction results</td>
<td>Can't get</td>
<td>Can get High accuracy</td>
</tr>
</tbody>
</table>
German highway construction site with smart construction
On building an animal bridge connecting the forests to protect the ecosystem

Thank you for your interest in Komatsu