Construction of Global Shipping Big Data Platform Based on Information Sharing

Shulong Dai[1], Shuping Liu[2], Jian Sun[3], Linhai Du[4], Yuguang Gong[5]

*1. Dalian Maritime University, shulong88@126.com, Nautical Training and Research Centre, Dalian
Maritime University, Liaoning, China. Tel: +86 18098836630/13478529326.
2. Dalian Maritime University, lspdlmu@163.com.
3. Dalian Maritime University, dreamsunjian@dlmu.edu.cn.
4. Dalian Maritime University, 13664266331@163.com.
5. Dalian Maritime University, 1025439420@qq.com.*

Abstract With the development of the maritime technology and technique, Maritime Education and Training (MET) and safety of navigation confronts with great challenges. First, there is a regional imbalance for different countries, especially in MET and safety of navigation. Second, for the seafarers, they have rarely chance to get further career development education and professional advice. In addition, the rate of maritime accidents keeps increasing in recent years. It has become a challenge for global shipping that how to give the maritime students from different countries the equal chances to receive high level MET, and create chances for seafarers to receive career development education, including techniques, career planning, occupational psychology and so on. Therefore, it is necessary to develop a comprehensive studying platform for all maritime students and seafarers with different levels, backgrounds and countries.

This research proposes to construct the Global Shipping Big Data Platform (GSBDP) using the optimized MET and navigational resources collected, which can predict navigation dangers and provide useful information for maritime users. Based on the idea of Big Data, the GSBDP builds several databases by analyzing and processing these data from all kinds of maritime resources, and provides to different users in different ways after a recombination. Generally, GSBDP includes two main parts, MET and safety of navigation. For MET, it consists of two modules, which are college education and career development education. With a method of modular learning, it offers the maritime students and crew all the learning resources they need, such as professional courses, international convention and regulation, crew business, working procedure, etc. For safety of navigation, GSBDP can predict navigational dangers and offer important information for seafarers to ensure the safety of navigation and ship's security by collecting and analyzing a large amount of navigational data and accidents. Above all, GSBDP can play an important role in improving and balancing the level of MET and safety of navigation worldwide, strengthen the cooperation of different countries, and advance the development level of global shipping.

Keywords: Big data platform, Maritime education and training, Safety of navigation, Information sharing, Career development education, International cooperation

1. Introduction

This research aims to bridge the gap among different countries in MET (Maritime Education and Training) and ensure the safety of navigation. With the rapid development of marine science and technology, the global shipping has raised to an unprecedented level. However, due to the differences in foundation, emphasis, and investment of different countries, there is a regional imbalance in the development of global shipping, especially in MET and safety of navigation. The developed countries, like Britain and the United States, have rich and high-level educational resources, and take a leading part in MET. However, developing countries are lack of information and educational resources. To a certain extent, this situation restricts the healthy development of global shipping, lowers the quality of international MET, and is prejudicial to the safety of navigation worldwide.

At present, the research of big data is still in a stage of exploratory, and has been successfully applied in some fields like politics, public transportation, biomedicine, network information, etc. In politics, the

U.S. government launched "Data.gov" platform, which aimed to build an "open government", and opened about 390000 data, covering about 50 classes by December 2012. In public transportation domain, there are papers like "Big Data Platform Structure in Public Transportation" written by JI Qianqian and WEN Haoyu. In biomedicine, Biomedical Big Data Training Collaborative (BBDTC), which aims to bridge the talent gap in biomedical science and research, supports the biomedical community to access, develop and deploy open training materials for users at all levels. [1] Although the Big Data Platform has been successfully applied in some domains, it has rarely been proposed in MET. In recent years, E-learning is a more popular way in MET, like Directorate General of Shipping, the ministry website of shipping government of India. However, E-learning has disadvantages, such as incomprehensive, monotonous resources, lack of cooperation, etc. Some countries may conduct E-learning well, but they concern more on MET in their own countries, and are lack of international cooperation.

