



Industrial Edge 3rd Application Scenario

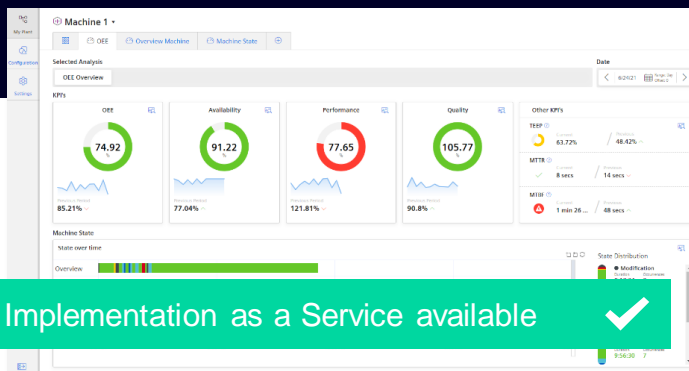
Example #1 - THT Close-Loop

Industrial Edge Application Scenario Background

Start your Industrial IOT journey

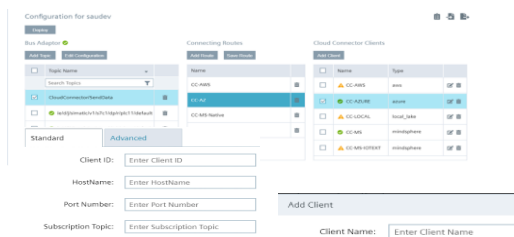
Performance Analytics

Detect and visualize root causes for efficiency losses in manufacturing



Shopfloor to Cloud Connectivity

Integrate machine & production data securely into the company cloud



Bring own applications to shopfloor

Management and deployment of self-developed apps to the shopfloor

Presentation as a Demo^{cloud} available

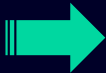


Industrial Edge Application Scenario Background

Application Scenario structure



Performance Analytics



Challenge

- No holistic OEE monitoring and lack of transparency
- Heterogeneous production landscapes

Solution

- Out of the box OEE monitoring
- 57 shopfloor data collection
- Local on-premise analysis with OEE without stopping production processes
- Basis to derive measures to increase the output per time



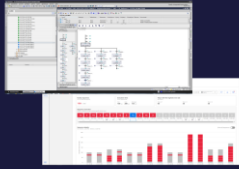
Example #1

Challenge

- Unclear line performance derivations
- Assumption-based decisions only

Solution

- Detection of root causes with sequence analysis of PLC data
- Target-actual comparison of the duration of each PLC action in line



Example #2





Shopfloor to Cloud Connectivity



Challenge

Central cloud access to heterogeneous shopfloor data meeting industry security standards


Solution

- Collection of multiple data with different legacy protocols
- Data harmonization
- CSV export possibility
- Cloud storage with MindSphere, Azure or AWS

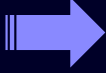


Example #1





Bring own applications to shopfloor




Challenge

Timely, continuous, stable quality feedback for PCB product and process parameter optimization for THT machine

Solution

- With the rigidity and convenience of data acquisition and processing at the edge side, the results can be inferred by the AI model in time
- Based on AI model training, the product qualification rate can be continuously and stably improved
- With the help of the Industrial Edge Management, the application can complete the rapid, batch and distributed deployment and management



Example 1# - THT Close-Loop

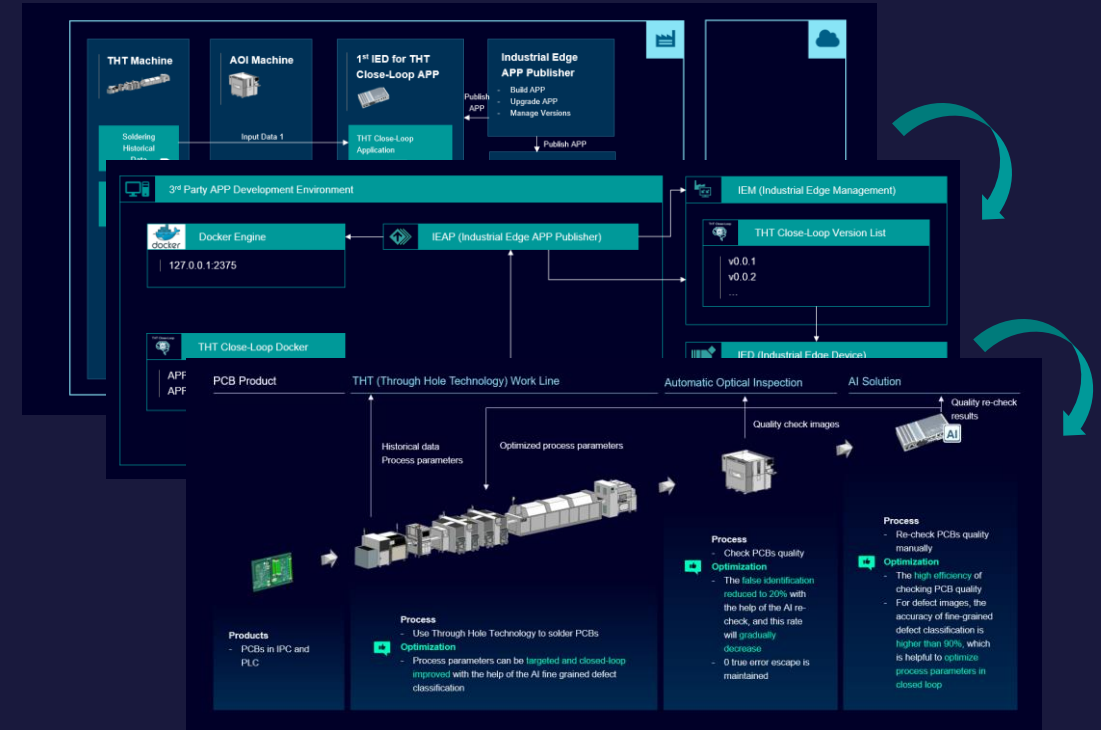


Challenge

Timely, continuous, stable quality re-check for PCB product and process parameter optimization for THT machine

