

Transforming Operations with Domain Knowledge and AI: Boosting Productivity through Generative AI

Hitachi, Ltd.

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About Inspire2027

2.1 Vision of Inspire 2027

HITACHI

Grow sustainably while contributing to a harmonized society where environment, wellbeing and economic growth are in balance



3.1.1 Evolution to Lumada 3.0

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Evolve to Lumada 3.0 with AI enhanced by Hitachi's domain knowledge

Lumada 1.0

IoT Platform

Evolve customers' operations
with data driven approaches

Lumada 2.0

Digital engineering

Evolve the entire value chain
of customers by digital

Lumada 3.0

Powered by AI

Evolve social infrastructure
through AI strengthened with
domain knowledge

Digital capabilities

Domain knowledge

Installed base

Hitachi Rail
STS

JR
Automation

Hitachi Global
Air Power

Hitachi
Energy

GlobalLogic

Hitachi Digital
Services

Hitachi Rail
GTS



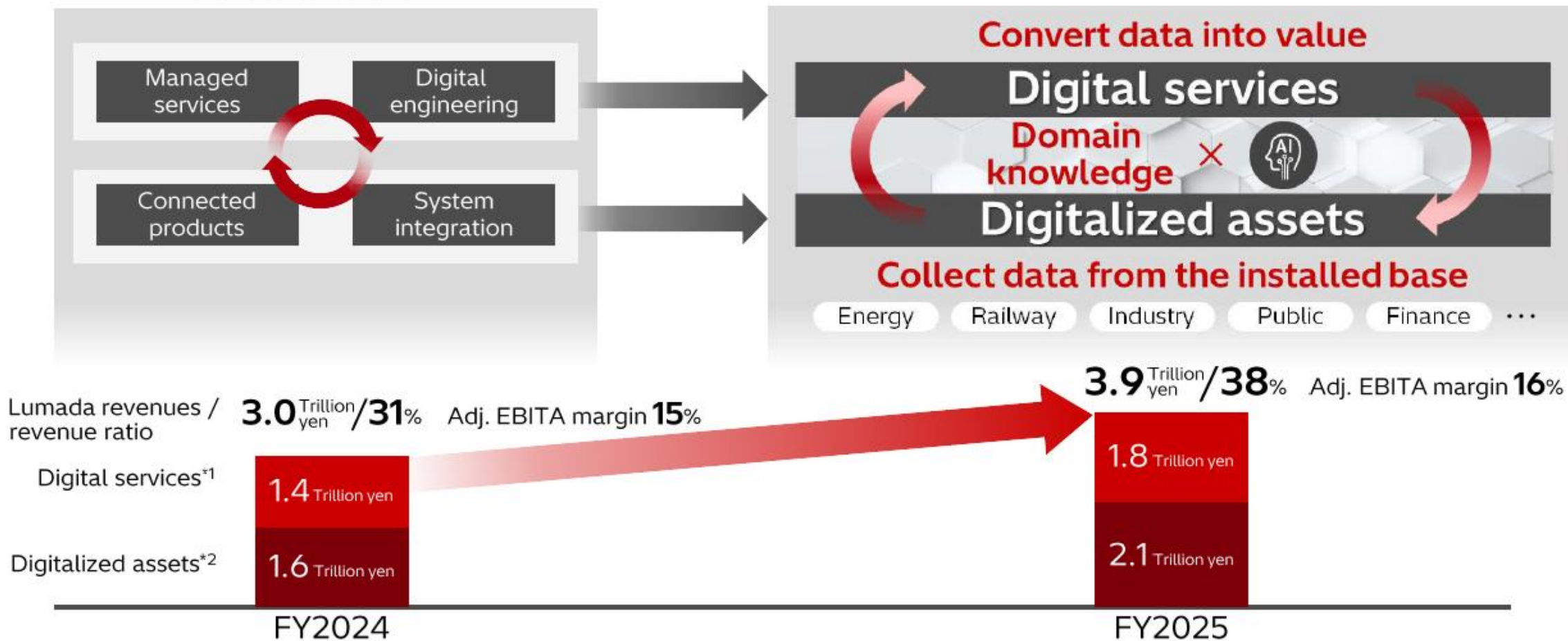
LUMADA

3.1.2 Lumada 3.0

Create value from an expanding installed base with Lumada, enhanced by domain knowledge and AI

Lumada 2.0

Lumada 3.0



3.1.5 Set new long-term management goals "Target Level"

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Strengthen Lumada business continuously to aim for further profitability improvement

Long-term management goal

Target Level LUMADA 80-20

Lumada revenue ratio 80%

Lumada Adj. EBITA margin 20%

Inspire 2027

Lumada revenue ratio 50%

Lumada Adj. EBITA margin 18%

Present

Strengthen Lumada investments and transform business portfolio

- Develop specialized LLM with learned domain knowledge
- Enhance interfaces with other companies' installed base
- M&As to strengthen the service businesses in four main businesses
- Reorganize businesses with no prospects for growth and profitability improvement

Project for Applying Generative AI to Quality Assurance Operations

Omika: A World-Leading Smart Factory

A Strategic Site Supporting Hitachi's Operational Technology (OT) Excellence

- Omika Works (Control Systems Department)

We provide systems that support the stable operation of essential social infrastructure such as electricity, railways, water and sewage, and industrial sectors—systems indispensable to our daily lives. From design and manufacturing to post-delivery operation, we offer total solutions for social infrastructure.



