Development of an AI-Based Automatic Detection Algorithm for Product Defect Using 3D Measurement Data

Industry-Academic Cooperation R&D Project

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Outline

1. Introduction to the Project

2. Current Defect Detection Methods and Challenges

3. Goals: Development of an AI-based Automatic Defect Detection Algorithm

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2. Current Defect Detection Workflow and Challenges

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Project Topic

- Developing an AI algorithm that automatically detects product defects using 3D measurement data.

- Previously, people had to review each dataset manually to identify defective products, but the objective now is to develop an AI model that can automate this process.

  - 3D Measurement Data means Coordinate Measuring Machine(CMM) Data

CMM(Coordinate Measuring Machine)

- CMM (Coordinate Measuring Machine) is a precision measurement tool used in the manufacturing industry to verify products defects inspection.

<CMM 측정기>

CMM(Coordinate Measuring Machine)

- Quality can be assessed by measuring the precision of dimensions, shape, and surface in three-dimensional space.

<CMM 측정기>

Product of Defect detect

- The measurement focus of this project is the parking sprag, a component related to automobile safety devices.

- This component is vital to human safety, as even minor processing errors can lead to significant risks.

- It is important to accurately measure 3D information with a CMM and inspect parts for defects.

[Similar product of Parking Sprag]

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Current workflow of defect detection

- After the part is manufactured, each part is measured using a Coordinate Measuring Machine (CMM) to check whether it is well manufactured.

- Print the measured CMM data on paper and manually determine whether it is defective.


[Measure with CMM]

