

March 19th, 2024
FPCJ Press Briefing

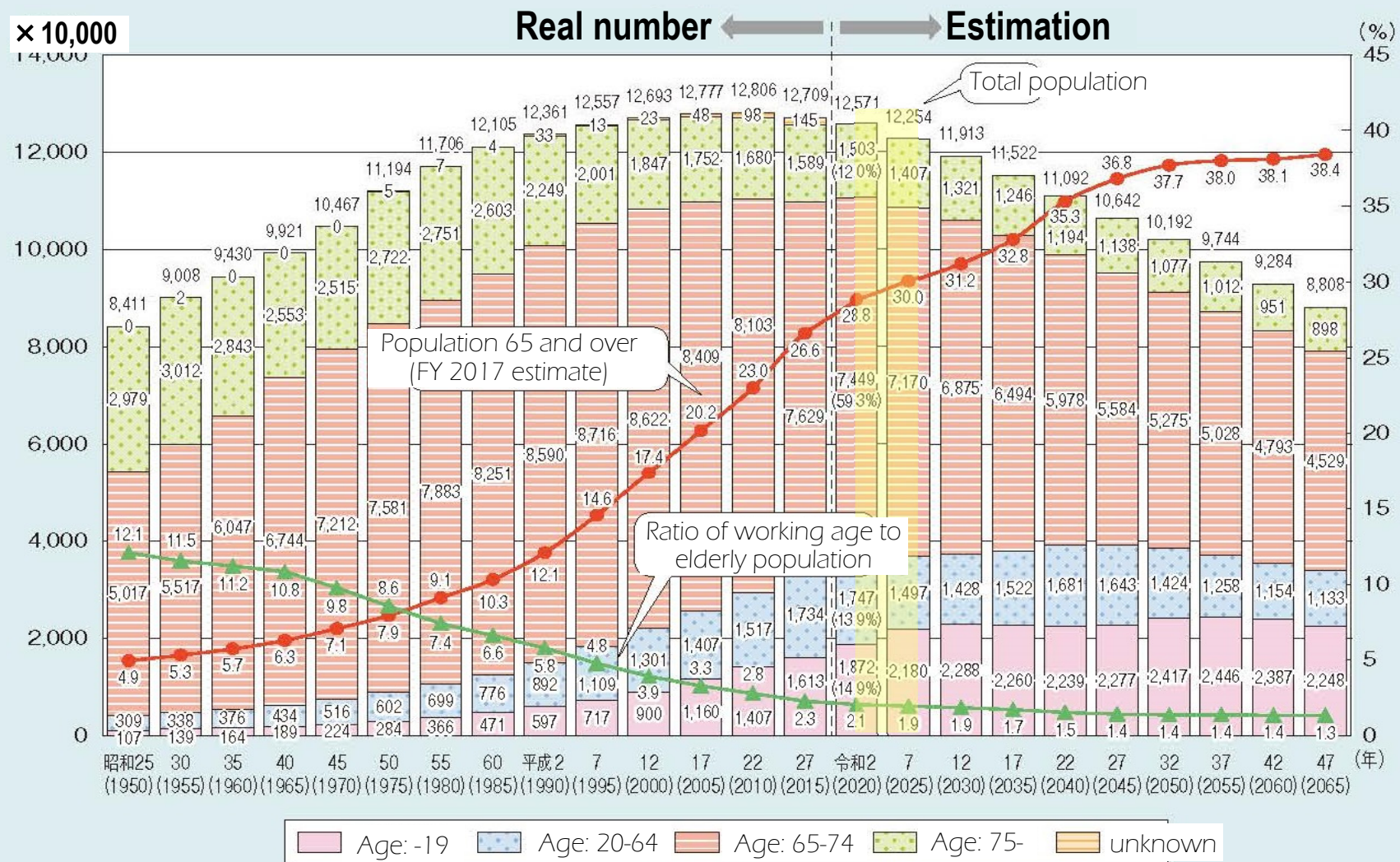
**Solving Problems in the Construction Industry in
an Era of Declining Birthrate and Aging
Population with DX**



Ritsumeikan University
Kazuyoshi Tateyama

Background for Necessity of Innovation in Japanese construction

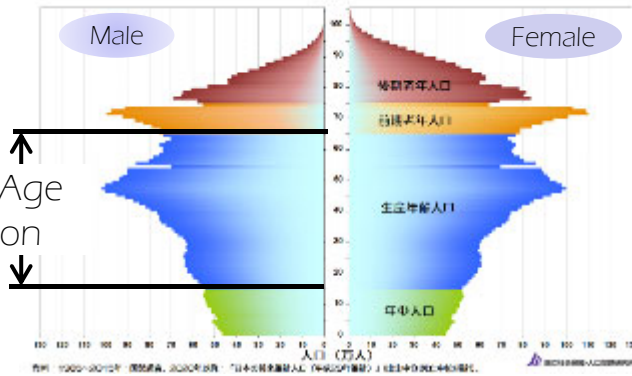
Population Movement and Prediction in Japan



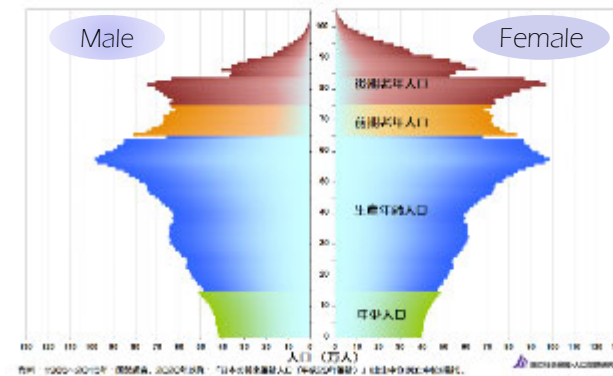
資料：棒グラフと実線の高齢化率については、2015年までは総務省「国勢調査」、2020年は総務省「人口推計」（令和2年10月1日現在（平成27年国勢調査を基準とする推計））、2025年以降は国立社会保障・人口問題研究所「日本の将来推計人口（平成29年推計）」の出生中位・死亡中位仮定による推計結果。

