Applying AI Model Management on the CSC's AIoT Platform

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OUTLINE

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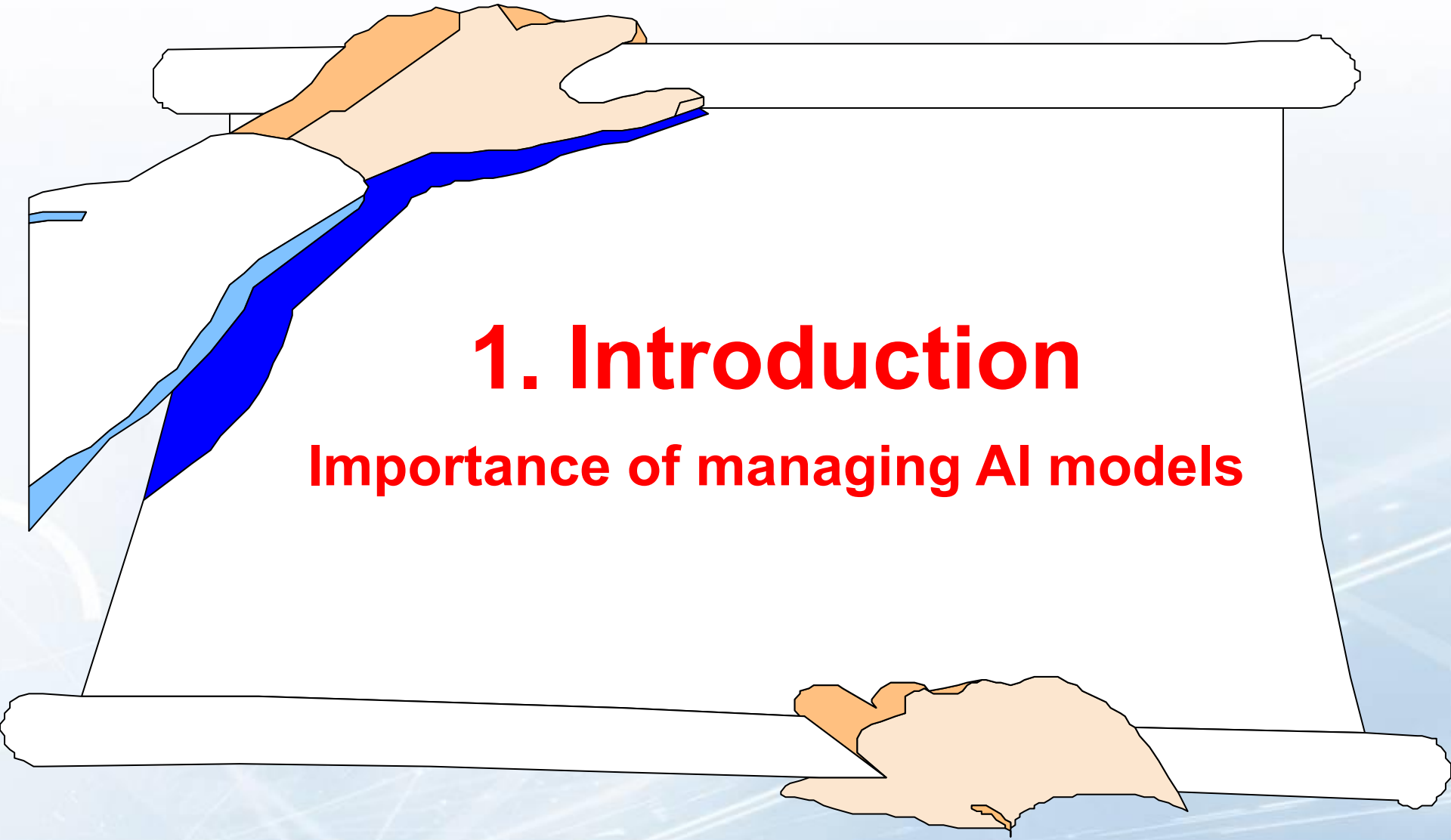


1. Introduction

Importance of managing AI models

Efforts on Creating AI Models

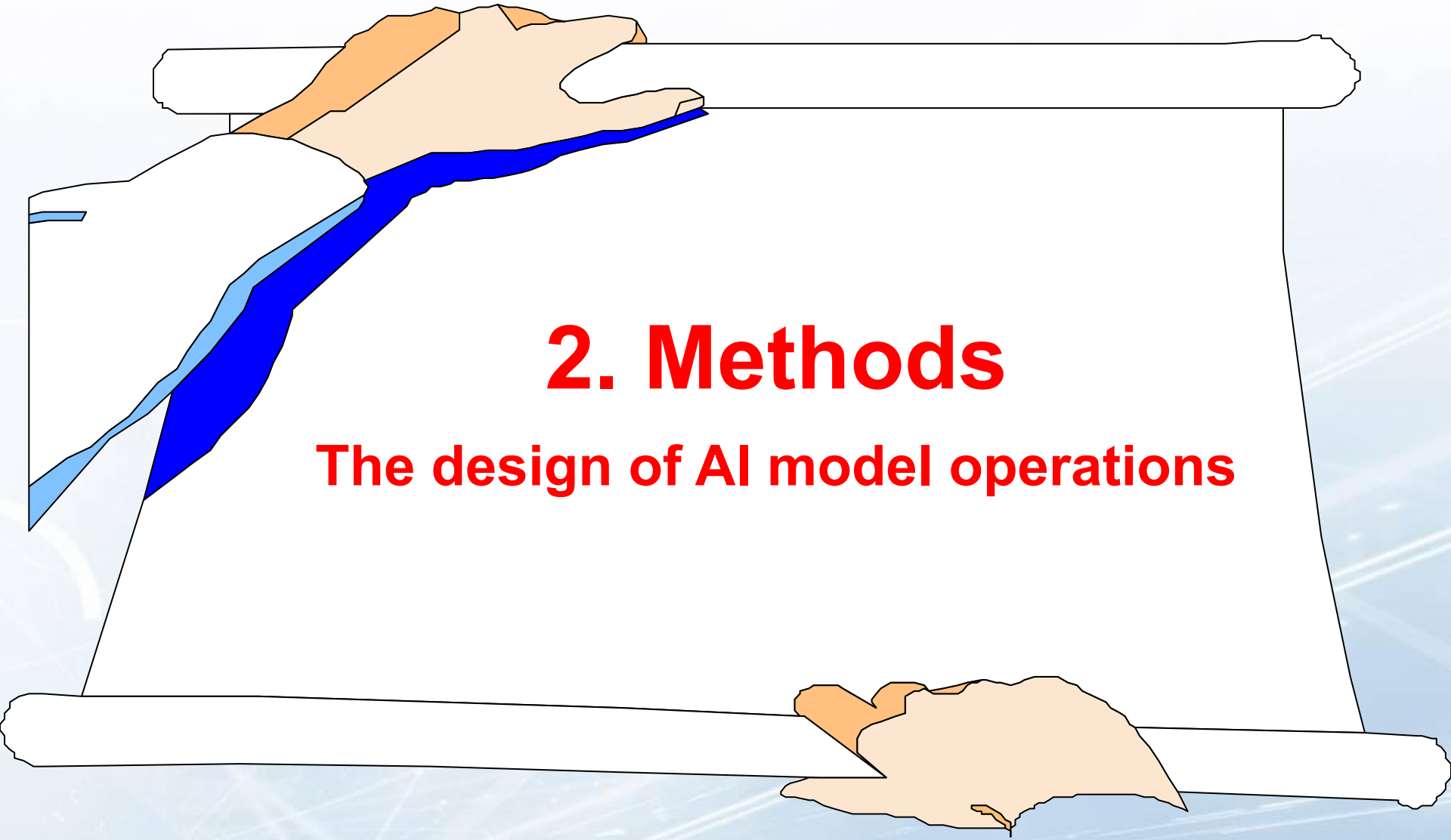
- The **foundation** of smart manufacturing solutions for solving specific production problems
- Require **significant efforts** for developing intelligent applications (Hechler, Oberhofer, & Schaeck, 2020)
  - Well-preserved data
  - Resource-intensive tasks
- Next, **deploy** the created AI models and **manage** real-time inference requests

