Technologies for Raising Efficiency in Support Services

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This paper describes Fujitsu Laboratories' research and development activities for raising efficiency in support services such as those provided by hardware support operation and call centers. Efficiency can be raised by assigning the appropriate human resources to support services and enhancing call center agent skills. This paper describes technologies that raise productivity by analyzing the large volume of data concerning customer inquiries and agent responses stored by support services. One of these is a technology for assisting in the creation of problem-solving knowledge that automatically detects and collects frequently occurring problems and ways of solving them. Another is an agent assignment assistance technology that simulates call center activity and accurately estimates key performance indexes.

1. Introduction

In support services such as those provided by hardware support operation and call centers, because problem solving is done by people (e.g., service engineers and agents), shortening problem-solving times will directly increase productivity in these functions. For this reason, frequently occurring problems and ways of solving them are collected as knowledge and are used for personnel training and as references when handling customer inquiries. While some types of knowledge, for example, knowledge in product specifications and catalogs, can be prepared beforehand, most knowledge exists in information that is not immediately available. This second type of knowledge comes from customer inquiries received by support services and the responses to them. To create such knowledge, it is necessary to select examples of frequently appearing questions and their responses from customer inquiry records.

When looking at support services from an overall perspective, the number of staff and their assignment locations will also influence how support services are conducted. In the case of a call center, agent assignment numbers are determined in consideration of work shifts because the number of incoming calls to the center varies with the time of day. The number of agents assigned is determined so as to achieve a balance between key performance indexes (KPIs), which are indicators of the ease with which telephone calls are responded to, and the personnel and other costs. However, because of the differences in individual capabilities, it is not easy for an operation manager to know beforehand the KPI scores that will be achieved with the personnel assignment plan under consideration.

The above issues can be addressed by analyzing the large amounts of data that have been accumulated by applying IT to the operation of support services. This data is kept in the form of electronic records of customer inquiries and responses made by service engineers and agents

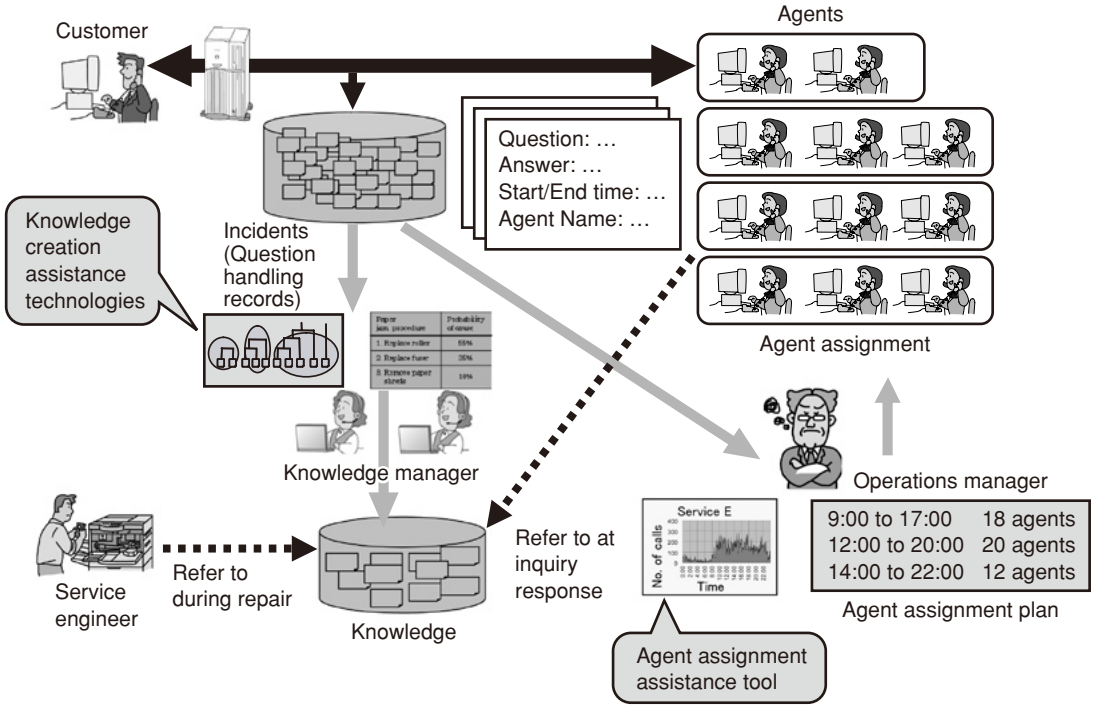

Figure 1
Technologies for assisting support services.

and includes details of faults, remedial actions, and the start and finish times for work.