Source: (Control Systems) Technology Department Website

- What is OT (Operational Technology)?

OT refers to control and operational technologies used in the field, such as in social infrastructure and factories. Examples include monitoring devices for power grids and control systems for production lines. The systems provided by the Control Systems Division can be considered "OT systems."

OT is closely tied to domain-specific knowledge—expertise unique to particular industries or operational environments.

This domain knowledge enables accurate design, operation, and troubleshooting of OT systems. For example:

- In the railway industry, specialized knowledge of traffic management and signal control is essential for OT operations
- In power plants, knowledge related to equipment safety and operational efficiency is directly linked to OT.

Quality Challenges in the OT Domain

As OT (Operational Technology) involves control and operational systems, the use of domain knowledge plays a critical role in determining quality.

■ On-Site Incident Response

The expertise of experienced personnel is crucial for quality



When a failure occurs in a live system or when operational inquiries arise, inaccurate responses can lead to serious consequences—such as train service disruptions—that affect people's daily lives.

Providing quick and accurate answers is difficult because relevant information is often stored in individual incident records (DB) or as tacit knowledge held by experienced personnel.

■ Ensuring Shipment Quality (Modification Quality)

Over 70% of on-site incidents are of similar types

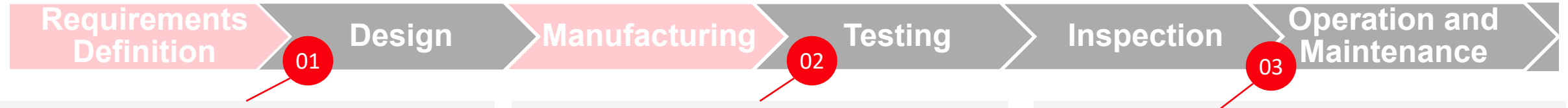


Social infrastructure systems have very long lifecycles, and frequent modifications to software and data are required even during operation.

Data shows that more than 70% of on-site failures are similar to past incidents. Therefore, eliminating recurring issues during delivery or modification is a key quality challenge for OT systems.

Utilization Scenarios of Domain Knowledge

OT refers to 'control and operational technology,' but the knowledge of OT systems is not only utilized during operations.



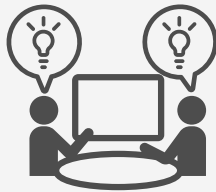
01 Design Phase

Main Users: Design, Quality Assurance

Use Cases: Document creation, Upstream review

Usage Method: Input development overview or modification details

Effect: We can prevent similar incidents by referencing information on defects from similar past developments or modifications



02 Testing and Inspection Phase

Main Users: Design, Quality Assurance

Use Cases: When creating design test items and inspection items

Usage Method: Add "What should I be careful about when creating test items?" at the end of the search query

Effect: The answer generation function extracts key items to be checked, enabling even inexperienced personnel to create high-quality test items.



03 O&M Phase

Main Users: Quality Assurance, Maintenance Staff

Use Cases: On-site inquiries and incidents occurrences

Usage Method: Input customer inquiries and incident details in text.

Effect: The answer generation function can quickly provide initial responses by analyzing 20 similar past cases and the top 5 most relevant ones.



Project Overview

case study on "customer inquiry handling," which plays a major role in quality assurance operations

At Hitachi's Omika Works, products are developed and manufactured in the OT*1 domain that supports social infrastructure systems such as transportation and nuclear power. Quality assurance operations that respond to various situations have traditionally relied on the experience and intuition of skilled personnel.

By applying generative AI to formalize and incorporate the tacit knowledge—experience and insights—of skilled personnel, it was confirmed that customer inquiry handling for issues such as equipment failures can be enhanced and made more efficient.

