

## Knowledge Bank System for Marine Engineering Operation

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**ABSTRACT** Seafarers' knowledge and skills were once passed along from people to people on board ships. But years went by and when the depression hit the shipping industries following the oil crisis, highly waged Japanese mariners began to lose the opportunities on board and they have been gradually replaced with lower waged foreigners. Because those foreign seafarers were hired on short term periodical bases, it has become difficult to pass along and maintain among seafarers the skills and techniques of tasks on board. More time has passed and what we call "The Year 2007 Problem" has already been taking its toll. A mass of experienced mariners are now retiring while younger generations can find more opportunities in other industries amid the economic boom. Obtaining seafarers has now become a big problem of this country. Meanwhile, more and more mariners are recently working as shore staff and required to use their experience and knowledge acquired on board ships in the shipping companies' offices. Consequently, their time spent on board ships during their whole employment period are progressively decreasing. Against this background, it is becoming more and more difficult to hand down the skills and experiences of seafarers to the next generations. Especially, it is very difficult to hand down what we call intuition or tacit knowledge, which is acquired only through various experiences on board ship. In order to pass along and maintain those skills and knowledge as much as possible to the younger generations, we collected, sorted out and compiled database on which the experienced seafarers can add and accumulate their own tacit knowledge while working on shore. Thereby younger mariners can have opportunities to learn those skills with their predecessors' actual experiences, the further engineering backgrounds and other applications. We chose engine part as its subject and studied for easy interface formats for the experienced but not computer savvy people and also studied for easy formats for easy access in order to get lots of access from many people.

**Keywords:** Education of marine engineer, Knowledge management system,

### 1. Introduction

What is called Year 2007 Problem induced with the perverted employment system has already started, the extensive retirement of skilled vessel crew also starts, and the secure reservation of seafarers is the important issue of our country.

Moreover, the seafarer has to work also in the shore where their technology cultivated onboard is important in a shipping company, and the total period of boarding service between the entrance into a company and retirement becomes shorter.

Based on such a background, it is very difficult to pass down the technology of people who work on vessel and the various experiences and knowledge especially called as the sixth intuition or tacit knowledge is disappearing. It is important and desirable to easily accumulate the knowledge including the tacit knowledge on board. If the management of knowledge and effective use are attained using the knowledge database that makes the opportunity for a young crew to peruse and learn, the seafarer's technical capabilities will be hold at the high-level and result as the safe operation of a vessel.

It is very important that the technology transfer on board should be assisted with the information technology(IT) and

the database accumulation nowadays.

### 2. Purpose of Research

In this research, the examination and creation of the database that accumulates easily on board and makes the opportunity for a young crew to peruse and learn were performed.

The knowledge for engineer was set as the target and the knowledge of trouble correspondence and routine work was examined in this research.

Furthermore, in order to obtain the opportunity of many accesses from many people, the search screen, which is easy to input the knowledge and obtain the desired information, was studied.

### 3. Knowledge Management System

As one of the commercial software, Knowledge Bank by Toyo Engineering Corp. is used in this research. The point that it seems that this system is fit for this research as compared with the other company is as follows [1].

As the first point, the system orients to put the importance on the knowledge analysis and can select and determine the appropriate technology and information to be accumulated. In this research, this knowledge analysis is

also one of the important themes.

As the second point, the system can prepare the keyword for search in advance and one screen can be displayed on a search screen. Although there may be information that can be retrieved in neither ambiguous search nor free sentence search, the keyword, which may be searched with this system, is selected in advance, and since the inputted information is appropriately associated with the keyword that those who search may choose, it is possible for a search person to pull out the information easily. In this research, the selection method of the keyword is also examined.

As the third point, it is possible to customize a screen in accordance with the information accumulated. This research also examined this point.

#### 4. Outline of Engineer's Job

Shown in Fig. 1 are the work contents of an engineer. In order to examine and find the engineer's knowledge, all the job of engineer was listed on the figure.