Solution

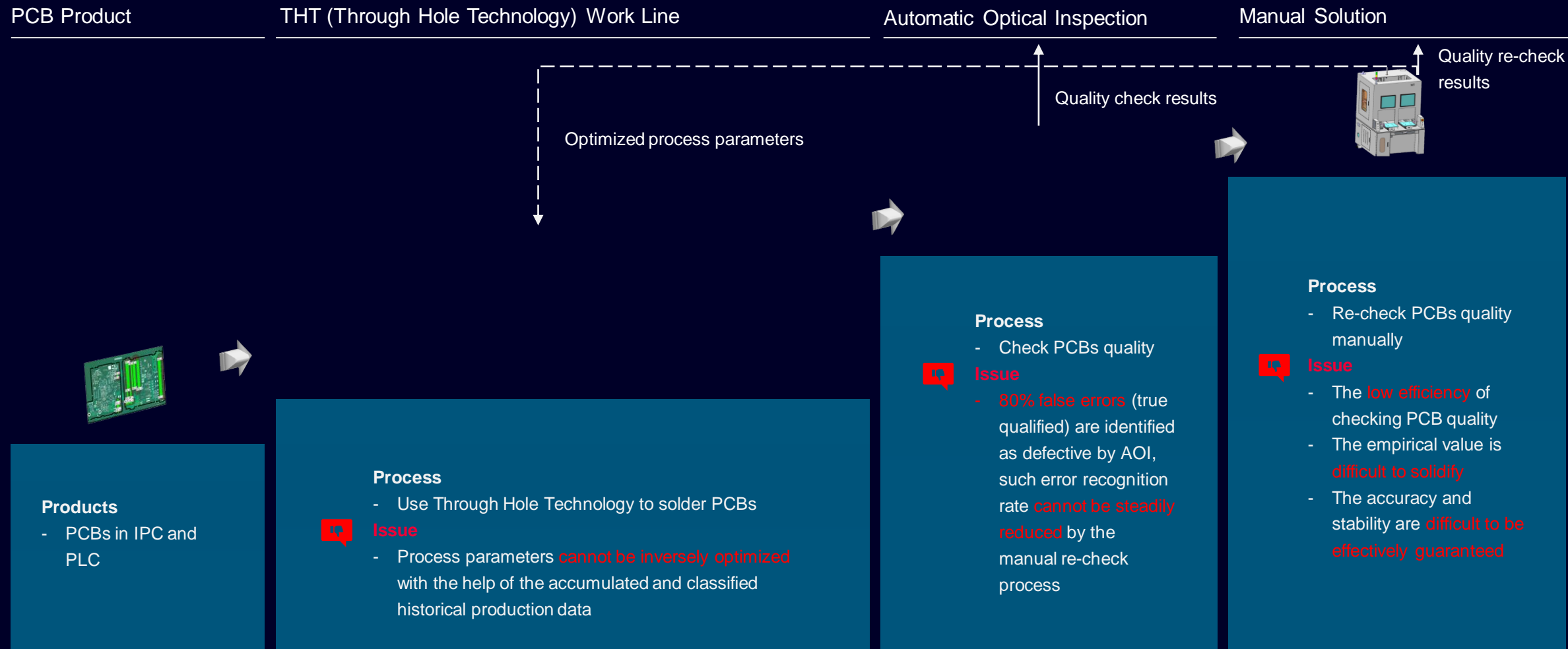
- With the **rapidity and convenience of data acquisition and processing at the edge side**, the results can be inferred by the AI model in time
- Based on AI model re-training, the product qualification rate can be continuously and stably improved
- With the help of the Industrial Edge Management, **the application can complete the rapid, batch and distributed deployment and management**



