

A Study on the Analysis System of Voyage Data Recorder

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Abstract : According to SOLAS Convention, a voyage data recorder(VDR) is to be fitted onboard ships to assist in the marine casualty investigation. However, a review of Korean Maritime Safety tribunal(KMST), shows that the current VDR systems is inconvenient in practical because the storage format of VDR and the casualty reproduction method are different from one manufacturer to another making it economically and timely difficult for the maritime casualty investigation bodies to carry out investigation in a proper manner. To solve this problem, this paper proposed a newly designed VDR Analysis System(VDRAS), which decodes the voyage data of VDR producea by different manufacturers, reproduces the condition at the time of casualty in an accurate, and performs necessary checks.

Key words : Voyage Data Recorder, analysis system, marine casualty, marine safety management

1. Introduction

According to the amendment of chapter V of SOLAS, a voyage data recorder(VDR) is to be fitted onboard ships to assist in the marine casualty investigation. The installation of VDR onboard the vessel was first initiated in 1993 to examine the marine-casualty caused by human error and to prevent recurrence. And in 1997, International Maritime Organization(IMO) adopted Resolution A.861(20) as performance standards for shipborne voyage data recorders(IMO, 1997). Also International Electro technical Commission(IEC) accepted the IMO's A.861-61996 and started applying it from July 2000. The installation of VDR onboard ships have entered into force since 1 July 2002.

VDR, which maintains and stores the information concerning the position, movement, physical status, command and control of a vessel over the period leading up to a casualty in a secure and retrievable form, was introduced by IMO to analyze the causes behind marine casualties(IMO, 2000).

However, according to a review carried out by Korean Maritime Safety tribunal(KMST), the storage format of VDR and the casualty reproduction method are different from one manufacturer to another making it economically and timely difficult for the marine casualty investigation bodies to carry out investigation in a proper manner.

To solve the problem, the VDR analysis system(VDRAS) which decodes the voyage data of VDR produced by different manufacturers, reproduces the condition at the time of casualty in an accurate manner, and performs

necessary checks is proposed in this paper.

2. Limitation of Current VDR

2.1 Composition and functions of VDR

The Maritime Safety Committee(MSC), at its 73rd session in 27 Nov. 2000, made the fitting of VDR mandatory on following vessels(IMO, 2000):

- Passenger ships constructed on or after 1 July 2002
- Ro-ro passenger ships constructed before 1 July 2002, not later than the first survey on or after 1 July 2002
- Passenger ships, other than ro-ro passenger ships, constructed before 1 July 2002, not later January 2004
- Ships, other than ro-ro passenger ships, of 3,000 gross tonnage and upwards constructed on or after 1 July 2002

A VDR is composed of a main-operation unit and a capsule for final-memory media. The main-operation unit comprises of a terminal-class interface for the information from a sensor, an signal transformer, etc.(Fig. 1).

And the elements of voyage record equipment's data are shown on table 1.

2.2 The limitation and problems of existing VDR

The purpose of making fitting of VDR onboard a vessel mandatory is to maintain and store information concerning the position, movement, physical status, command and control of a vessel over and the period leading up the casualty in a secure and retrievable form.

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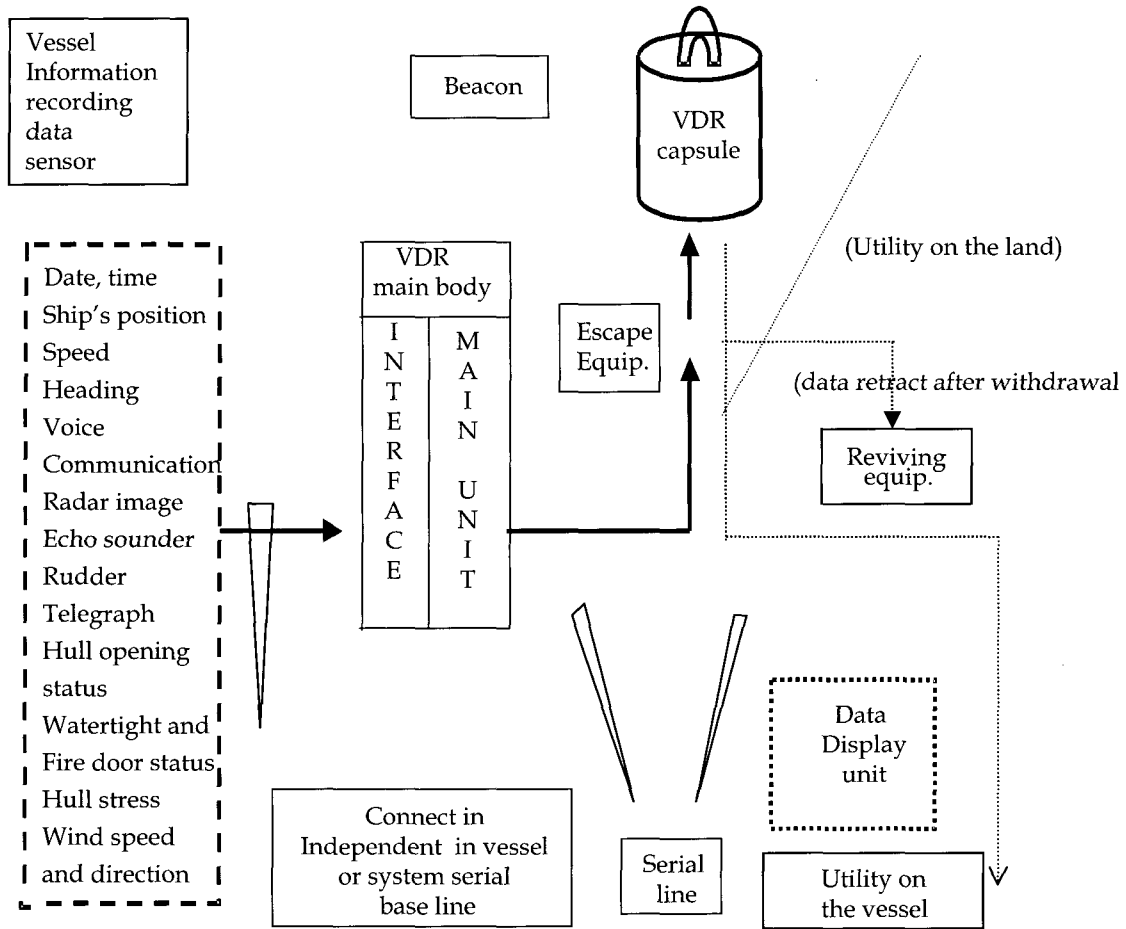