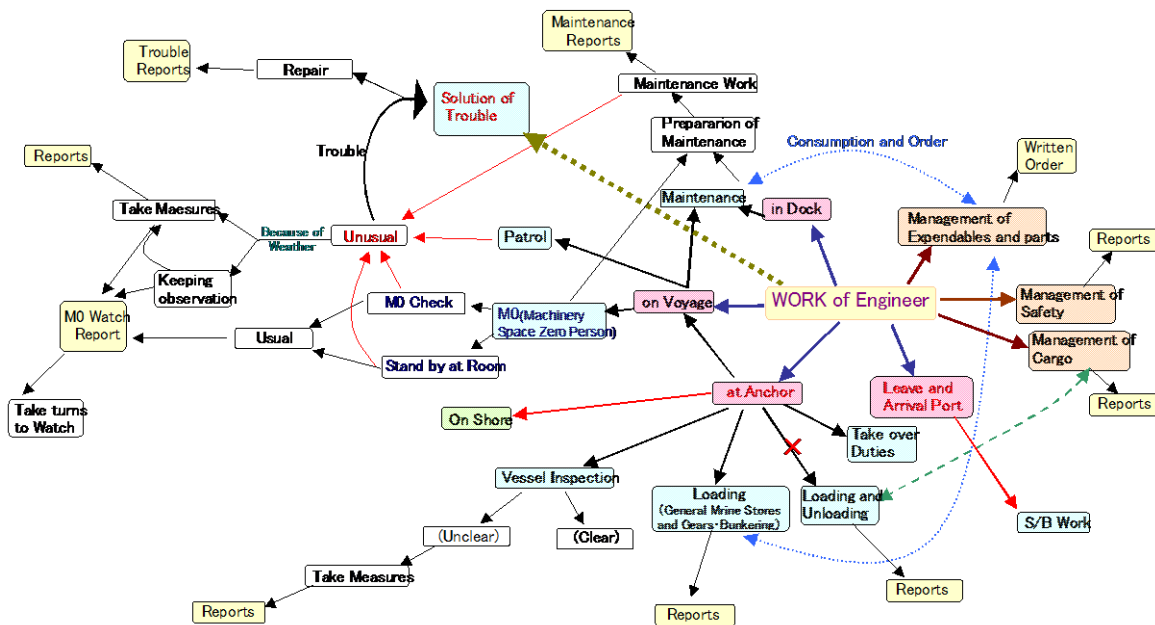


Figure 1. Work contents of an engineer

#### 5. Knowledge corresponding to Trouble

In order to maintain the sound operation of equipment and facility, it is necessary to act quickly by judging a situation at the time of trouble generating. Experience is required in order to determine the situation. The accumulation of the knowledge of trouble correspondence was studied to compensate the experience.

##### 5.1 Collection of Trouble Examples

Although the information corresponding to a trouble is managed for every ship company, these management system is based on paper and the information is strictly limited within the company. The collection of trouble examples is done publicly at Nippon Kaiji Kyokai or Japanese vessel engineer association every year. In the information, locations and cause of failure, the maintenance method, etc., is listed up. But the relevance about each information is not incomprehensible, and the information about the cause pursuit and the omen is not shown.

The chief engineer Mr. Ikeda of the training ship "Shiojimarū" of our university helped us to list up the work content based on his experience on the training ship and commercial ships as shown in Fig. 1.

Although the work content which should be first performed according to the state of a vessel was classified as Fig. 1, the routine maintenance, the trouble correspondence, report generation are necessary in general, and there is excess work according to the situation.

When it returns to the origin, the mission of the major premise of an engineers' work is summarizes by the following two points, "the organization which can respond immediately at the time of trouble" and "maintenance to prevent the trouble". In order to hold these two points, the work as shown in Fig. 1 is done.

In this research, the routine work of "in-and-out harbor and anchoring" and unusual work of "trouble correspondence" were studied intensively.

In the present research, the important and necessary information to be accumulated, the appropriate input screen to be easily inputted and the keyword required for quick search was studied.

##### 5.2 Analysis of Flow from Trouble Detection to Management

In Fig. 2, an example is given from the trouble collection of a Japanese vessel engineer association, and the knowledge that lurks there is shown. The corresponding action to the failure of dynamo starting is studied. The unusual noise was detected at the site after the alarm indicating the dynamo starting failure. When the dynamo motor cover was opened and the inside was checked, the breakage of a connecting rod and the damage of a piston were recognized. Inboard, since it was not able to respond, it repaired by requesting a repair shop. The cause of this fault was due to the insufficient warming up and the enough warming up was recommended in this report.