Example 1# - THT Close-Loop

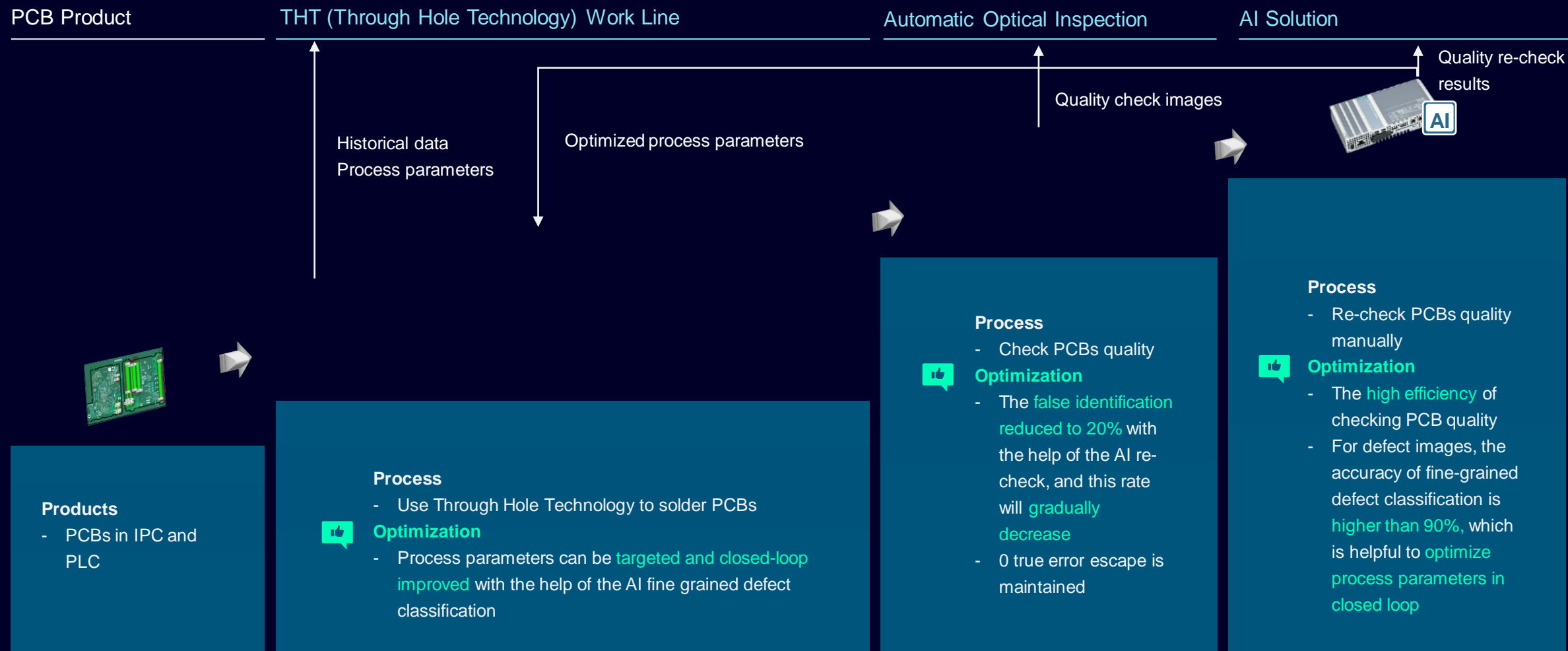
Application Scenario Background

Original work process



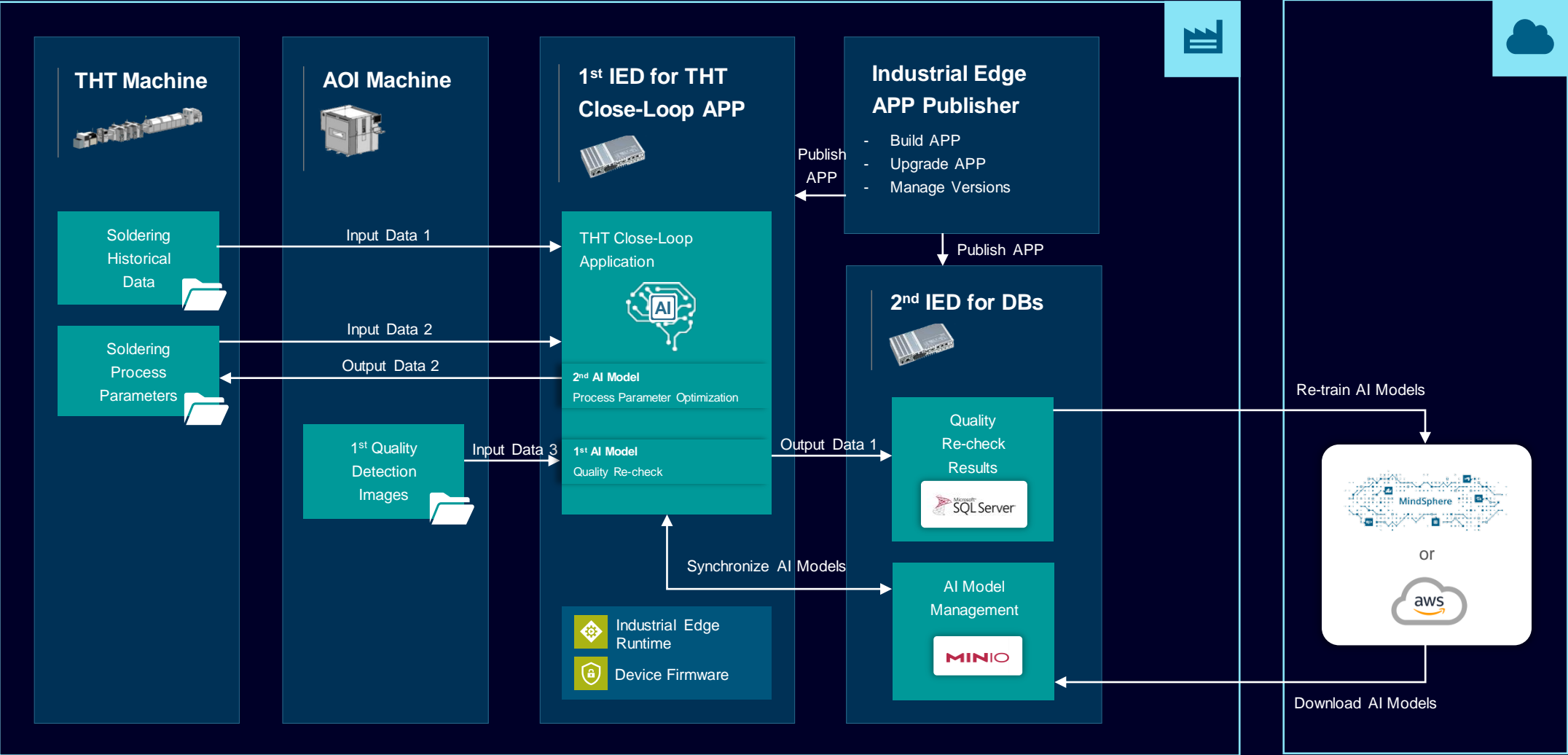
Application Scenario Background

Current work process

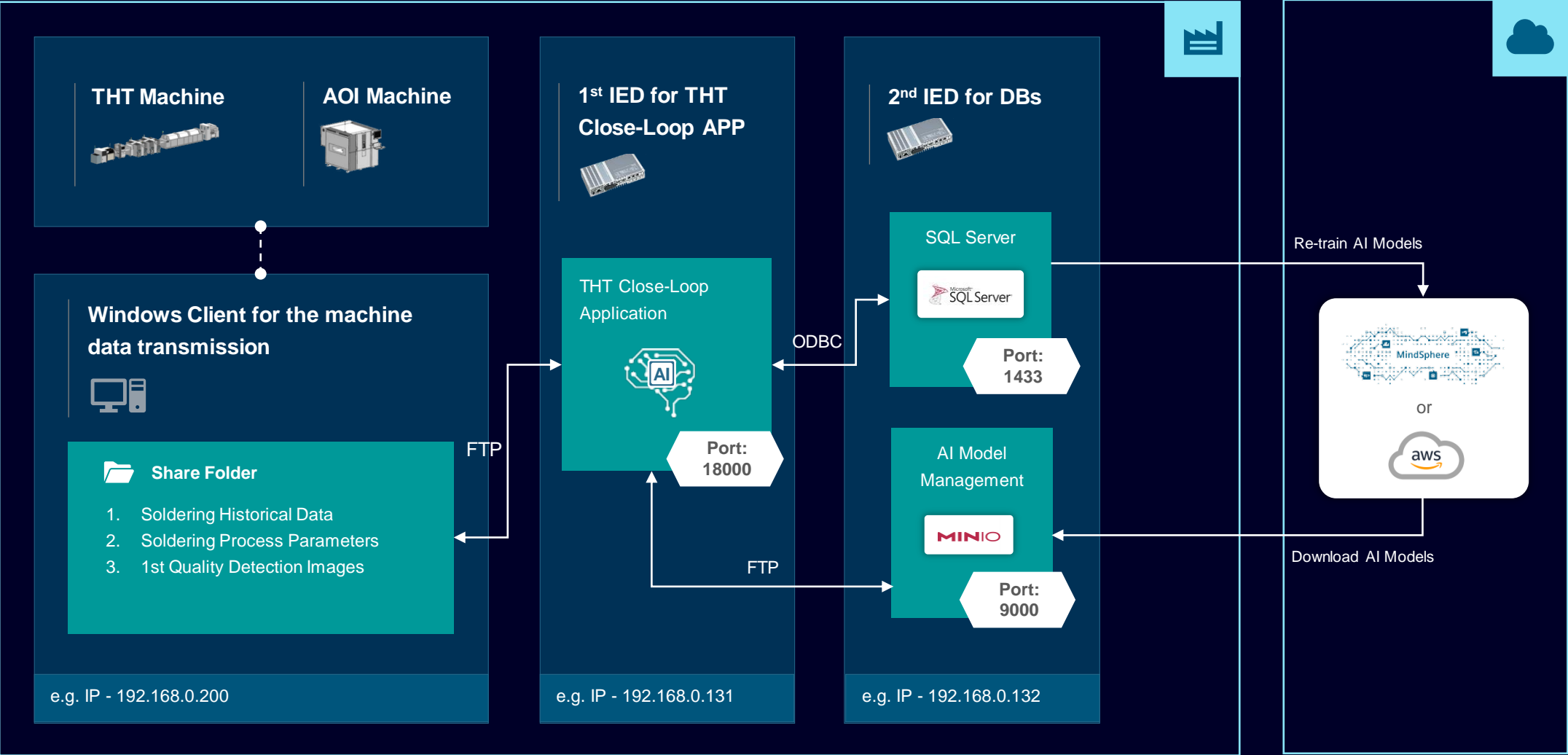


Reference Architecture

 Share Folder

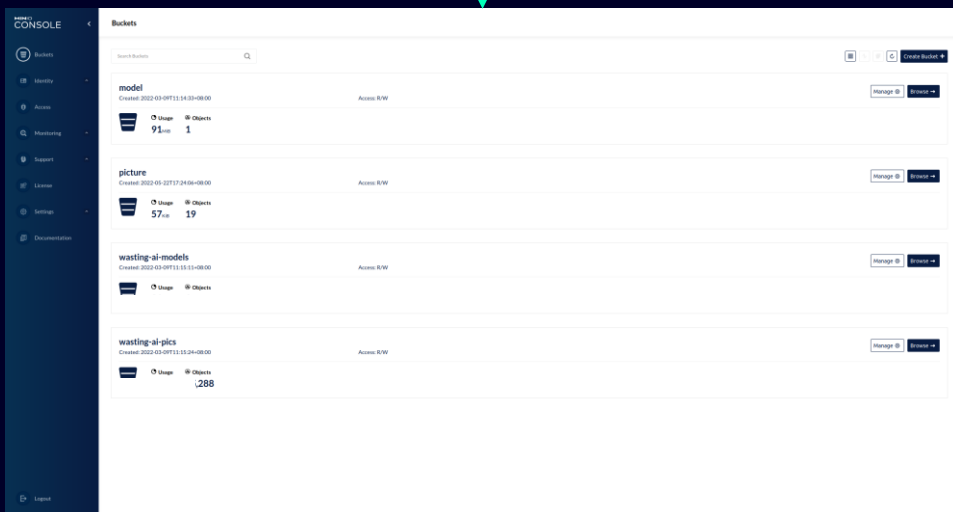
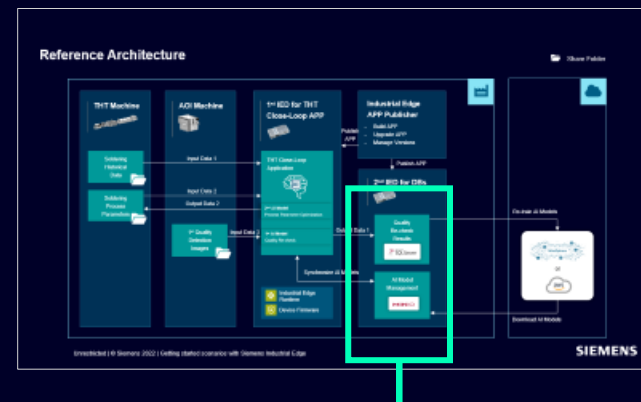