Generally, big data system has five main characteristics, summarized as 5 V, which are large amount of data (Volume), speed (Velocity), type (Variety), the value (Value), authenticity (Veracity) [2]. With regard to global shipping data, it, which features with large quantity, much variety, and precious value, can provide users with accurate information, meeting exactly the characteristics of 5V. Therefore, it is necessary to build a professional and comprehensive platform based on shipping data, which covers all MET respects and provides all professional courses and information, easy to access for users from different countries.

This paper suggests to develop the Global Shipping Big Data Platform（GSBDP）, which, as an community, can share MET and navigational resources with all maritime related staffs, and predict threats to ships, tendency of global shipping, problems in MET and safety of navigation, etc. On the one hand, it collects, proposes and shares all kinds of MET resources from maritime universities, training institutions, shipping companies, websites, etc., in order to optimize the resources and decrease the gap in international MET. On the other hand, it collects and analyses data like personal experiences, navigation data, accidents, meteorological data, etc., to give supervision and prediction.

2. The framework of Global Shipping Big Data Platform

Global Shipping Big Data Platform (GSBDP) is a platform that conducts collection, collation, analysis and verification of all MET and navigational resources to optimize the resources, and predicts dangerous, sharing with all maritime students and crew in different levels and backgrounds worldwide. It aims to provide an equal resource sharing platform for students, crew, ships, shipping companies and related institutions of different countries, which is more comprehensive, systematic, practical and easy to access.

2.1 Structure of Global Shipping Big Data Platform

The GSBDP includes three parts, which are data source, storage and processing, and data output (Figure 1). Data source is the foundation of the whole platform, whose function is to collect all kinds of MET and navigational resources in different formats from different locations and instruments. Then the data is sent to storage and processing. This part is the brain of GSBDP, where all the raw data is pre-processed, stored, analyzed and processed. Specially, the raw data is converted into practical information we need. Furthermore, databases are established in this part, which will detail in 2.2. After that, in data output part, the practical information is output as forms of courses, operation videos, predictions, danger warnings, etc.
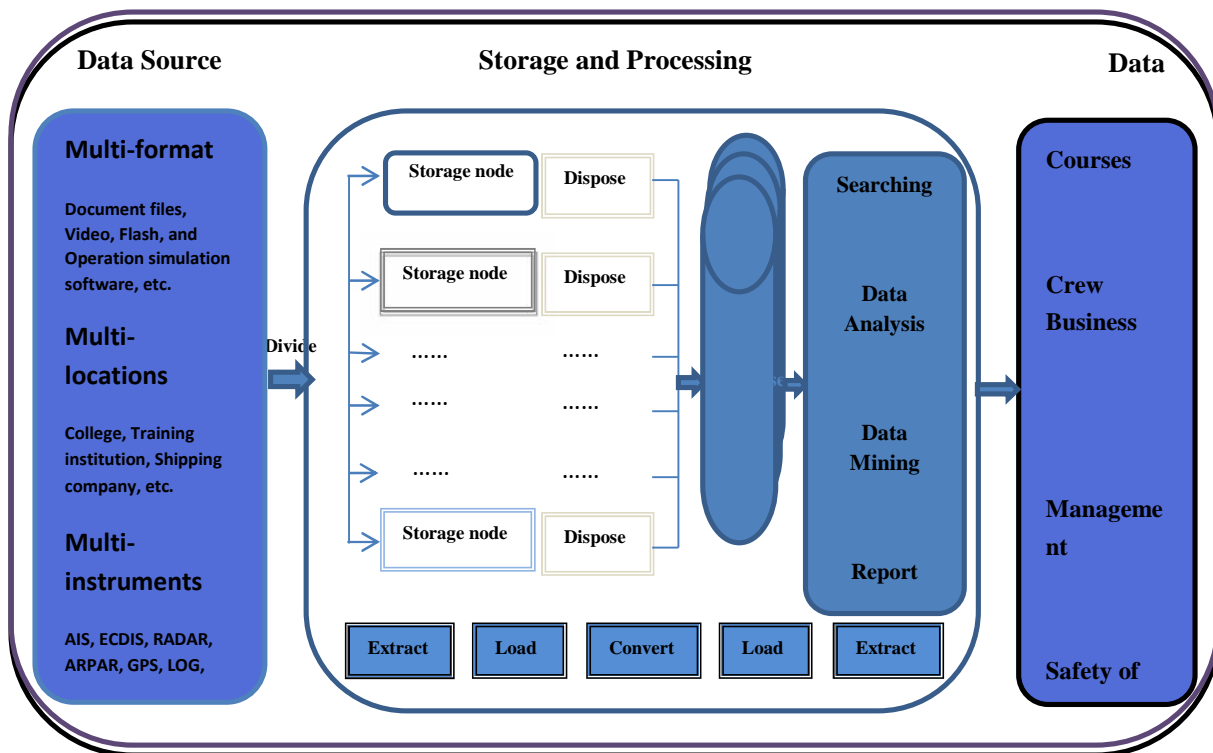
Figure 1 Structural diagram of GSBDP