2020

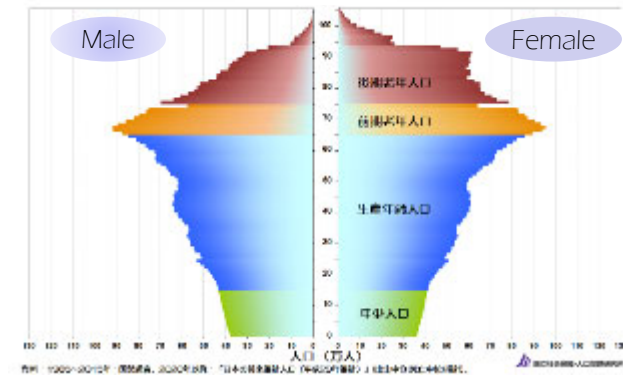
Working Age
Population



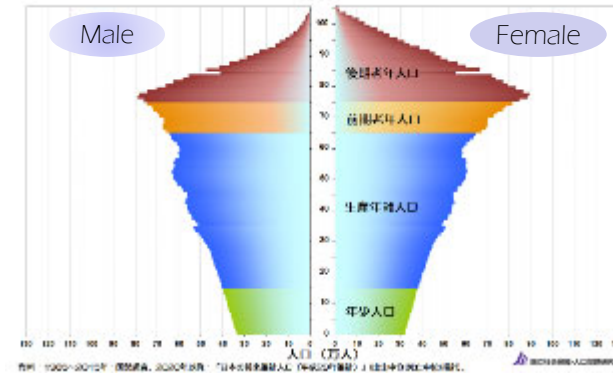
2030



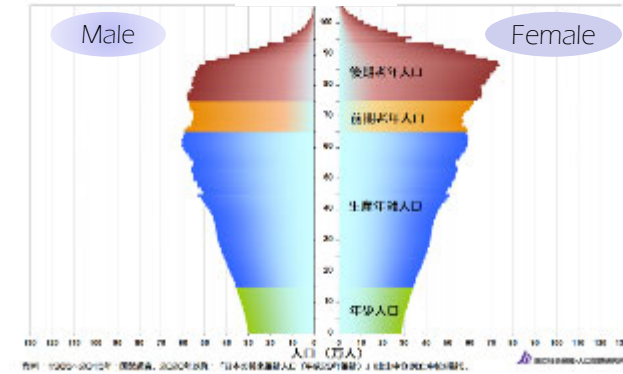
2040



2050

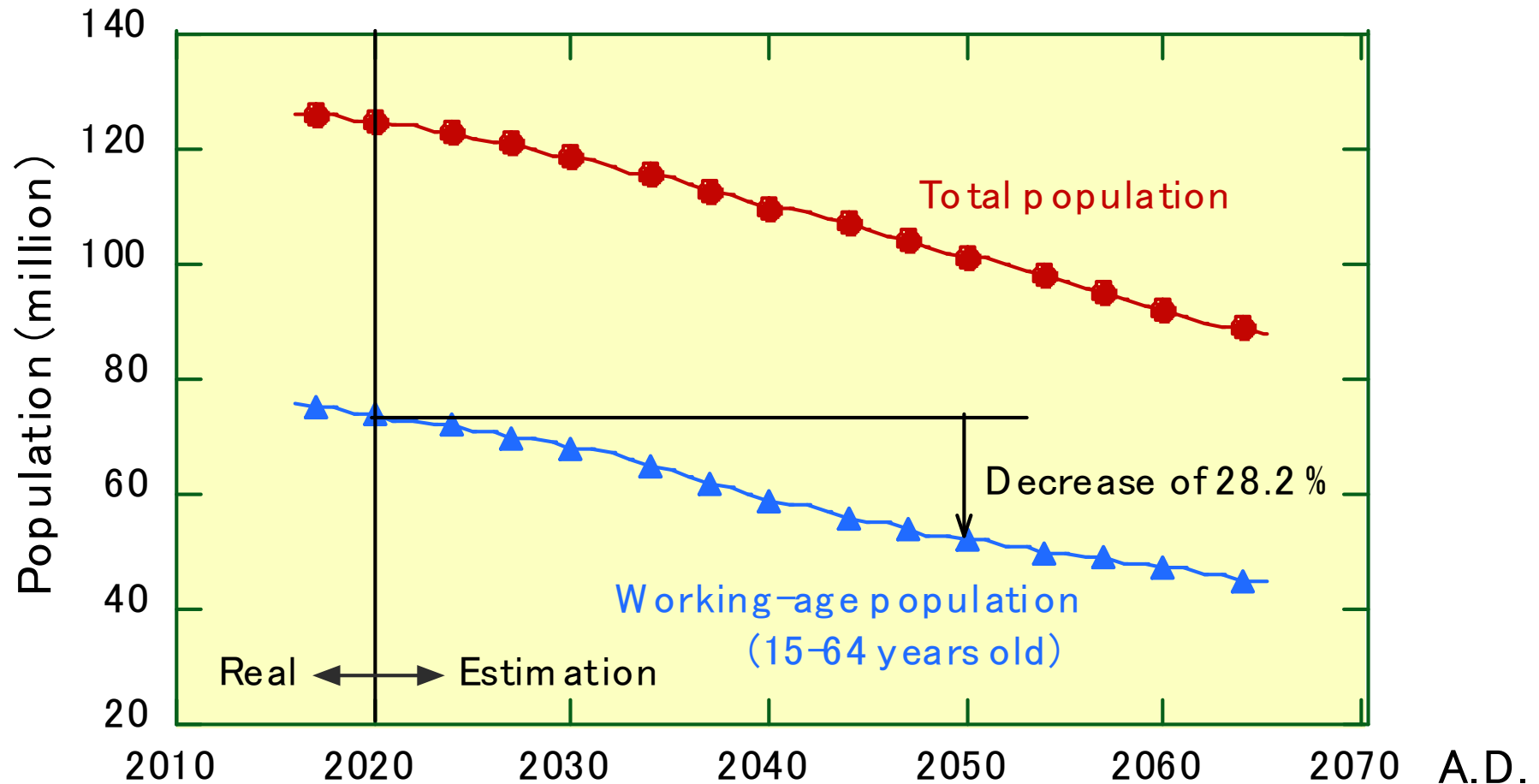


2060



Population Pyramid in Japan

Prediction of population in Japan

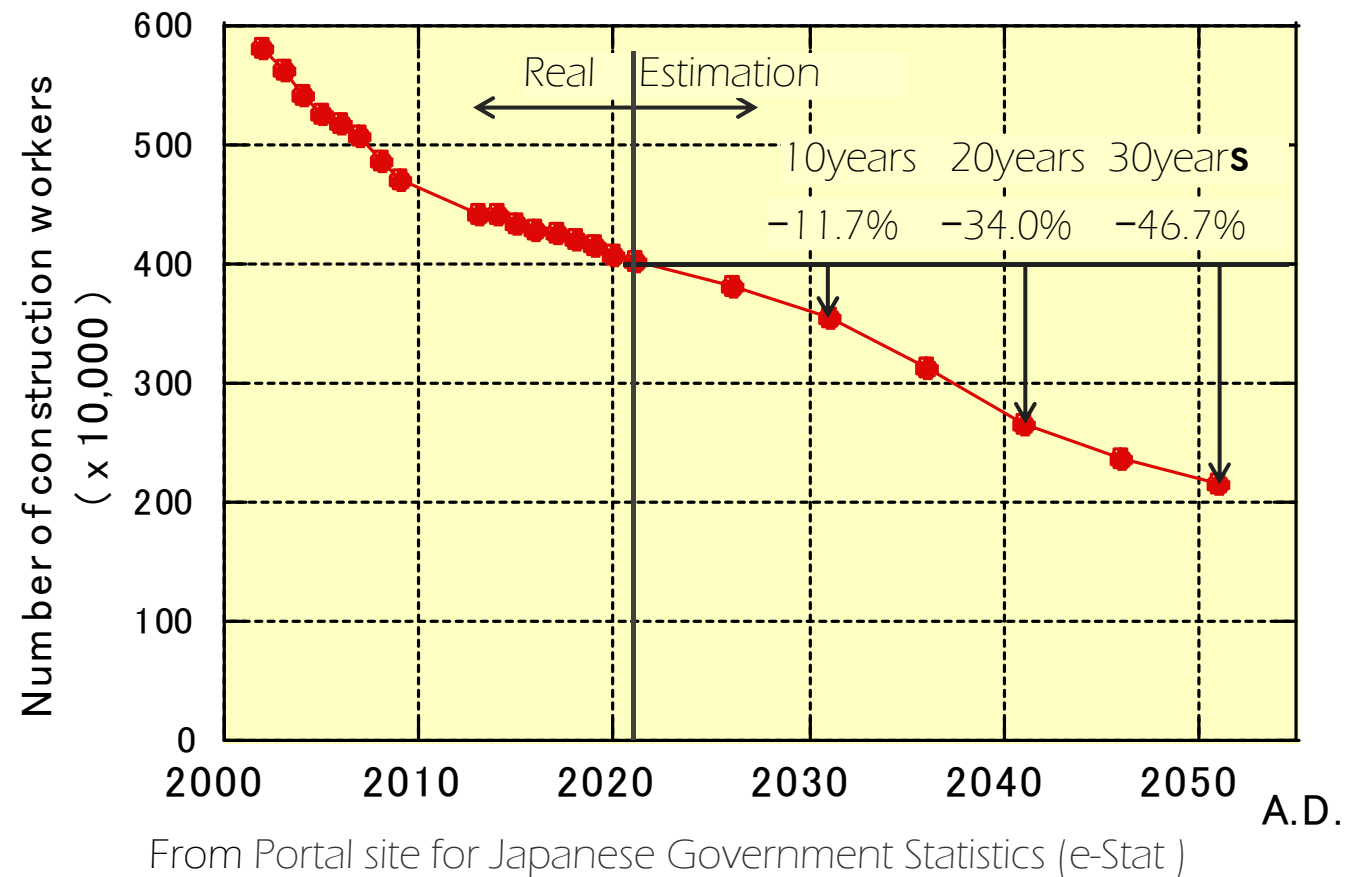


- Working-age population will fall to 71.8 % after 30 years.
- The decrease in the number of construction engineers and workers will accelerate.
- Reduction of the tax revenue → Shrinking of budgets for public investment.