This paper describes several knowledge creation assistance technologies that analyze call center operation data and feed back the results to achieve improvements. It also describes agent assignment assistance technologies that compute agent skill levels and KPIs to facilitate personnel assignment (**Figure 1**).

2. Knowledge creation assistance technologies

Knowledge creation consists of the screening of records of dealing with customer inquiries and the description of the measures that should be taken. There are analysis technologies to assist with these tasks, and in this section, we describe a hardware maintenance support system that uses these technologies to generate timely maintenance support information from previous cases of hardware maintenance (**Figure 2**).[1)]

Hardware maintenance for corporate customers involves a service engineer visiting the customer's office to perform maintenance work such as parts replacement. To raise the efficiency of hardware maintenance, the maintenance time and the number of replaced parts must be minimized. For this purpose, it is essential to provide service engineers with maintenance support information that enables them to achieve recovery as quickly as possible.

A maintenance work support system incorporates fault type analysis, which is equal to screening of candidate cases that can be used as knowledge, and fault cause analysis and preparation of maintenance procedures, which is equal to creation of knowledge.

2.1 Fault type analysis

Fault type analysis involves producing a summary of similar faults by using a knowledge screening assistance technology (**Figure 3**) that selects similar fault descriptions in several hundred thousand maintenance sheets. In view

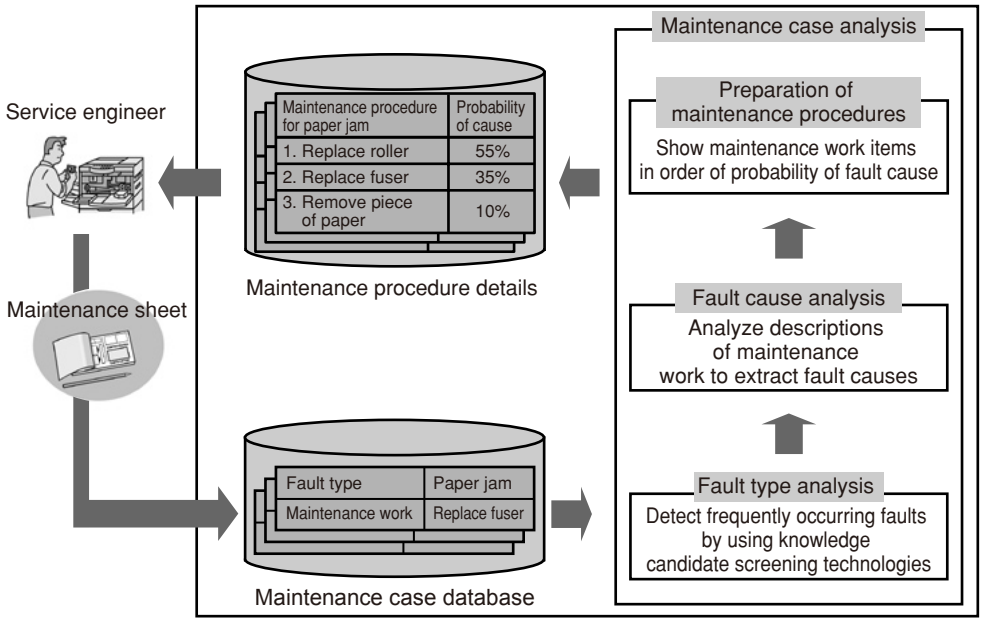

Figure 2
Maintenance work support system.