9
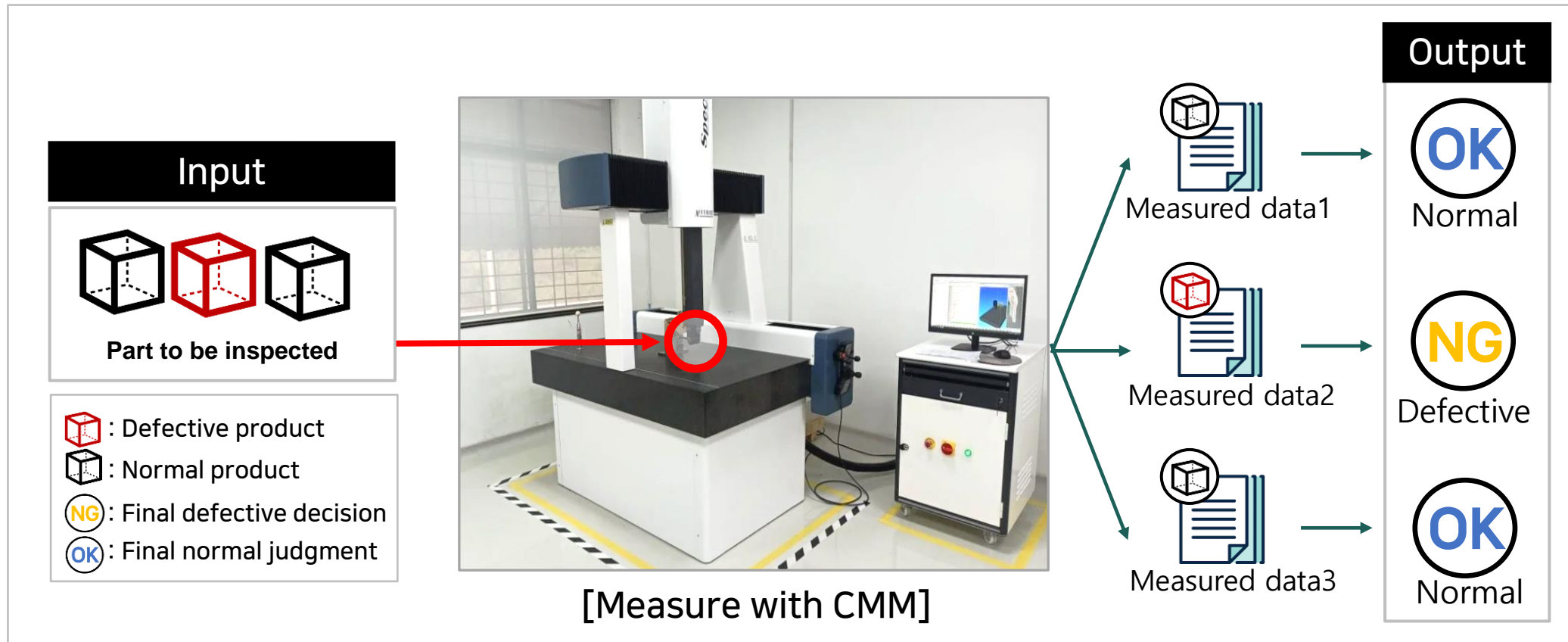
Problems with current workflow

- The measured CMM data is in a text file format, and the operator can directly determine the defect by printing it.

- There are issues with high labor costs and a lot of time wasted because each defect is judged individually.

<Existing measurement data management method>

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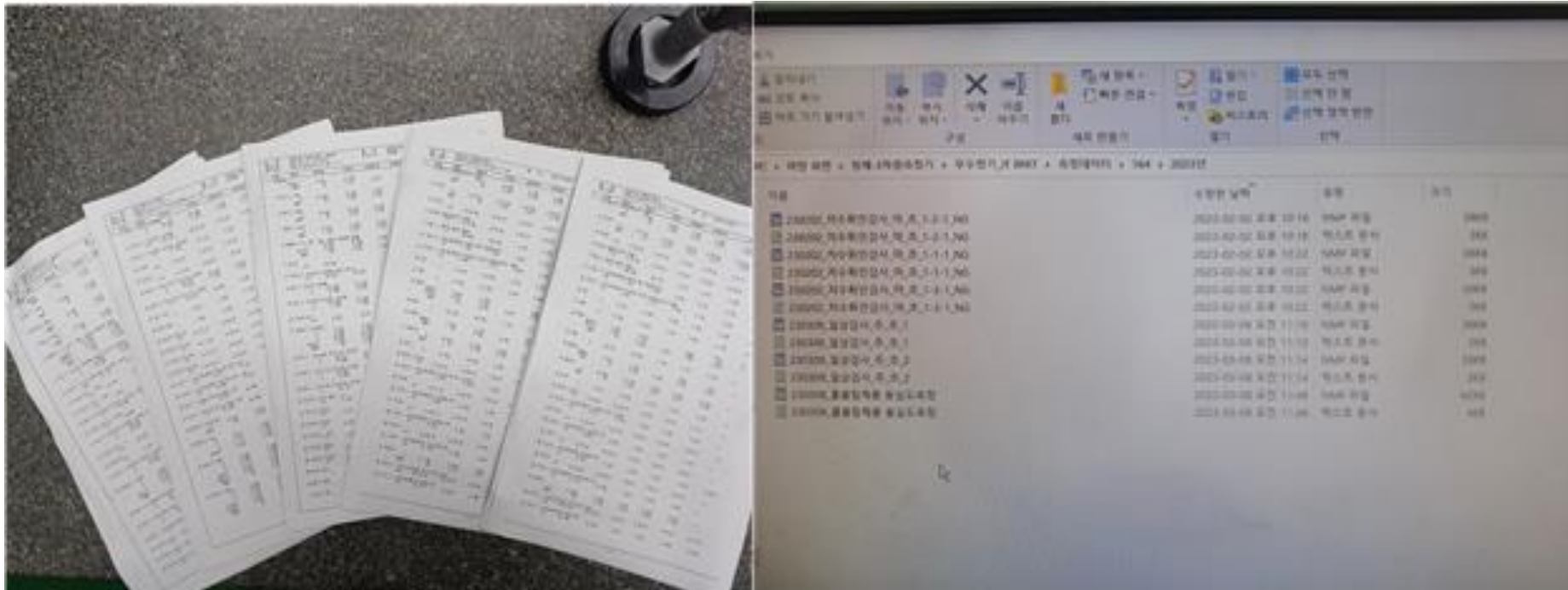
Specific Workflow of defect detection

- A defective judgment may be made initially, but in some cases, an additional secondary verification process is required.