Predicted number of workers (15-64 years old) in the construction industry

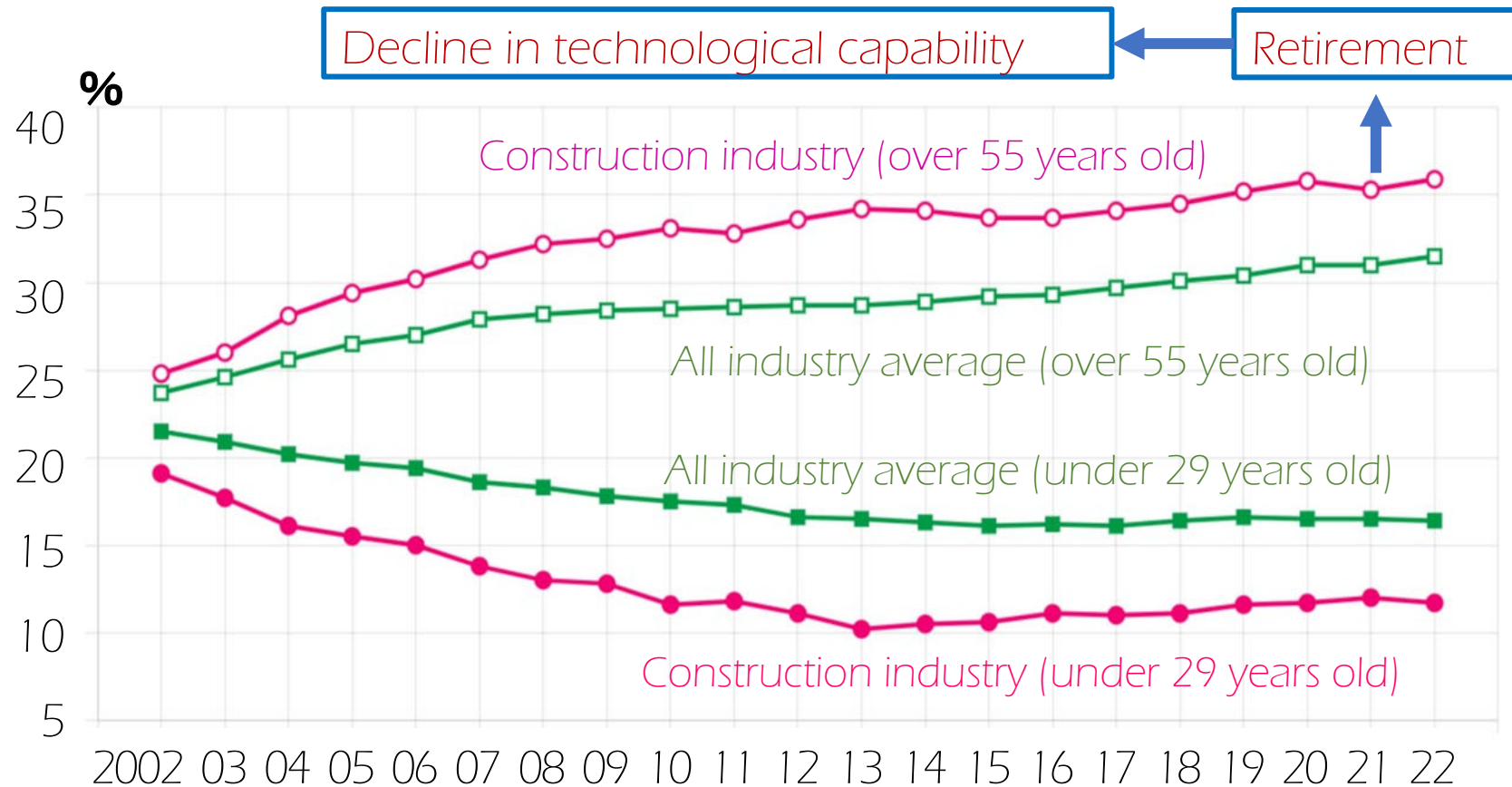
Number of workers by
age group (x10,000)

Age-group	2021	After 5 years
15-19	3	3
20-24	21	21
25-29	33	21
30-34	32	33
35-39	42	32
40-44	51	42
45-49	69	51
50-54	63	69
55-59	47	63
60-64	42	47
Total	403	382



- The forecast assumes that the composition of the working population by age group will remain unchanged.
- Mid-career leavers and mid-career entrants are not considered.

Construction industry with an aging workforce



From Digital Construction Handbook 2023 (Japan Federation of Construction Contractors)

- The technical capabilities of the construction industry depend not on the organization but on the engineers' long years of experience.
- Retirement of skilled engineers = Decline in technical capability.

The 2024 Problem in the Construction Industry

At the end of March 2024, the grace period for the upper limit on overtime work that exceeds the legal working hours (by Labor Standards Law) will end.

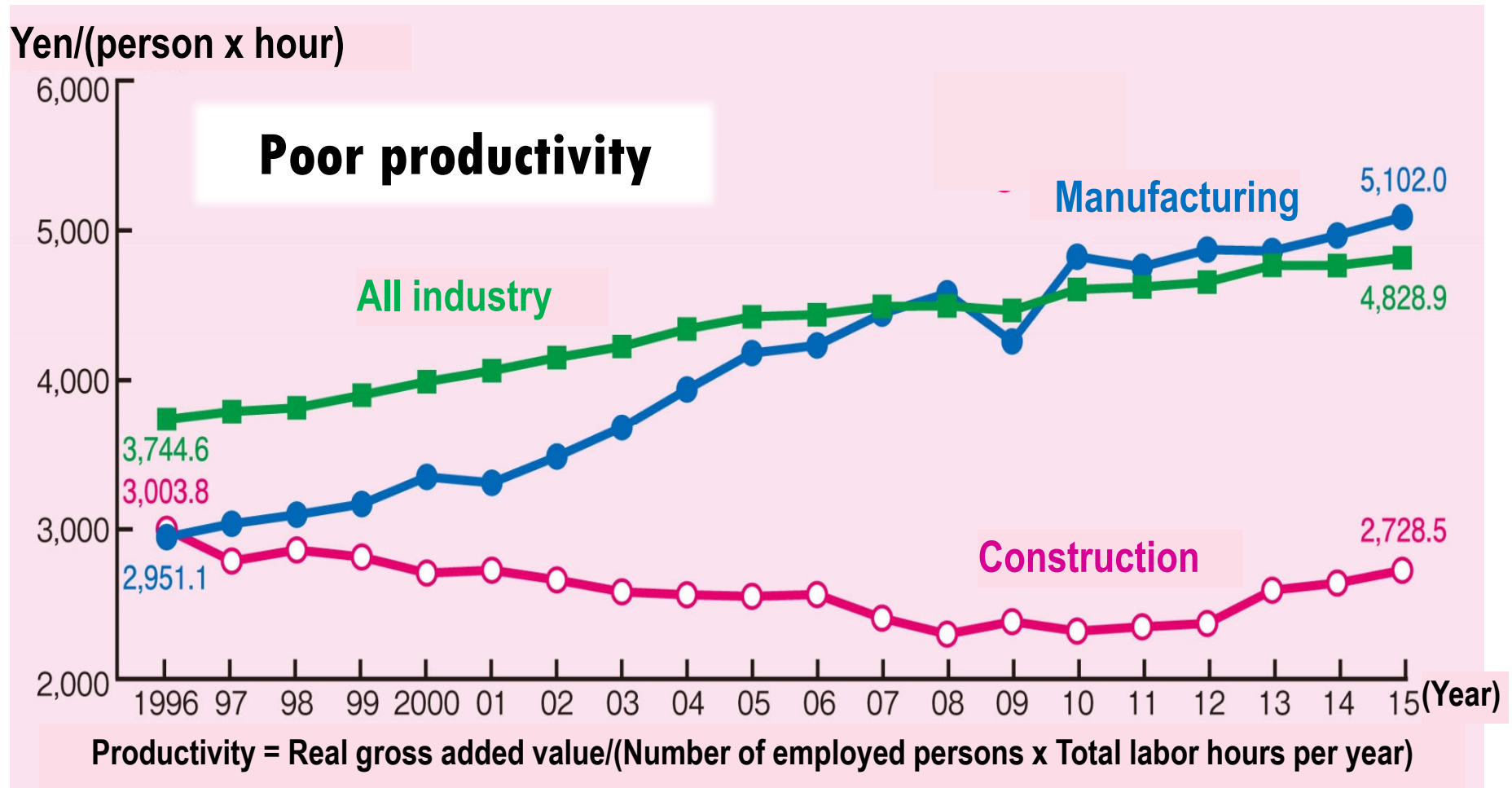
➡ Construction workers' working hours must be constrained.

