Theme 2: Construction Kaizen as a bottom-up-pull

A Notable Technology in Construction

1. Visual Construction
2. Work-style reformation

Ritsumeikan University
Kazuyoshi Tateyama
A Notable Technology in Japanese Construction

1. Visual Construction
Advanced Management utilizing Video Information

Construction period: 17th July 2014 – 27th March, 2015 (about 8 months)
Client: Ministry of Land, Infrastructure and Transport
Contractor: Kani Construction Co. Ltd.
Description of work: Remedial work of river embankment (3,100m³)

Development of a system to record and share the information of construction site

Intelligent database system
Video Recording System

System Configuration

Camera 1
- Observation; Excavation

Camera 2
- Visualization of whole site

Camera 3
- Observation: embankment

Camera 4
- Observation: River water level

Remote access
- PoE Switching HAB
- Power supply, Network device

Network Video recorder
- Network device

Mobile terminal
- Internet

Kani Construction Co Ltd.
Time lapse video system

A method of creating a video from still images recorded at regular intervals. It can express changes in events over a long period of time with a short time video.

- Video stream
- Slice data
- Time lapse video

Effect of time lapse
- Data compression
- Time shorting
- Improving visibility
Example of time lapse video by Kani Construction Co. Ltd.

1s slice data (30 x speed)  5s slice data (150 x speed)

10s slice data (300 x speed)  30s slice data (900 x speed)
Recording of the site information to the database

- Video data
- GPS data
- GPS data and Photo data are integrated into the database automatically.
- Photo data
- Internet or personal circuit
- USB
- Memory card

PC (Database)

by Kani Construction Co. Ltd
Intelligent database (Listing of data, Visualization)

Original Data
- Time lapse data AVI
- Photo data JPG
- GPS data TXT

Automatic listing function for DB

Visualization (Graph, Diagraph)
Advantage of Utilizing Video Data in Construction

(1) Recording function of video data
- Cause analysis in case of malfunction or accident
- Verification of construction plan and its feedback
- Simplification in management tasks
  (Reduction of huge amount of documents)
- Advance examination of preceded construction by archiving

(2) Visual education of employees
- Small companies highly dependent on the skills of individual engineers.
  → Improving the experience of young engineers through virtual education.

(3) Others
- Sharing of site information between the client and contractor
  (Reducing of inspection works in the sites)
- Suppression of unsafe behaviors
  → Prevention of occupational accidents
Recording function of video data

Analysis on the causes of serious events (changes in strain of the sheet piles) from the time lapse video data in widening work of a road

When a concrete wall collapsed, a large vehicle passed over the area.

by Kani Construction Co. Ltd
The video data were shared with the contractor and the client whose office was far away from the site.

By Aiki Co. Ltd., Ehime Pref.
Example of machinery accident: The cause of the accident is unknown.

An operator did a leveling work with a mini-power shovel alone. He was found dead under the shovel in the bottom of a ditch.

The cause was guessed because of no witnesses.

Prevention of repeated occurrence by early detection and cause investigation by video

by Japan Institute of Country- ology and Engineering
Improvement of management works using ICT

Reduction of Inspection documents, etc.

Quantification of video information

Replacement of inspection documents by video

Database of video data
Study group on utilization of video data in construction (2016)

Guideline for video data utilization in construction (2017)

- Streamlining construction records (utilizing the larger usefulness of video than that of photographs)
- Reduction of site inspection through sharing the site conditions with video system
- Facilitating communication between clients and contractors
- Improvement of the safety management

Trial construction ➔ Standardization
Expectation to visual construction

- On-site video data contains a wide range of information, from simple information that anyone can easily handle to information that requires advanced technical skills to handle. Depending on the technical level of the user, it can be selected and used effectively.

- There are many applications that have not been developed yet. Development of such new technologies will be extremely useful for the advancement of construction.

- Accumulation of on-site trials and sharing of results will lead to advancement of visual construction technology.
A Notable Technology in Japanese Construction

2. Work-style reformation, by building new organization and introducing new facilities
Increasing momentum of technological development triggered by i-Construction

New standards & guidelines such as Public surveying manual
http://www.mlit.go.jp/sogoseisaku/constplan/sosei_constplan_tk_000031.html

The standards and manuals that were apt to be fixed has been greatly revised.

The introduction of many new technologies will be tried according to the actual situation in the field.

Point

It is easier to get a certain effect if you do not aim to introduce ICT but decide on the purpose and consider using ICT.

Expected to increase the momentum for technical development on site.
Improving the efficiency of management work with ICT

Transition of social capital development

Systematization of design
Setting standards
Manual construction

Mechanism for efficient infrastructure development

Increase in administrative work (office work)

Reduction of creativity
Declining intention of new technology introduction

Efficient management work using ICT and reduction of document work

Return of engineers to the field
Promotion of new technology introduction
Work-style reformation by building new organization 1

Uncommonly in the Japanese construction companies, half of employees are women. Koishi, Oita Pref.

Creation of an environment where mothers, building up their children can work easily.

- Flexible working time
- Work with children
- CAD education
- Skill up for each employee

Surveying on sites jobs + Data reduction Indoor jobs

Engineers

Surveying on sites jobs

Data reduction Indoor jobs

Engineers

Taking charge more sites

CAD operators

Job division system with ICT
Work-style reformation by building new organization 2

Current situation

Women play an active role by changing their work style (role)

• Expansion of office work (addition of duties, relocation)
• Return position for female engineers (maternity leave, childcare leave)
• New employment (ICT, inexperienced person)

- Long hours jobs of on-site engineers for document preparation work
- Difficult technology transfer due to lack of human resources
- No communication between site and office

• Skill up of office employee by mastering specialized skill of the site managements
• Field support with IT and communication

Construction Director Training Program

Basic social skills / career / construction law / construction management / photo & documentation management / CAD / estimation / cost management, communication, etc.

by Kyoto Sander, Kyoto Pref.
Work-style reformation by introducing new facilities

Data is instantly shared with others via the cloud using communication functions

Utilization of smartphone equipped with application for construction management

Advantages of smartphone
Communication function, camera function, PC function
(Waterproof, dustproof, impact resistance)
Smartphone usage (1)

Streamline on-site photo management

Conventional method
- Carrying a blackboard.
- Rewriting the blackboard for each subject.
- Unclear characters and numerical values
- Cumbersome work for organizing photos

Electronic blackboard
- No need to carry a blackboard.
- Blackboard can be created in advance.
- Automatic photo organization

Photo shooting with smartphone + field information input with app

Cloud

PC in office

Handwritten blackboard
Writing down the measured values and create a document

Documents are automatically created simply by reading data

Input at the spot

Transfer

Cloud
Employment of foreign engineers

Foreign engineers are employed to do mainly the ICT job which Japanese engineers are not good at, such as 3D CAD simulation or PC works, etc.

Mr. Abudu (from Egypt, Kani Construction Co. Ltd.)
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.
Image of work-style reformation by building new organization

Conventional Organization

Engineers, Technicians, Workers

New Organization

Engineers, Technicians, Workers

New employees

Labor saving by ICT
Three years have passed since i-Construction started. Other than the standard methods, some unique efforts have been begun to improve the productivity in construction.

In particular, some local small and medium-sized companies take noteworthy efforts based on their own issues.

The construction industry is definitely moving, now. We should excite this movement and turn construction into a vibrant industry.
Thank you for your kind attention