Decision Making support Panel (DMP) - Decision Making Support of Emergency Response by Integrating HFE with ICT

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In the case of conducting direction and control in an emergency, all people concerned therewith are required to promptly make decisions and execute actions. In an emergency, the massive amount of information is complicated, so the burden in information processing and decision making is very large. This is an issue common to the fields of emergency response. The Decision Making support Panel (DMP), which is the integration of the Human Factors Engineering (HFE)* technology owned by Mitsubishi Heavy Industries, Ltd. (MHI) and ICT, evolves the massive amount of complicated information during an emergency to practical information that supports human decision making, converts the information to a from that is suitable for the perceptions and actions of the directors and responders and provides it.

*HFE: Takes an engineering view of human beings' perception, working time, tendency of consideration and action, burden, etc., to design, manufacture and verify computers, machinery and work environments to conform to the psychological and physical characteristics and abilities of human beings.

1. Introduction

1.1 Importance of intangible elements in emergency response

In addition to the "item" perspective such as efficiency enhancement through the introduction of ICT package products, contemporary emergency response is conducted from the "event" perspective such as the operation of emergency response in an organization. In society as a whole, efforts to improve responsive capabilities and resilience in an emergency including these "items" and "events" have become active.

In cases where computer systems and tools are used for emergency response, it is important to reflect non-visualized activities related to human beings, i.e., events, into product design for improving the affinity of human beings and systems and reducing the burden. With such a background, we developed products based on our expertise on HFE cultivated in the nuclear field.

1.2 Necessity for reducing human beings' work burden and error

Regardless of the industry, emergency response includes a wide range of organizations such as task forces, headquarters, local bases, etc. In the field, the situation is ambiguous and responses are carried out under time constraints. Currently, emergency response collects information from records such as handwritten notes and computer terminals, and visualizes the situation by making full use of a white board, oral communication, etc. Based on this, a series of command and control processes of situation assessment, planning, decision making and the execution of the decision are carried out. In the state of confusion in an emergency, such manual manipulation of information collection and processing takes time and effort, and there is a high possibility of the occurrence of human error (missing description, erroneous description, time gap between information sharing, etc.). In addition, since information is output in various media, it is expected that information will become diffused and the confirmation of the latest information will become difficult. For directors and responders to make appropriate decisions in an emergency, it is necessary to reduce this work burden and the possibility of errors.

To comprehensively support the activities of directors and responders to solve these problems, we incorporated the human perspective, i.e., a method in the HFE into product

development, performed task analysis, and applied the solutions into ICT design processes. By this, information diffused in the emergency response space can be provided at a new level and a reduction of work burden and error was realized. **Figure 1** shows before-and-after images of emergency response with the application of DMP. In terms of the emergency response environment, emergency response using analog means shifted to emergency response making full use of ICT.

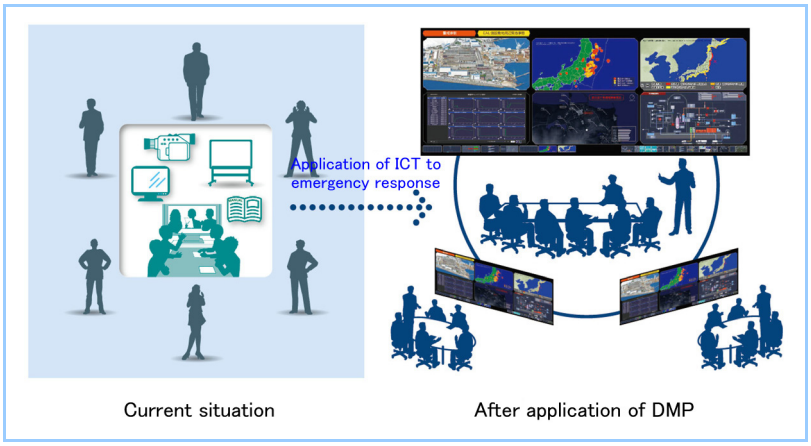

Figure 1 Application of DMP to emergency response

2. Characteristics of DMP

2.1 Application of HFE

This product adopted technologies including task analysis pertaining to HFE, integrated system validation (ISV), user experience (UX) and graphic user interface (GUI) to incorporate the aforementioned intangible elements. To shorten the product development process and improve the product value, a prototype was made and the tacit knowledge elements in design, manufacturing and operation were clarified and solved at an early stage. In addition, interviews with subjects and behavioral observations were conducted during the emergency response practical training and the results were reflected in the product design. **Figure 2** illustrates the prototype.