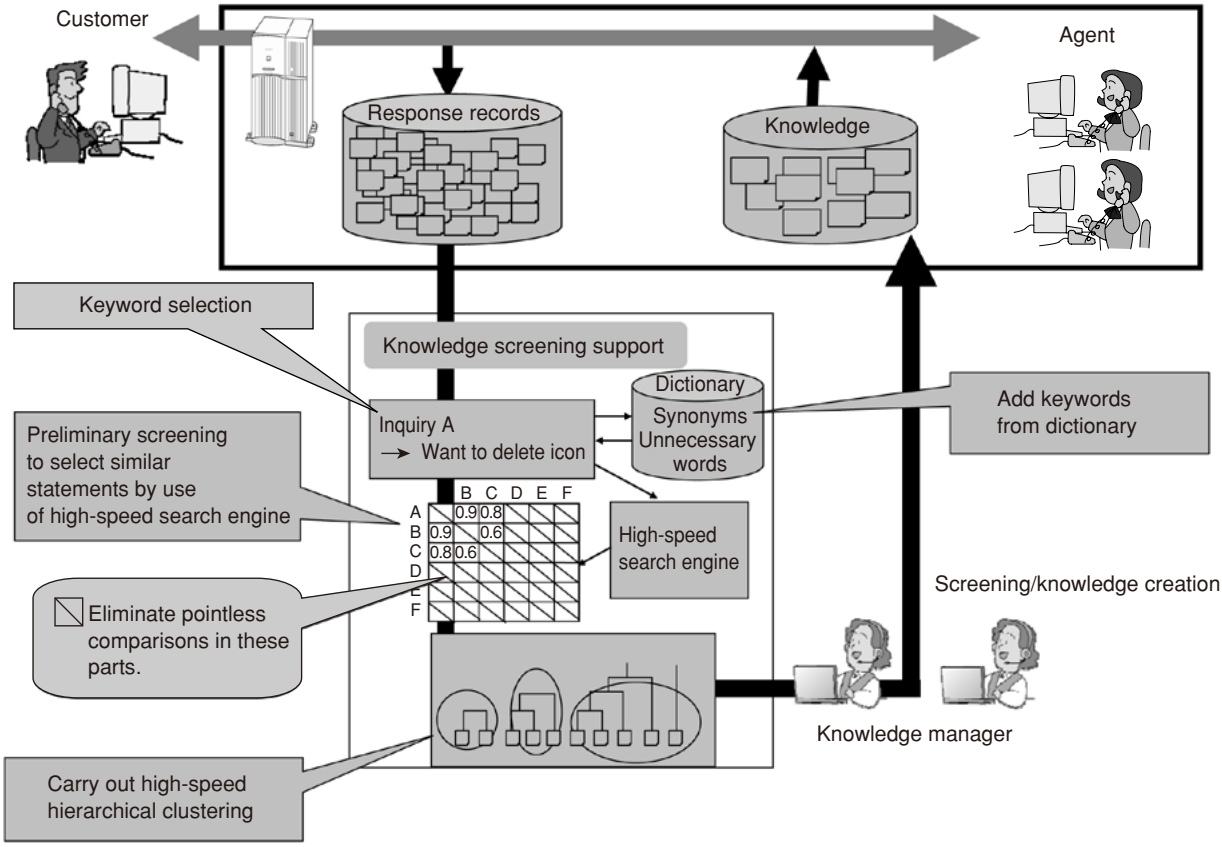

Figure 3
Knowledge screening assistance technology.

of the huge number of maintenance sheets to be processed and the need to detect cases with occurrence rates of much less than 1% in order to raise the knowledge coverage rate, this task cannot be done manually.

Hierarchical clustering, in which similar cases are gathered together in clusters, is suitable for detecting frequently occurring faults, but is difficult to apply to the huge numbers of documents assumed in the case of support services. Therefore, the use of preliminary screening methods that employ high-speed search engines to reduce the number of similar document pairs in knowledge screening assistance technologies enables hierarchical clustering to be applied with normal computer resources, even when there are several hundred thousand data items (Figure 3).[2] This enables the knowledge manager to detect frequently occurring faults, including faults that were not assumed at the equipment design stage and therefore not described in maintenance manuals.