Network Architecture



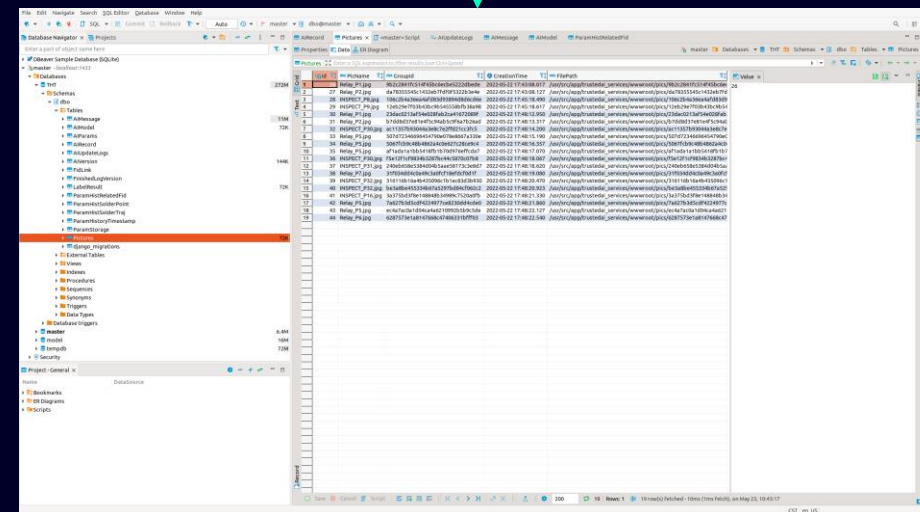
MinIO and SQL Server Features

Data storage and bidirectional transmission between app and cloud



MinIO

- Download the AI models from the cloud and synchronize to the THT Close-Loop APP
- Collect the dataset from the THT Close-Loop APP and upload to the cloud for the AI models retraining



