# Projection Assembly System - Study Case and Customers

OKI TOMIOKA Manufacturing

Research and Development

DAIHO 大宝工業株式会社

Quality improvement in assembly process of high-mix low-volume production by hand

azbil

Promoting standardization and commonality through work support for small-lot, high-mix, mixed-flow production lines

YAMAHA

Used for navigation and quality assurance in outboard motor assembly process

SANSO

Improved quality and productivity through navigation in the pump assembly process

Jatco

Navigation and digital applications in the CVT (Continuously Variable Transmission) inspection process

# Moving away from LED picking method.

## OKI Tomioka Factory

Target :

1. Early Skill Development of Workers
2. Stable Assembly Quality
3. Continuous Work Improvement and Innovation

### Challenges with the LED method

▶Limitations on navigation content (cannot display instructions or reminder messages)

▶Time-consuming to build or change equipment (installation and wiring of LEDs and photoelectric sensors are required for each part).(installation and wiring of LED and photoelectric sensors are required for each component)

### Key Points for Introducing the Projector Method

▶Only general-purpose IT equipment such as projectors and USB cameras are required to build the system (reducing the investment cost to about 25% of the conventional cost).

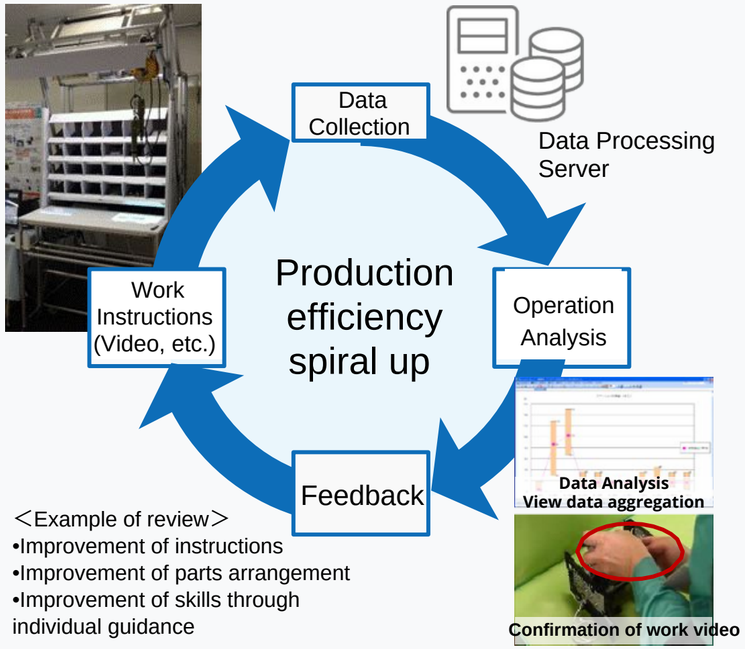
▶Able to acquire work performance data, which can be analyzed and feedback for improvement.

### Results of implementation

▶Production efficiency increased by 150%UP

- Quality improvement: Minimized occurrence of errors
- Training of new employees and work training: Approx. 2 weeks ▶ Approx. 2 days
- Check sheets eliminated through acquisition of work performance data
- Space reduction by establishment of mixed-flow production line and elimination of kit boxes

Continuous Work Improvement Efforts at Tomioka Plant




＜Example of review＞
•Improvement of instructions
•Improvement of parts arrangement
•Improvement of skills through individual guidance

**Voice of PIC**

Visualization of manual processes has accelerated on-site improvements.
We will continue to utilize IoT to further improve efficiency by linking with upper-level systems.

# Visualization of assembly line progress ▶ Daily improvement activities

## OKI Tomioka Factory

### Challenges to date

▶The progress of the assembly line is not monitored .
▶Since the progress status is not monitored, no measures can be taken until the problem is detected, and it is difficult to determine the root cause of the problem, so permanent and continuous measures cannot be taken.