Measures for an era of serious labor shortages

1. Creating a system that enables more work than ever with less manpower ⇒ "Productivity improvement" through manpower saving and efficiency improvement
2. Transformation into an industry in which a different type of workers can also play an active role

Perspectives on technological succession are important.

Comparison of Changes in Labor Productivity by Industry



From Digital Construction Handbook 2017 (Japan Federation of Construction Contractors)

★ Construction industry has enough potential to increase the productivity. ★

A New Policy of the Ministry of Land, Infrastructure and Transport

i-Construction from 2016

Remarkable Improvements in Productivity through

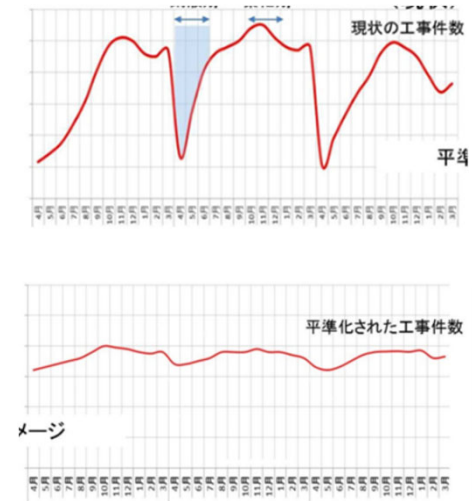
Aggressive Use of ICT in Construction



Standardization of the Specifications



Balancing of Orders throughout a year



**Hard
Dirty
Dangerous**



**High wage levels
Sufficient holidays
Safe labor environment**

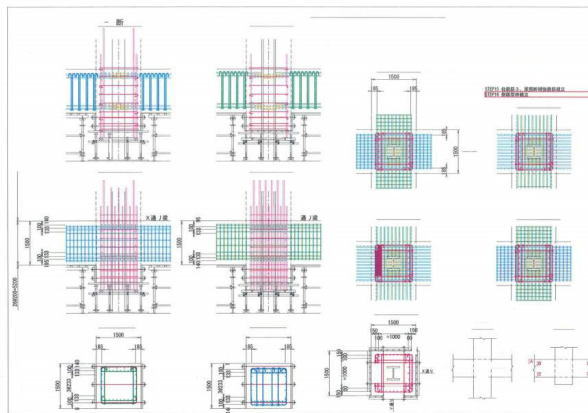


**Drastic Development
as an industry**

Promotion of i-Construction

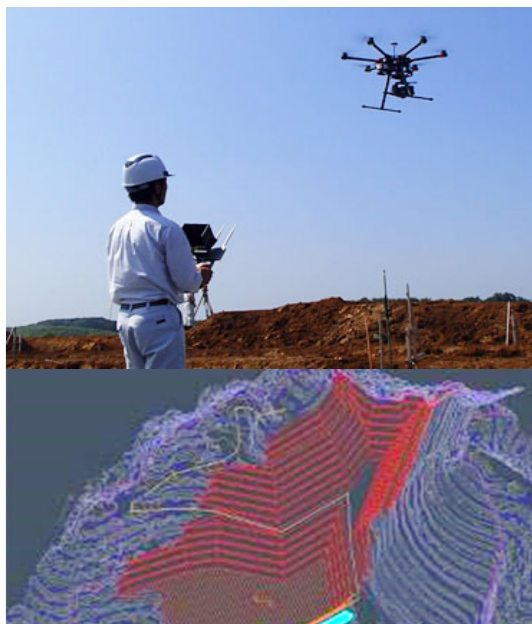
Full use of ICT

Conventional method

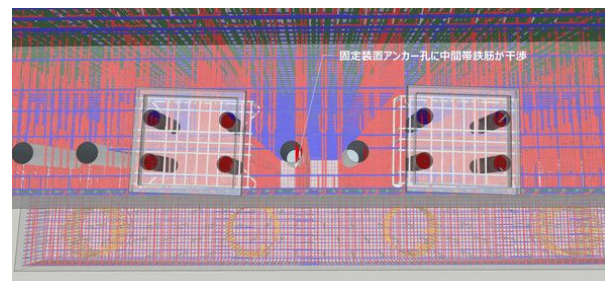
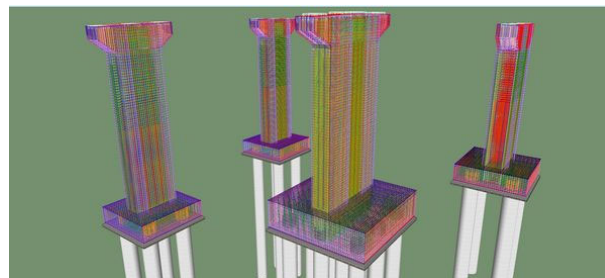


From 2D to 3D

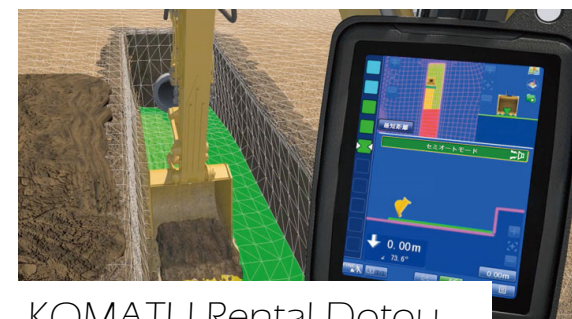
ICT Construction



Okumura Engineering Corporation



Interference check of rebar by 3D model
NPO Green Earth

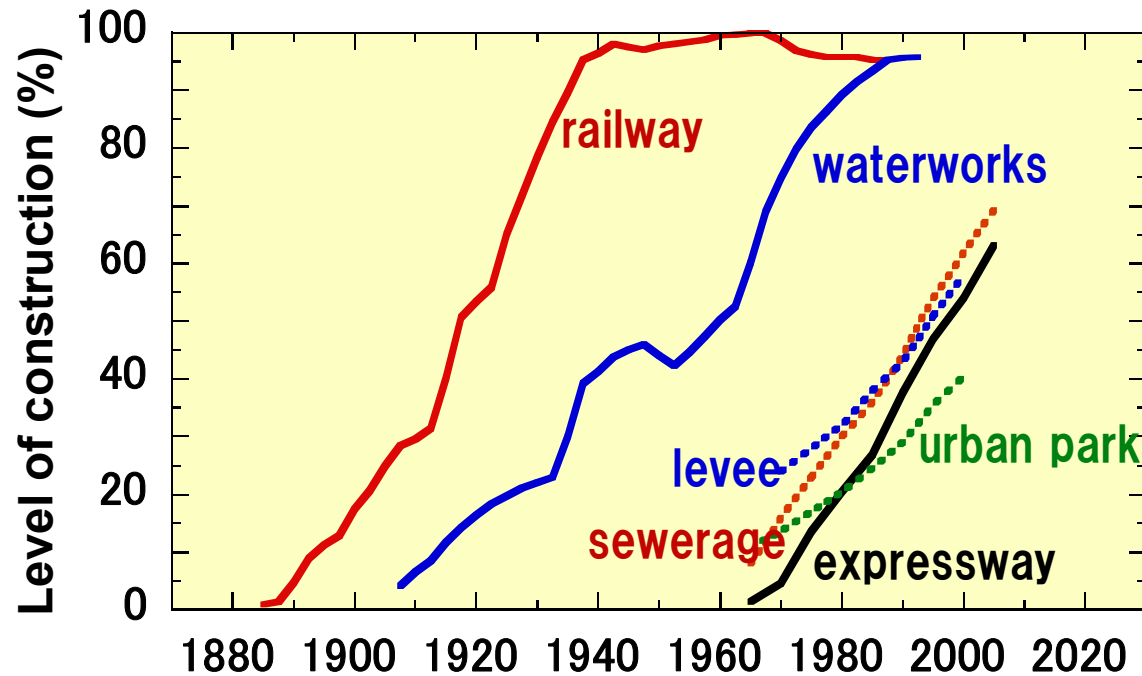


KOMATU Rental Dotou



Autodesk

Efficiency through fixed and uniform management of construction methods - Merits and Demerits -



Growth of infrastructures in Japan
(white paper on Japanese construction)

- Systematizing design
- Settling criteria
- Completing manuals



Efficient system for
construction of
infrastructure



Uniform management in
construction

- Establish infrastructure of a certain quality in a short period
- Fixation of construction methods and reluctance to introducing new technologies
- Inducing waste through uniform management

ICT in Construction : Need for a Next Step

- ICT, mainly MG, MC, and drone surveying in earthwork and pavement construction, is being introduced to a certain extent.
- Signs of productivity gains in construction are beginning to emerge.

but

- Those companies that are able to introduce ICT are doing so. For companies that cannot cope with the prescribed ICT introduction, another scheme is necessary.
- In particular, the challenge is to introduce the system to local governments and local companies that support infrastructure development in rural areas.