Figure 2 Prototype of DMP (large touch panel)

2.2 Identification of cause and provision of solution

As mentioned above, there are various problems with emergency response. A general approach to these problems includes the collection and sharing of information focused on "symptoms." This approach allows for understanding of what is happening at the moment, but cannot provide action guidelines for directors and responders, so the problem of the burden in information processing and decision making still remains. For example, when dealing with problems of large-scale infrastructure, grasping the cause in the deep layer in addition to phenomena in the surface layer leads to an appropriate solution. To solve these problems, the DMP intuitively provides "causes" and "resolutions" necessary for assessing the situation, planning and making decisions.

Beyond that area, this product provides support necessary for root cause identification and solution determination by directors and responders using an intuitive interface.

2.3 Compliance with standards relating to emergency response

This product conforms to major standards relating to emergency response centering on ISO 22320 "Emergency management - Requirements for emergency response" and incorporates expert knowledge through collaboration with academic institutions.

3. Specifications

3.1 Main application functions

The DMP provides directors and responders with various applications relating to emergency response as shown in the example in **Figure 3** and a system environment where the applications can be utilized while being switched flexibly. Specific examples of applications include functions such as timeline, event progress prediction, decision making, task management, resource (personnel, portable equipment, etc.) management, etc., in addition to understanding the overall situation. All the applications have specifications that lead to specific actions in conformity with the decision-making process, rather than merely collecting and displaying information. In addition, an intuitive interface that offers features such as site on-site image sharing and a voice input function is included as a mechanism to reduce human burden in inputting information.

Figure 3 Application for emergency response

3.2 System configuration

Figure 4 depicts an example of the overall system configuration of the DMP. By coordinating bases through the network centering on the DMP application server and the data server, an organic response by the entire emergency response organization is made possible. Furthermore, by accessing the system from a base in the field using a mobile terminal, responders can input and understand the information.

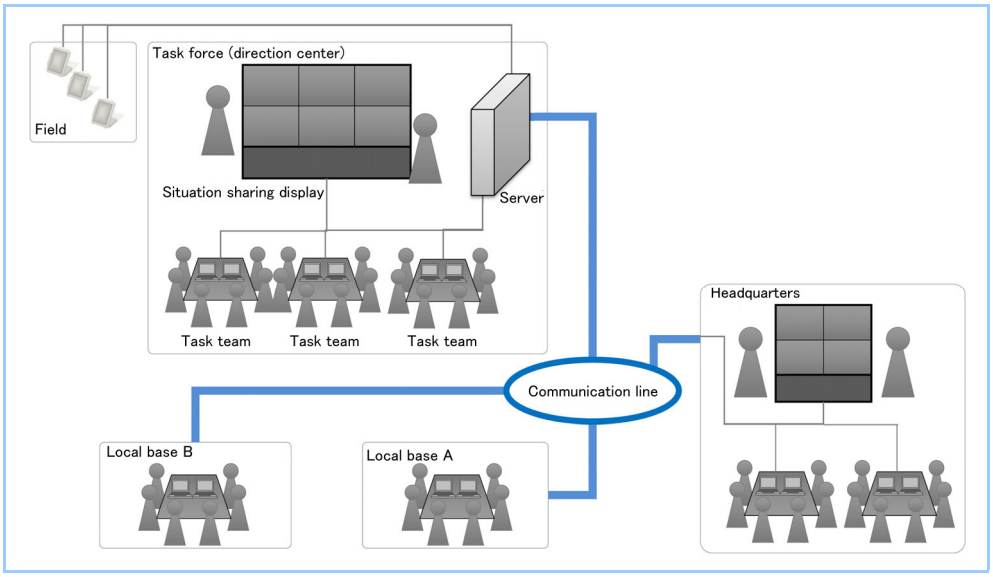

Figure 4 Outline of system configuration (e.g., disaster countermeasures)

In terms of robustness of the system, consideration is given to its design, which includes measures such as the installation of various types of backup equipment and server multiplexing to

deal with the loss of the power supply. In addition, considering cases where the automatic collection of online data becomes difficult due to the loss of network functionality, etc., the system also has a manual data input function.