11
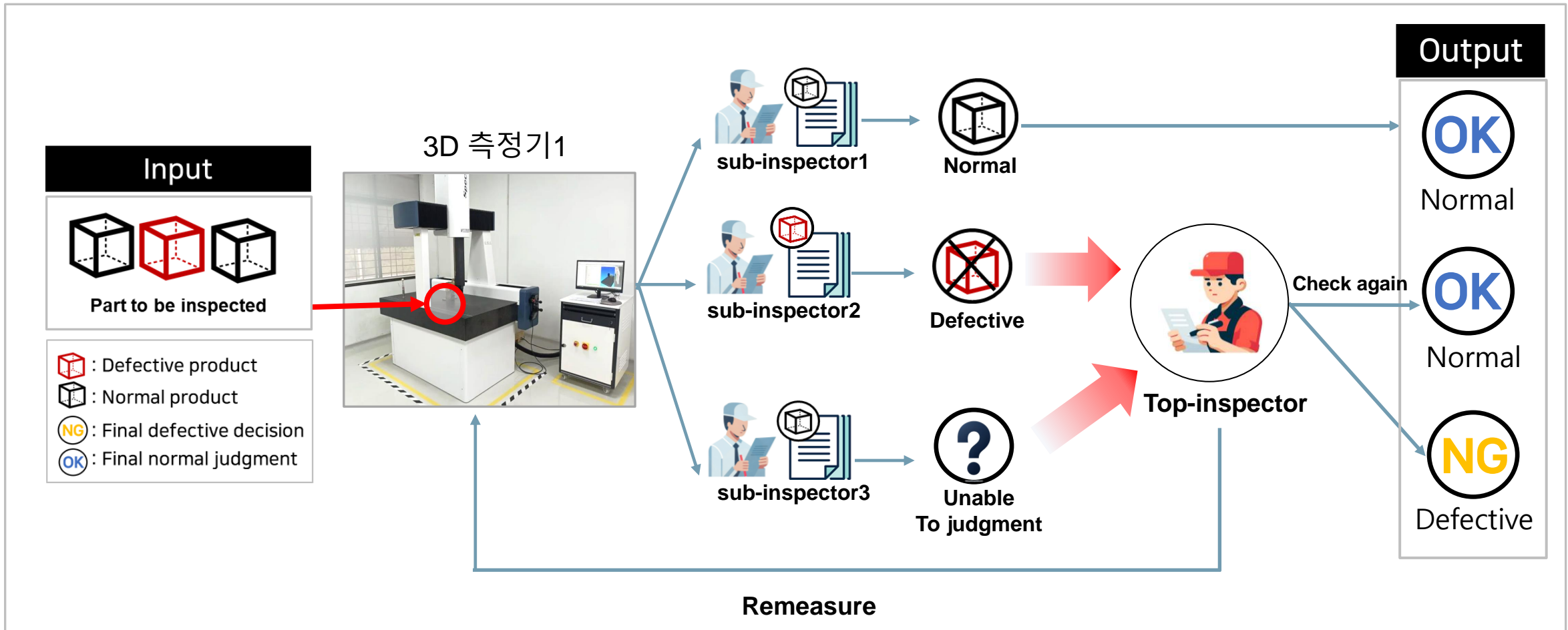
Primary inspection in current workflow