DX Promotion in general society



Need to promote digitalization more than ever in Construction

Promoting Digitalization in Construction

I. Digitization

Digitization of analog work



Optical surveying



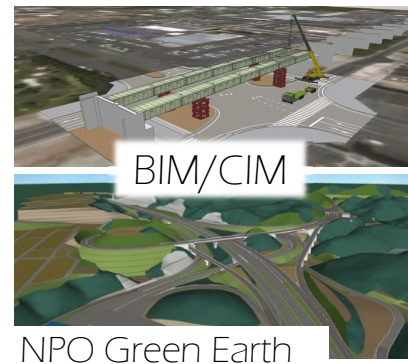
GNSS surveying



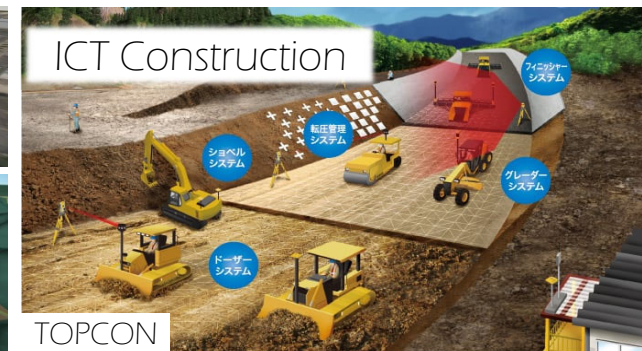
UAV surveying

II. Digitalization

Systematization of construction with ICT



NPO Green Earth



TOPCON

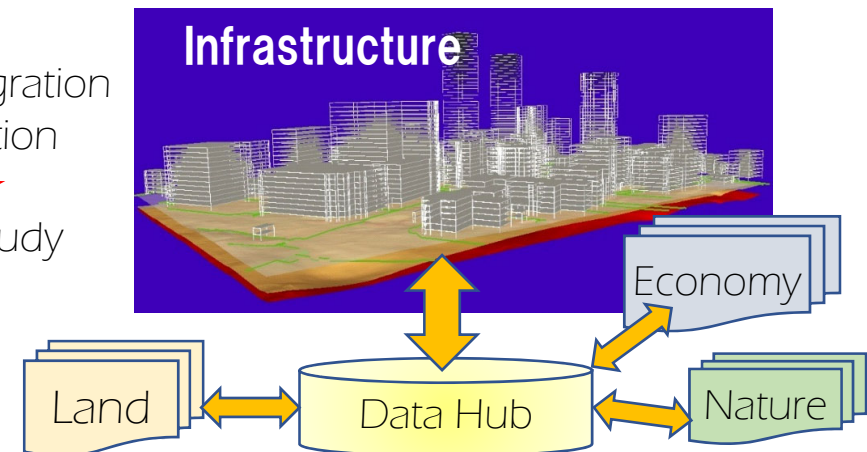
III. Digital Transformation

Inducing new content through data fusion

Data Integration
Simulation

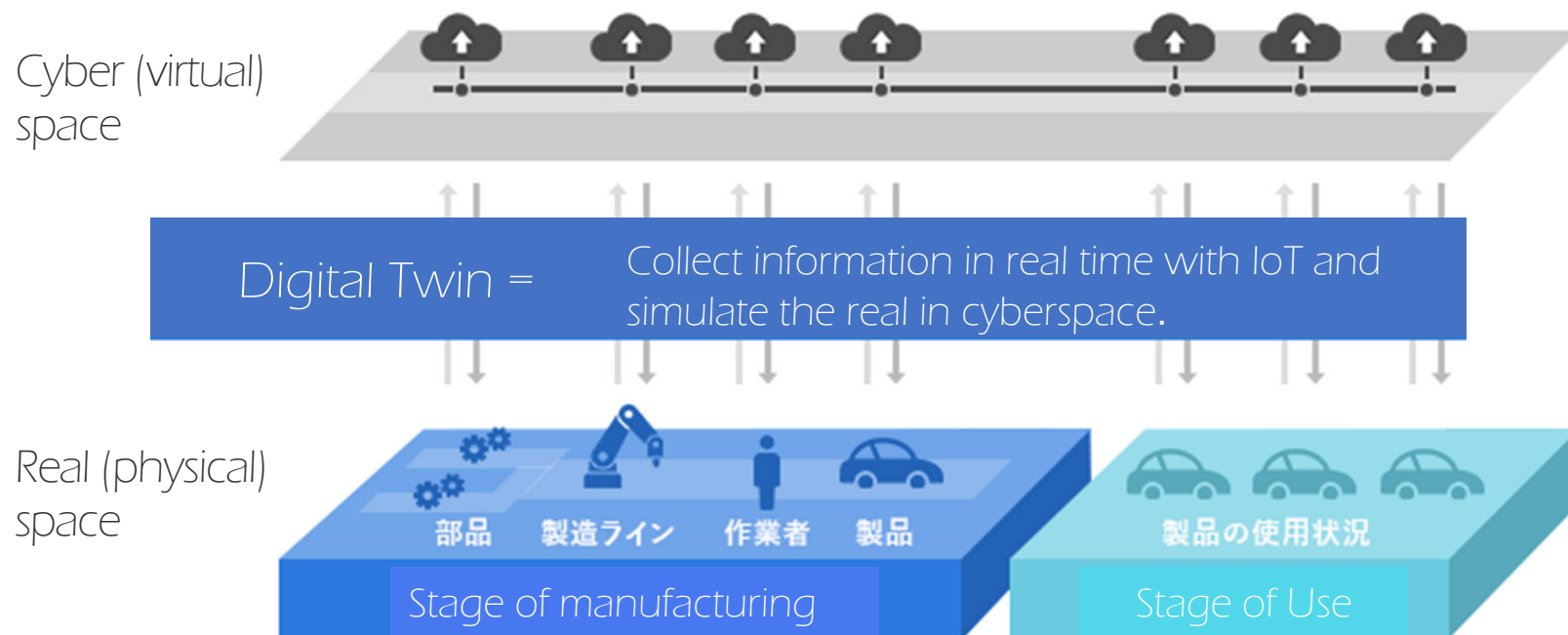


Case Study



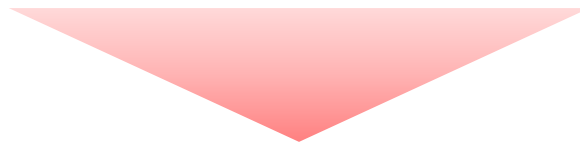
III. Digital Transformation DX \Rightarrow Digital Twin DT

A technology that reproduces a real space in a cyber (virtual) space based on data collected in a real (physical) space using IoT, etc. Unlike conventional virtual spaces, this technology is characterized by its ability to reproduce a more realistic space in real time. It is like the world in a mirror that copies the environment of the real world into the virtual space, and is called "digital twin" in the sense of "digital twin".



Infrastructure Development with Digital Twin

Digital twin allows us to simulate various scenarios and redo them as many times as we want.