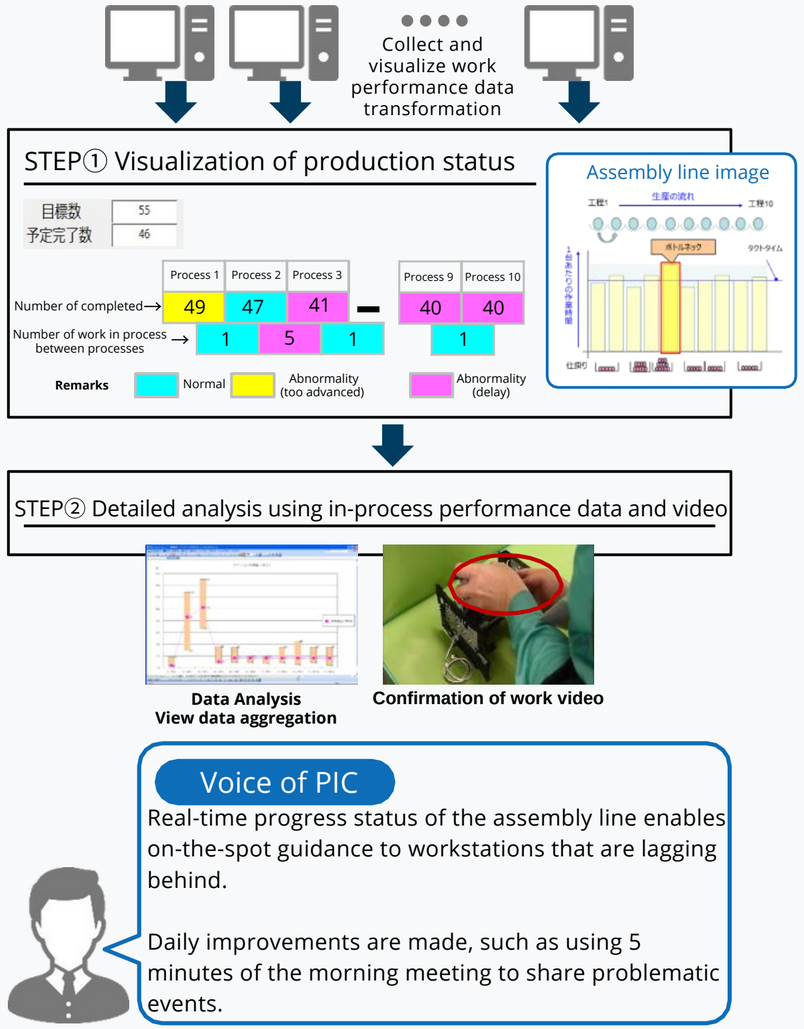
### Key Points for Utilization

▶Work performance data can be exported in CSV format or referenced from a database .
▶Data can be visualized using Excel or BI tools to identify problems. and detailed investigation using video clips is also possible.

### Results of implementation

▶By arranging data on work performance at multiple workstations, it has become possible to get a bird's-eye view of where the bottlenecks are on the assembly line.
▶Every morning at the morning meeting, the team shares the previous day's problem points and continues to make daily improvements.

### Visualization of Assembly Lines at Tomioka Plant




**Voice of PIC**

Real-time progress status of the assembly line enables on-the-spot guidance to workstations that are lagging behind.

Daily improvements are made, such as using 5 minutes of the morning meeting to share problematic events.