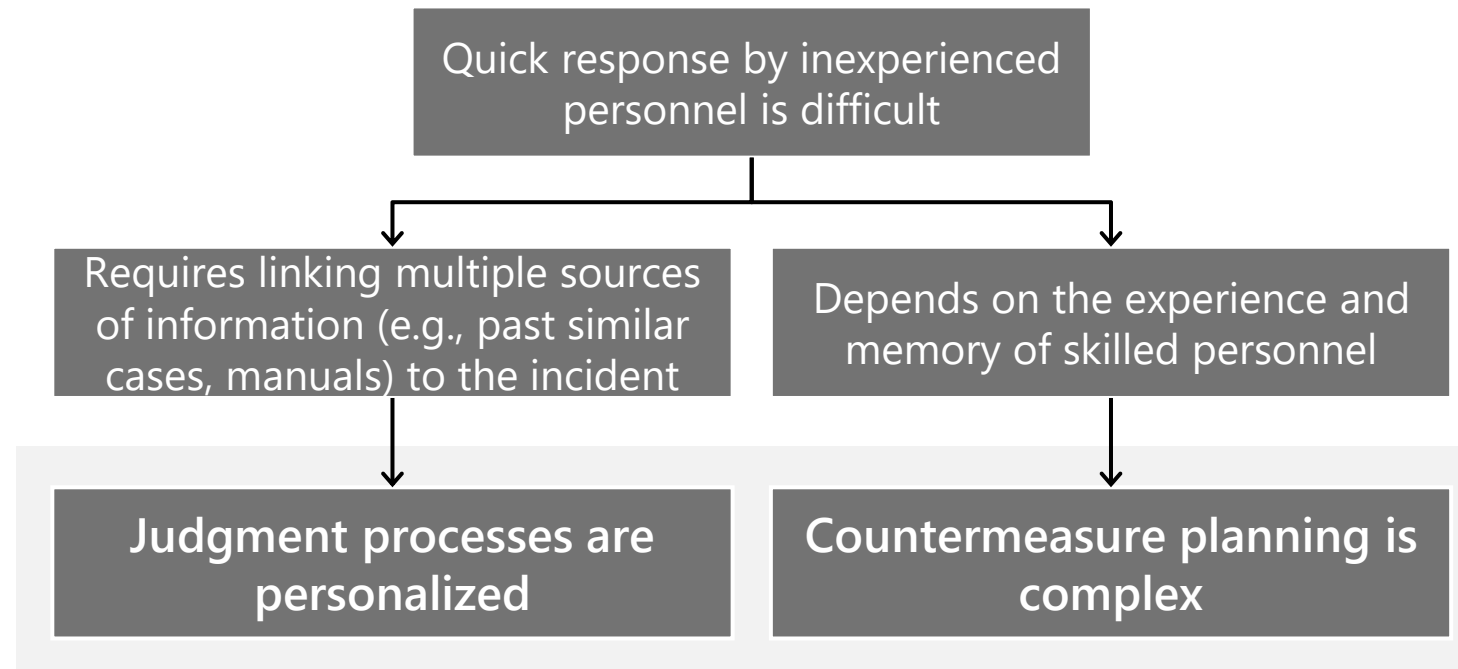
Scope	Quality assurance operations at Omika Works (OT domain for social infrastructure)
Objective	Enhance and streamline customer inquiry handling
Approach	Application of generative AI
Method	Formalize the tacit knowledge (experience and insights) of skilled personnel and integrate it into the system
Results	<ul style="list-style-type: none">• Applied generative AI to customer inquiry handling (search, analysis, report creation) at the operational level• Expanded application to design phase for searching past cases, aiming to reduce defect introduction from upstream processes

*1 OT: Operational Technology (control and operation technologies)

Challenges in Handling Inquiries

It is difficult for inexperienced personnel to respond quickly

In the quality assurance of complex social infrastructure equipment, extracting appropriate information from vast amounts of data and linking it to necessary countermeasure information requires the experience and memory of skilled personnel, making it difficult for inexperienced personnel to respond quickly.



Generative AI

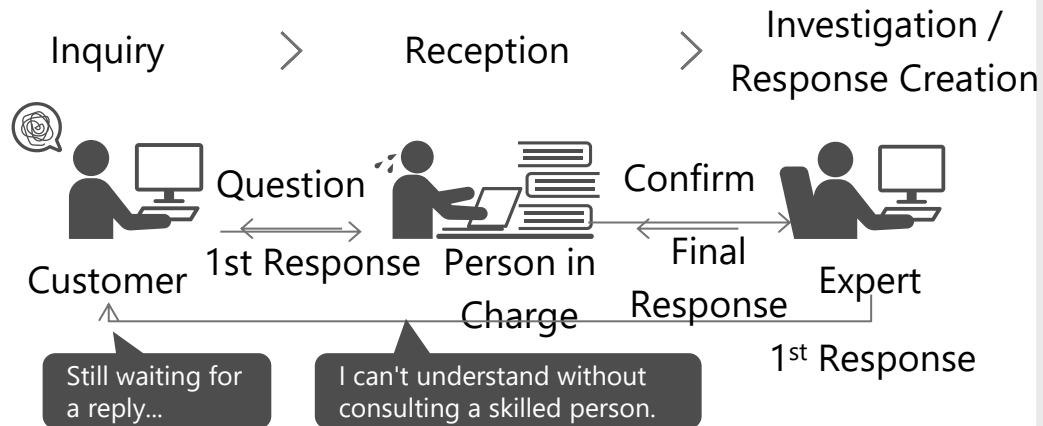


We want to make it possible for anyone to respond by utilizing generative AI!

Expected Effects

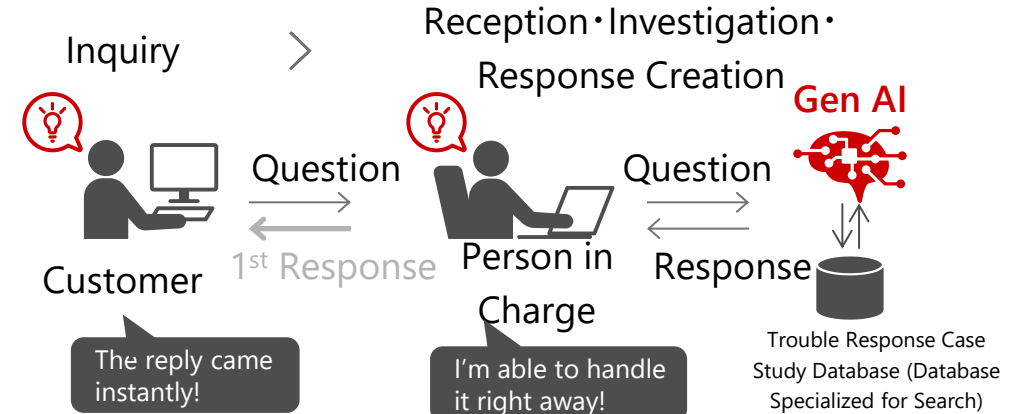
Enhance Hitachi's quality and trouble response capabilities, and strengthen continuous support for customers' business operations

AS-IS



- There are cases where it is difficult for inexperienced personnel alone to investigate and respond to trouble.
- Without experienced personnel or key persons, initial response cannot be made, and it takes time to provide a first response to the customer.