Data / AI Model Drift

- However, **data/AI model drift** inevitably occurs along with the changes in production
- **Affect performance** over time
  - Accuracy
  - Reliability
- **Proper maintenance helps the online AI models**
  - **Function normally** and contribute to effective production processes
  - **Without deteriorating** by accumulated biases

The Practice of CSC

- Construct the CSC's **AIoT platform**
  - Hyper-converged infrastructure (HCI)
  - The central hub of intelligent manufacturing solutions
- **Apply AI model management**
  - **Quality monitoring mechanism**
    - Beneficial to form the foundation of trustworthy AI with open data, processes, and algorithms (Janssen, Brous, Estevez, Barbosa, & Janowski, 2020)
  - **Suitable management approach** for the increasing intelligent applications (Gartner, 2021)
    - such as XOps (DataOps, MLOps, ModelOps, etc.)

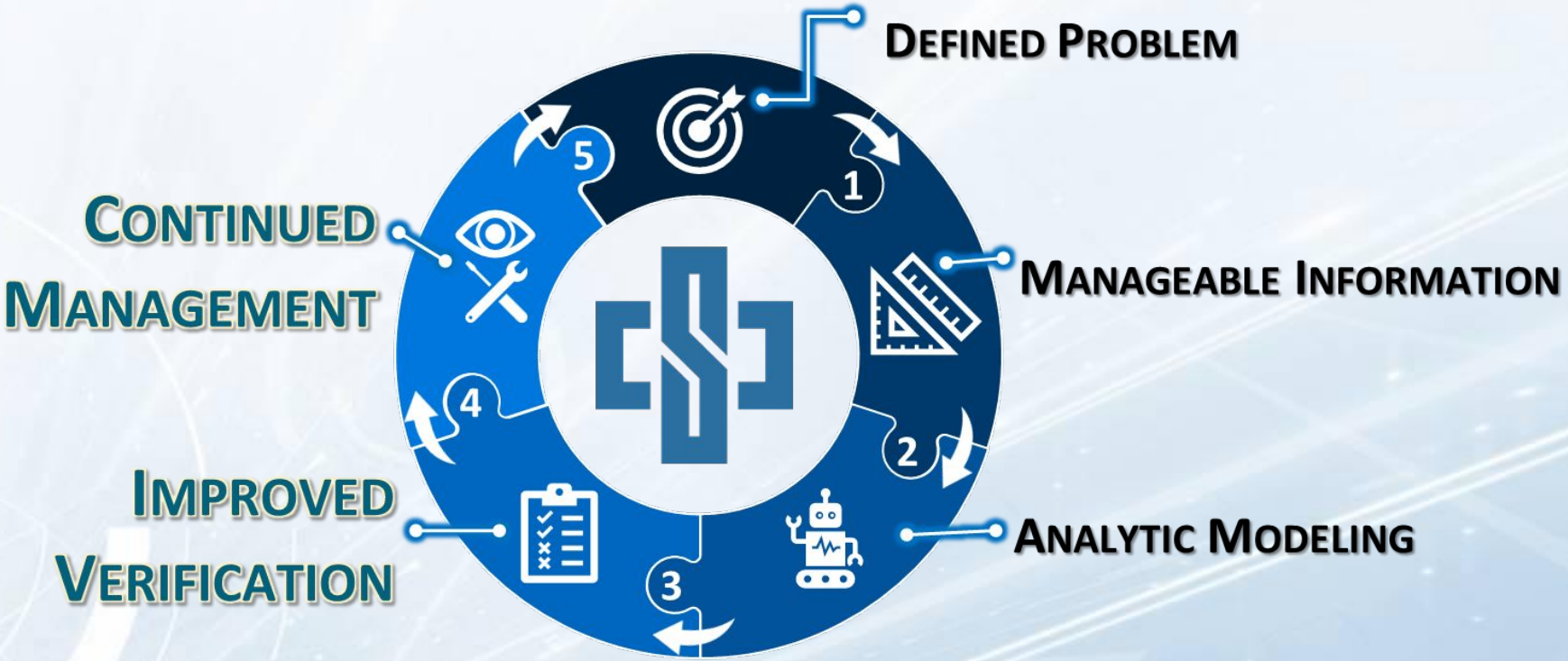


2. Methods

The design of AI model operations

The CSC's Procedure

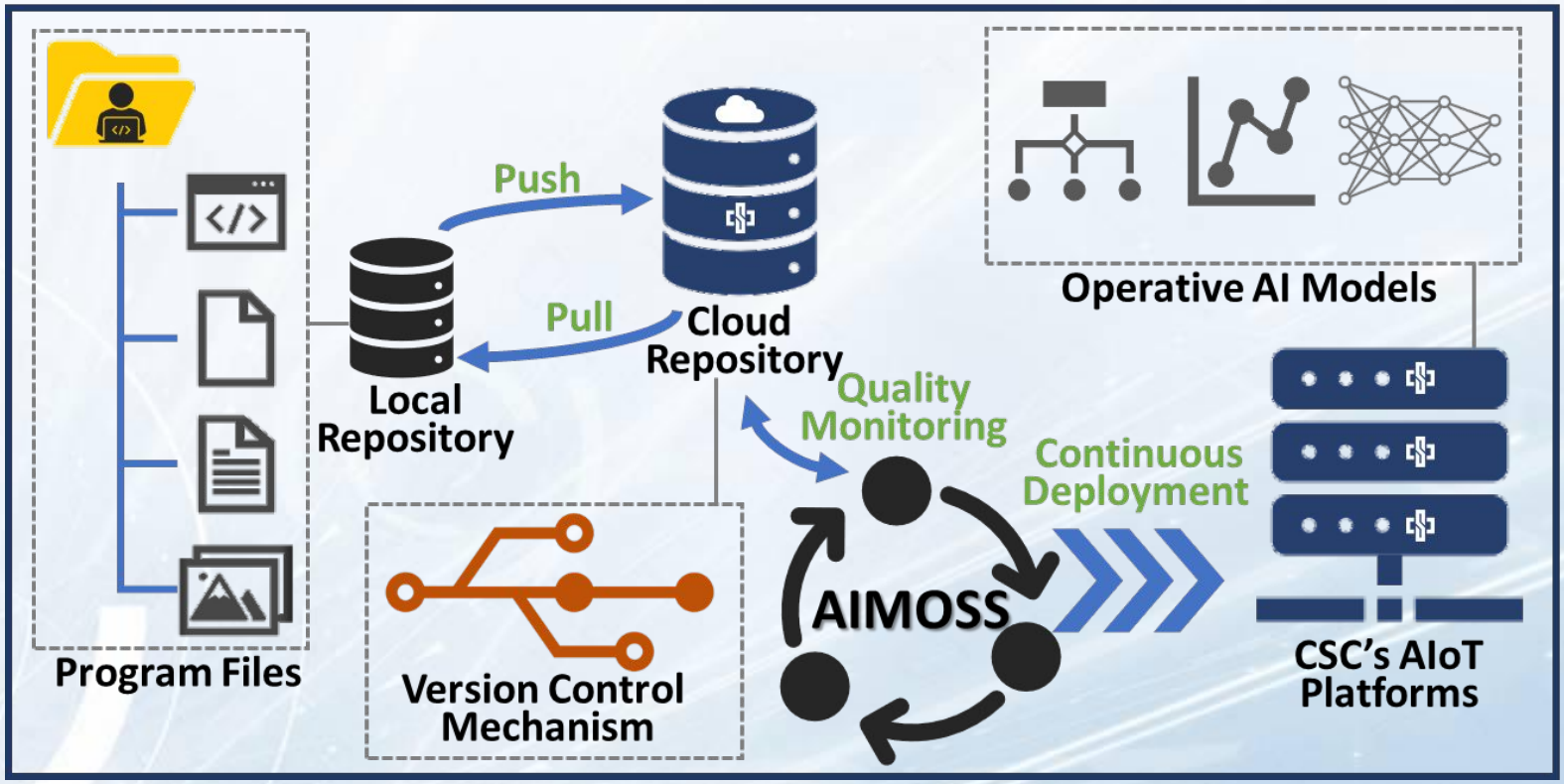
for Developing Intelligent Applications



- Learns from the experience and defines the five steps
- Focuses on **the last two steps** for **ModelOps**

AIMOSS

AI Model Operationalization Support System



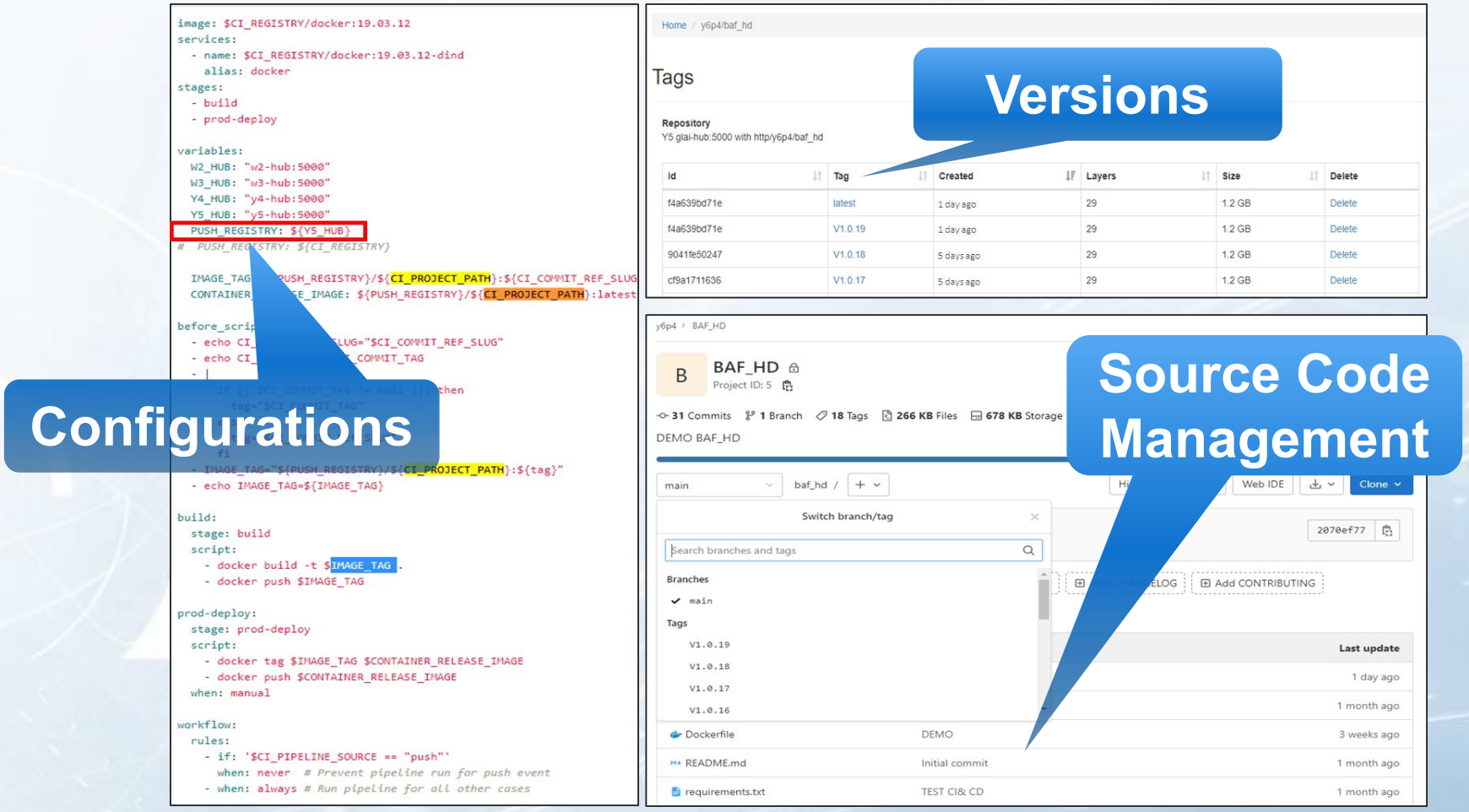
- Operationalizing AI models on the **CSC's AIoT platform** is based on **continuous deployment** and **model management**
- Specifically designed and implemented to meet CSC's demands