- In the initial inspection, the subordinate worker determines whether the product is defective.
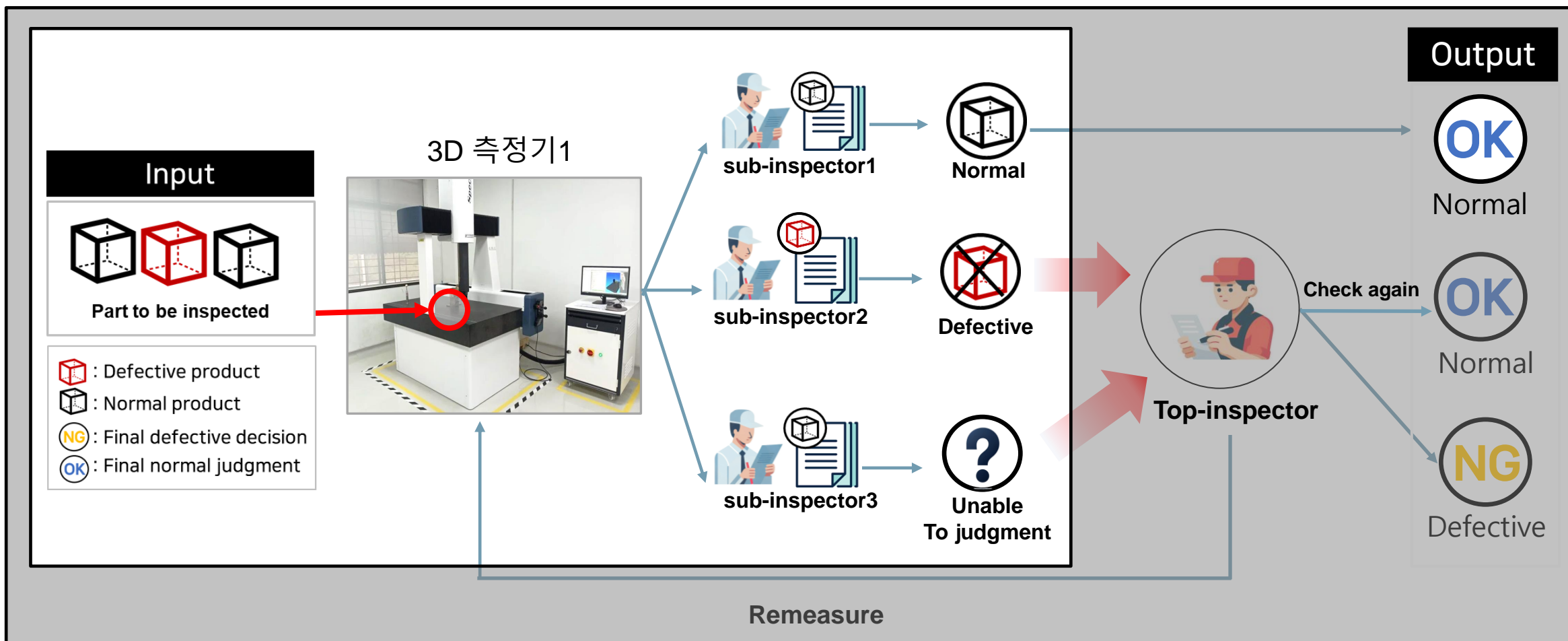
Current Workflow: Additional inspection

- Even if the lower-level worker initially identifies the product as defective during an additional inspection, it is not immediately discarded;