TO-BE



- Even in the absence of skilled personnel or key persons, initial response can be made, and **the time until the customer receives a first response can be shortened.**
- In the future, by allowing customers to access troubleshooting information, **it will be possible to provide initial responses 24 hours a day.**

Expected Effects

(Reference) Quality Status Analysis & Customer Report Creation Support

Quality Status Analysis

Features Analyzes chronological data and product-specific trouble status from textual information in trouble response reports.

Provided Value

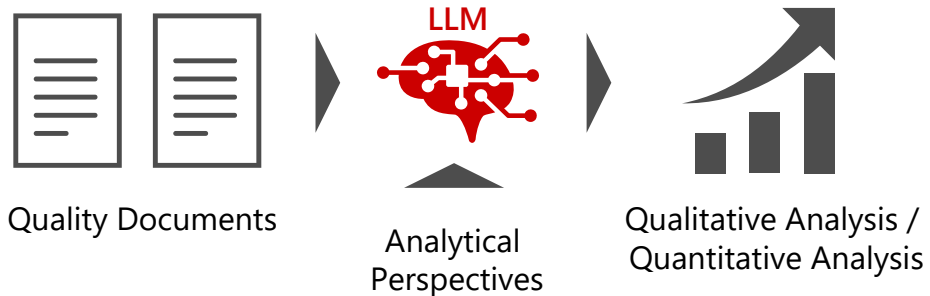
- Enables efficient understanding of trouble status and strengthens response capabilities
- Feedback to development helps improve Hitachi's quality levels

Support for creating customer reports

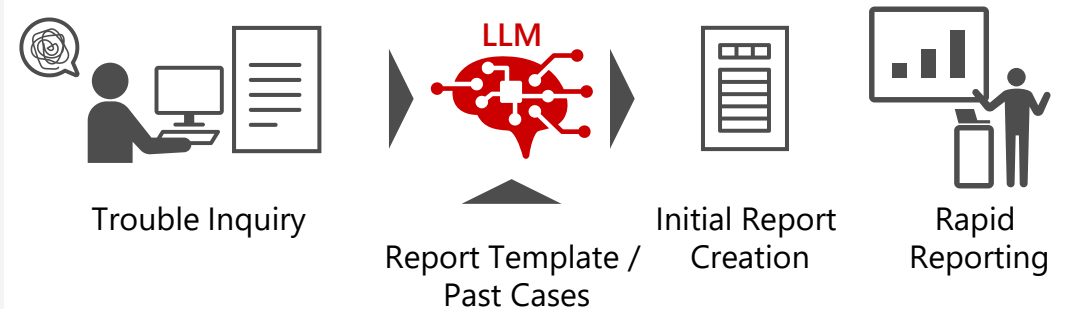
Features Supports report creation using generative AI for past case searches and similar case recommendations

Provided Value Anyone can create a draft version of a trouble response report, enabling quick delivery of an initial report to the customer (leading to improved customer satisfaction)

Quality Status Analysis (Quantification of Textual Information)



Creating customer reports (Improving Customer Satisfaction)



Achieved Results

Significant reduction in time spent on search, analysis, and report creation tasks.



Shortened time for each task related to troubleshooting, enabling quicker responses to customers.