Continuous Deployment

- How to manage various intelligent applications in a production field?
  - Especially when operation engineers take over the upcoming deployable AI models

- **Source code management (SCM) mechanism**
  - **Easily switch** in between different versions of a deployed AI model
  - **Automatically switching** without being intervened by operation engineers

The Configuration and Versions
of an AI Model Operation

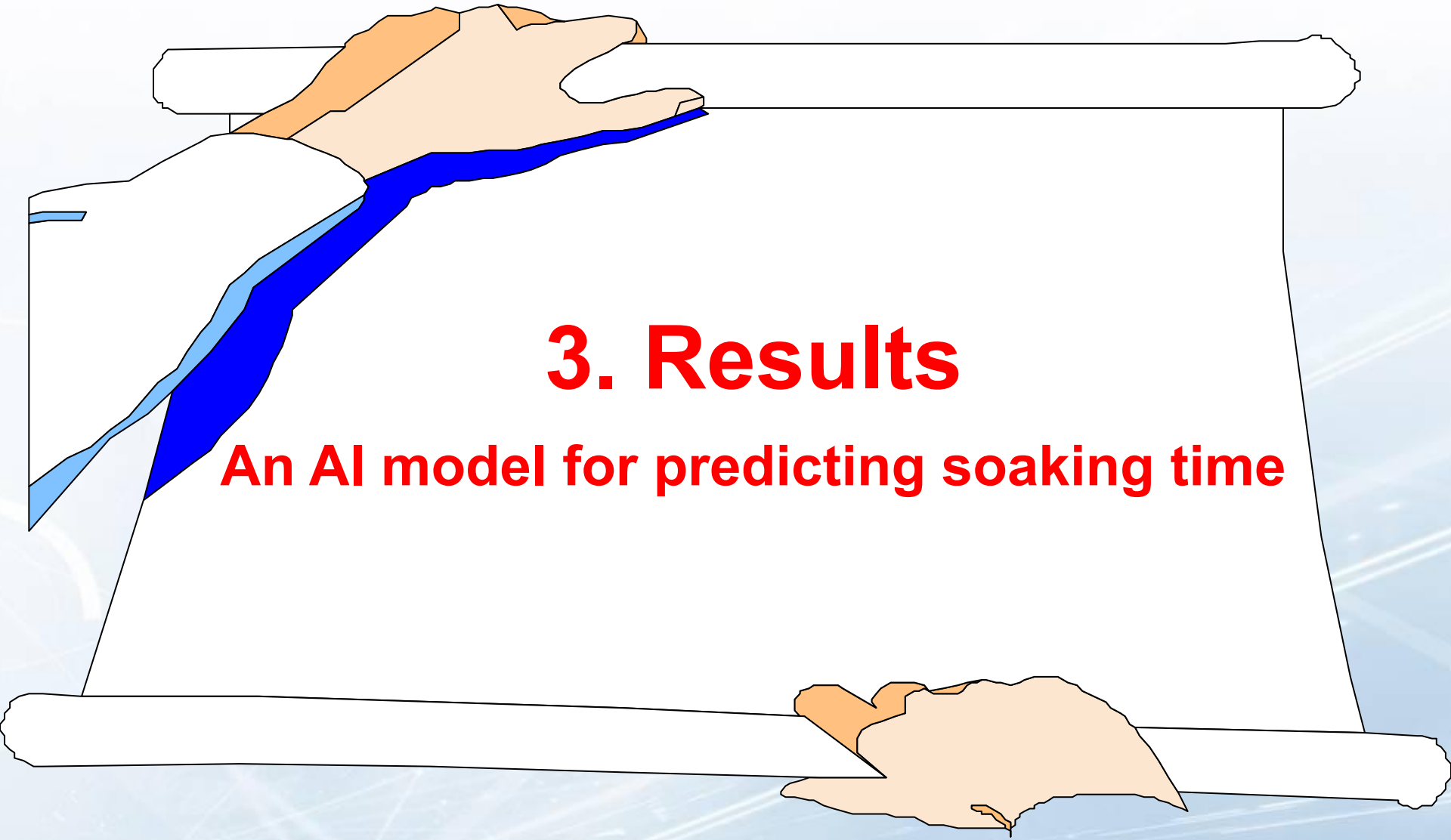


Model Management

- How to manage outdated AI model and replace it?
  - With another retrained AI model when operation engineers maintain the existing online AI models

- Monitors the quality and performance of AI models

Component	Description
1. Predicting	Services for providing prediction results of the online AI models
2. Validating	Quality monitoring by automatically validating the online AI models
3. Retraining	Model drift correction by automatically retraining the online AI models