3.3 Training function

To enhance the practical skills of emergency response, it is necessary to conduct various on-site training scenarios under normal conditions. In disaster prevention training, a disaster scenario is set up and the training is carried out, but there are restrictions on the simulated environment such as the means for trained personnel to understand the situation and contents. To improve emergency response skills and abilities, it is desirable to train in a simulated situation that is as realistic as possible. The DMP provides a dynamic training execution function to meet the above needs. By connecting a simulator to this system, it is possible to carry out dynamic training and improve the effect of training using the review function, etc.

4. Human-in-the-loop test

4.1 Test execution content

In emergency response, a system is used in cooperation with a wide range of organizations and multiple constraints as described above, so there may be operational uncertainties in the design stage. As such, we conduct a so-called Human-in-the-loop test including actual system operation by human beings to solve unvisualized operational problems.

In the test, a dynamic and complicated environment is constructed as much as possible. A complex event is assumed as the test scenario. The directors and responders selected are actual members. Multiple response teams participate so that sufficient verification data can be collected. For the data collection, various methods such as video recording, behavior observation by experts, interviews, etc., are used. Data analysis results are fed back to the design and manufacture of the product. Through these activities, we achieve product reliability and quality improvement, and the product has been well-received by customers.

4.2 Examples of application in the field

Examples of specific market deployment include emergency response in nuclear power plants, emergency response by the coast guard utilizing unmanned vehicles (**Figure 5**), etc. In these case examples, we performed trial operation in the field and confirmed the effectiveness of the system.

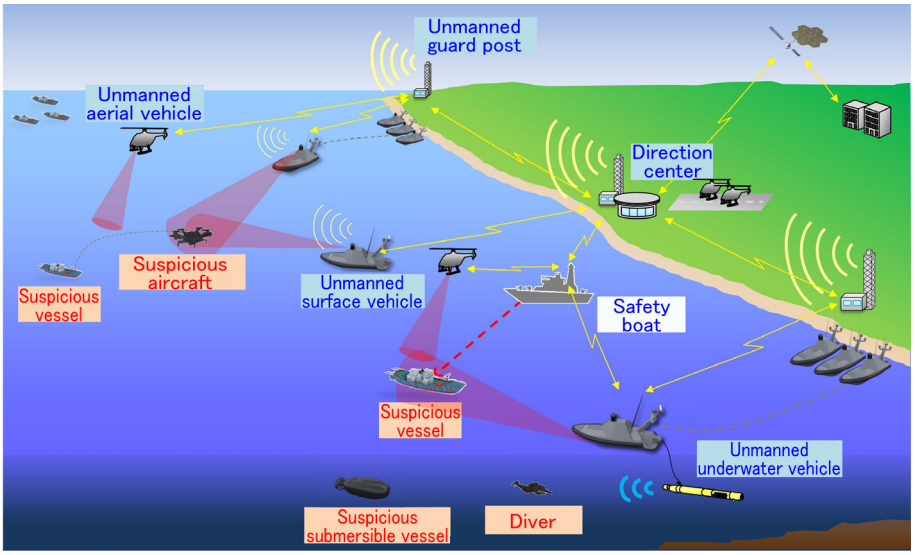

Figure 5 Example of application (coast guard system utilizing unmanned vehicles: Coas Titan™)

5. Future prospects

It is expected that in the future the boundary between human beings and computers will change, the integration of HFE-related technology and ICT will progress, and more robust emergency response will be offered to society. In addition to resolving expressed problems such as

the burden on directors and responders, MHI will continuously improve the system to solve implicit issues in terms of emergency response and provide a new form of emergency response utilizing our technology. It is planned that this product will be rolled out in multiple business areas in need of decision making in an emergency, and we will be committed to implementing the plans.