Search Time

Approximately **90%** reduction



Analysis Time

Over **80%** reduction



Report Creation Time

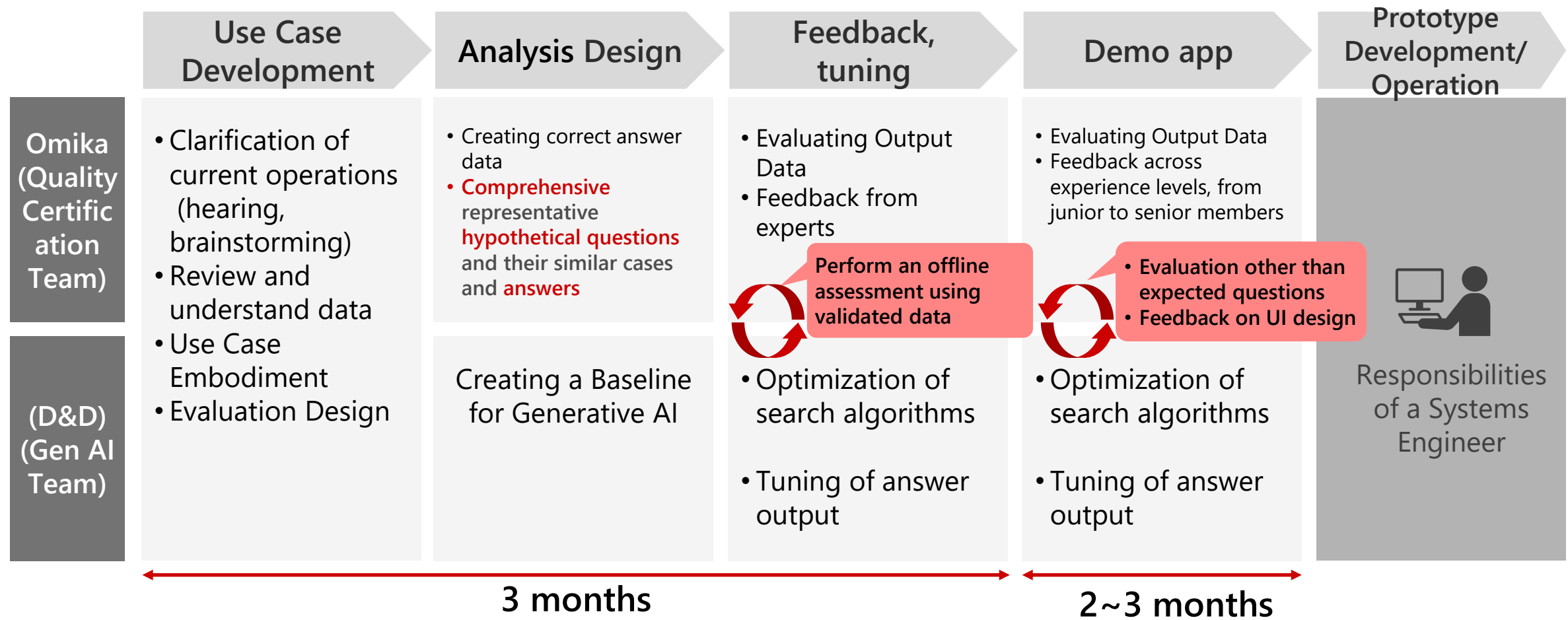
Over **80%** reduction



Implementation Method of Domain Knowledge × AI

Project implementation process

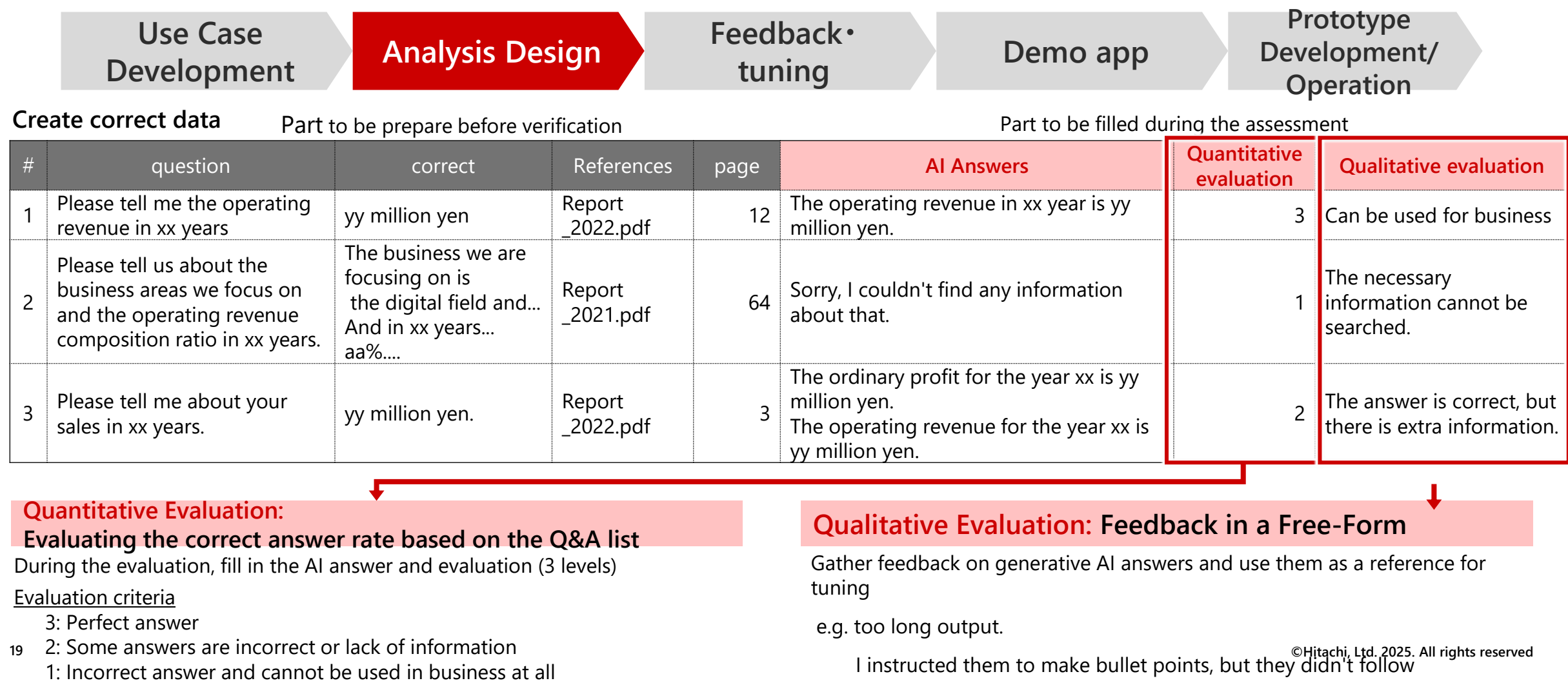
The QA and generative AI teams will work together to drive the process from use case exploration to evaluation and feedback