Although this report looks like apparently very useful information, only the crew who had the above experience can imagine all the situations. The crew who did this work is making various judgments at the place that has not been written in this report.

The various knowledge is included in his corresponding judgment. The first one is how to determine the opening of the motor. The second one is how to determine the cause due to the insufficient warming up. The second one is how to determine the request to the repair shop instead of repairing on board. The third one is how to determine the future preventive measures recommending the enough warming up. These judgments were done with the knowledge supported by experience and engineering knowledge.

It is desirable that the information of the knowledge and

the performed action can be accumulated automatically on the database.

The knowledge which judged it must be in a base when acting. Action and knowledge were called "correspondence" in this research, and "correspondence" is considered to be one set and it enabled to be inputted together. In order to accumulate the useful information which can be used in a knowledge management database, the recognition of this "correspondence" as knowledge, and it is necessary to prepare the form which is easy to input in the input screen.

In the present, the important and necessary information to be accumulated, the appropriate input screen to be easily inputted and the keyword required for quick search was studied.

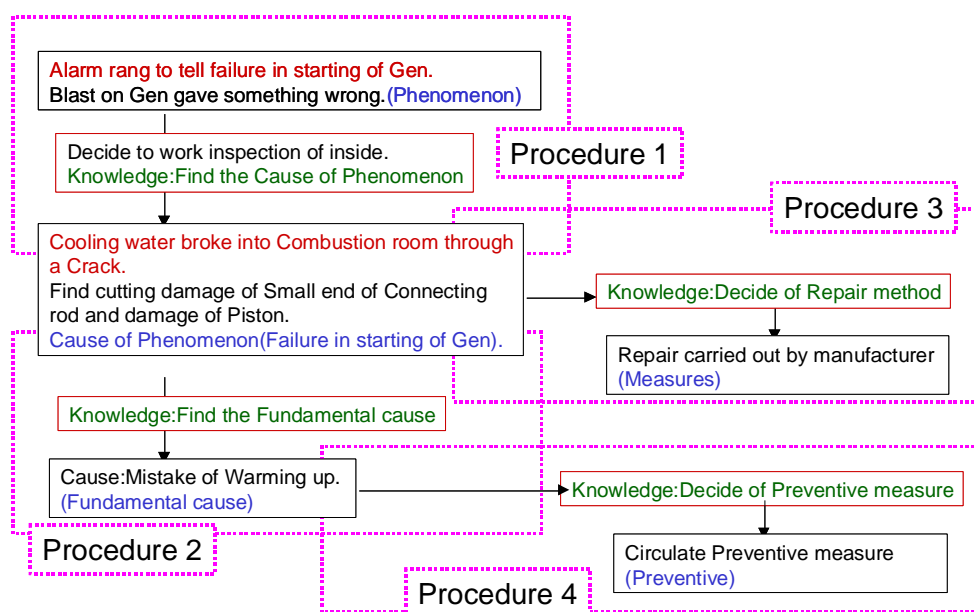


Figure 2. Corresponding action to the failure of dynamo starting

### 5.3 Examination of Input Screen

Information to be inputted is all the items shown in Fig. 2, and there is very much information. It is better to be able to look through the item that must be inputted if possible in one screen, in order to have the whole of this information filled in.

In addition, it is more convenient to be able to peruse the information on one screen, since the input screen also becomes the reading screen of the information.

For this reason, the general information about a trouble was always displayed on the upper half of the screen, the "correspondence" of action and knowledge was classified into the lower half according to the tab for every time series of judgment, and the tab which stores each "correspondence" in the same form. This screen is shown in Fig. 3.

### 5.4 Selection of Search Keyword

After being able to accumulate the information including useful knowledge, it is important that the information can be utilized usefully. In order to arrive at the needed information certainly, it is necessary to select the

method of better search.

On the knowledge bank, by also using ambiguous sentence search together and choosing two or more keywords which is indicated in the 1 screen, it narrows down and the selection can be done. It is possible to set more keywords which may be chosen beforehand to the inputted information. These techniques are different from that in the web page and the information can be obtained certainly in this system in which the information limited to some extent is retrieved [1].