SQL Server

- Store all historical data and key results of the THT Close-Loop APP
- Provide data support for data interaction between MinIO and THT Close-Loop APP

THT Close-Loop APP Feature - Quality Re-check

Quality re-check AI model



Input data

Unqualified results from AOI



Quality re-check model

Model content	Description
Name	ResNet (Residual Network) 50
Definition	The series of ResNet (ResNet50, ResNet101) are widely used in the fields of target classification, also regarded as a part of the backbone classical neural network for the computer vision tasks.
Layer amount	50
Parameter amount	25.5*10^6
Goal	Classify Quality re-check result into three types 1. OK 2. missing soldering 3. insufficient soldering

ResNet50 network structure

1. Convolved the input
2. Enter the four residual blocks
3. Complete the full connection operation to facilitate the classification task

layer name	output size	18-layer	34-layer	50-layer	101-layer	152-layer
conv1	112x112			7x7, 64, stride 2		
conv2.x	56x56			3x3, 64, stride 2	3x3, 64, stride 2	3x3, 64, stride 2
conv3.x	28x28			3x3, 128, stride 2	3x3, 128, stride 2	3x3, 128, stride 2
conv4.x	14x14			3x3, 256, stride 2	3x3, 256, stride 2	3x3, 256, stride 2
conv5.x	7x7			3x3, 512, stride 2	3x3, 512, stride 2	3x3, 512, stride 2
FC	1x1			1000, 1000, 1000, 1000		

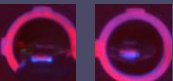
Table 1. Architectures for ImageNet. Building blocks are shown in brackets (see also Fig. 5), with the numbers of blocks stacked. Down-sampling is performed by conv3.1, conv4.1 and conv5.1 with a stride of 2.

input → Conv 7x7 → Block 1(9 conv) → Block 2(12 conv) → Block 3(18 conv) → Block 4(9 conv) → FC (conv) → output

Output result

Classify unqualified results into three categories

Type 1 - Qualified



Type 2 – Unqualified in missing welding



Type 3 – Unqualified in insufficient welding

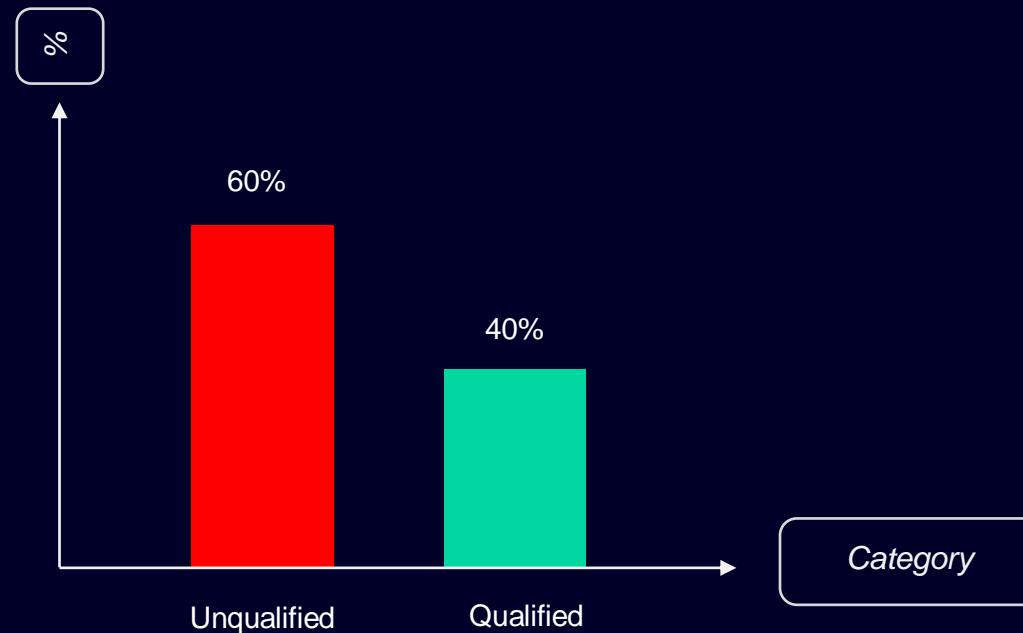


THT Close-Loop APP Feature - Quality Re-check

Quality re-check AI model – inference benefits

- Re-check the unqualified results from AOI and select qualified products, reduce product waste, and greatly reduce the false identification rate from 80% to 20%
- Classify the unqualified products into 2 types – missing welding and insufficient welding, provide direction for THT process parameter optimization