- Instead, it is escalated to a higher-level manager for a reevaluation or remeasurement to confirm the defect.
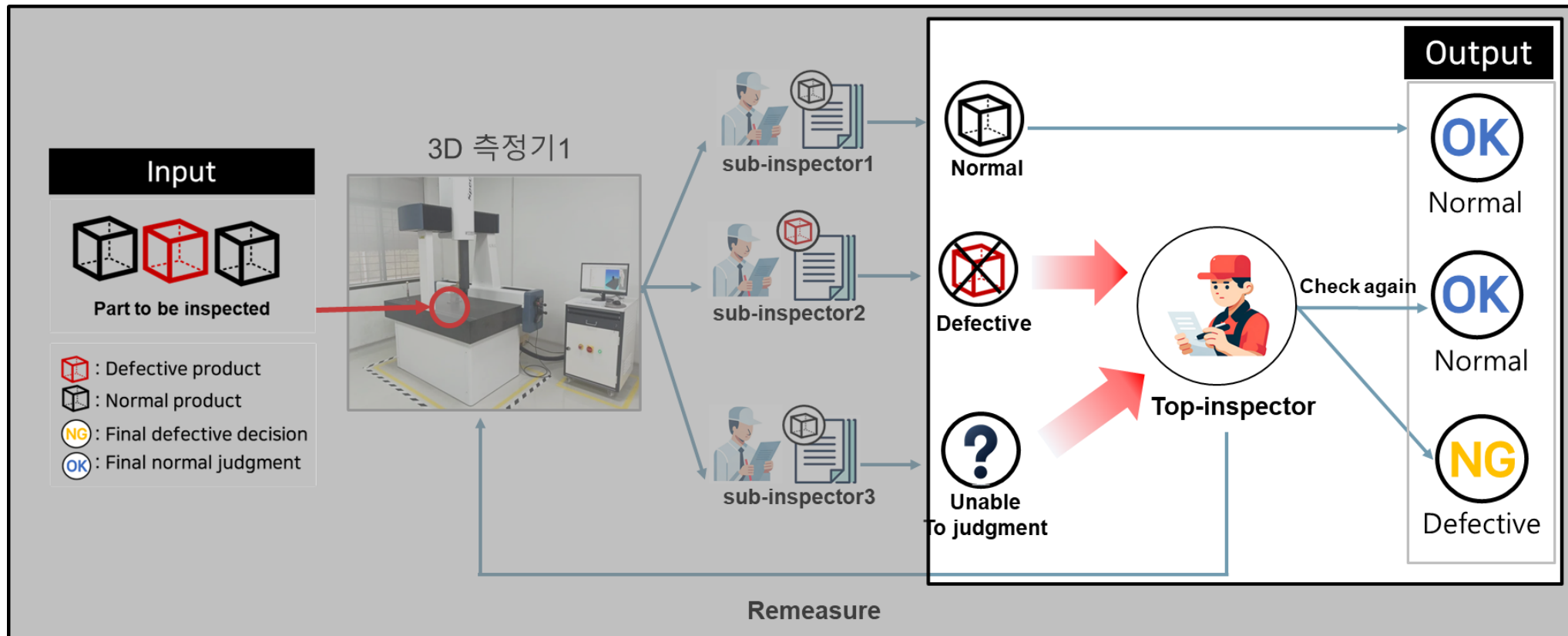
Current Workflow: Additional Inspection