The keyword was picked up from the collection of Japanese vessel engineer association trouble examples, and sorted out the situation of each part name of apparatus and abnormalities, the phenomenon at the time of discovery, etc. A keyword screen is shown in Fig. 4.

### 5.5 Verification of System

Based on the above examination, the information was inputted into the system, the required information was retrieved, and it was verified whether required information could be acquired. As a result of verifying, it was possible to acquire the desired information certainly.

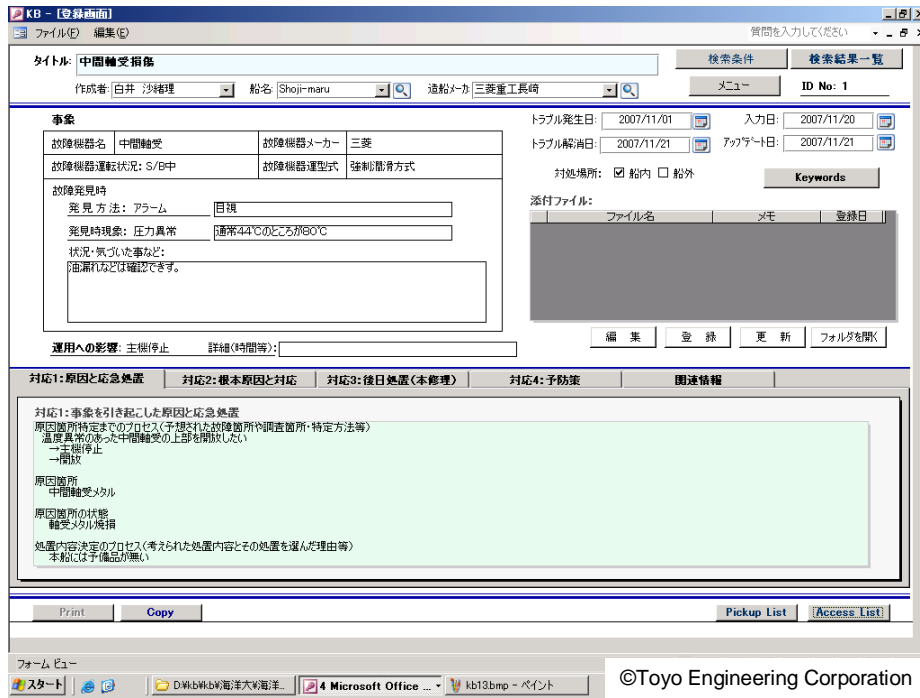


Figure 3. Input and reading screen

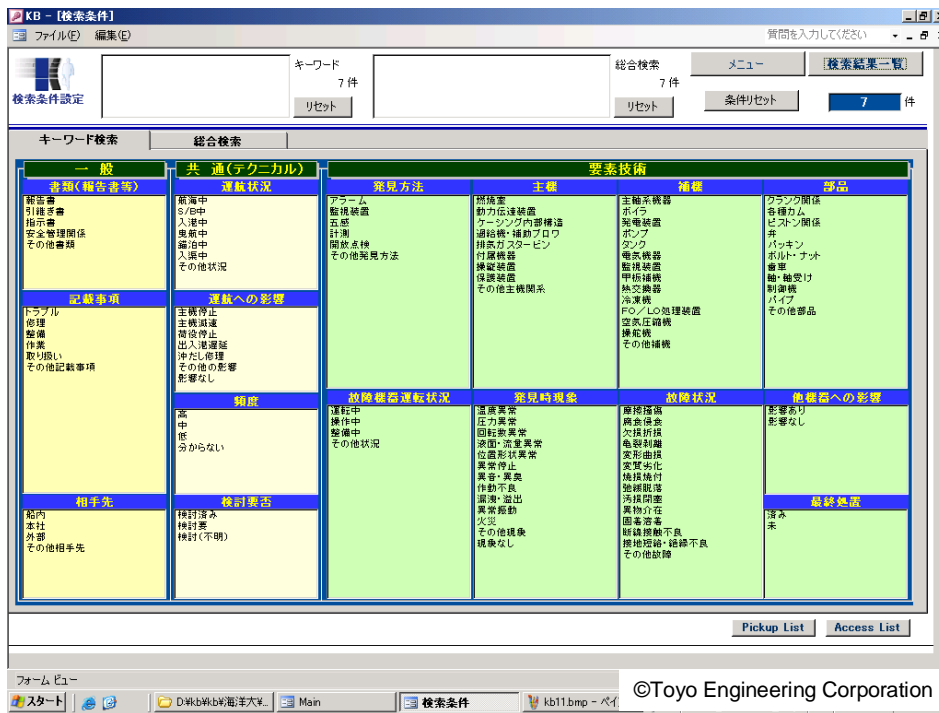


Figure 4. A keyword screen

## 6 Knowledge of Routine Work

Following on accumulation of the knowledge corresponding to a trouble, the knowledge of routine work was studied. Usually, it is very difficult to pick up the important knowledge of routine work because the unconscious knowledge is included in the routine work. Then, the wearable camera was equipped to the engineer, and the unconscious knowledge to be accumulated is pick up with checking the movie together with the engineer. With this picking up work, the education manual for the engineer was created based on the multimedia manual of Toyo

Engineering Corp.. The work of this picking up was done with the cooperation of the chief engineer and first engineer of training ship ‘Shiojimarū’ of our university.

In this research, the work accompanying the in-and-out harbor and the voyage work, which are frequently done as the routine work in “Shiojimarū”, was studied as an example in the engineers’ work shown in Fig. 1.

### 6.1 Making Movie of Work

The movie was taken on the work in the experimental voyage for two nights and three days of training ship

“Shiojimarū”.

The wearable camera was equipped on the engineer and the view from him was recorded, and also the digital video was taken in order to check a motion of engineer. Shown in Fig. 5 shows the situation of making the movie.



Figure 5. Situation of making the movie

### 6.2 Creation of Multimedia Manual

Looking at the movie of the work, the rough flow of work has been recognized. Shown in Fig. 6 is the menu panel of multimedia manual in which the work that inquired this time was shown. Then, the hearing was conducted by checking the movie with the engineer in each work. In the hearing, in order to find out the unconscious work, many

questions were prepared. For example, the necessary reason of the work, the possible accident without the work, the reason of the inspection and the appropriate indicator were asked about every work.