PCB quality check by AOI

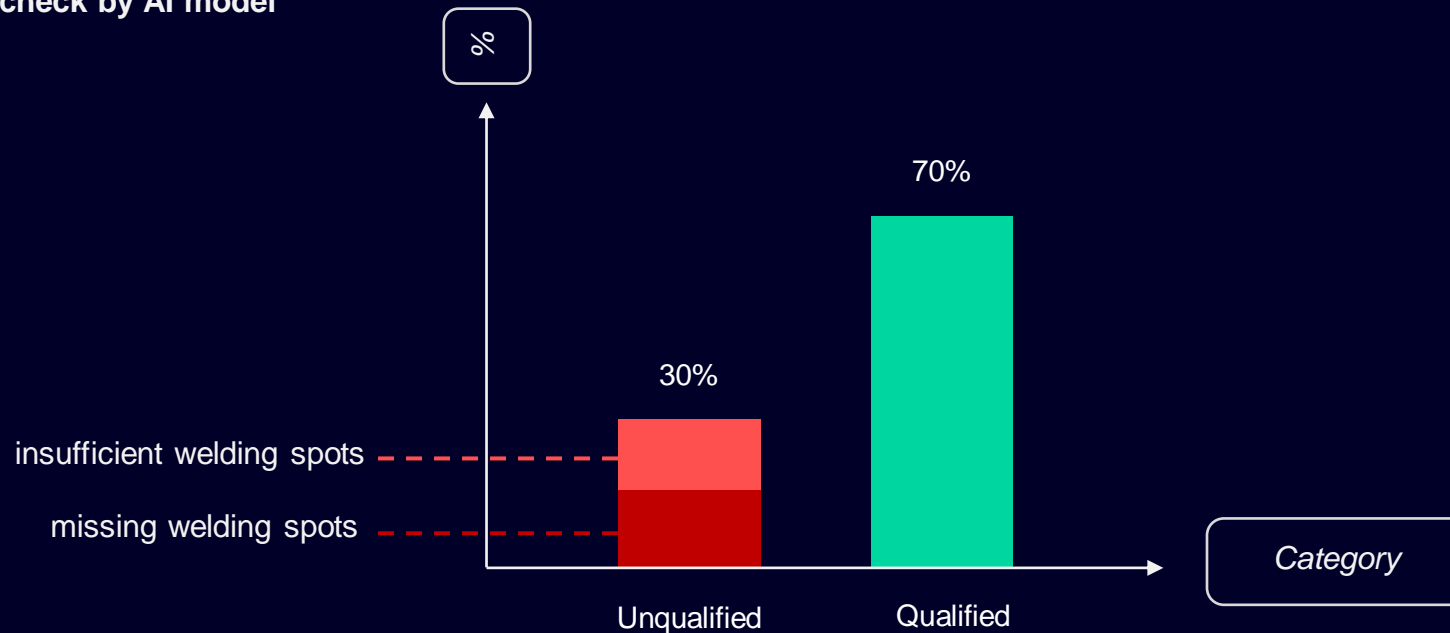


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PCB quality re-check by AI model



THT Close-Loop APP Feature - Quality Re-check

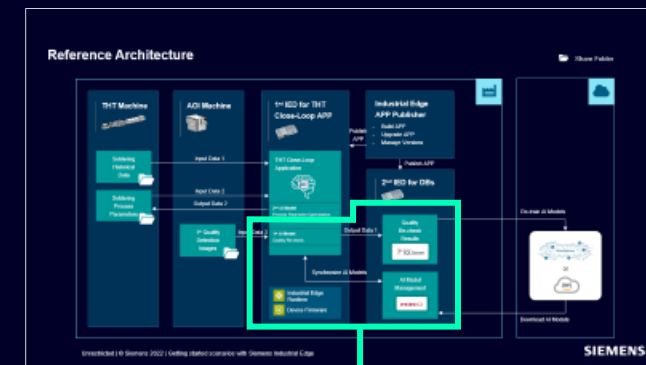
Quality re-check AI model - retraining

Description

- Not all re-check results are accurate, especially in the early stage of model deployment, which requires repeated training of the model through human intervention to make the model deduction results more accurate

Operation Step

- Select a user-defined time range to view the PCB THT quality re-check results
- Using the field experience to correct some of the AI re-check results, then save and upload the correction results to the cloud, so that the model can be further trained and optimized based on these corrected results

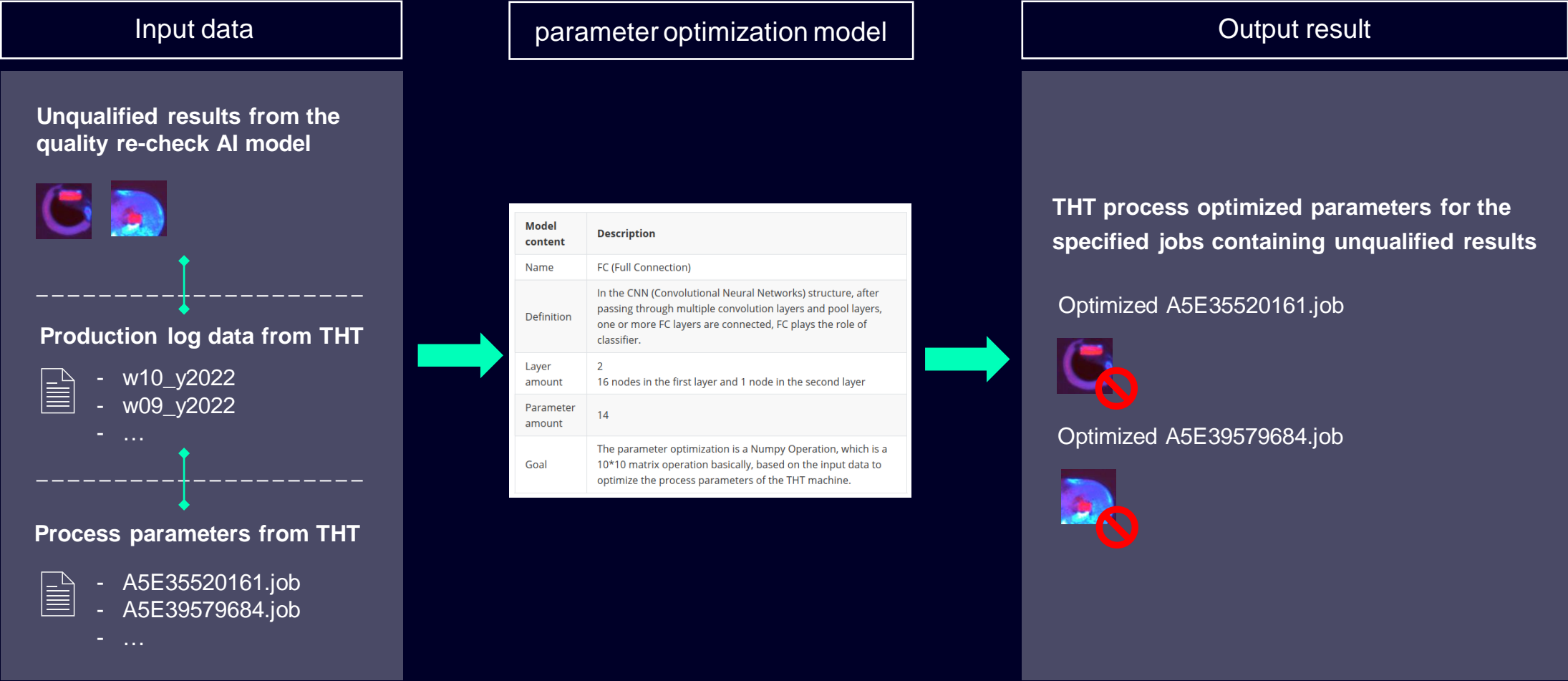
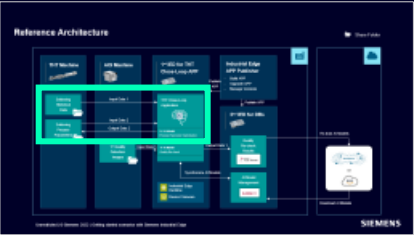


