

# The Research of Integrated Maritime Digital Information System

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**ABSTRACT:** This paper describes the Integrated Maritime Digital Information System (IMDIS) holistically, expatiates the functions and meaning of constructing this system. Then the basic frame of this system and the problems what we would meet during the construction have been discussed. In the end, it discusses how to intelligitize the functions that base on the IMDIS and presents the notion of “classificatory alert”.

## 1 INTRODUCTION

Nowadays, as the means of transportation on the sea is improving gradually, a lot of information systems that have the function of collision avoidance, scan, patrol and surveillance have been used abroad. This makes the traffic on the sea more safe and administrable. But these information systems don't have a consistent data format; the information between them can't be shared effectively. Another problem is that the design principle of these systems is different and some functions of equipments are overlapped. Then they work singly and the data collected by them can't be used effectively. These go against to the contrasting and using of the data for the manager.

In order to satisfy the growing demand to transportation on the sea of economy development, we need to reinforce the management of traffic on the sea, advance the service ability and manage level. Based on these things, we present the notion of “Integrated Maritime Digital Information System” (IMDIS).

## 2 SUMMARIZE OF IMDIS

IMDIS is a system that can collect most information of ships in range based on present VTS, integrate the information from different equipments and synthesize them to create exacter and all-sided vessel information. In this system, the data from radar and radar data processing system, AIS system, CCTV, short-massage ship location report system, port database and Web can be integrated effectively to create a piece of exact and all-sided information of every vessel target. These integrated vessel data could be visional on an all-around display and we also can control and process these data. In this system, processing and contrasting information can be realized in time and effectively. This can reduce the work intensity of operator and play down the waste of resource. Then we can make communion of every resource from system inside and improve the lever of the service to vessels. IMDIS will make the vessel traffic service system based on a new technology level, increase the producing, organizing and managing ability of port. It is very necessary.

## 2.1 The problems that maritime information system at present has

- 1 Although there are several VTS in China already have strong function DBMS and precision data of track target on the sea from various sensors, they still can't share their information with other systems in port like harbor control system, examine and approve system. Lots of information needs orderly worker to input by hand. This increases the work intensity of VTS manager.
- 2 The information offered by communication equipments between VTS and vessels always overlapped with each other, and because of the different precision they often make the information of vessels in confusion.
- 3 It is like information lonely island between different systems. So it is restricted in differentiating whether the data collected is from one target. What more is that one target in each system has different identify name. This also makes VTS manager difficult in contrasting and integrating information.
- 4 The MIS database of VTS isn't used effectively.
- 5 The operation of these equipments is dissimilar and this increases the burden of port operator.

## 2.2 Why it is necessary to build a IMDIS

- 1 IMDIS can make the VTS manager more convenient to get kinds of information of vessels and equipments in port and transmit data according to different system requirement.
- 2 This system can created more consistent data format and make VTS connect with each other.
- 3 Using this system can make the manager master more dynamic information on the sea and advance the quality of service to vessels.
- 4 Achieving uniform management and application of the equipments in port by using IMDIS.
- 5 It is propitious to the VTS managers to pay more attention to ships' situation, release the work intension of watches
- 6 Based on this system we can achieve the basic intelligent operation on vessel management.
- 7 The adjacent VTS can cooperate with each other when there is emergency.

## 3 THE BASIC FRAME OF IMDIS

Based on the collection of maritime affairs, the basic frame of IMDIS as follow:

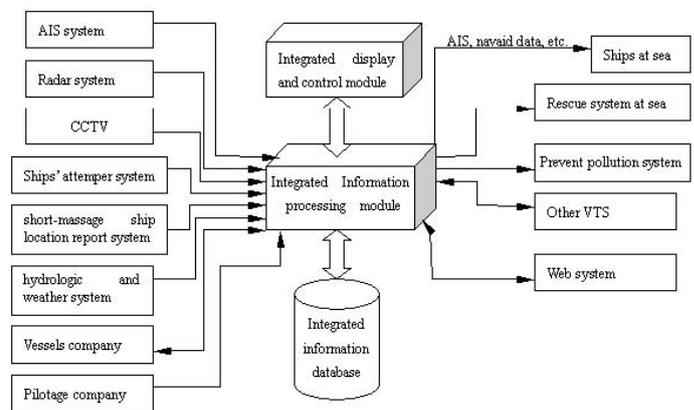


Fig. 1. Basic frame of IMDIS

IMDIS gathers information from some systems just as what we can see in figure 1. These systems contain most information of vessels. IMDIS integrates them and put them on the ECDIS for surveillance and achieve the interlinkage between VTS. Then there are a lot of functions that we can offer to vessels, such as send the real-time location of vessels to ship company who can know their ships' location any time, satisfy kinds of demand of ships on the sea; communicate with other VTS, emergency rescue center, .etc to complete management on the sea together; put the dynamic information of ships in port on web to send the port real-time information to ministry of communications and ships can web ID or PSW to report.

IMDIS consist of three modules structurally: Integrated display and control module, Integrated Information processing module, Integrated information database module.