- Alternatively, if a lower-level worker finds it challenging to make a decision, they should escalate the matter to a higher-level manager for a definitive determination of the defect.
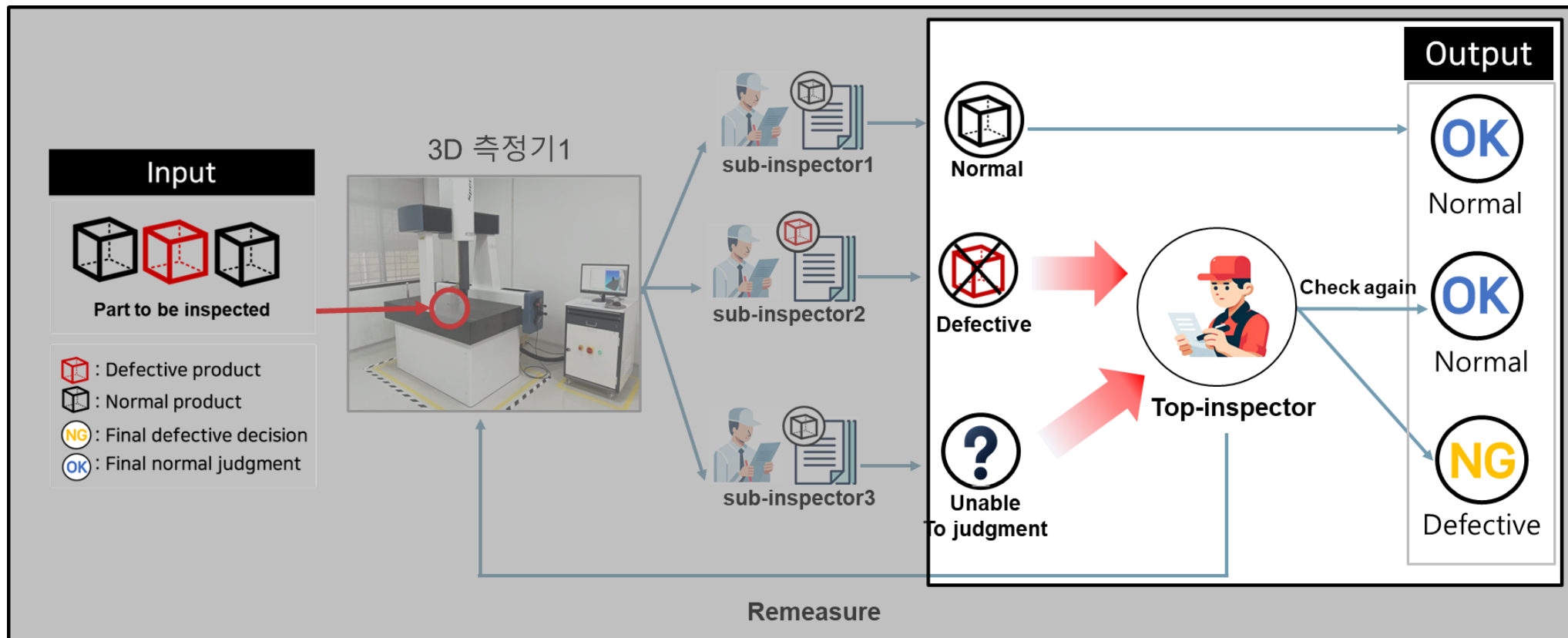
Current Workflow: Additional Inspection

- If a sub-level worker spots a defect, the product isn't discarded right away but rather sent to a higher-level manager for further assessment or measurement.
  - Even if determined defective, there are defects that may still allow the product to be usable.

- If a lower-level worker struggles to make a decision, they should consult with a higher-level manager to determine if the product is defective.
  - When it is ambiguous to make a judgment based on existing simple defect measurement standards.
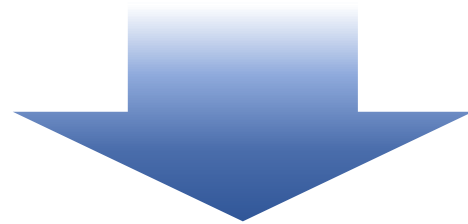
There is no clear standard for judging defects, and the simple standards used by existing companies to judge defects have vague boundaries.

Second Problems with current workflow

- The existing standard for subordinate workers to judge defects is a simple rule-based standard, making it unreliable.

- Due to the lack of clear standards and unclear measurement criteria, the current workflow is inefficient and results in unnecessary time wastage.