Extraction of optimal scenarios

⇒ Optimization of urban planning

Estimating the effects of introducing new technology

⇒ Promotion of new technology introduction

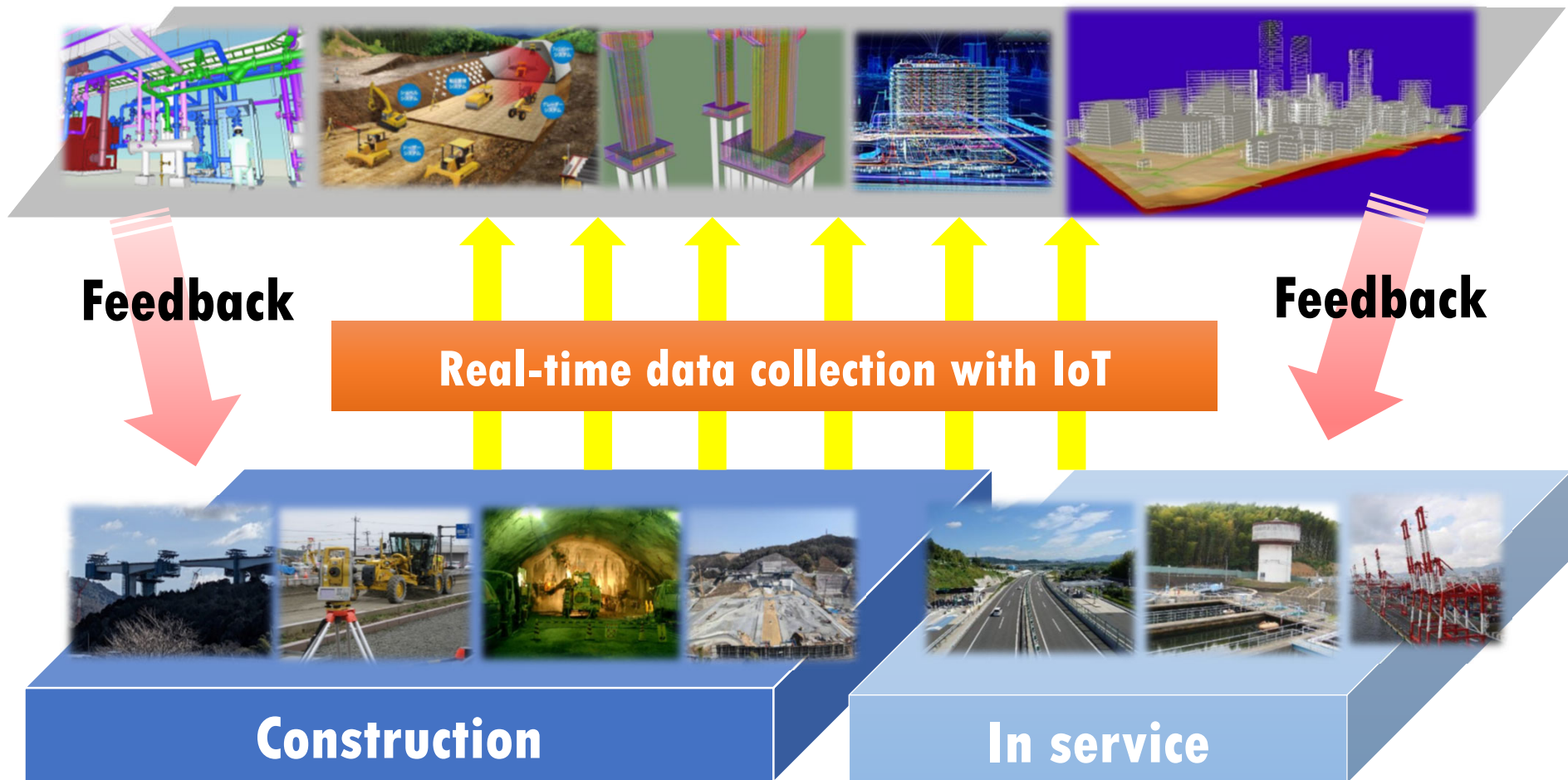
Inducing new technological development

⇒ Innovation in Infrastructure Development

Digital Twin as a base for infrastructure development

Cyber (virtual) space : Simulation of real phenomena

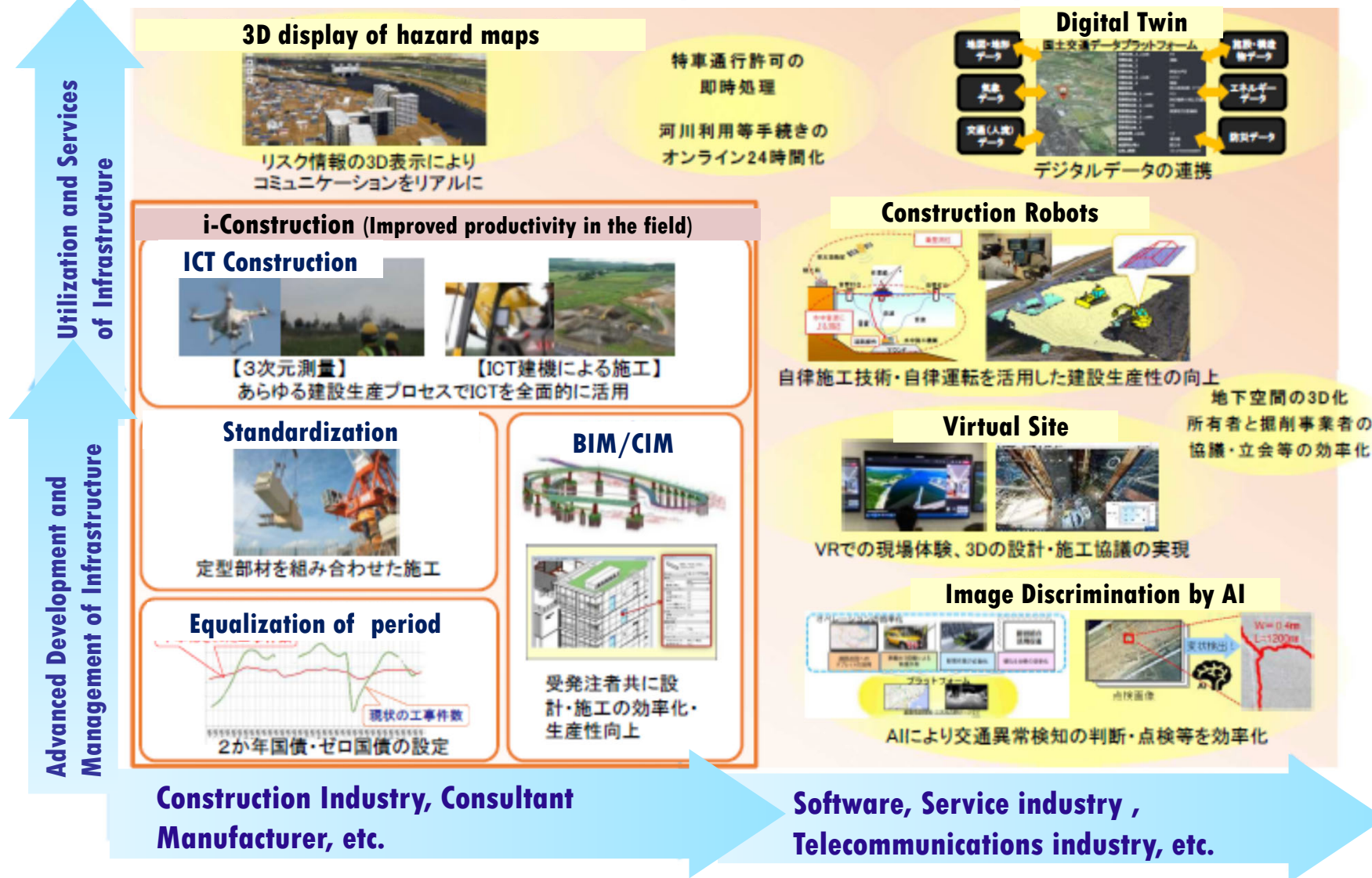
➔ **Extraction of optimal scenarios, conditions, and methods**



Real (reality) space : Data collection on events

Evolution from i-Construction to Infra-DX

DX in the infrastructure sector (Reform of organization, processes, culture, and ways of working)



Significance of ICT implementation

1. Improvement of efficiency and manpower saving.

- ✓ **Productivity improvement through manpower saving and efficiency improvement by utilizing ICT**
- ✓ **Promotion of manpower saving through automation and autonomous technology**

2. Creation of opportunities for diverse human resources

- ✓ **It allows people who have never been involved in construction before to share in the work.**
- ✓ **Engineers can use their free time to work on more specialized technical work with more time to spare.**

3. Reduction of excess through precise management

- ✓ **Optimization of construction through reduction of excesses that are inevitable with uniform management.**