- 1 *Integrated display and control module* is the part to display and control, VTS manager use this to keep the vessels under surveillance and control. In this module the radar data, AIS data, CCTV, shipping attemper information, .etc can first be integrated then display at the ECDIS.
- 2 *Integrated Information processing module* is the hard core of IMDIS, the main function of it as follow:
  - Process (like decode, classify, integrate, etc.) the information collected from subsystems. The information after the process includes vessel's name, location, call sign, and the number of voyages, etc Connect with MIS of VTS, put the ship information into database for playback in future;
  - Accept dictates from control unit, complete operation to vessels' information;
  - Achieve putting part dynamic information of vessels on web;
- 3 *Integrated information database module* can store, vindicate and use the information of IMDIS. Its function is store ships' maritime

affaire information; satisfy demand of VTS and subsystem of IMDIS.

#### 4 MAIN TECHNIQUE PROBLEMS IN THE CONSTRUCTION OF IMDIS

IMDIS is a huge system that includes various data of sensors and HDS (Heterogeneous Distributed System). So a lot of technique problems should be solved in the construction of IMDIS.

- 1 Problems of the transformation between different information systems and the interchangeability between different databases.
- 2 Problems of the synthesis display of radar data, AIS data and the data of ship's location from short message.
- 3 The format of VTS.
- 4 Which information should be interchanged when different subsystems are exchanging information?
- 5 The problem that which data format of heterogeneous database should be used when different VTS centers interchange information.
- 6 The problem of protecting the IMDIS from being attacked when it is linking with the web.
- 7 CCTV links with the moving targets on the ECDIS.
- 8 The problem of protecting the IMDIS from being attacked when it is linking with the web.

The problems upwards are unavoidable in the process of construction of IMDIS, some of them have been solved in some MSA (Maritime Safety Administration). For example, Shenzhen MSA had used the distributed data processing technology, the CORBA middleware technology and the trigger technology for integrating the VTS system, POE examine and approve system, vessel visa/checking system, pilot-apply system, etc. In 2003, Tianjin VTS center had used computer serial interface for picking up tailed radar data. Then, Tianjin VTS Center invented electronic chart display system, and displayed the data on the system.

According to the problems upward, there are some measures have been proved to be feasible, such as:

- 1 According to the problems of the transformation between different information systems and the interchangeability between different databases, CORBA middleware technology could be applied. This technology can interchange VTS system with series of exterior operation information systems. CORBA was put forward in 1991 by OMG as a technology rule facing distributed objects. Its purpose is making the software basing on distributed objects more

reusable, more flexible and more inter-operate to share information and resources more conveniently. CORBA can solve the problem of data format of heterogeneous database of VTS Centers.

- 2 How to avoid being attacked when IMDIS links to the web is a very important problem. Because of the importance of this system, it is required that even if it is attacked, it must can go on working; the information of web management/web disposition cannot be stolen. It must possess such a system that can inspect and tail after the inbreak ,supply flexible and efficiency communication services. The example of Shenzhen MSA was proved that the united system consist of firewall system, inbreak-inspection system, virus-defending system and data-backup system can defend net attacks efficiently.
- 3 For the integrated display of radar data, AIS data and the data of ship's location from short message, there already are a lot of methods used for the integrated of radar data and AIS data by now, and a single static database of vessel information has been formed. However, the integrated of short-message ships' location reporting system and the ECDIS are still in research.

The other problems will be solved in our future research.

#### 5 THE INTELLIGENTIZE OF VESSEL TRAFFIC MANAGEMENT BASED ON IMDIS

According to the research of IMO, the reason of 80% maritime accidents is related to the man-made factor. That is to say these accidents are mostly caused by the oversight or misoperation of the one on duty. Through the analysis of hundred of typical maritime accidents, I find that almost any tache in accidents are avoidable by personnel's effective treatment. But because of the limit of latter-day alerting mechanism, potential danger can not be deterred. Actually most accidents happened on the moment that the environment at sea not very bad, good weather make the manager's mind don't concentrate, then accidents happen.

So now it could be solved based on IMDIS. With the IMDIS we could integrate the information at sea furthest. Then IMDIS could make some simple judgments to the situation, give first alert and take some basic measure automatically, then release the burden and mistake of managers.

By analyzing dozens of traffic accidents at sea, I summarize that the wrong judgment of

encounter ship of watches can be divide into four arrangements.

- 1 The person on watch don't discover encounter ship, then accident happen;
- 2 The person on watch discover encounter ship, but don't pay enough attention to the pulse of it, then accident happen;
- 3 The person on watch discover encounter ship and pay enough attention to the pulse of it, but don't adopt right and effective measure to avoid accident;
- 4 The person on watch pay enough attention to the pulse of encounter ship and adopt right and effective measure but don't understand the intention of encounter ship, then accident happens.

Based on the situation above, this paper presents the notion of "classificatory alert" to corresponding the four arrangements above.

*Classificatory alert* is a new function based on IMDIS, the system uses the information collected forecasting the vessels' navigate intention, divides the dangerous situation to four levers and sets four alert levers. The watches on boat and VTS could pay different attention according to different alert lever.

Then it could make the watches have a known of danger on degree.

## 6 THE END

IMDIS is a huge system. It is a lot of practice problems during the construction. This paper describes it on the whole. Other key problems will be researched in the future. The question on how to intelligentize the function of IMDIS will be discussed deeply.

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