Point 1: A practical and comprehensive evaluation Q&A that tests expert knowledge

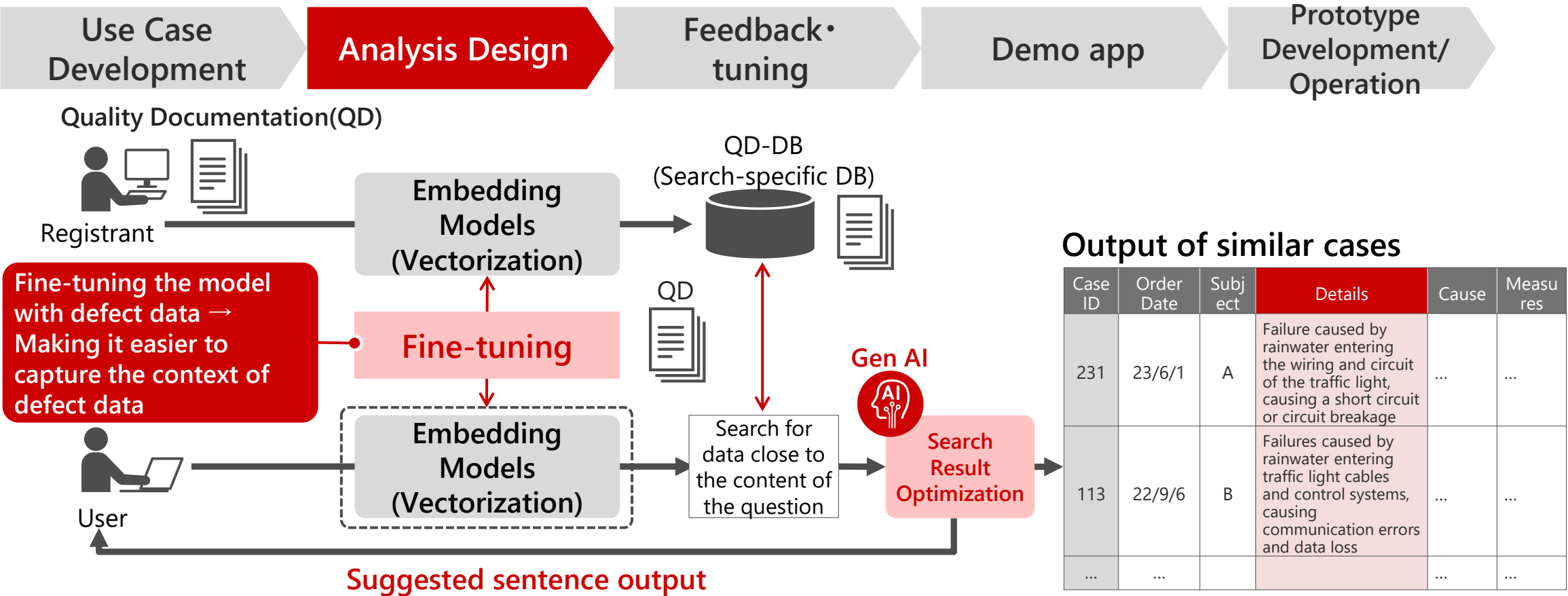
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By having experts create representative question and answer pairs (correct data), the quality standards for AI responses are defined >>> This will serve as a basis for incorporating the knowledge of experts



Point 2: Capture the context of technical terms and internal documents

To improve search accuracy in a specific field, fine-tuning the embedding model
 >>> The embedding model makes it easier to capture "the text written by an expert from Omika."