# Quality improvement of manual processes in conjunction with electric screwdrivers and automatic screw feeders

## OKI Tomioka Factory

Measurement and control equipment manufacturer

### Background of implementation and problems

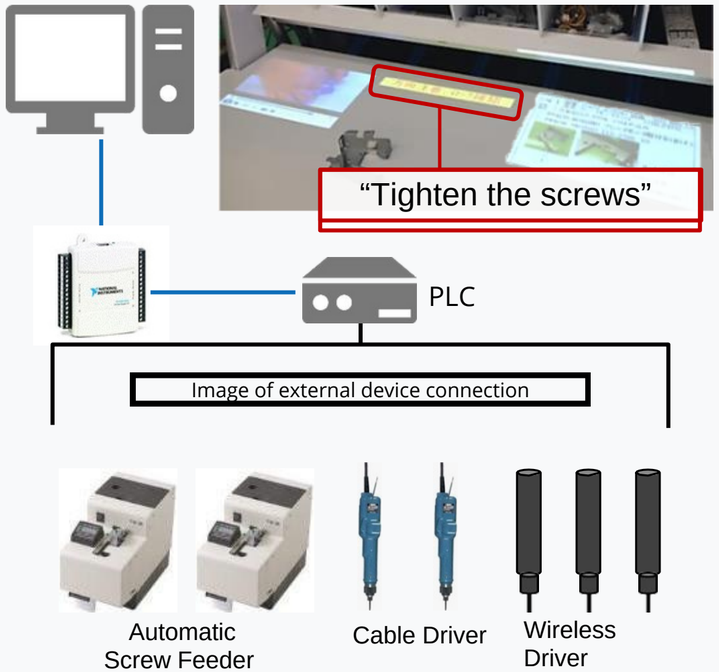
▶There are many variations in the manual assembly process, and frequent process changes occur.
▶There are many types of screwdrivers and screws to be handled, and it takes time to learn how to use them.

### Key points and reasons for implementation

▶General-purpose I/Fs are provided, so external devices such as electric screwdrivers and automatic screw feeders can be connected.
▶Instructions and instructional videos can be displayed at the appropriate timing, this reduces the burden on the operator.

### Results of implementation

▶Currently, we have completed a workbench for trial use (connected with 5 electric screwdrivers and 2 automatic screw feeders) and are verifying the implementation of the system.
▶Select about 3 assembly lines for trials, and determine the effectiveness of the implementation while listening to the opinions of workers onsite.




**Voice of PIC**

The mechanism is simple, so it can be used in a variety of ways in our company. External devices can be connected directly, but by using a PLC in between, the control of external devices can be left to the PLC.

# Quality improvement in assembly process of high-mix low-volume production by hand

**Daiho Industrial Co., Ltd**

(Plastic parts processing and assembly manufacturer)

## Background of implementation and problems

▶Many variations exist in the manual assembly process, Frequent process changes also occur.

▶It takes time for the company and its contractors to quickly learn the processes, and quality problems such as errors occur.

## Key points and reasons for implementation

▶ Preliminary verification was conducted through the "Tottori Strategic Industry and Employment Creation Project (Note 1)" promoted by the Tottori Prefectural Government.

▶ Appealing to suppliers and other external parties as a progressive approach to quality assurance

## Results of implementation

▶After about two months of preliminary verification (trial introduction on our own production line), we succeeded in eliminating assembly errors.

▶Further reduces training time for operational proficiency.

Operational site image (Note 2)

**Voice of PIC**

The question-and-answer format ensures the reproducibility of work procedures on the cellular assembly line, and has produced significant results in terms of quality assurance.

Note 1: Tottori Prefecture Strategic Industrial Employment Creation Project
A project in which the national government (Ministry of Health, Labour and Welfare) subsidizes a portion of the cost of a project concept for voluntary regional employment creation that is integrated with industrial policy in order to solve regional problems and create stable, high-quality employment in regions where the employment situation is severe. Tottori Prefecture has been selected for the second phase of the project from 2016 to 2018, following the first phase from 2013 to 2015 .