2.2 Fault cause analysis and preparation of maintenance procedures

Fault cause analysis consists of analyzing the maintenance work done by service engineers to collate frequent causes of faults. Specifically, it involves extracting fault cause information by analyzing the descriptions of maintenance work in maintenance sheets.

As shown in **Figure 4**, fault causes consist of a cause type and a cause part. Because maintenance sheets are written by many different service engineers, maintenance work is described using a wide range of expressions; however, fault causes can be quickly and accurately extracted by using analysis methods that target sentence structures.[3]

Fault causes extracted from cases of maintenance in fault knowledge are aggregated and probability distributions are prepared for them. Then, the fault causes are arranged in descending order of probability and the optimum maintenance procedure is assigned to each cause type.

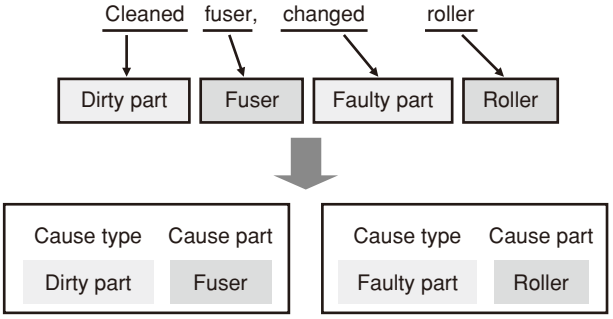

Figure 4
Extracting failure causes from maintenance work descriptions.

2.3 Effects of above technologies in raising the efficiency of maintenance work

We developed a maintenance work support system (Figure 2) that applies the above technologies and verified its usefulness in maintenance work for several Fujitsu systems. Previously, there were no maintenance manuals for roughly 50% of all faults; however, with this system, we were able to provide new maintenance procedures for about 40% of these faults. We also reduced the average maintenance work time by about 4% and in some cases achieved a reduction of as much as 50%.

3. Agent assignment assistance tool

The assignment of call center agents is based on the rate of call answering by agents and the waiting time, which are calculated from the usual number of calls received and the number of agents using the Erlang B and C formulae. (Because both formulae can overestimate the number of agents by at least 30%, call center managers and engineers may have started using the A formula, which is an improved version.) However, since these formulae assume the simplest of call center models, in which the agents all have the same skill level and provide a

single service, they are not sufficiently accurate when the agents have widely differing skill levels and multiple services are provided. This is especially true when the helpdesk accepts requests for catalogs and answers software questions that require widely differing amounts of time to handle. If we compare the simulation results when 1) half the agents have 50% of the average ability and the other half have 150% of the average ability and 2) all the agents have the same ability, the helpdesk in case 1) will need 10 to 20% more agents than the helpdesk in case 2). Also, if we assign agents to handle multiple services, we can reduce their number by 5 to 10% compared to when agents are assigned to deal with only one service.

Therefore, to accurately estimate KPIs for the assignment of agents and link this with accurate cost control, we need agent assignment assistance tools that enable realistic simulations in which there are differences in agent ability and individual agents handle multiple services. Furthermore, these tools must accurately estimate KPIs for agent skills because KPIs are fundamentally important data items.

To meet these needs, we developed the following technologies:[4)]

3.1 Agent assignment assistance technology

This technology consists of 1) a pseudo-call generator that generates calls for services individually and 2) an agent simulator incorporating complex agent attributes (e.g., work shifts, back-line escalation, and skill for each service). It is used to accurately estimate KPIs for the abandoned call rate, operation rate, and waiting time (**Figure 5**). The special feature of this