### 6.3 Composition of Multimedia Manual

A multimedia manual classifies the flow of work roughly and includes what is called the manual of the operation using a movie or a figure. The knowledge information is incorporated into this manual and it makes possible to study the wide information, which is not a manual of mere operation and should be known in accordance with work. The preparation screen of work was shown in Fig. 7.

Here, the information on the purpose of work, notes, required protective equipment, etc. is shown. Each work is classified into the page of work according to the time series, and the outline of work and the link to the work flow are shown.

Shown in Fig. 8 is the work flow screen. The each work can be studied with clicking the flow figure of an upper right portion, and the movie of work and the related figures can be seen. In addition, the information that should be known is indicated at the lower memorandum column. In addition, on the left-hand side of a screen, it is possible to check the flow of the whole work and the necessary technical terms.



Figure 6. Menu panel of the multimedia manual



Figure 7. Preparation screen of work



(a) Upper screen



(b) Lower screen

Figure 8 Work flow screen

#### 6.4 Relation between Multimedia Manual and Knowledge Bank

The multimedia manual can show the necessary minimum information including the PDF drawing and the paper about the related engineering knowledge and can be linked with the knowledge bank where the various experiences especially called as the sixth intuition or tacit knowledge can be accumulated. By using the multimedia manual cooperated with the knowledge bank, the technology of people who work on board will be handed down to the young people smoothly.

#### 7 Conclusion

Seafarers' knowledge and skills have been passed down from people to people on board ships. But recently, it is becoming more and more difficult to hand down the skills and experiences of seafarers to the next generations. Especially, it is very difficult to hand down what we call

intuition or tacit knowledge, which is acquired only through various experiences on board ship. In order to pass down and maintain those skills and knowledge as much as possible to the younger generations, we collected, sorted out and compiled database on which the experienced seafarers can add and accumulate their own tacit knowledge while working on board. By using the multimedia manual cooperated with the knowledge bank, the technology of people who work on board will be handed down to the young people smoothly.

#### References

[1] Masashige Takahashi, "Practice of the technical transfer learned from the example of failure of [measure against Year 2007 Problem] ", Piping Technology, 49, 7, (2007)