Fig. 2 Scheme showing the concept of the VDR

However, according to a review carried out by KMST, the storage format of VDR and the casualty reproduction

equipped with VDR reproduction equipment of all manufacturers or request the manufacturers to analyse the method are different from one manufacturer to another. As a result, every marine accident inquiry agency needs to beVDR data. The making a request for analysis not only consumes a lot of time, but also poses data reliability problem as the raw data can be easily manipulated during the analysis process. As the maritime casualty is often accompanied by loss/injury of life and economic/environmental impact as well as involves many different countries, the reliability of VDR data is very important.

Table 1 Recorded data in VDR

No.	Data List
1	date and time
2	ship's position
3	speed
4	heading
5	voice, channel 1
6	voice, channel 2
7	radar data
8	echo sounder
9	main alarm
10	rudder order and response
11	engine order and response
12	hull openings status*
13	watertight and fire door status
14	accelerations and hull stress**
15	wind speed and direction

* : apply to Ro-ro passenger ships

** : apply to condensing sensor ship

It is economically impossible for casualty investigation bodies to purchase all VDR casualty reproduction system of different VDR manufacturers to carry out the investigation in a proper and accurate manner.

Therefore, this study looks into developing a VDR analysis system which can decode the voyage data of VDR produced by different manufacturers, reproduce the condition at the time of casualty in an accurate manner and perform necessary checks.

3. VDR Analysis System(VDRAS)

3.1 Composition of VDRAS

As stated above, VDRAS must be composed as one system to analyze casualty and must take the necessary data and reproduce the casualty as closely to the original condition as possible. Therefore, in this study, VDRAS composed of following is proposed (Fig. 2).

The composition of VDRAS is:

1) Common Interface Apparatus(CIA)

As an equipment to readout stored data in VDR, there are common interface functions which readout data stored in different brand of VDR.

2) Portable Common Interface Apparatus(PCIA)

Portable CIA readout data of VDR installed on vessel on the spot.

3) Data Storage System

Data storage system store data from each equipment.

4) Analysis and assessment system

Analysis and assessment system is a reproduction system with necessary data stored in an exclusive server. This system is composed of voice analysis, image analysis and navigation information analysis. Also it is composed so as to allow the analyst to choose VDR's time, position and pause data. And each image data, voyage information and

time data have the output equipment to enable usage at the time of judgment.

5) Total check system.

This system is equipped to assemble data in each analysis system. The data of this system were used by KMST to analyze the marine casualties. It is composed of compound debriefing system for marine-casualty related personnel to observe condition at the time of casualty with condition and time data. Like the analysis and assessment system, it also has an output equipment to enable usage at the time of judgment.

6) 3-D simulator

VDRAS's data can be reproduce 3D optical by the composed program(3D simulator). It is composed so as to enable usage as a maritime casualty prevention equipment or virtual equipment.

7) Output system

Each evidence cannot provide image type but data type. Therefore, each condition reproduced by VDR could be printed to be used as a judgment data. And it could also print total assessment system and analysis and assessment system.