Note 2: Excerpt from our press release
https://www.oki.com/jp/press/2018/11/z18059.html

# Promoting standardization and commonality through work support for small-lot, high-mix, mixed-flow production lines

**Azbil Corporation, Shonan Plant**

(Control and measurement equipment manufacturer)

## Background of implementation and problems

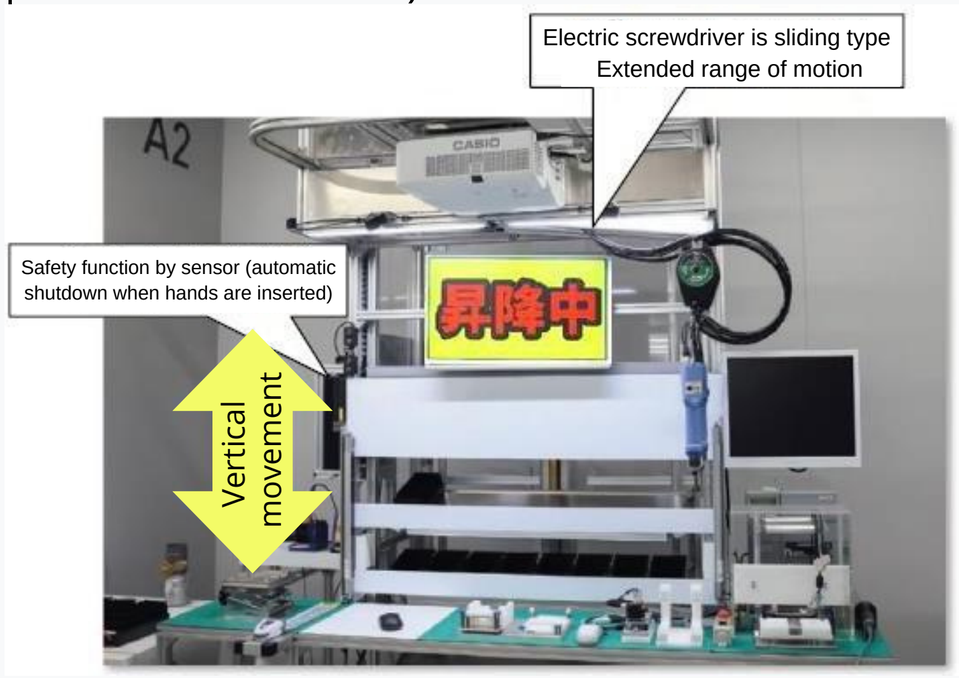
▶Training burden on workers in small-lot, high-mix, mixed-flow production lines where demand fluctuates rapidly.
▶A mechanism is required to achieve standardization and commonization of operations, and to be independent of people and locations.

## Key points and reasons for implementation

▶Software was developed in-house, and the " ambiguous search" function for model numbers greatly reduces the man-hours required for registration.
▶Simple and highly scalable, with motors attached to shelves to allow vertical movement, enabling the assembly of multiple types of products.

## Results of implementation

▶Training period for workers, which conventionally takes 2 to 3 months, has been reduced to almost zero.
▶The ability to move individual units provides a solid foundation for standardization and commonality in global production.




**Voice of PIC**

The video commentary and projection mapping guide the picking process, so that the instructor's workload has been greatly reduced. The unit can be moved to any location in or out of the country for immediate production.

# Used for navigation and quality assurance in outboard motor assembly process

## Yamaha Motor Corporation, Fukuroi South Plant

### Background of implementation and problems

▶Due to the special production system, it was difficult for the workers to learn the work, and it was necessary to take measures against human errors (missing parts, incorrect assembly, and skipped work) .

### Key points and reasons for implementation

▶ The system can be linked with various external devices (wireless drivers, wireless torque wrenches, and pressure testing devices) to enable total quality assurance.

▶ The system can be used not only for picking at the time of assembly, but also for parts input using QR codes and for preventing input errors and managing traceability by connecting to various external devices.

### Results of implementation

▶The risk of human error has been eliminated almost completely.

▶ There are a total of approximately 1,200 work procedures (6 types x 200 procedures), and the introduction of this system has made it possible to perform work with peace of mind and reduced the mental burden of the workers.

Outboard motor assembly workbench

**Voice of the PIC**

We are very grateful for the total process assurance. When a problem occurred, we were able to find out what caused it in the video data and log, which greatly reduced the time required for analysis.
In the future, we would like to work with the upper-level system and devise a way to register procedures more promptly even when design changes are made.