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Our Goals

- Our goal is to automate defect identification by replacing the existing rule-based defect detection with AI.
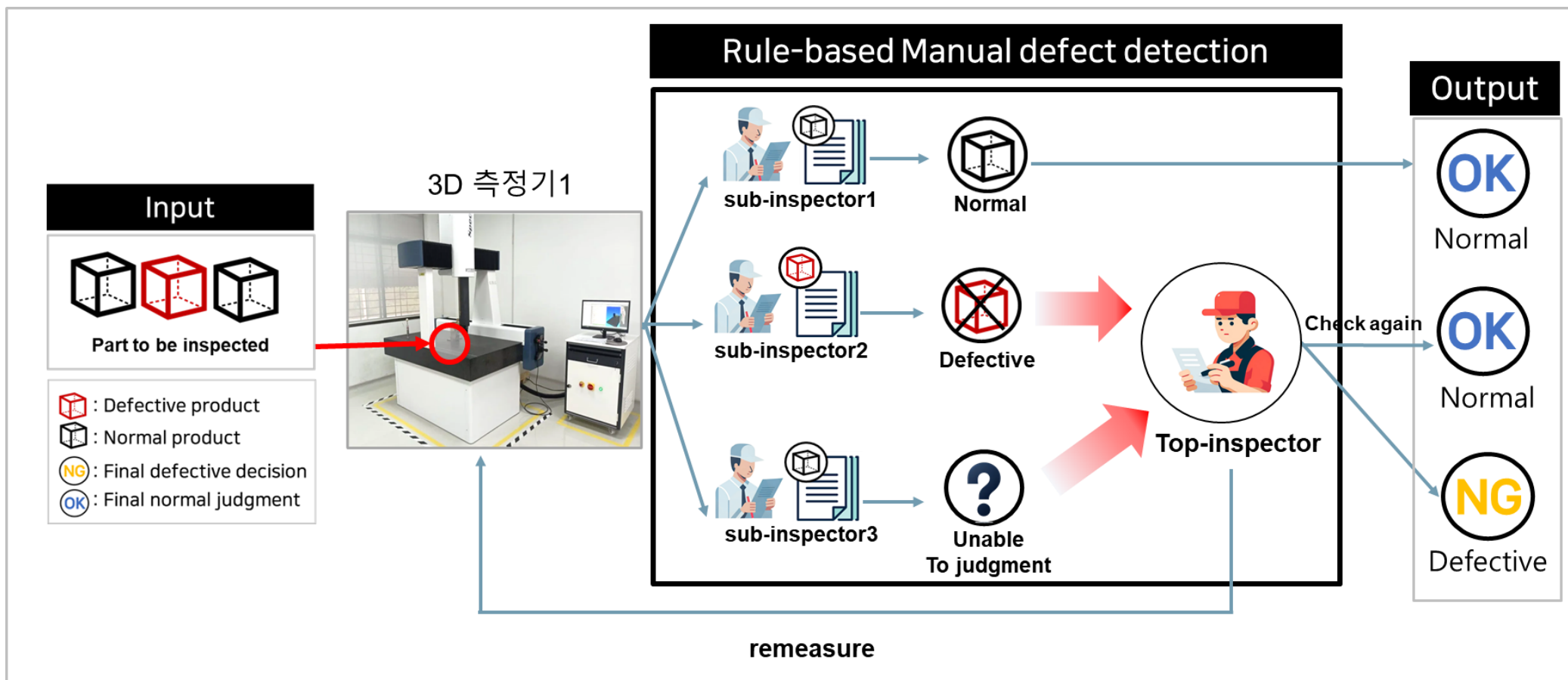
Automation of defect determination using deep learning