3. Results

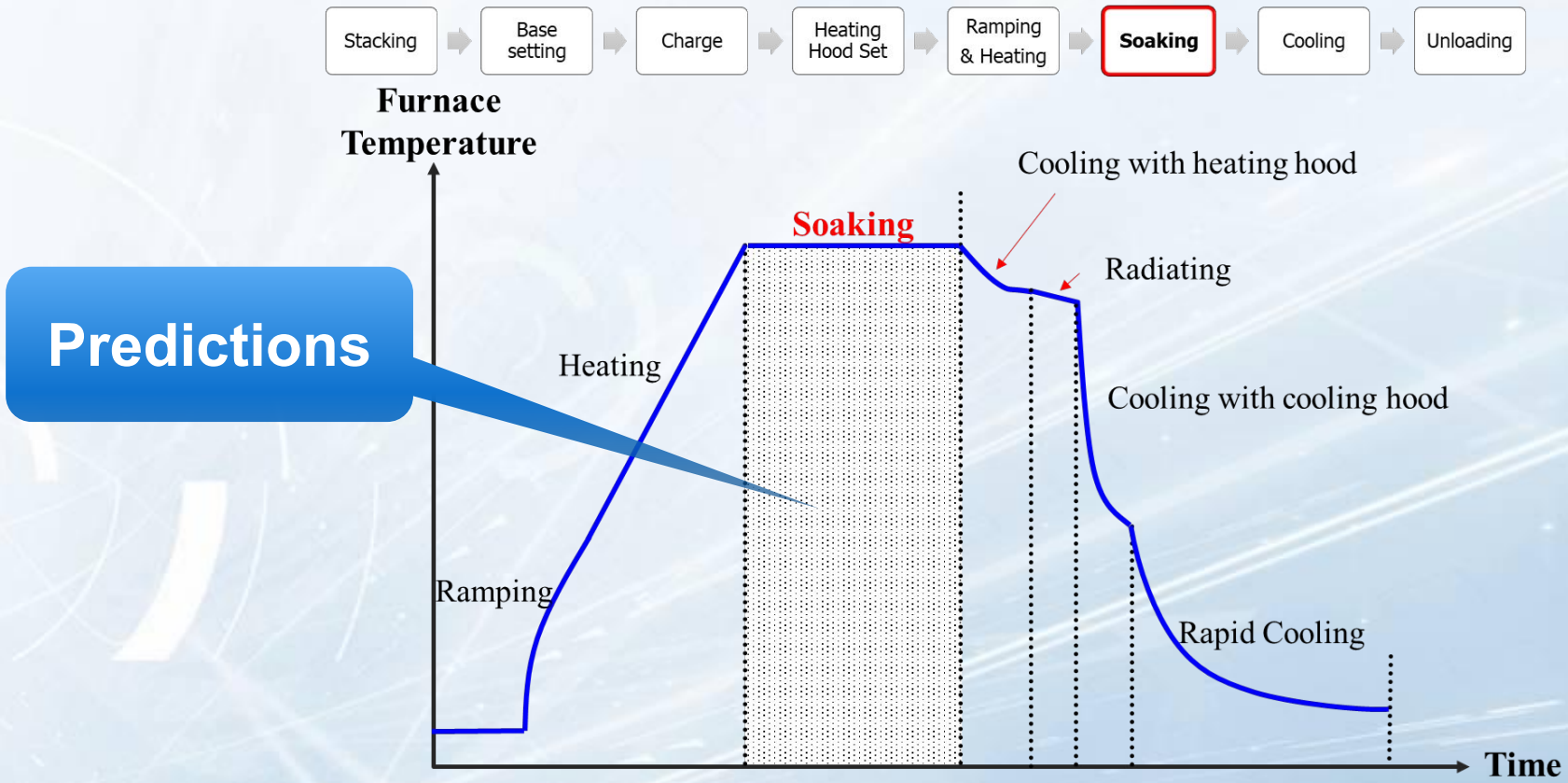
An AI model for predicting soaking time

A Pilot Case

- To **evaluate** the effectiveness of the AIMOSS
- The selected AI model was designed to provide **predictions of soaking time** in a batch annealing furnace (BAF)
  - A heat treatment for cold-rolled steel coils to **relieve mechanical stress** and **achieve specific mechanical properties**
  - Production engineers **adjust production parameters** for meeting customers' requirements