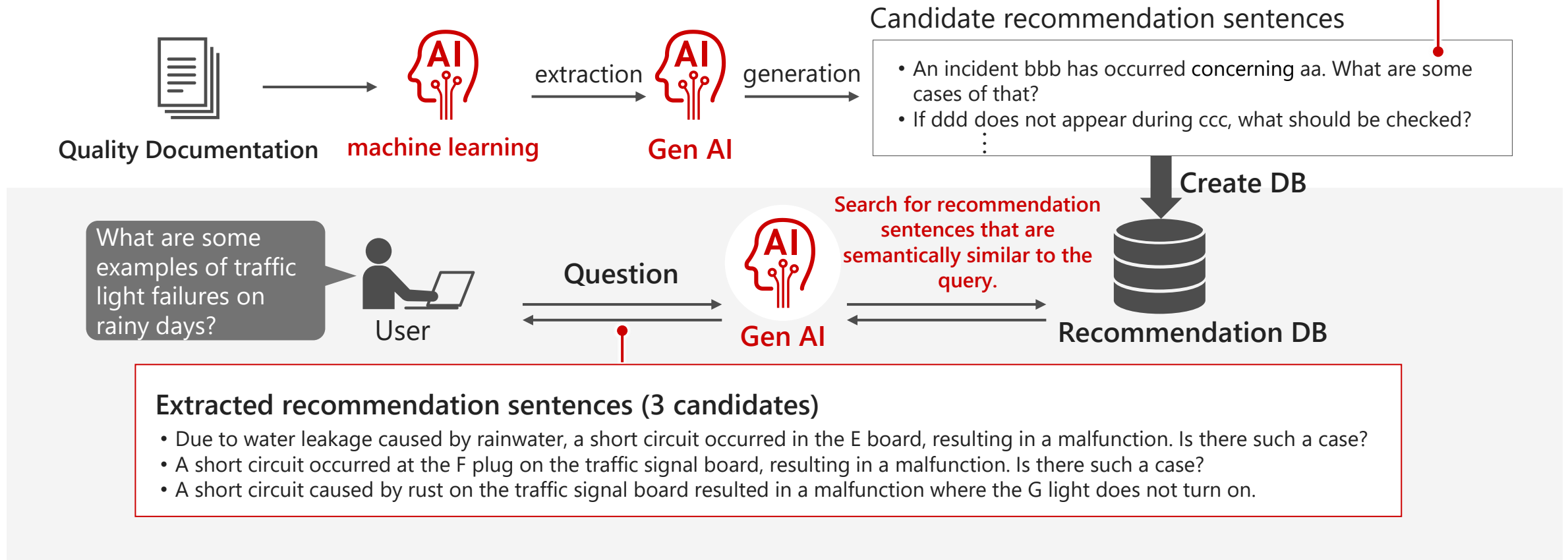


(Reference) Function for improving the search efficiency of quality documents: Recommendation function

Based on the content of each quality document, AI generates potential questions.

When a user inputs a question, AI suggests semantically similar questions from that set.

Incorporating the thinking of experts



Point 3: Incorporate expert knowledge feedback into generative AI

Using the comprehensively created evaluation Q&A, determine whether the answers provided by the generative AI are truly usable in the field



Use pairs of "questions and correct answers" that cover actual business operations to improve answer accuracy (this case includes more than 100 questions)

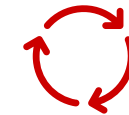
Formulate common evaluation criteria



Feedback



Feedback from Expert

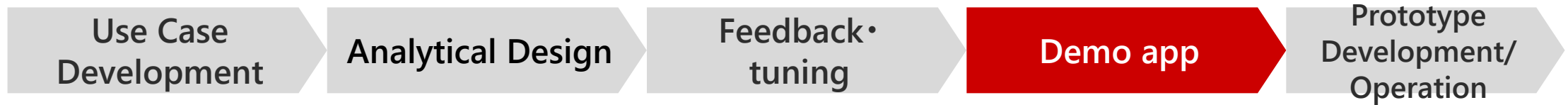


- Establish quantitative evaluation criteria and provide evaluation and feedback by multiple persons in charge
- Provide feedback on key points of answers through qualitative evaluation (comments)

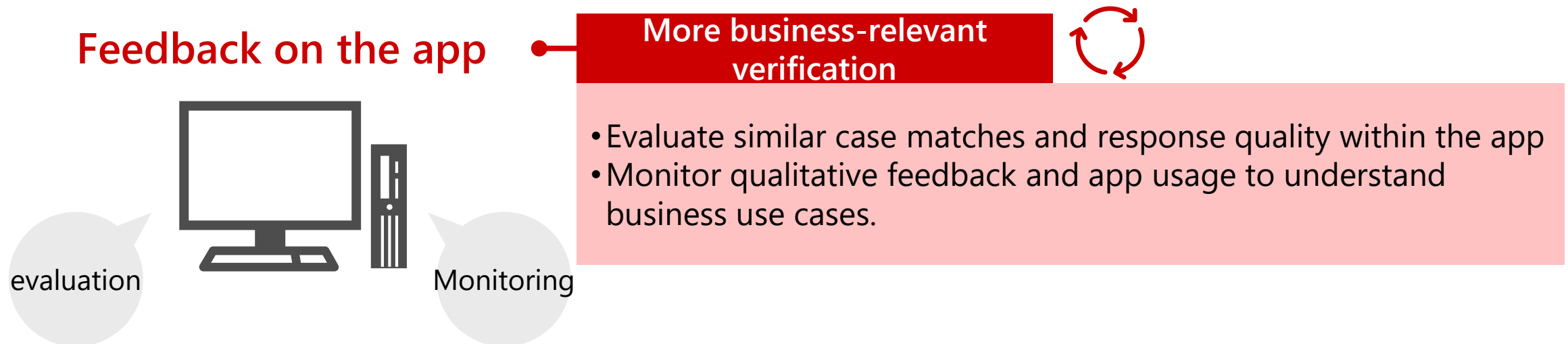
Use expert feedback to enhance AI-generated answers, making them practical for the field.

Point 4: Realistic usability evaluation

Evaluation of realistic usage in work other than expected questions, and feedback on the UI for actual work



Develop **an app with a feedback feature** prior to its deployment in actual business operations

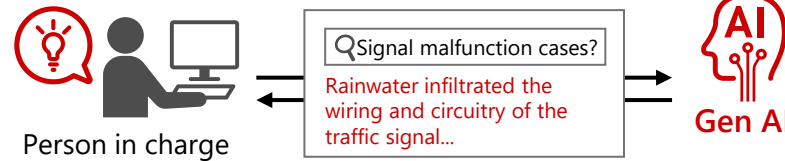


The results obtained

This was useful not only for inexperienced personnel, but also helped experts explore similar cases deeper.