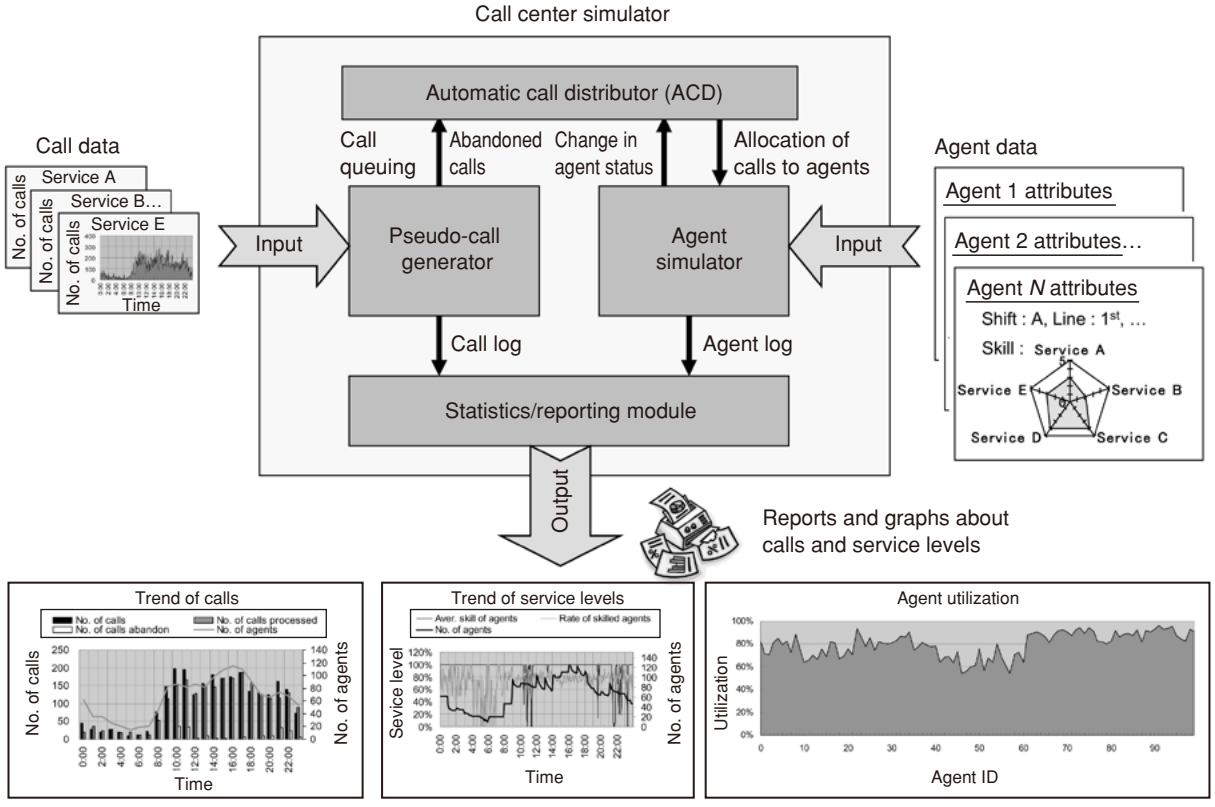

Figure 5
Agents arrangement support system.

technology is that it enables faithful and realistic agent simulations for call centers to be made very rapidly. By using this technology, a 1-day simulation of a call center having 1000 agents can be performed on an ordinary notebook PC in about 10 minutes.

3.2 Automatic agent skill estimation technology

This technology automatically estimates agent productivity and skills for each service from accumulated call and response records. Because call center agents prepare response records for existing customers and new customers at the same time, the productivity figures obtained by simply aggregating the call time and time taken to create the response records will be inaccurate. Therefore, to make the most realistic distributions, agent productivity is estimated by reorganizing the call time and response time distributions of each service for individual agents. Then, the new distributions are used to obtain realistic average call and response times.

In addition to generating data for simulations, this technology can also be used to grasp the agent skills and prepare training plans.

4. Conclusion

In this paper, we described technologies for raising the productivity of support services based on customer inquiry data in text form accumulated from the operation of support services and the inquiry response times. With the increasing use of call recording devices, an adequate amount of audio data from client-agent conversations has also been accumulated. In combination with the analysis technologies we have mentioned, the future application of voice recognition technology and other voice processing technologies should greatly contribute to raising the productivity of support services in the future.

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