2.2 Database of Global Shipping Big Data Platform

The database of GSBDP includes mainly three parts, which are MET, Safety of Navigation and Expert Database (Figure 2). As a key part of the GSBDP database, MET database includes different kinds of data, like professional courses, practical training, international convention and regulation, working procedure, etc. Safety of Navigation database contains mainly voyage data, navigational instruments data, accidents, etc. Expert Database brings together experts in shipping industry, and gathers their experience, intelligence, resources, and technical assistance. Although the three databases are constructed respectively, they are of interdependence. MET can provide theoretic support for Safety of Navigation, and Safety of Navigation in turn offers practical support for MET. When they meet some problems, Experts database can help them with experience, intelligence and technic.
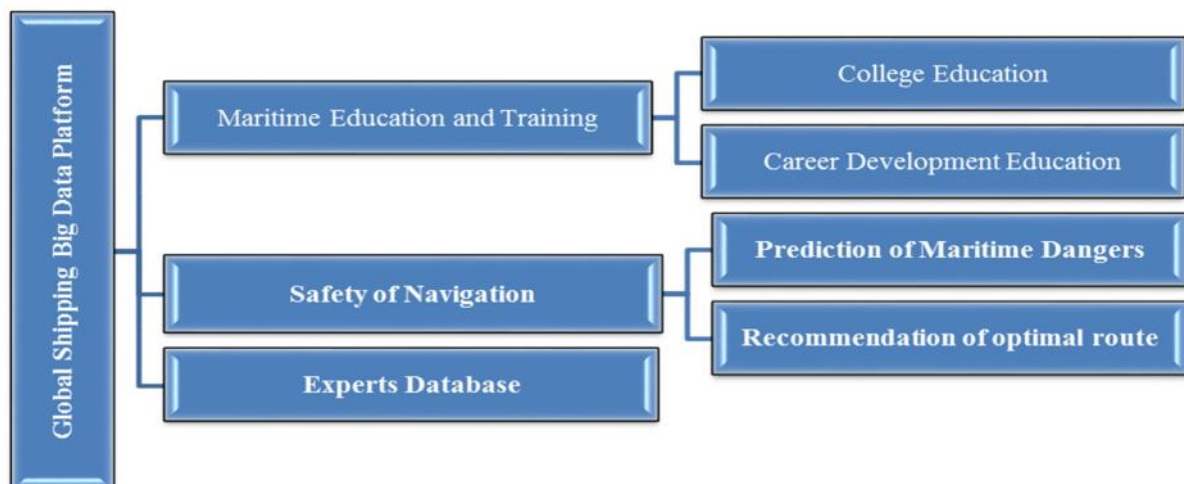