Effective Search

Generative AI interprets questions entered in natural language and displays documents in order of similarity

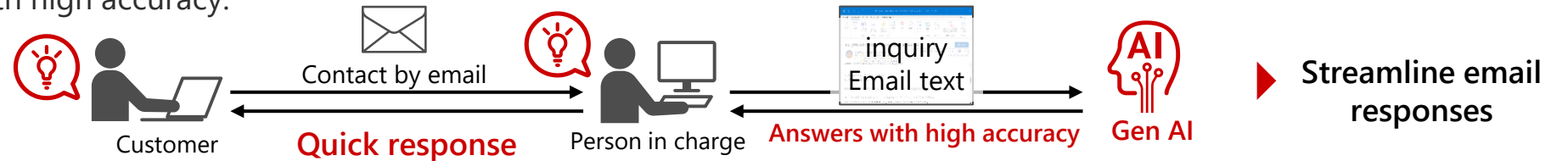


output

CaseID	Order Date	subject	Details	Cause	Measures
231	23/6/1	Branch A	Failure caused by rainwater entering the wiring and circuit of the traffic light, causing a short circuit or circuit breakage
113	22/9/6	Branch B	Failures caused by rainwater entering traffic light cables and control systems, causing communication errors and data loss
...

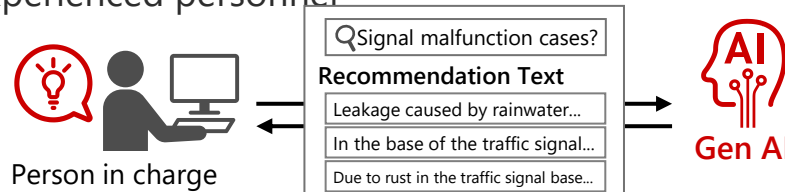
Search and Answer Generation

Even if you enter the text of the inquiry email from the customer as it is, you can search and generate answers with high accuracy.



Recommendation function

Support search by providing specific question suggestions, and effectively utilize past knowledge even for inexperienced personnel

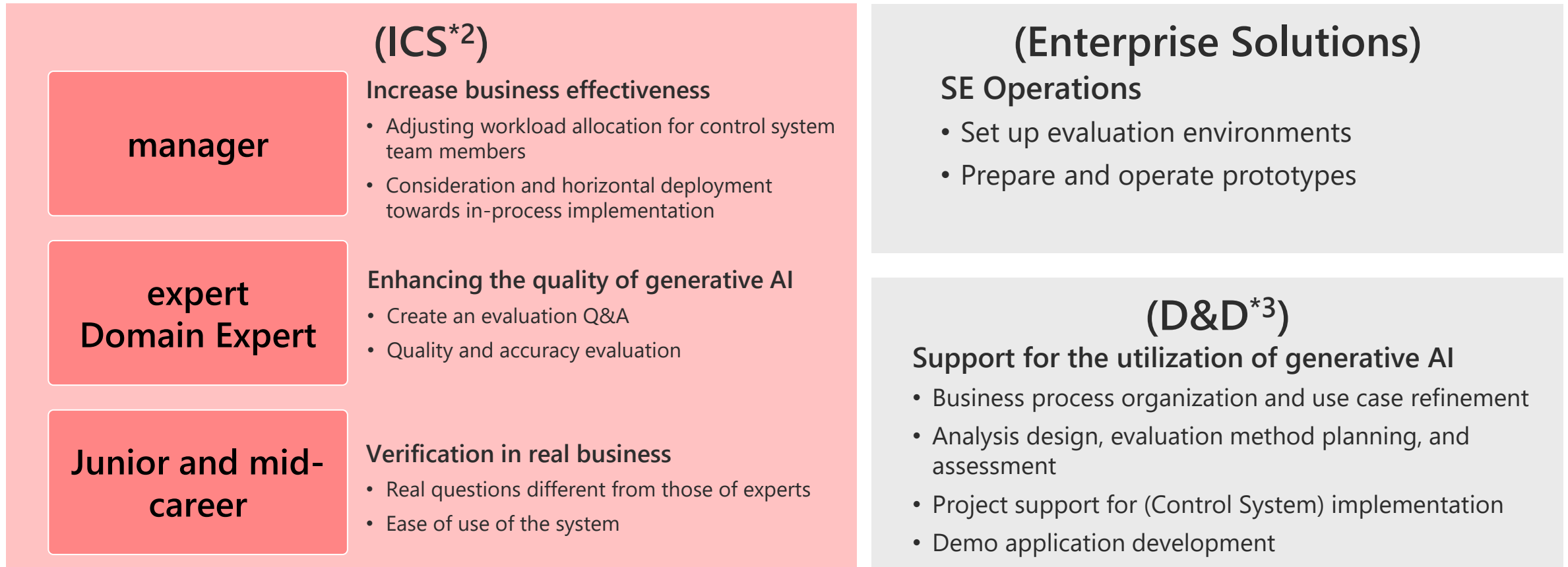


Secondary Effect: Enables deeper exploration of similar cases

Experts were also able to use the recommendation feature to find spot-on countermeasures.

Project structure

(ICS QA^{*1}) personnel work with data scientists to actively promote usecase review and evaluation



In-depth Exploration of the Project

Q&A

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