The screenshot shows the 'Inference Result' table in the THT Close-Loop APP. The table has columns for GroupID, Pictures, Creation Time, AI Inference Result, and Labeling Type. The 'Labeling Type' column contains dropdown menus for selecting the correct inference result. A red circle with the number 1 highlights the 'all Pictures' button in the top right corner. A red circle with the number 2 highlights the 'False Failure' dropdown menu in the 'Labeling Type' column.

GroupID	Pictures	Creation Time	AI Inference Result	Labeling Type
6287573e1a8147668c47406331bf03		2022-05-22T17:48:22.557	Miss Weld	False Failure
9c4a7a0d1d04ca8a2109f02b0c0de		2022-05-22T17:48:22.150	Miss Weld	Insufficient Weld
78627500d84224977be623058f0a0		2022-05-22T17:48:21.877	False Failure	Miss Weld
3a375b039e14884834989c7520a0b		2022-05-22T17:48:21.347	Miss Weld	False Failure
bc3a8be455334b67a5297b0841f62c2		2022-05-22T17:48:20.940	Miss Weld	False Failure

THT Close-Loop APP Feature - Process Parameter Optimization

Process parameter optimization AI model



THT Close-Loop APP Feature - Process Parameter Optimization

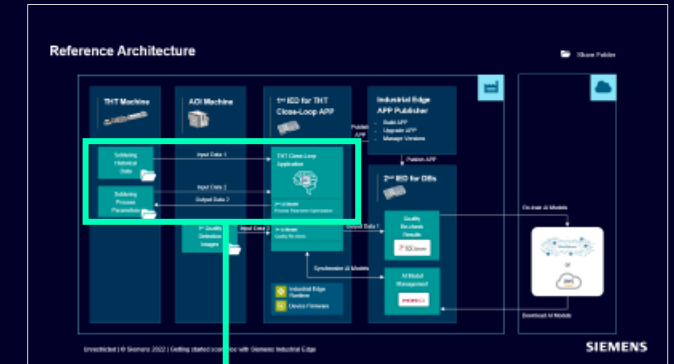
Process parameter optimization AI model - inference

Description

- When the data imported to the process parameter optimization AI model, the app can inference and display the optimized parameters for the corresponding jobs and product, so that user can view the optimized results in real time

Operation Step

1. Select and apply a specified version of the AI model for the inferencing
2. The app can display the latest optimized parameters for the specified product
3. User can intervene the optimized parameters based on the operator experience so that the THT process can use the most accurate and correct parameters to solder the PCBs in the next batch



Dashboard

Execution App

Labelling App

Parameter App

Dashboard

Parameter App

Parameter App

Version: V2.0

Apply

Jobs No.: ASE50302021

Load

AI Result: 0_SOLD_L24

Not latest data? please click and get the latest data

Export log

Edit

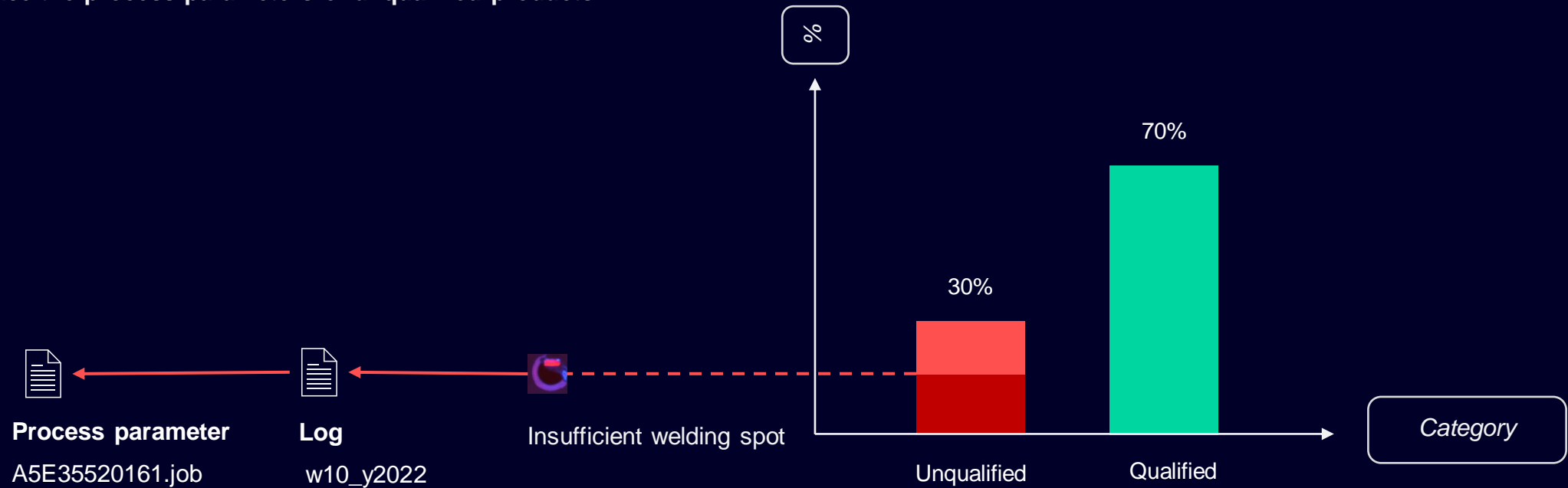
Time	Trajectory	Parameter	Original Value	AI Value	Manual Value	Ultimate Value
2022-05-26T14:26:40	0_SOLD_L24	v0	1000.000	876.637	---	---
		w1	100.000	93.599	---	---
		w2	100.000	93.599	---	---
		t2	0.000	-0.352	---	---
		h	10.000	9.086	---	---
		s1	50.000	48.910	---	---
		b1	0.500	0.120	---	---
		pl	6.000	5.527	---	---
		ph	0.000	-0.352	---	---
		v	15.000	13.805	---	---
		ho	10.000	9.086	---	---
		s2	50.000	48.910	---	---
		b2	0.500	0.120	---	---
		More>>				

