

Introduction

In June 2010, the proposed amendment to the STCW Convention and the Code was adopted at the diplomatic conference convened in Manila. This amendment includes many amendments to the Convention to meet the contemporary technologies and to eliminate ambiguity of the provisions. And as one of the amendments, a requirement of knowledge on Engine-room resource management (ERM) has been newly introduced into the competence table for engineer officers at the operational level. This requirement, as a knowledge, understanding and proficiency for competence “Maintain a safe engineering watch”, requires engineer officers to acquire the knowledge of ERM and to practice ERM. In practicing ERM, it’s vital to develop consciousness based on its concept and comprehension of the components constructing ERM. Furthermore, since ERM cannot be practiced if it is only understood by specialized personnel, it is essential for all personnel to share common perceptions about its necessity, understanding ERM equally and appropriately. From this aspect, it is also necessary for the engineer officers at the management level to review ERM at this time as it becomes a mandatory requirement, taking into account that the competence of “Use leadership and managerial skills” as an essential element of ERM has been introduced into the competence table of the function of “Controlling the operation of the ship and care for person on board” at the management level.

Marine engine-room resource management (ERM) is an important development in the elimination of human errors in engine rooms and the reduction of marine accidents. In the Manila Amendments to the Seafarers’ Training, Certification, and Watchkeeping (STCW) Convention, which went into effect formally in January 2012, ERM is the general principle that should be followed for marine watch duty in order to maintain acceptable standards. ERM has become the mandatory competency standard for maintaining a safe engineering watch, application of leadership and teamwork skills, and using leadership and managerial skills (International Maritime Organization, 2011). Thus, ERM training and assessment have become a new research field. At present, seafarer competency is still assessed manually, involves a high level of subjectivity, and entails expending substantial human labor and material resources. Intelligent assessment using marine engine simulators and expert systems can not only improve efficiency and save expenses but can also realize automatic checking, recording of operational data, automatic evaluation, and replaying of operational processes. Moreover, it can eliminate

subjectivity and improve the fairness of assessment (Zhang et al., 2014). The Maritime Safety Administration of China has started to reform the assessment model. However, intelligent assessment is still at the research stage. In recent years, some experts have proposed a fuzzy comprehensive evaluation based on a marine engine simulator. However, this method still involves considerable subjectivity in weight determination and can only be used for individual technique assessment. Jiang and Zhao (2011) proposed a method that entails training in daily work and emergency management using an engine room simulator. Jia et al. (2013) demonstrated training and assessment methods and analyzed the types and characteristics of engine room resources. Cao et al. (2014) detailed a comprehensive competence assessment theory for marine engineering training that combines subjective weight factors. On this basis, we proposed the man-ship resource system model and the intelligent assessment method based on a genetic algorithm. The components of ERM are not based on a new idea or imagination, but it can be said to be previously-existing human elements. Consequently, anyone can practice ERM by understanding its purpose and necessity of the components without having specialized technical skills, but by adopting the human elements as non-technical skills such as leadership, communication, situational awareness and others.

ERM is an approach to achieve a ship's safe navigation by appropriately managing the resources of personnel, equipment and information in the machinery space and by effectively utilizing them. So, allocation, assignment and prioritization of resources, effective communication, assertiveness, leadership, situational awareness, consideration of team experience and knowledge of ERM principles are stipulated in the amended competence table as essential requirements in practicing ERM. In addition, management of resources includes personnel management, equipment management and information management and personnel management means that personnel are appropriately arranged based on their qualifications, their experience and their certifications.

Equipment management is to manage the operation and maintenance of machinery, and running and maintenance records. Information management is to manage records of information, sharing of information and appropriate understanding and response to information. It's said that full practice of ERM is essential to ensure the ship's safe navigation especially in such a situation of entering/leaving ports where operational condition is continuously changing.

A correlation diagram that presents skills/elements constructing ERM based on the amended competence table A-□/1 is shown below. The diagram says that communication is the most essential competence in

practicing ERM and the communication can be a fundamental competence supporting leadership and assertiveness and also a shared common competence, and also there is the common competence between leadership and assertiveness. Consideration of team experience is also supported by communication and shares common competence with leadership. Three requirements regarding resources and situational awareness can be said to be independent skills/elements sharing no common competence with communication. The inside the framed rectangle means ERM principles. ERM principles are fundamental elements included in ERM and are the principles regarding personnel arrangement, how personnel arrangement should be, personnel's capability required and a code of conduct. Particularly, by the amendments, ERM principles for carrying out watches are described in Part 3 (Watchkeeping principles in general) of STCW Code A-□/2 (Watchkeeping arrangements and principles to be observed) as shown in the paragraph 8 (ERM principles after the amendments in 2010).