# Improved quality and productivity through navigation in the pump assembly process

## SANSO ELECTRIC CO.,LTD (Head Office and Factory)

### Background of implementation and problems

▶ We are concerned about whether foreign and new workers can guarantee the same quality as skilled workers.

### Key points and reasons for implementation

▶ Improved picking operation by changing the size of the frontage between the left side (small parts) and the right side (cast parts) .
▶ Sorting out and managing the number of parts for the planned number of units to be produced
▶ Quality assurance by linking with the torque check system used in the past.
▶Instructions for taking out parts according to work procedures

### Results of implementation

▶Led to improved production efficiency, such as a 20-second reduction in checking standards and a 36-second reduction in picking operations.
▶Improvements in quality initiatives were promoted to customers, leading to stable orders .

Assembly Workbench

**Voice of the PIC**

We initially introduced this system to improve quality, but it has also reduced the time required for checking standards and picking, leading to an increase in the production rate. We would like to expand the system horizontally to other lanes in the future.

# Navigation and digital applications in the CVT (Continuously Variable Transmission) inspection process

## Jatco Ltd., Fuji No. 1 District Plant

Automobile parts manufacturer

### Background of implementation and problems

▶ Operators must follow a predetermined procedure in a predetermined order from among more than 50 types of gauges, which places a heavy burden on them.
▶During the training of new operators, the person in charge must give lectures to ensure that they are proficient in the work.

### Key points and reasons for implementation

▶The gauges to be used can be indicated by "arrows" so that even beginners can intuitively follow the procedure.
▶ Video can be used to show how to use the gauges, which would be difficult to explain in a procedure manual alone.

### Results of implementation

▶Succeeded in eliminating check sheets, reducing man-hours per day by about 3% (about 30 minutes/day)
▶Progress status of the work site can be checked at any time from the office by utilizing the acquired data.

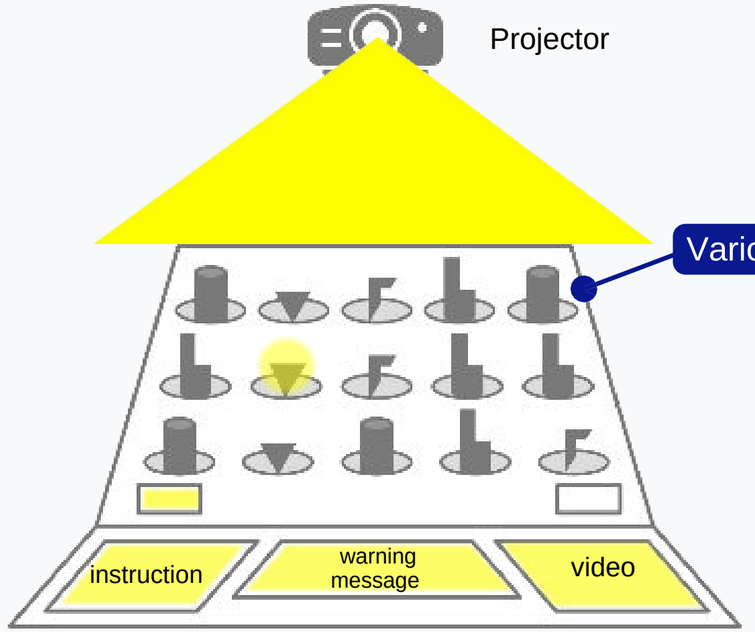



Image of quality measurement workbench

Voice of PIC

To shift workers' man-hours to high-value-added items, tasks such as recording on check sheets and transcribing to PCs should be automated as much as possible to increase efficiency as well as quality.