1. Productivity improvement by utilizing ICT

Aerial surveying with UAV

Overlapping photographic shots

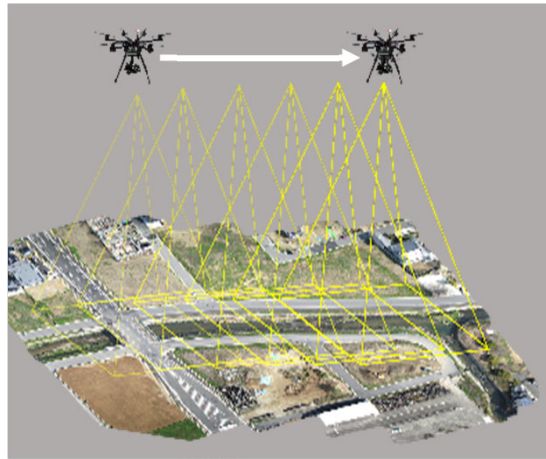
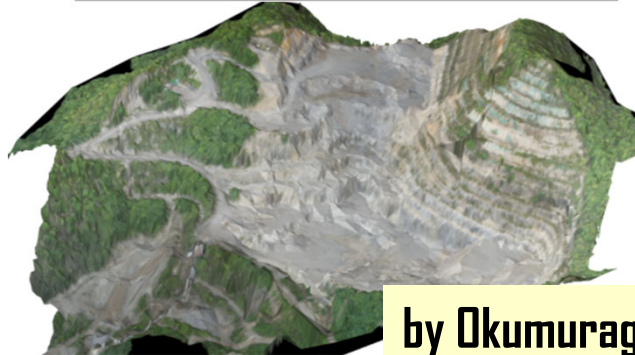


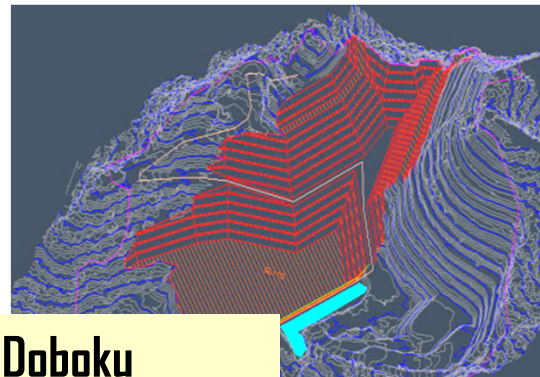
Photo surveying

Point cloud data

Quantification of landform
by 3D data set



by Okumura Gumi-Doboku



by Kajima Corporation

Methodology	Area	Time	Human works	Cost
UAV	2ha	1 hour	1man day (1day)	1.0
3D Laser scanner	2ha	1 day	2 man day (2days)	4.0
Electro-optical measurement	2ha	3 days	10 man days (5days)	5.6

1. Promotion of manpower saving through automation and autonomous technology

- Comparison with Factory Automation (FA) -

Manufacturing



- Form and materials are clearly specified in design.
- Working environment is stable because of indoor jobs.
- Working objects come to robots by themselves on a conveyer.

Construction

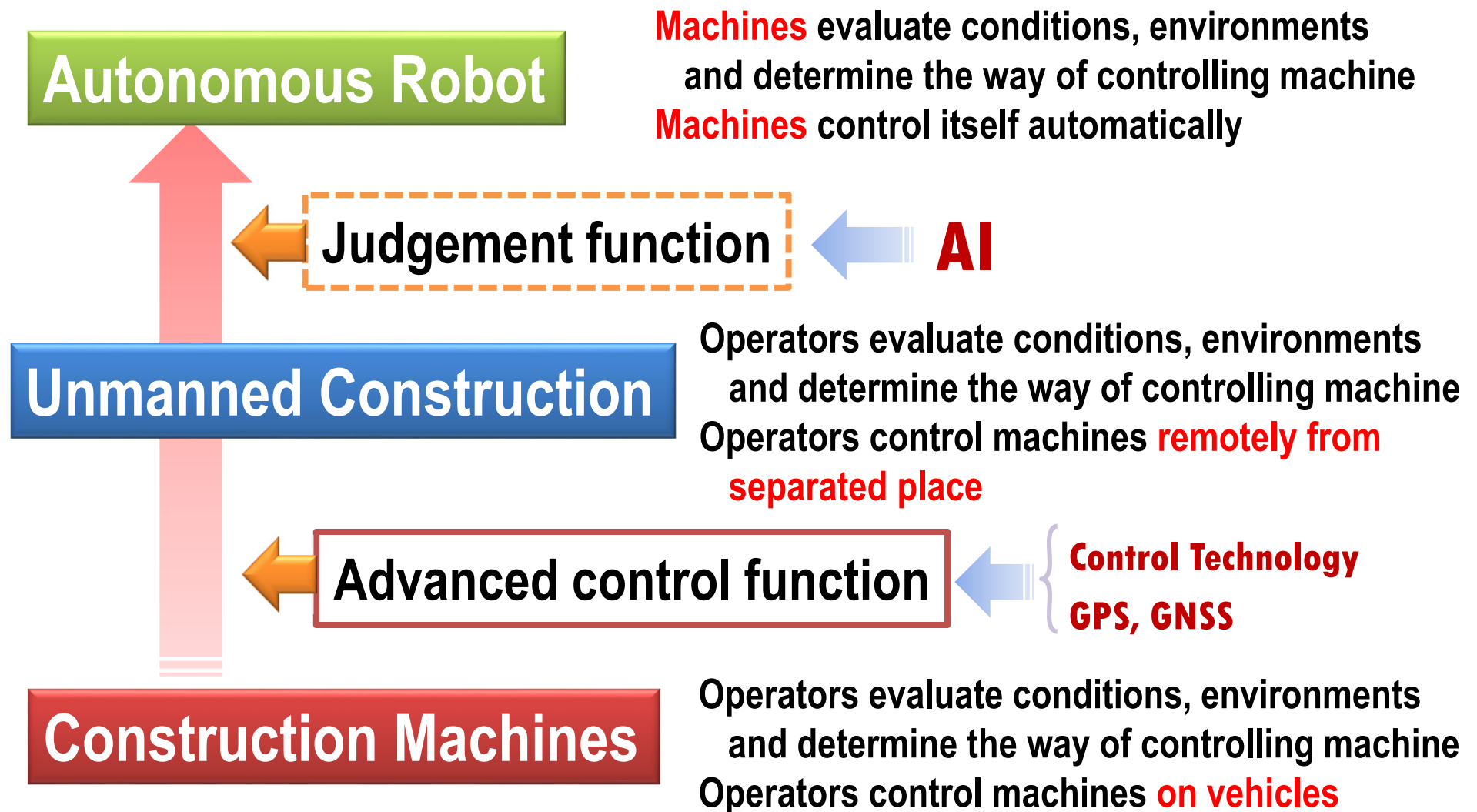


- Materials are soil and rocks and thus their properties are variable
- Outdoor working conditions are much affected by weather
- Machines must arrive at working objects in a huge field.

Construction robot should have a function to determine its own action flexibly according to the situation of each construction site.

From construction equipment to autonomous robots

Evolving construction work utilizing peripheral technologies



Autonomous Construction Robot (Kajima Co. Ltd.)



System consisting with plural different machines which do their jobs corroborating each other.

Each machine can do its own jobs, while grasping the information on surrounding circumstance, the working object, the move of other machines and determining the optimum control way of itself.

2. Creation of opportunities for diverse human resources to play an active role



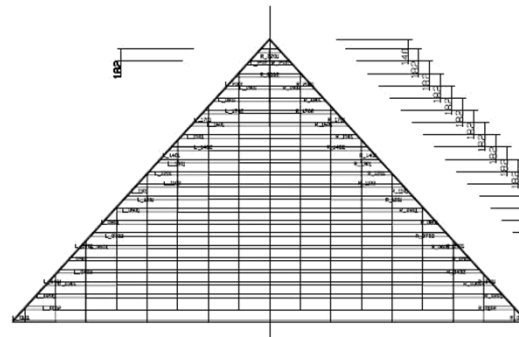
Dangerous Job on high roofs, Aged workmen, Lack of successors
Low productivity. There are a lot of the issues to be solved.

Challenge of Matsuzawa Pantile Co. Ltd.