Predictions of soaking time

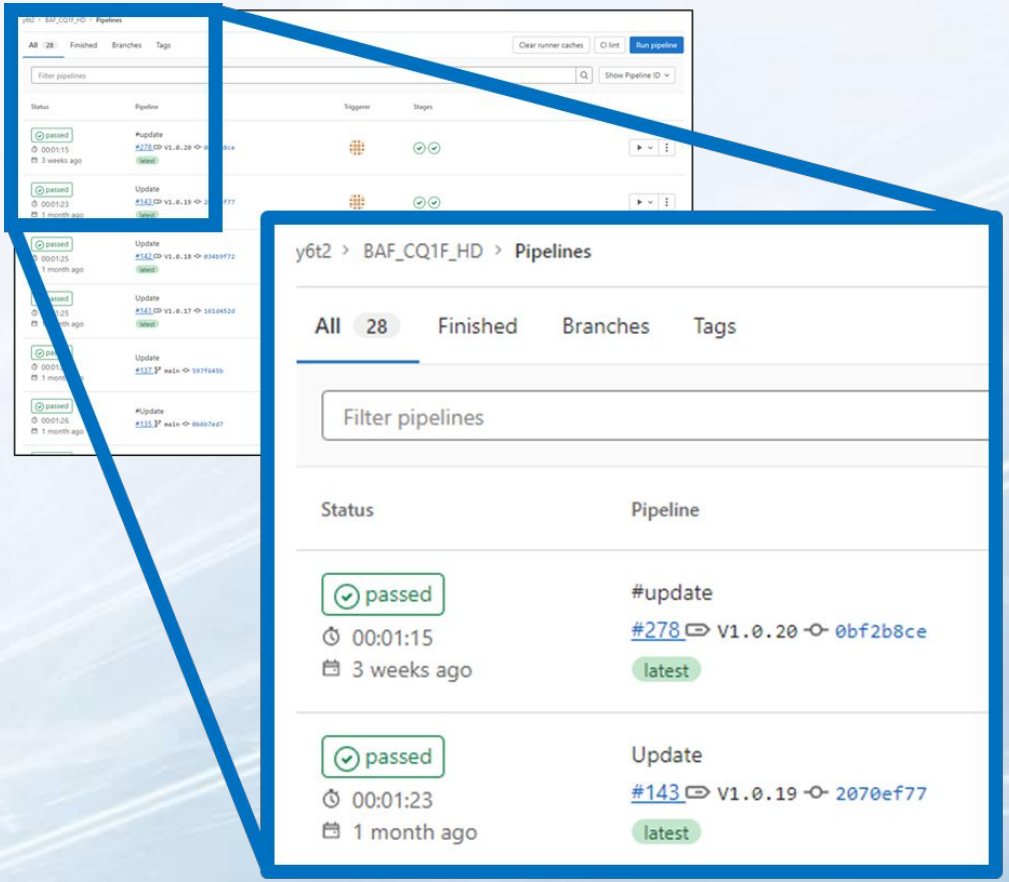
in a batch annealing furnace



AI model operationalization

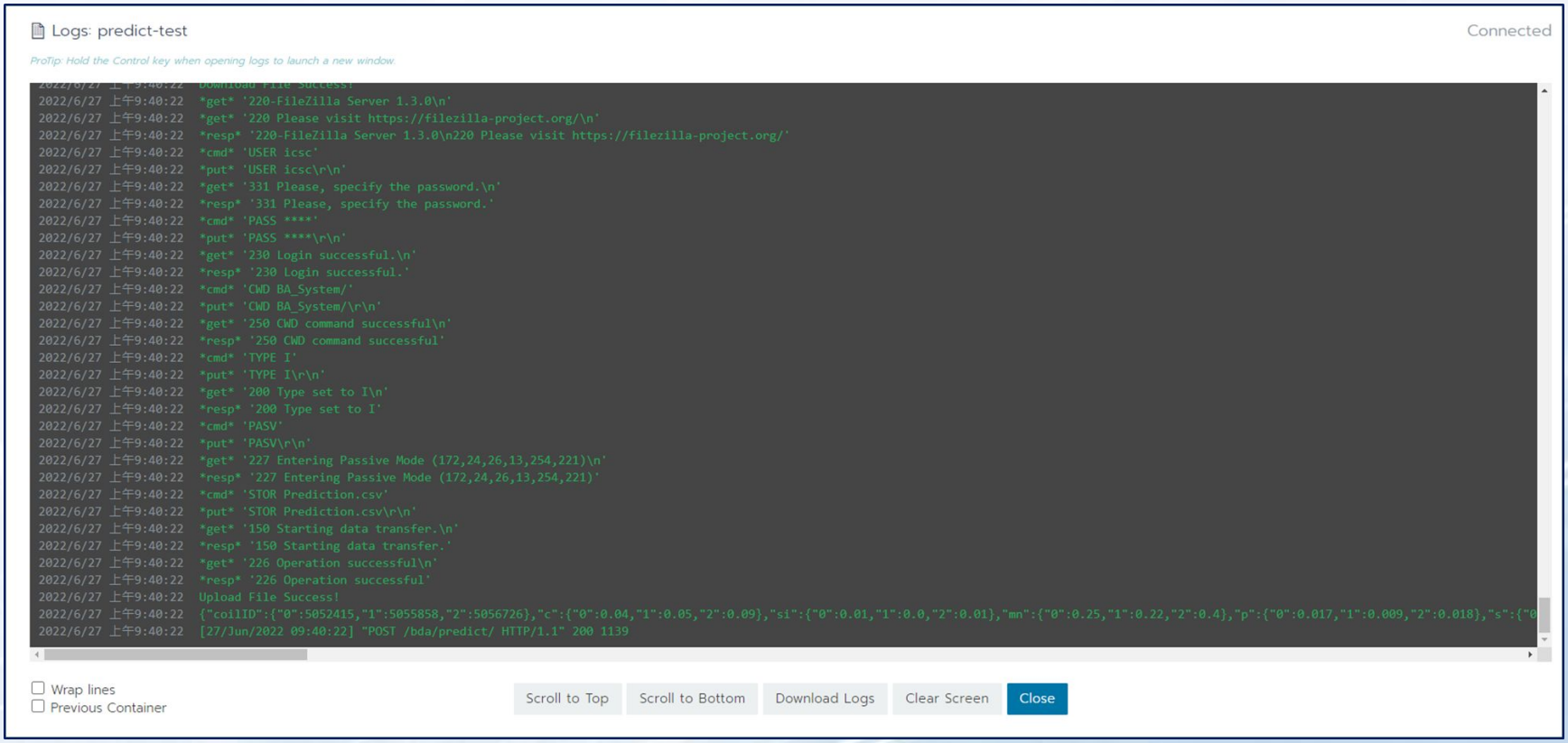
Build Pipelines

- **Input data**
  - IoT devices
  - Databases across various production fields
- **Target mechanical properties**
  - Hardness
  - Yield Strength
- **The AIMOSS automatically**
  - Prepares the corresponding **runtime environment image**
  - Creates a **container** on the CSC's AIoT platform



AI model operationalization

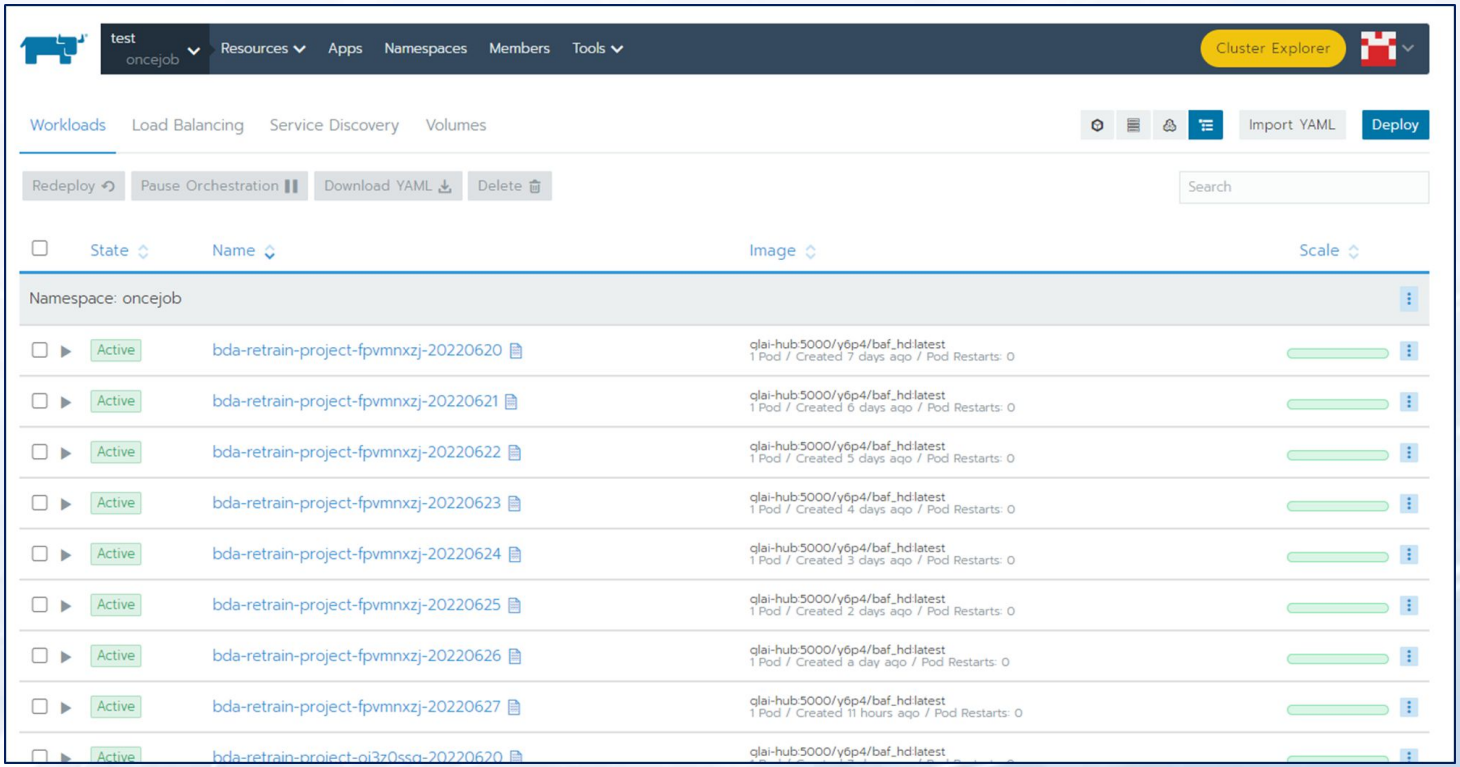
Predicting



- Prediction results can be presented in real-time execution logs with the web-based command line interface