# Navigation of "processing location" for large products and "quality check" support

## Manufacturer of large products (use case : sink)

### Challenges to date

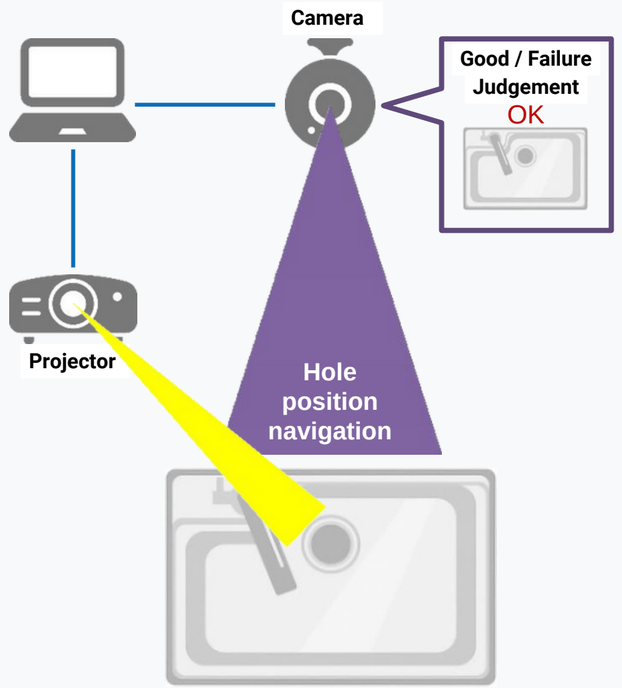
▶ Manufacturing errors occur due to high-mix low-volume production (customized products).
▶There were cases in which defective products were shipped because of the position of processing (holes) or the presence or absence of processing (holes).

### Key Points for Utilization

▶ Able to perform everything from assembly support to inspection in a single package, allowing for quick implementation.
▶ Pattern matching function allows users to register images and verify operation by themselves.

### Expected results of implementation

▶ Projection mapping directly onto the product eliminated eye movement and reduced the burden on workers.
▶ Reduction of training time and zero shipments of defective products




**Voice of the PIC**

Projection Assembly System
We did not need to purchase a separate inspection system in addition to the projection assembly system, and were able to realize the system as a single package, reducing costs and the introduction period .

# Support for "looking inspection work" after machining and assembly processes

## Automobile Manufacturers

### Challenges to date

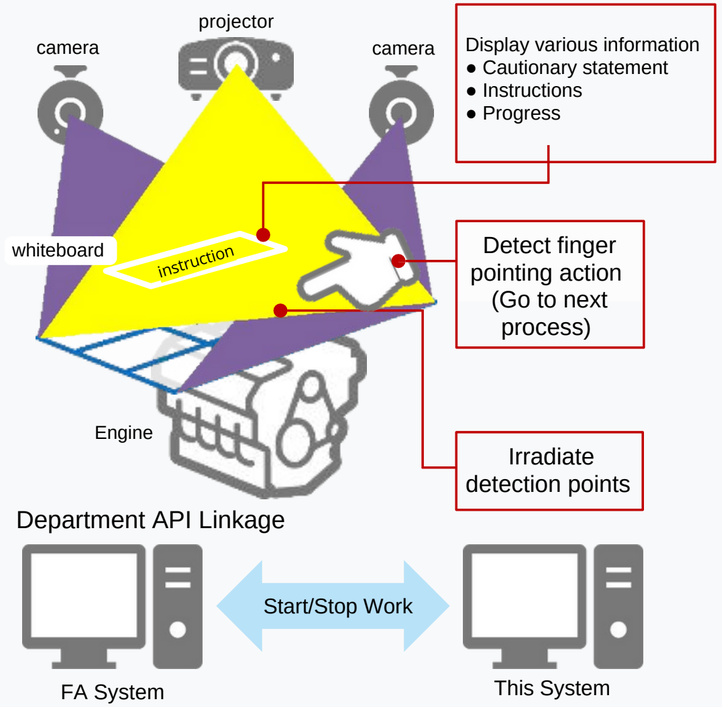
▶Each process requires a thorough "finger pointing" check of important parts for each product .
▶There was an urgent need to create a system to reduce the workload of workers while maintaining high quality and precision .