THT Close-Loop APP Feature - Process Parameter Optimization

Process parameter optimization AI model - inference benefits

- Trace and optimize the process parameters of unqualified products, solve the problem of unqualified products from the root, and further reduce the unqualified rate of products

Step 1 – Trace the process parameters of unqualified products

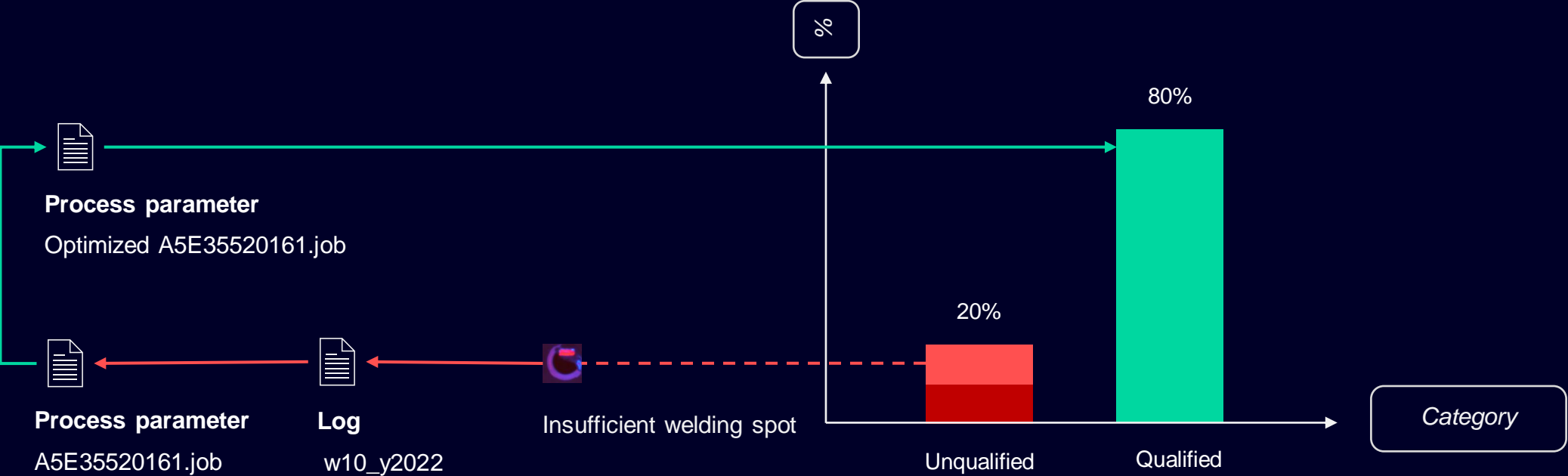


THT Close-Loop APP Feature - Process Parameter Optimization

Process parameter optimization AI model - inference benefits

- Trace and optimize the process parameters of unqualified products, solve the problem of unqualified products from the root, and further reduce the unqualified rate of products

Step 2 – Optimize the process parameters of unqualified products

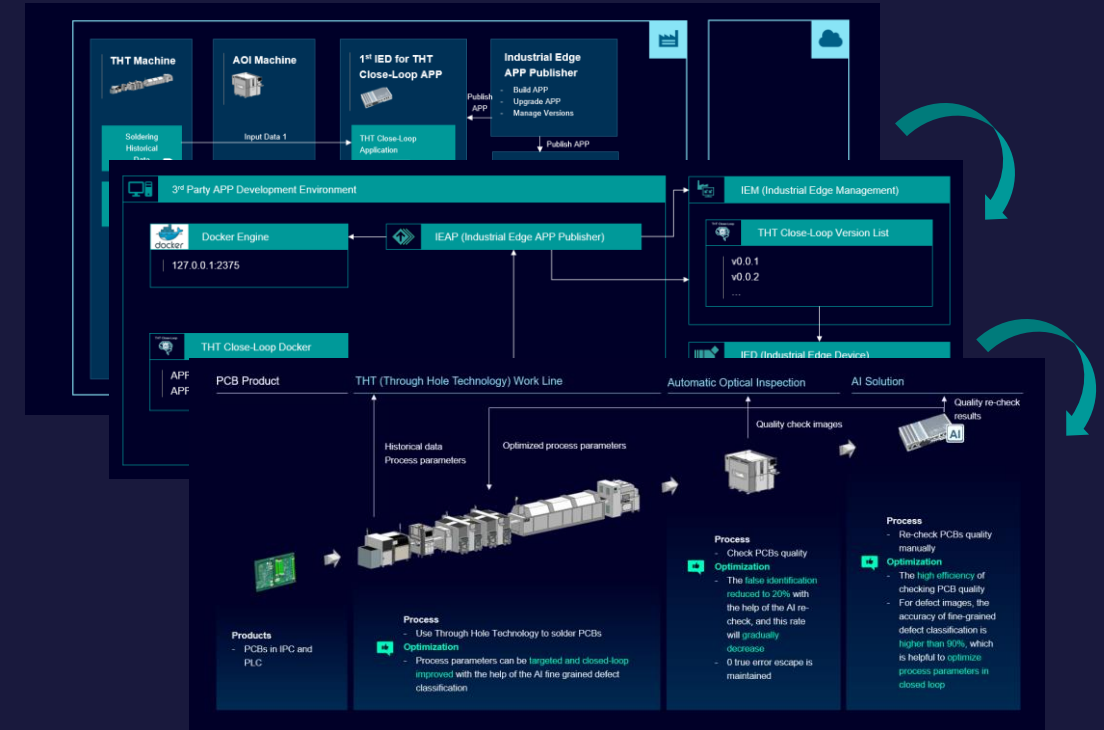


Challenge

Timely, continuous, stable quality re-check for PCB product and process parameter optimization for THT machine

Solution

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Example 1# - THT Close-Loop

Thank you !