Figure 2 Structural diagram of GSBDP database

Data is the foundation for this platform. How to acquire a comprehensive, correlated, and huge-volume data is critical to this project. For MET data, it can be collected from universities like IAMU members, who are willing to share education resources, training institutions, who are willing to promote their training level, shipping companies, who can offer practical resources, management experience and so on, and the Internet. As to safety of navigation, data mainly come from ships and the Internet. Ships can offer data recorded by ECDIS, GPS, AIS, RADAR, ARPAR, SOUNDING, Main Engine, Auxiliary, etc., and all kinds of accident data. In addition, the Internet can also provide all kinds of safety of navigation information worldwide.

As the quantity of data is very large and the types of data are various, a data processing system is needed to convert raw data to useful information. Figure 3 shows the basic flow of big data processing.
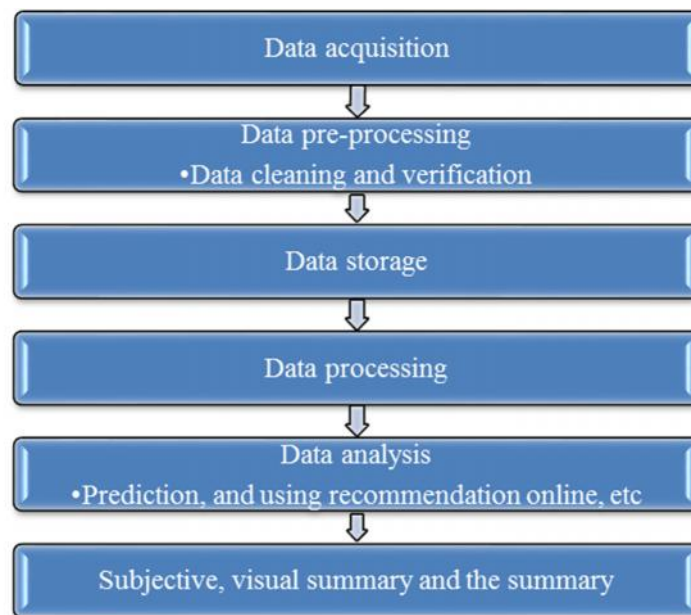
Figure 3 Flow chart of Data processing

3. Key Modules of Global Shipping Big Data Platform

3.1 Maritime education and training

To meet the requirement of on-board working, this module provides theoretical and practical courses, real scene English conversation, working procedure demonstration and so on. However, it shouldn't be used as a replacement for in-class instruction, but as a supplement. Formal education is designed to provide the knowledge for the students to undertake their future tasks on board. This is also the case with MET: its main purpose is to give the students the theoretical background and the knowledge that they require on-board ship, but in practice it is not doing so. The problem is what is taught for certification assessment does not coincide with what is required on-board ship, so that the students learn to pass tests rather than learn for on-board work. [3] There are two main modules in this part, which are college education and career development education.

3.1.1 College education

College education, a main module of MET, provides outstanding education resources for students, teachers, researchers and administrators, etc. As to students, according to the requirements of the 2010 Manila Amendments to International Convention on Standards of Training, Certification and Watch keeping for Seafarers (STCW), the platform collects all kinds of professional education-related materials, including video public class, teaching plan and material, notes, PowerPoint and extending knowledge,

etc. Materials collected are provided by each cooperating college and institution. Related experts are responsible for resources integration and reorganization. By doing this, all the professional knowledge is covered, which satisfies the needs of different learners of different levels and backgrounds. The courses are mainly theoretical and practical parts. Specific forms include open courses, text interpretations, video demonstrations, flash demonstrations, operations of simulation software, etc. There are mainly four items in this module, which are professional courses, practical training, professional English and international convention and regulation.

