

Support for Creating After-Sales Service Reports (Work Reports and Proposals) Using Generative AI

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To more efficiently create after-sales service reports (work reports and proposals) of higher quality by field service engineers, a report creation support system utilizing generative AI was developed. In the past, there were key challenges, such as the heavy workload required to create reports on-site and variation in the quality of the reports, as well as a significant operational burden associated with pre-work preparation and post-work processing. With the introduction of this system, work reports could be generated in real time and proposals could be prepared at an accelerated rate, while high operational feasibility could be secured by integrating existing operational systems and implementing measures against communication environment issues. As a result, improvement in operational efficiency and enhanced responsiveness to customers could be achieved, contributing to higher customer satisfaction.

1. Introduction

Field service engineers (hereinafter referred to as FSEs) at each base of the Customer Relation Center (hereinafter referred to as CRC) for paper converting machinery visit customer plants and submit a "work report" after completing their work, as well as a "proposal" to suggest future maintenance as necessary. (the work reports and proposals are hereinafter collectively referred to as "service reports.")

Because work reports must be presented in real time after work completion, creating them has been a heavy workload, especially for less experienced FSEs, and variation in the quality of the described content due to differences in skill has been a challenge. Furthermore, in cases where report creation took a long time, the customer was kept waiting.

On the other hand, proposals that suggest additional inspection and maintenance based on work results were sometimes submitted at a later date, and this delayed submission could lead to missed business opportunities.

To address these challenges, the System Integration Department of the Digital Innovation Headquarters at Mitsubishi Heavy Industries, Ltd. and the Printing & Packaging Machinery Headquarters of Mitsubishi Heavy Industries Machinery Systems, Ltd. (hereinafter referred to as MHI) jointly developed a service report creation support system. To achieve this, generative AI was combined with multiple general-purpose SaaS (Software as a Service) platforms, aiming to both improve customer satisfaction and reduce the workload of service report creation tasks. This report describes the development process, implementation effects, and future prospects of this system.

2. Conventional work flow and challenges

After completing work at a customer plant, FSEs must create and submit an on-site "work report," and separately create and present a "proposal" as needed. Because work reports must be submitted on-site in real time, preparing written text in a short period of time is essential but a heavy operational burden, especially for less experienced FSEs.

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In addition, because the contents described in the reports depend on individual FSE skills, variation in the granularity of content and expressions tended to occur, making standardization of quality a challenge. Furthermore, maintenance proposals based on the inspection results, which also required time-consuming proposal creation, were sometimes handled at a later date. The inability to make proposals at the appropriate time led to the risk of missed business opportunities.

Moreover, as shown in **Figure 1**, before leaving for a site, FSEs perform pre-work preparation by downloading a report format containing information, including the customer, machine model, and project name from an operational system that manages customer information. After work completion, creating and printing the report, presenting it to the customer, and then receiving a signature on paper are required. Furthermore, after returning to the office, tasks to convert the report into a PDF file and text data, and updating this information into the operational system are carried out.

In this way, in addition to on-site work, extensive pre- and post-processing administrative tasks were involved, and the heavy burden on the entire operation was a challenge. These challenges caused not only a decline in operational efficiency but also affected the quality of customer response, necessitating improvements.



Figure 1 Integration with operational systems

3. Work report and proposal generation system

As shown in **Figure 2**, this system implements automatic generation functions for "work reports" and "proposals" by utilizing generative AI and RAG (Retrieval-Augmented Generation).

In creating work reports, FSEs input key points of the work performed on-site, findings from inspections, measured values, and other relevant details. Along with this input information, the system searches past cases and related information (hereinafter referred to as "the knowledge base") using metadata linked to each project. Project names, target machine models, and other data are used as metadata.

The knowledge base stores past work reports and documents describing standard work processes, to which multiple pieces of operational metadata, such as project names and machine models, are also assigned. In other words, during a search, semantic similarities based on work content and filtering based on operational context using metadata filters are achieved simultaneously.

Through this mechanism, existing document information of verified quality is integrated with the work details input by the FSE while on-site, and a draft report in a standard format is generated based on a predefined prompt. With this system, reports can be created with standardized quality in a short period of time.

On the other hand, when creating proposals, a search of past maintenance cases and recommended actions is carried out based on input information regarding inspected areas. By integrating the extracted document information with the FSE's input details, a draft proposal in a standard format is generated, only using the work report, thereby supporting prompt proposal activities on-site.

Furthermore, when utilizing generative AI, ensuring accuracy of the output is important. This system limits data stored in the RAG knowledge base to high-quality and highly reliable

information, and introduces a mechanism to numerically evaluate any discrepancy between AI output and model responses, in addition to subjective evaluation of the generated results by the FSE.

In addition, a monitoring platform was constructed to ensure traceability of all generation processes, and a mechanism to record input parameters, reference information, LLM (Large Language Model) responses, and generated metadata was established. Consequently, updates to accumulated data and revisions to prompts can be carried out objectively, thus achieving continuous improvement in accuracy.