AI model operationalization

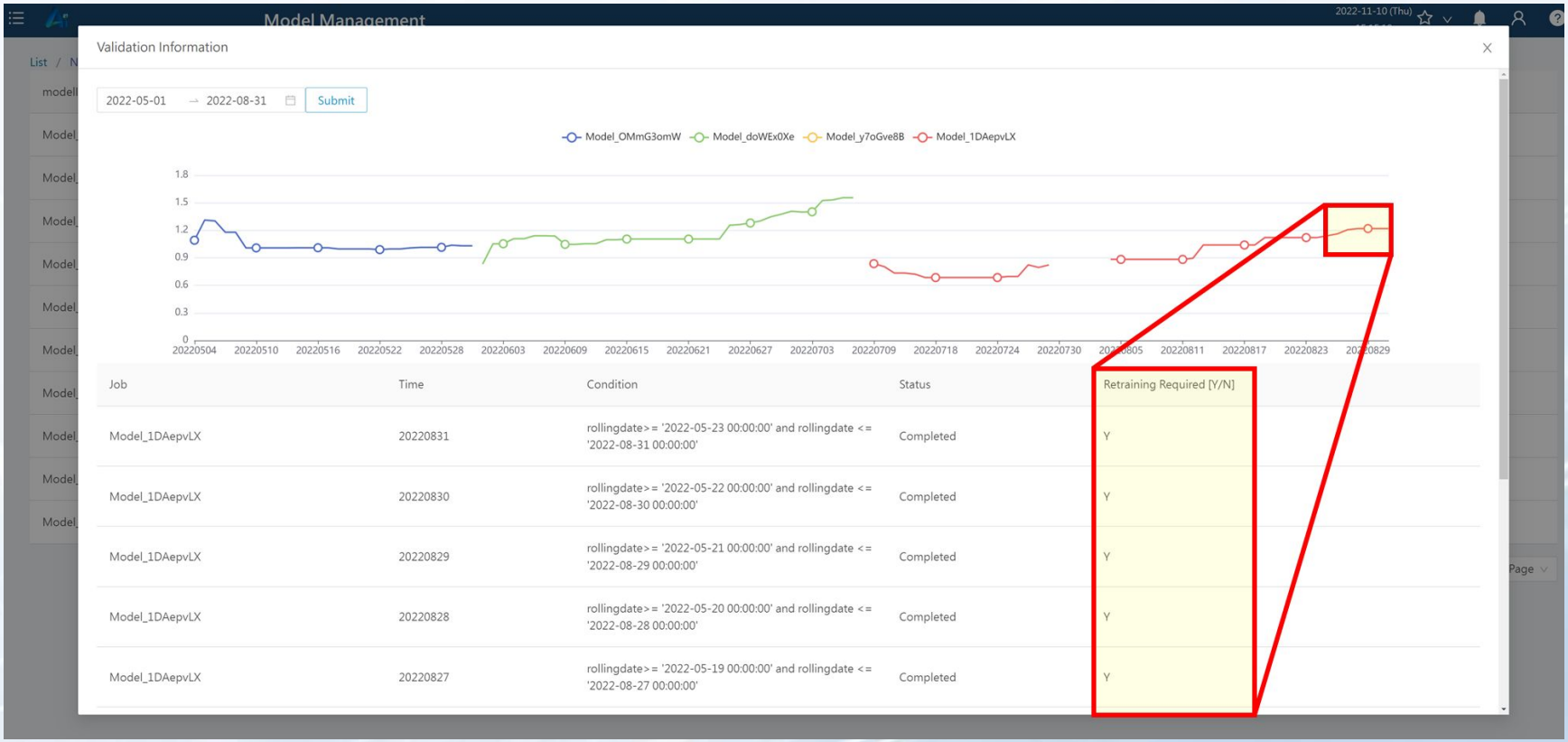
Validating & Retraining



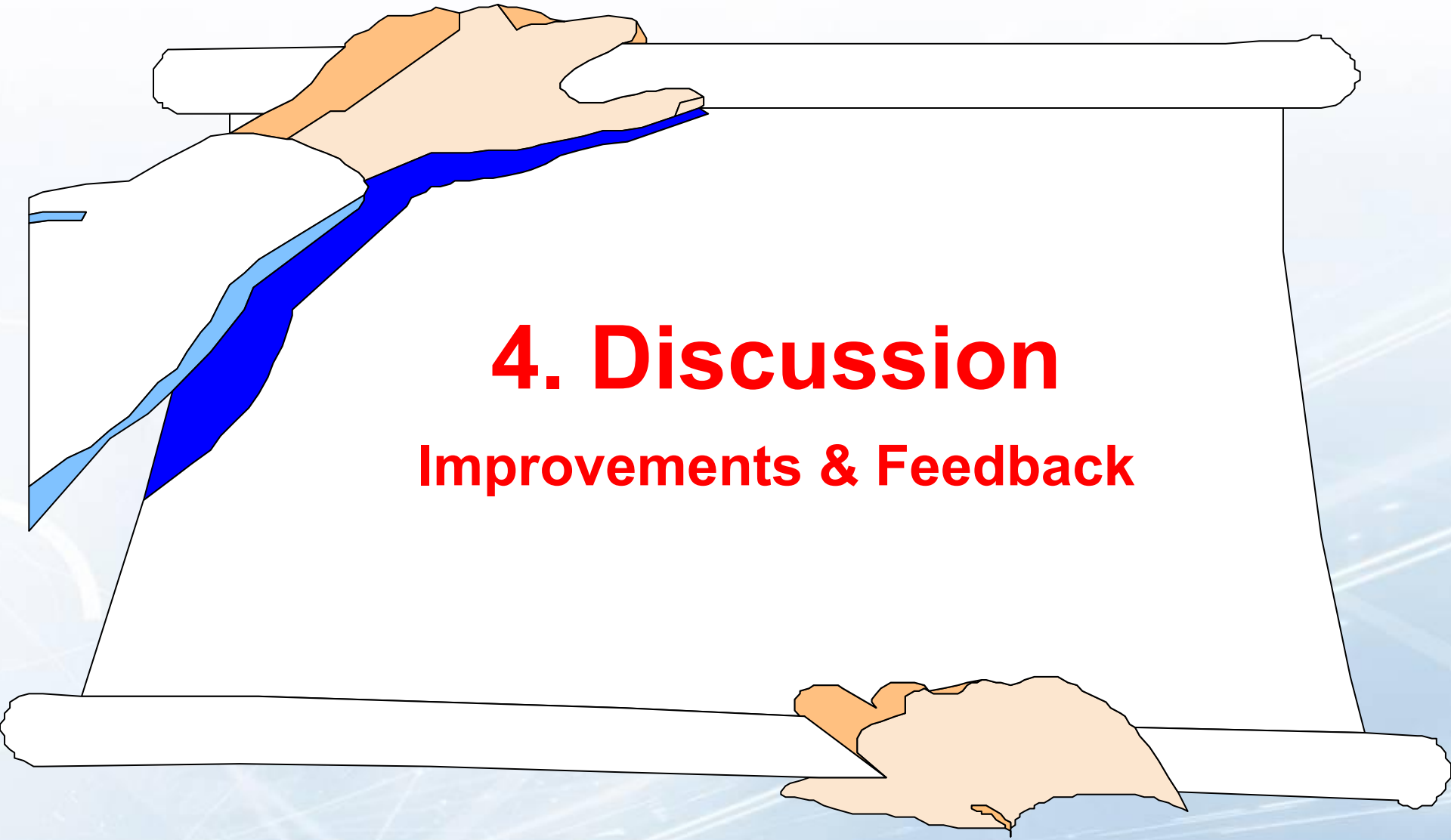
- According to the pre-determined AI model operation parameters
  - training dataset, the validation dataset, validation rules, and notification settings