### Key Points for Utilization

▶ Pointing confirmation points and work procedures are projected directly onto the workpiece itself by projection mapping.
▶The trigger to start work was automated by linking with FA system.

### Results of implementation

▶Even in a process where there are many variations depending on the car model or type, the question-and-answer format eliminates omissions.
▶ Visualization of work performance data is used to identify "variations in work time" and "problem areas in work procedures.




**Voice of PIC**

The projector displays the work to be checked and the details of the checks, allowing the operator to check the work while looking at it, thereby reducing the workload on the operator and reducing errors.

# Support for "training" of maintenance work on telecommunications equipment (work instructions, confirmation of quality results through image detection )

**Equipment maintenance company**

## Challenges to date

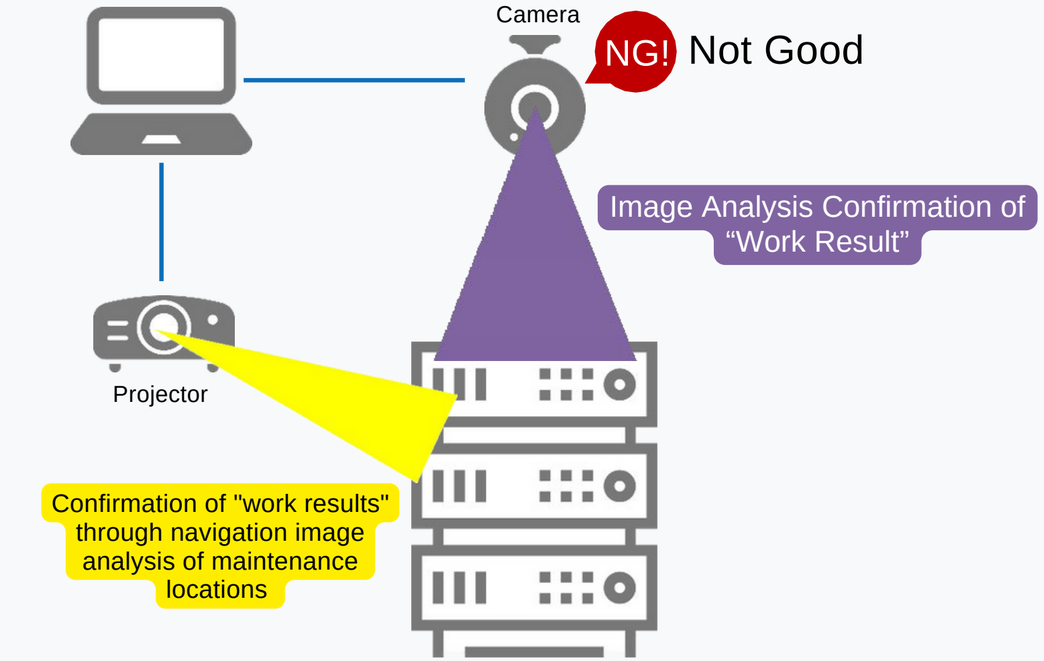
▶The process of building and maintaining telecommunication equipment is complicated.
▶Skilled personnel (educators) are required to spend a lot of time for training and education.

## Key Points for Utilization

▶A projector is installed on the upper rack of the communication server, and a mirror jig is attached to the top of the rack for reflective projection.
▶ Confirmation of the correct work location by image analysis while navigating to the work location (e.g., insertion/removal of cables, etc.).

## Expected results of implementation

▶Reduce time for new employees to learn new skills
▶Can also be used for training on building new products, etc.
▶Work data can be used to improve work efficiency.




**Voice of PIC**

The system enables work training with a variety of contents, such as work videos and audio, and has led to a reduction in training time.

In addition, the pattern-matching function allows us to check cable insertion and removal, which is very useful.