(1) Professional courses

Facing to anyone who wants to receive professional and comprehensive MET, this module offers open courses involving all the related fields, like navigation, marine engineering, electrical and electronic engineering, marine law, etc. With a selection and combination of professional courses in global maritime universities and colleges, it will provide appropriate courses for the users all over the world. The courses are classified according to the fields, which are carefully organized to help users study systematically. In addition, users can link to extensive knowledge in their learning process. This module plays an important guiding role in the international MET integration and resource sharing. Open courses of navigation, marine engineering, marine law and so on, are recorded by professors and instructors in different maritime universities and colleges. After carefully chosen and classified, more professional, systematical, and authoritative courses are available for the users. As for students in backward areas, it will be a fully supplement and support to the education they received.

(2) Practical training

Different from traditional practical training, this module carries out training in the way of video, flash, and operation of simulation software, etc. Video demonstration and flash demonstration are mainly for practical parts. Videos record real working scenes on board and exemplify typical operations in detail, including demonstrations of entering enclosed space, releasing lifeboat, working aloft, repairing failure of the main engine, dealing with man overboard, etc. Flash, which makes the content more vivid, mainly presents some regular operations, including operation procedure of fire extinguishing system, garbage classification, usage of oil preventing equipment, etc. Operation of simulation software mainly helps to be familiar with operation instruction. It can improve crew's practical operation ability, including steering simulation software, radar operation simulation software, positioning simulation software, collision avoidance simulation software, stowage simulation software, etc.

(3) Professional English

Maritime English, as a common language on board, is more and more important to both routine work on the ship and external communication. There're a total of 26 modifications and supplements directly to the maritime English in the 2010 Manila amendments to STCW convention. The basic principle does not change, but general requirements are higher. In addition, the convention has a special emphasis on the seafarers' language accepting ability, especially reading and listening ability. This module presents the users how to communicate in all kinds of scenes on the ship in English. This method, more vivid than text interpretation, can put the crew in the specific scene and help them to memorize the professional English. Taking the business of the third office as an example, English communication scenes consist of the organization of fire-fighting practice, organizing drill, steering and steering orders, loading and unloading, gangway watch, etc.

(4) International Convention and Regulation

This module includes all the international conventions, regulations, rules and relevant documents. As mandatory rules or suggestion, international convention and regulation plays important roles in international shipping to regulate the behavior of shipping companies, crew, relative institutions, etc. They include but not limit to the International Convention for the Safety of Life at Sea (SOLAS), the International Convention on Load Lines, the International Convention for the Prevention of Pollution

from ships, the International Maritime Dangerous Goods (IMDG) Code, the International Maritime Solid Bulk Cargoes (IMSBC) Code, the International Regulations for Preventing Collisions at Sea (COLREG), the International Code of Signals, etc. For example, in the 2010 Manila Amendments to STCW, it stipulates explicitly that captain, officers and engineers should have knowledge of related international maritime conventions and recommendations, and national legislation.

3.1.2 Career development education

Based on the crew's responsibility, this module helps the crew to enrich their business related knowledge systematically, and aims to become an encyclopedia for seaman career development education in the way of modular learning. The ways of training can be video material recorded, a demonstration of job operation process, the summary of crew's own experience, or experiences and lessons drawing from accidents. Based on modern methods，the platform will build a large database of maritime career development education. In addition, it will make every effort to help the crew to solve the problems they meet, such as lacking of career related information, without professional support and unsystematic process of study. By establishing information database and expert database, it will make the maritime vocational education more open, professional and diversified, and achieve the goal for optimization of nautical education system. There are mainly two items in this module, which are crew business and ship quality management.

(1) Crew business

On the basis of the 2010 Manila amendments to STCW convention, this module is divided into different units according to different positions, and focus on the practical operations. This module mainly combs and spreads the business knowledge of corresponding positions on board, aiming to contain all relevant business. For those who want to make development and improve their business ability, it provides them a self-learning opportunity, making it easier for them to understand and research in their business.

