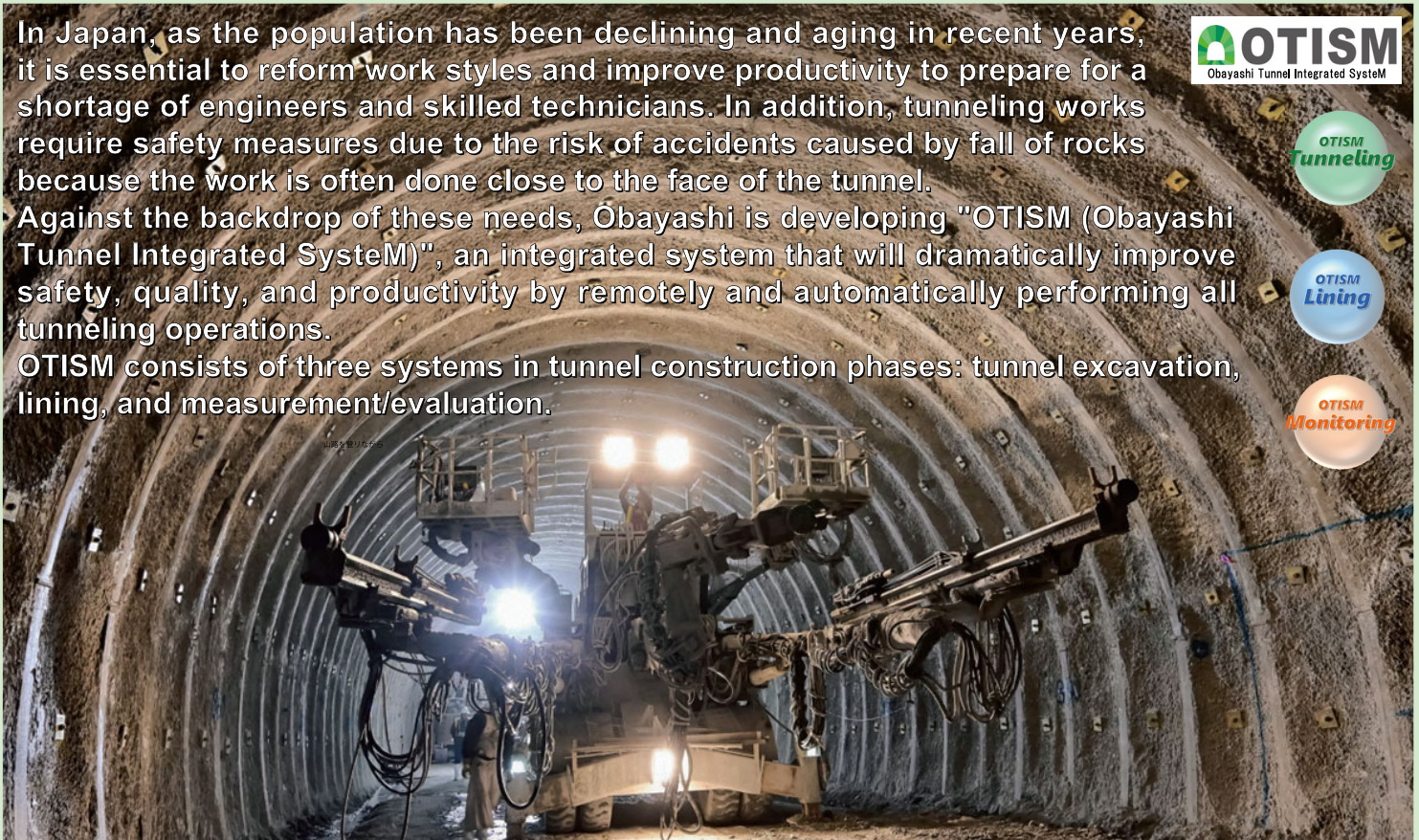


In Japan, as the population has been declining and aging in recent years, it is essential to reform work styles and improve productivity to prepare for a shortage of engineers and skilled technicians. In addition, tunneling works require safety measures due to the risk of accidents caused by fall of rocks because the work is often done close to the face of the tunnel.

Against the backdrop of these needs, Obayashi is developing "OTISM (Obayashi Tunnel Integrated System)", an integrated system that will dramatically improve safety, quality, and productivity by remotely and automatically performing all tunneling operations.

OTISM consists of three systems in tunnel construction phases: tunnel excavation, lining, and measurement/evaluation.



OTISM Tunneling Remote Explosive Loading System

Remote and automatic explosive loading system by robots

- ▶ Robots can load explosives without workers entering directly under the face.
- ▶ Reduction of the number of operators by automating the explosive loading.