AI model operationalization

Quality Monitoring



- Monitor the quality of online AI models
- **Automatically** retrain the unqualified models with the latest dataset



4. Discussion

Improvements & Feedback

Before

Applying Model Management

- The online AI models were deployed on workstations of different IT facilities of production fields
- **Limited** computation resource of workstations
- **Requiring** operation engineers
  - To **monitor** the online AI models
  - To **conduct** a retraining process
  - To **deploy** revised AI models to the platform

After

Applying Model Management

- The **CSC's AIoT platform** serves as a **central hub** of intelligent manufacturing solutions
- More **powerful** and **flexible** computation resources
- The AIMOSS can **automatically**
  - **Find** out outdated AI models
  - **Retrain** AI models with the latest training datasets
  - **Create** proper runtime environments for AI models
  - **Deploy** AI models to the CSC's AIoT platform

Benefits
of The AIMOSS

Before

- IT facilities for AI models located in **different** production fields
- Retraining process usually takes up to **1 hr**
- Various **manual** operations for manage the online AI models

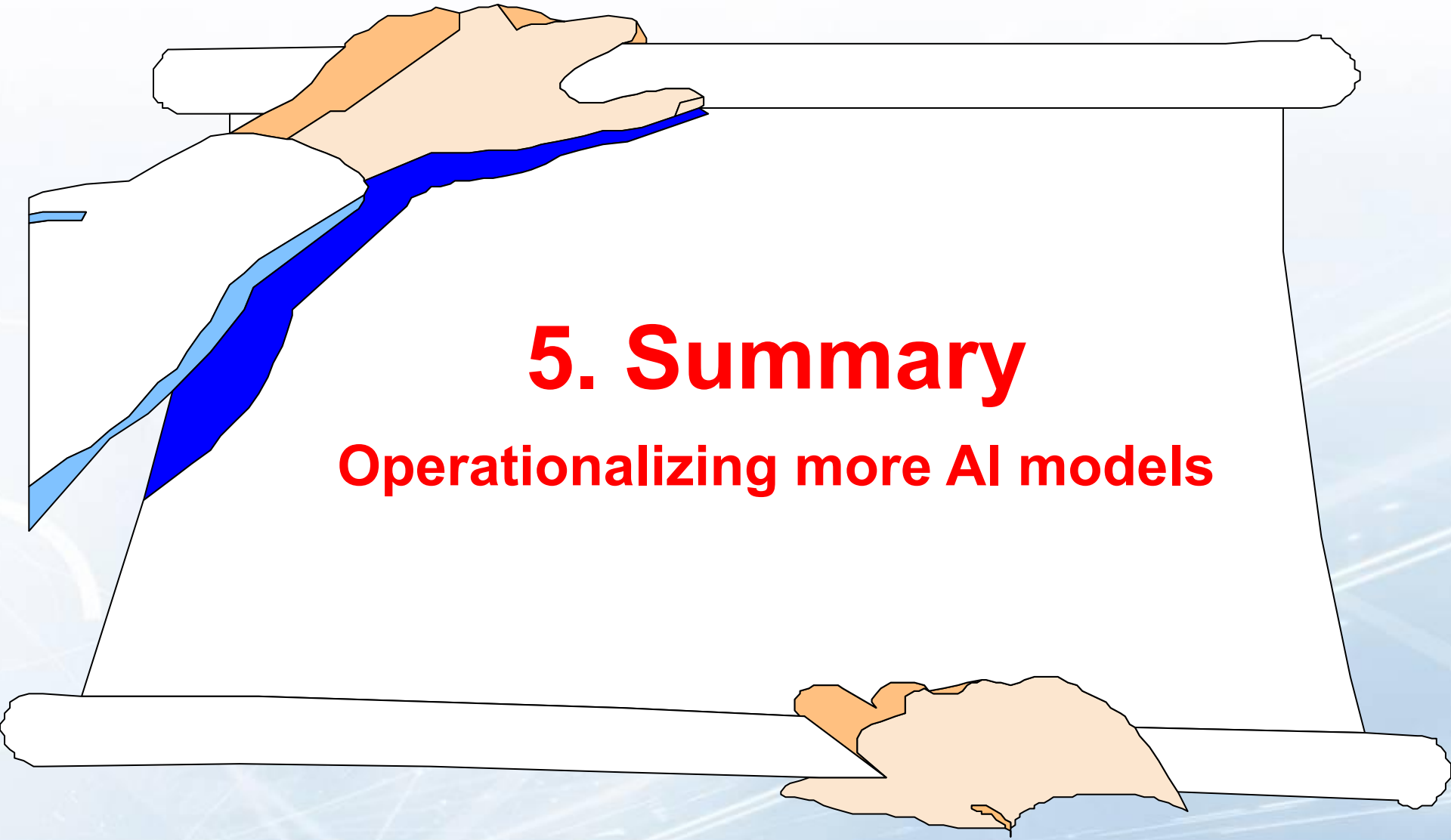
After

- The AIoT platform as the **central hub** for the online AI models
- Retraining process shorten to about **10 min**
- **Automatic** operations for manage the online AI models

Feedback
of Operation Engineers

- **Technical specifications of the AIMOSS**
  - Delineate in **more detail** for operation engineers
  - E.g., Container running options
    - Prediction frequency of AI models

- **Interactive web-based command line interface**
  - **Execute** more management commands
  - **Increase** efficiency and flexibility of debugging



5. Summary

Operationalizing more AI models

Operationalizing more AI models
on the CSC's AIoT platform

- Present the practice and progress of developing and deploying AI applications
- The upcoming challenges
  - **More** intelligent applications
  - **More** loads of daily operations
- By utilizing **AIMOSS**, the CSC's AIoT platform becomes more capable of operationalizing more intelligent applications

Thank You