Reduction of works on high roof by changing players from skilled workmen.



i-Construction in Roof Construction



UAV surveying of the shape and size of the roofs as 3D data

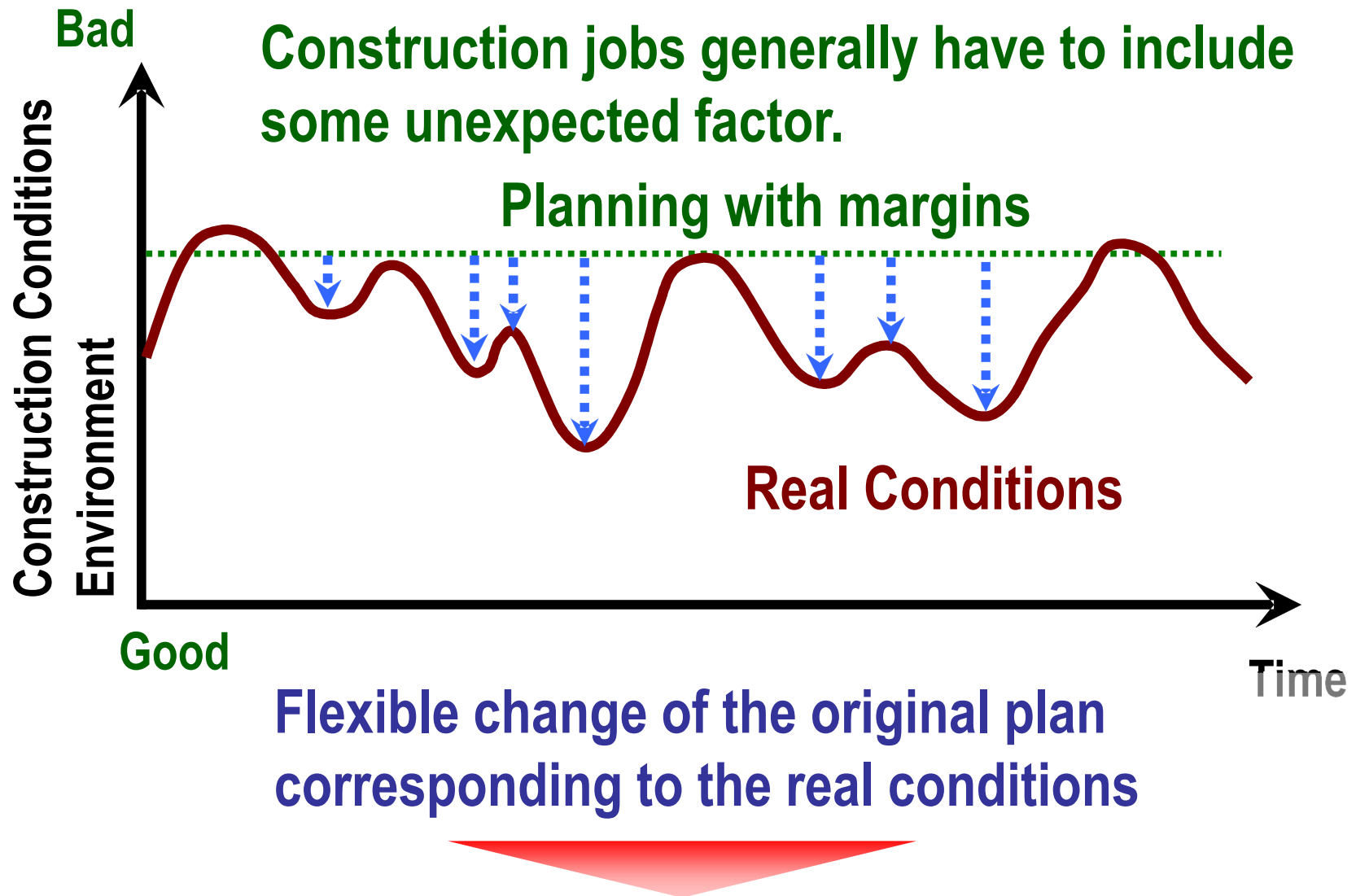
Design, Constructing planning, Estimation with 3D CAD

Precutting of roof tile indoors

Placing roof tiles

**Various personnel can enter the construction industry with ICT.
Various trials for Diversification of Professional Staffs has started.**

3. Reduction of excesses through precise management

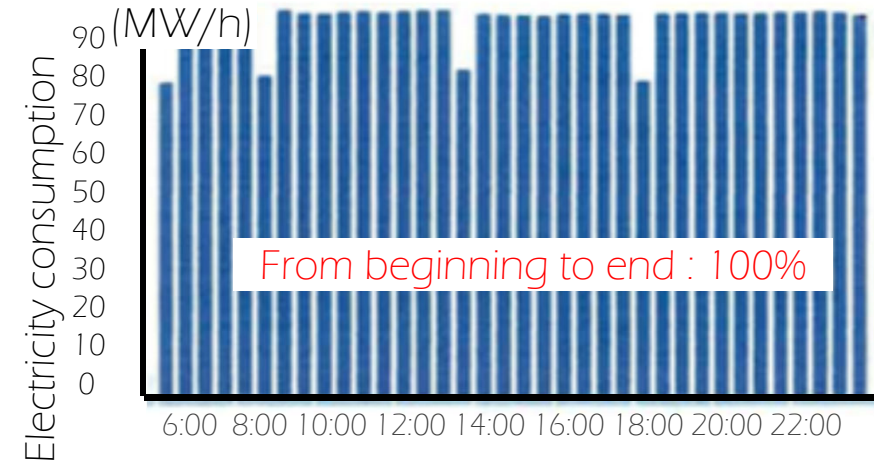


Optimization: Saving labors, materials and energies, etc. 25

Precise management : Energy conservation monitoring in tunnel construction

Conventional

Size of Tunnel
Blasting planning
Machinery planning
↓
Design of ventilation
equipment

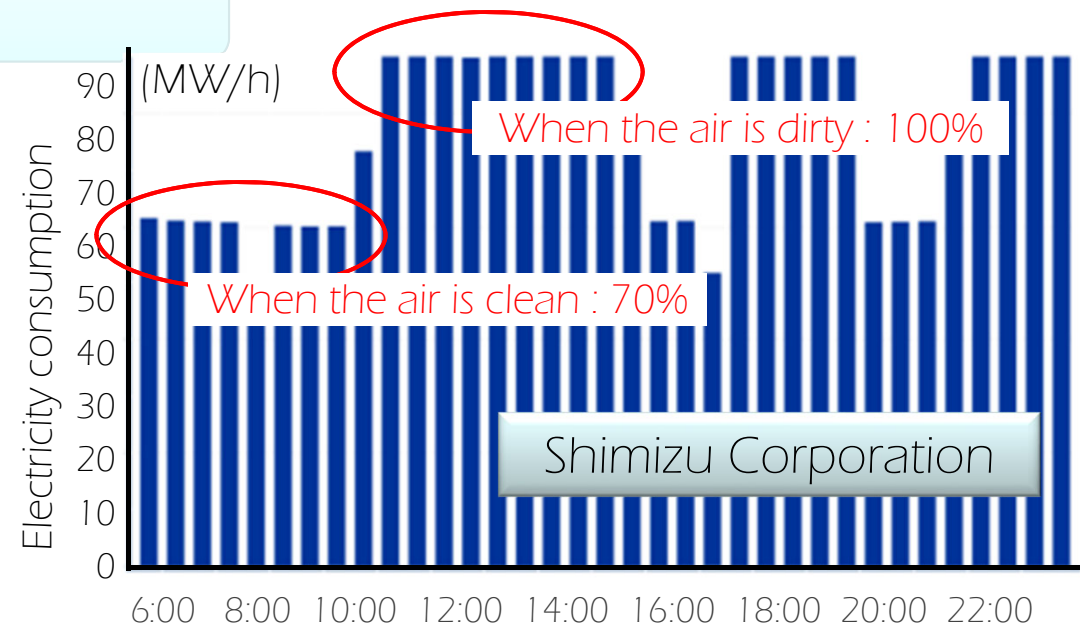


Control of airflow to suit the environment
inside the tunnel

Measurement results of
Description of work, CO₂,
Oxygen concentration,
Dust content, Toxic fumes, etc.



When the air is dirty. ⇒ 100% power
When the air is clean. ⇒ 70% power



Infrastructure Development

20th century : Streamlining with the standards

<Uniform management>



21st century : Elaboration by engineer's judgment

<Individual Evaluation>

Reduction of waste and effective use of resources

Summary

- **The construction industry is certainly on the move.**
- **We have a great opportunity to set up a system to overcome the problems that are sure to come in the future.**
- **What is most needed is a positive change of mindset on the part of each individual.**
- **In construction, it is necessary to foster a culture that appreciates challenges rather than blames failure.**
- **It is important to proactively try what we can do now that we have a little more time to spare.**

**Can DX solve the problems of the
construction industry?**