OTISM Tunneling Erecting of steel support "Quick Telector"

A system for remotely erecting steel supports with dedicated erectors and a guidance system

- ▶ The work in the immediate vicinity of the face is zero.
- ▶ Reduction of support erecting workforce from 5 to 3



OTISM Lining Form setting "Fully Automatic Traveling Form Setting System"

A system that automatically moves the formwork to the next casting position and places it in place at the touch of a button

- ▶ Reduction of workforce and work hours to 1/3 of conventional ones
- ▶ Reduced risk of defects due to contact with existing concrete and setting errors using sensing technology



OTISM Lining Casting "Hose Extension and Retraction-type Concrete Casting System"

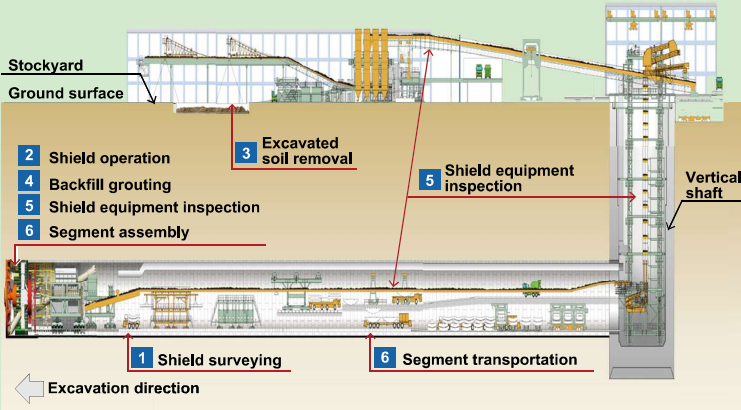
A system that automatically pulls up the hoses and continuously casts the concrete according to the height of cast concrete

- ▶ Prevention of material separation
- ▶ Prevention of entrapment of excess air
- ▶ No need to switch heavy steel piping
- ▶ Reduction of workforce for lining casting by 1/3



OGENTS is a technology that automates the entire shield construction work by linking six automation technologies related to shield excavation. It eliminates the needs for manual work in dangerous areas, and enables shield construction to be performed with fewer people and of a quality equivalent to or better than that performed by skilled technicians.

Automated shield construction by six tasks



Obayashi
OGENTS

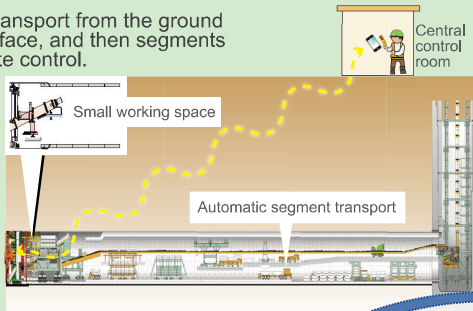
Achieve labor saving, quality assurance, and safety improvement

1 2 3 4 5 6
All automated

6 Automatic assembly of segments

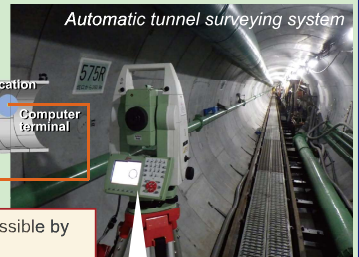
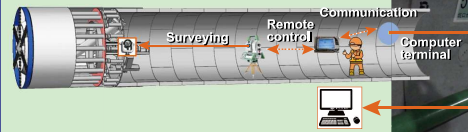
It automates segment transport from the ground stockyard to the cutting face, and then segments are assembled by remote control.

It prevents labor's slip and fall or entanglement injury accidents.



1 Automatic survey of shield

It automates surveying and measurement of shield machines, segments, etc in the tunnel.

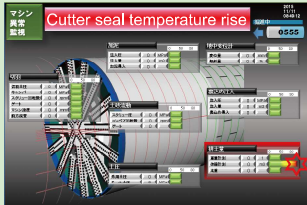


Tunnel surveying become possible by only one person.
Reduction of 30% in working time.

It can be operated remotely using a tablet device.

5 Shield equipment automation

It collects operating data of each equipment, and detects and warns of abnormality.



It can prevent problems with shield equipment before they happen.

4 Automatic backfill grouting

It adjusts appropriate injection volume and pressure according to advance speed and tail void size automatically.

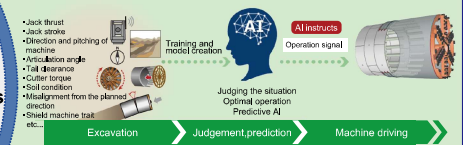
Visualization of the backfill injection status is possible.

Using this technology, backfill grouting is performed reliably and deformation of ground surface and surrounding ground is prevented.



2 Shield autonomous driving technology

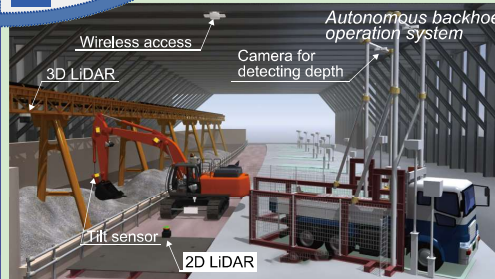
It automates the direction control and operations of the shield machine to ensure cutting face stability instead of skilled technicians.



AI controls the direction of the shield machine properly.

3 Automatic removal of excavated soil

The autonomous backhoe automates the loading of excavated soil into dump trucks.



No backhoe operator is required.