(2) Ship quality management

This module provides a platform to share resources for those who want to know something about the safety management system of other companies or departments. In addition, this module also offers some mature management experience and successful cases as part of effort to provide references for new recruits or the crew having such demand. On this basis, the platform adds teacher link module, which gives solution and guidance online to solve the problems encountered in the process of autonomous learning.

3.2 The safety of navigation

In this part, we establish a database of maritime accidents. With a statistical analysis of them, it can provide suggestions for accidents prevention and control. At the same time, as a communication platform, when some accidents or dangers happen at sea, the first ship finding it can post the message on the platform, thus ships passing through can take measures to keep away from distress. There are several modules that play different roles in this platform.

(1) Prediction of maritime dangers

The most valuable advantage of big data is prediction. The advantages of this module includes accident statistics and prevention advice, early warning of maritime dangerous, prevention and against of the pirates, etc. Firstly, by collecting different kinds of navigational data, the platform can predict the dangerous about to happen, which is very important for safety of navigation. Secondly, by collecting, classifying and statistical analysis of maritime accidents, it can obtain the reason, percentage and result of different kinds of accidents, so that suggestions or procedures preventing accidents from happening can be acquired. Thirdly, when some accidents, bad weather or other dangers, happen at sea, the first ship who finds it can post the message on the platform, warning ships passing through this area. Finally,

it makes a statistical analysis of global pirate attacks, for example types of attack, the way pirates board ship, weapons and outfits equipped and the successful case out of danger and so on, and marks different colors on the chart according to the probability of pirate attacks happened in different areas. This will help the ships passing through these areas be well prepared for piracy earlier and give some suggestions to prevent the pirate attach.

(2) The recommendation of optimal route

By collecting and analyzing different kinds of navigational information from different ships, this module offers a choice of optimal route to meet ship's requirement. First, navigation information is collected from navigation equipment, such as electronic chart, Radar, AIS and so on. Then, after series of data processing, it will provide recommended routes for ships navigating around the world, such as economic priority route, distance priority route, and time preference route, etc. Meanwhile, the users can optimize the recommended route combining with their own needs. After choosing the recommended route, some related information can also be labelled on the route, which ensures the safety of navigation. The information includes all hazards at close range, shallow water, narrow channel, traffic dense areas and any dangerous on the way. Besides, it can also provide some other information, like reporting point, reporting frequency, regulations of ports, etc. Users can obtain the above content only by inputting the GPS-coordinates of the departure point and destination point.

3.3 Expert Database

This module links to maritime experts so as to give online or email instructions to students and seafarers. They can help them solve practical problems, build up correct career development plan, and improve professional abilities. Experts will be selected from eminent professors in maritime colleges and universities, and remarkable captains or chief engineers in shipping companies. They must be well-versed in their own business, have an acute insight, be good at discovering and solving problems, and be willing to share their precious experience. Upon meeting thorny problems, designated relevant expert is requested to give an online guidance. Every few months, experts are called up to discuss problems recently happening together in a way of video conference to find out solutions. It can not only save time and energy, but also make good use of the integrated resources. Furthermore, it is also a great chance for maritime elites to cooperate together.

4. Conclusion and expectation

To balance the international maritime education resources and provide help for the safety of navigation, this paper proposes a creative idea of constructing the GSBDP. Through establishing MET database, it will provide the same opportunities for students from different countries to receive high level maritime education, help the crew to improve their business, and solve the problems they meet in work. In addition, it will also contribute to safeguarding and providing favorable conditions for navigation. GSBDP will strengthen the cooperation of different countries in MET and safety of navigation, and play an important role in pushing forward the development of shipping industry worldwide. On this basis, we can establish a feedback system of crew tracking and assessment, which helps to evaluate the working process of the crew, collect the difficulties and confusions they meet in work process. Furtherly, if we can improve the database, form a closed loop, and make continuous improvement, it will play an immeasurable role in pushing forward the shipping development.

Acknowledgements

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