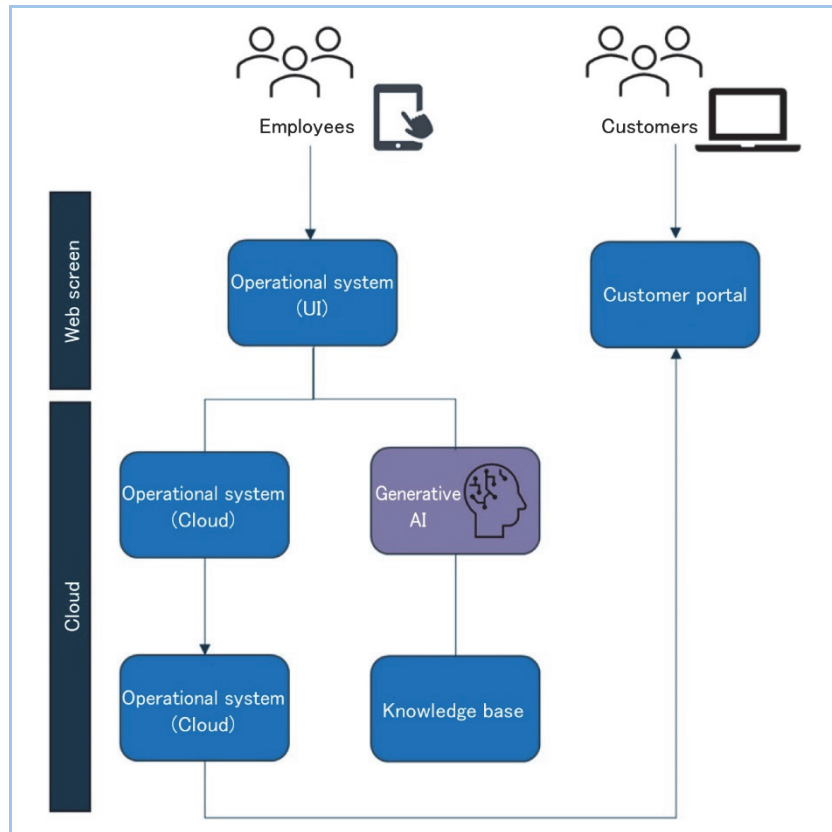


Figure 2 Architecture overview

4. Integration with operational systems

This system does not function independently but is designed on the premise of integration with existing operational systems.

When a project order is received, information such as the target machine models and device names is registered in the operational system as metadata, which is used for aggregation and analysis, prior to on-site work by the FSE. In this system, by linking and utilizing this information with past work performance data, highly relevant search results can be obtained. This mechanism improves search accuracy of RAG, contributing to enhanced content quality of generated reports and proposals.

In addition, by integrating the operational systems, redundant data entry is reduced, streamlining the entire work flow. Proposals created on-site by the FSE are provided to the customer via email as PDF files, and for projects where an estimate is requested, the information is linked to the maintenance proposal system on the MHI portal site. In this system, proposal details and estimated amounts are displayed alongside photographs of the targeted sections of the machinery, and are stored so that the customer can view them at any time, even after the work has been completed. As a result, customer communication that integrates sales activities and after-sales service is achieved.

5. Challenges in communication environment and countermeasures

Regarding on-site operation of this system, securing the communication method was a key challenge. Particularly in customer plants, conventional portable Wi-Fi routers sometimes did not maintain sufficient communication speed and stability due to constraints of the radio wave environment.

To address this challenge, portable Wi-Fi routers compatible with multiple mobile carriers are utilized in order to select the optimal communication line according to the radio wave environment on-site. Furthermore, in environments where communication quality could not be maintained using common public mobile phone networks, network connection methods that utilized satellite communication were introduced to maintain a stable communication environment.

With these countermeasures, stable utilization of this system even in diverse on-site environments is possible.

6. Implementation effects

By introducing this system, the time required to create service reports has been significantly reduced, resulting in a reduction in the operational burden on-site. In addition, by using generative AI to complete written text, standardization of the described content has progressed, achieving uniform report quality.

Furthermore, as proposals can be created in real-time, they can be promptly presented to the customer, contributing to improved quality in customer response. Responding to potential demands that were previously overlooked has become possible, leading to the creation of sales opportunities.

7. Future prospects

This system has begun operation at the largest CRC in Japan, and deployment to bases nationwide is planned in the future. In addition, looking ahead to application to overseas service bases, a review of necessary requirements and studies on functional expansion have progressed.

Furthermore, by continuously expanding accumulated data and improving the accuracy of the AI model, the system aims to realize more advanced proposal support functions, such as utilizing work images.

8. Conclusion

This report described the construction of a service report creation support system utilizing generative AI and RAG, and discussed the improvements to efficiently create service reports of higher quality within the work of field service engineers. In particular, the ability to generate documents on-site in real-time contributes to a reduction in operational burden and mitigates variation in description quality, which were conventional challenges. Furthermore, construction of a mechanism capable of withstanding actual operations through the overall design, including integration with operational systems and optimization of communication methods, was important.

In addition, promptly submitting reports and presenting proposals in real time have improved the speed of response and the clarity of explanations to customers, contributing to higher customer satisfaction. Moreover, as proposals can be made at the appropriate time, the ability to respond to potential needs has also been enhanced, leading to the provision of higher-value services.

In the future, through the expansion of target operations and improvement in AI accuracy, the balance between operational efficiency improvement and customer satisfaction will continue to advance, aiming for continuous enhancement of service value.