- Based on the accumulated CMM data, we are working to develop a deep learning model that can identify defects by learning from the characteristics of complex 3D defective product data.
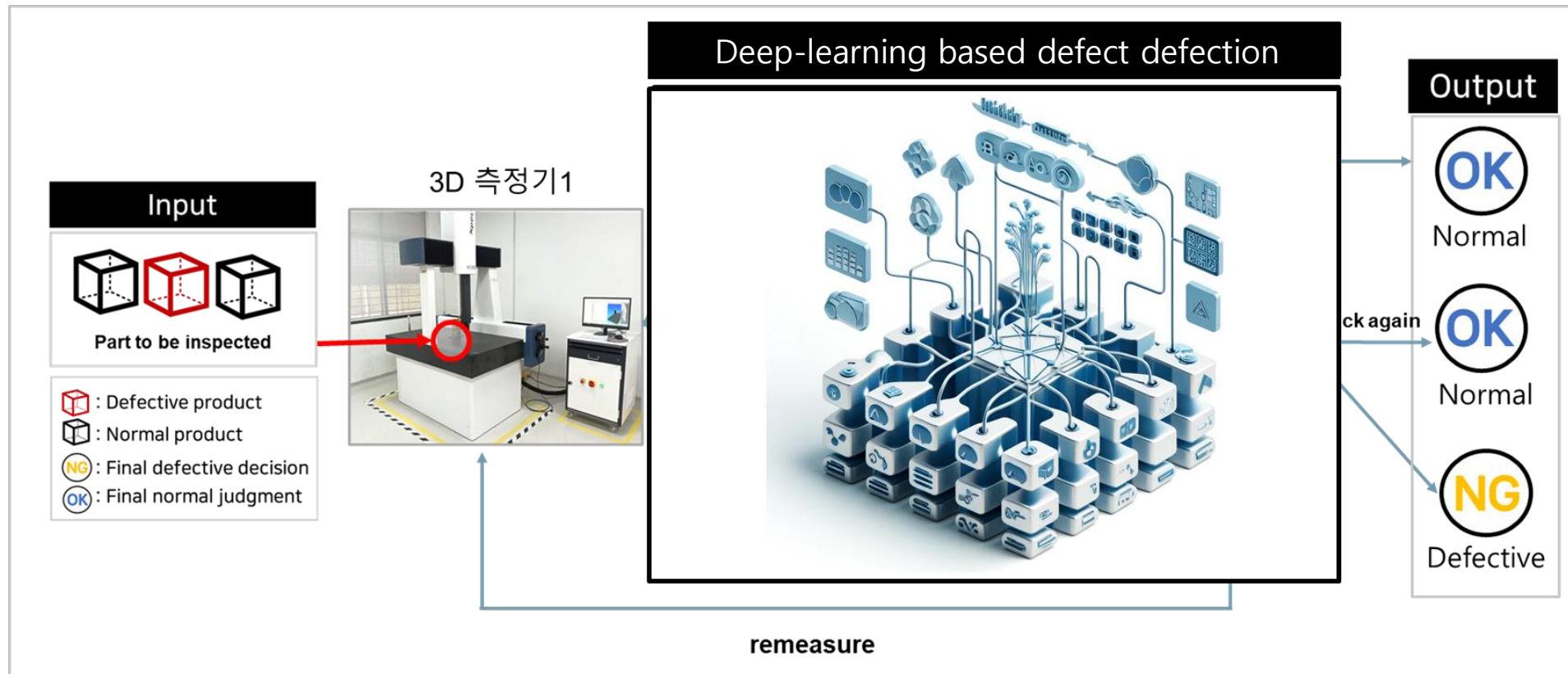
Transition from Rule-based to Data-driven Automation

- The developed model allows for a transition from rule-based processes to data-driven work automation.

20

Current work progress

Domain study

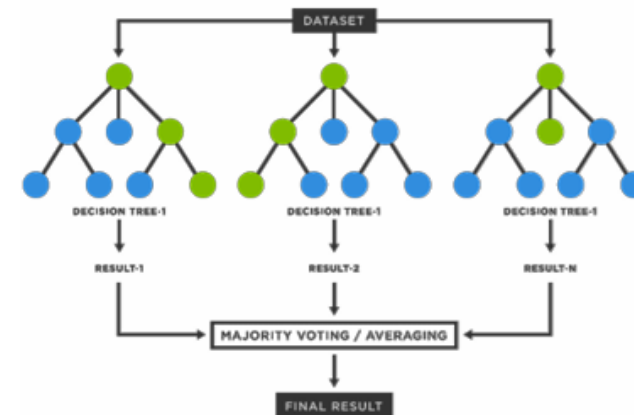- Detailed Review of Procedures and Methods in CMM Processing and Measurement Steps.

https://m.blog.naver.com/openst33/221900492594

CMM data analysis

- Analysis of characteristics and preprocessing through CMM data analysis.

Model Identification

- Identifying and studying a model suitable for the characteristics of CMM data.

Thank you for Watching