8) National Wide Network

With nationwide network, VDRAS's data can be transmitted to analysis department in each regional

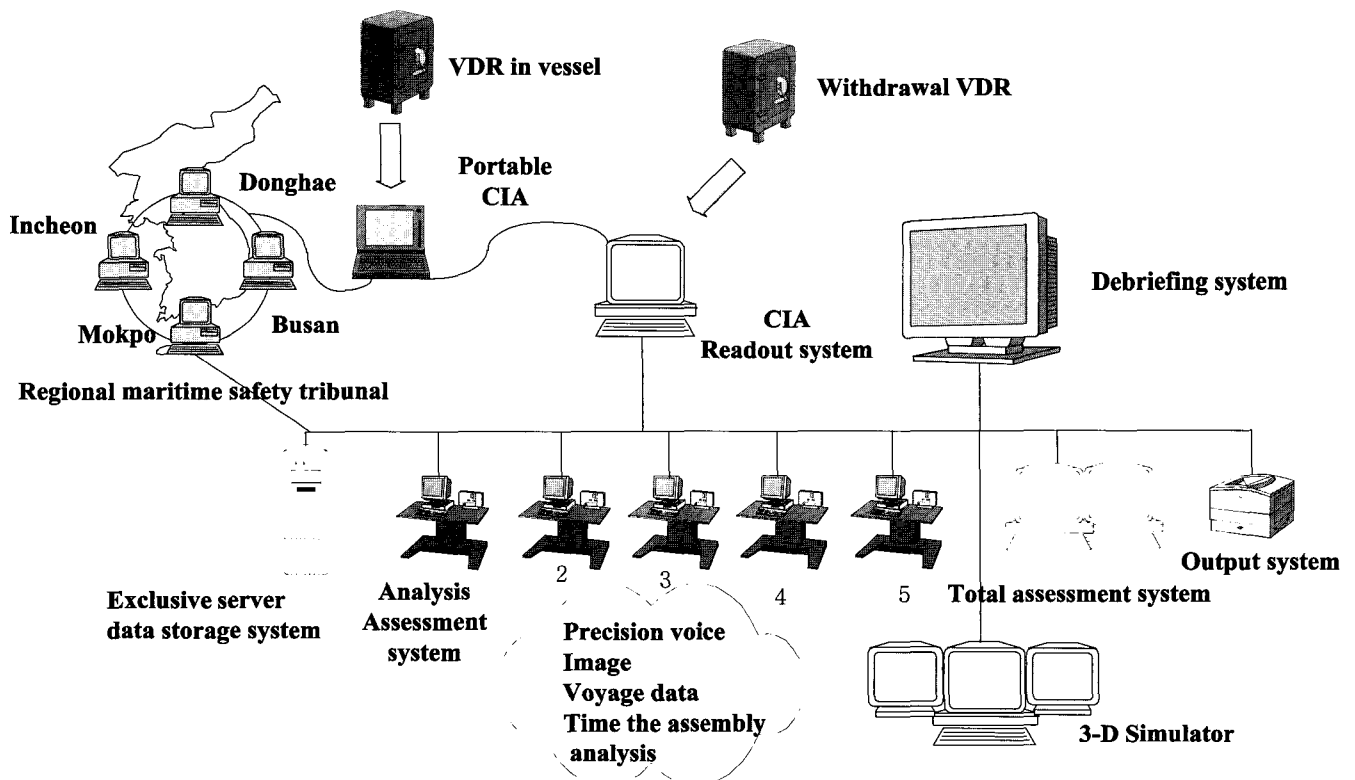


Fig. 2 Scheme showing the parts of the VDRAS

maritime safety tribunal. Network system is composed so as to reproduce analyzed condition at real time in each region.

3.2 The function of VDRAS

VDRAS function are as follows:

1) VDR data readout function

Readout record from VDRAS or VDRAS in vessel from CIA or PCIA.

2) Analysis · assessment function(voice analysis, image analysis, navigation information analysis, total analysis)

Using analysis and assessment system and total assessment system, data stored in the exclusive server is produced. Voice analysis, image analysis, navigation information analysis and time line total analysis could be analyzed by reproducing the condition with data. And it can choose VDR's time, position and pause data wanted by each analyst. And data analyzed by each analysis system is collected to single place for the marine casualty analysis by KMST. Also, the condition with time line or conditional data at the time of casualty may be observed by the marine casualty related persons.

3) Reproduce function

Each necessary data stored in exclusive server is reproduced to voice, image and voyage information. Also it could reproduce the time line or condition and time, place

and part.

4) Simulation function

Using the composed program, VDRAS's data can reproduce 3D optical enabling usage as a marine casualty prevention equipment or a virtual equipment.

5) Output · storage function

Each evidence cannot provide image type, but a data type. Therefore, each condition reproduced by VDRAS could be printed to be used as a judgment data. And it could also print total assessment system and analysis and assessment system.

6) Save function

Stores the VDRAS's data readout by CIA, PCIA and analyzes and makes judgments by total assessment system, analysis and assessment system and simulated by 3D simulator.

7) Network function

With nationwide network, VDRAS's data can be transmitted to analysis department in each regional maritime safety tribunal. Network system is composed so as to revive analyzed condition at real time in each region.

3.3 The composition of the software of VDRAS

To achieve the function of analysis system, the software is necessary to draw out, store, analyze data. VDRAS is a stored voyage record composed of 14 items as capsule type.

Image Module	radar image	Interval under 1 minute.
	target information	- ID set up: serial number input. - information items: true bearing, distance, speed, ship's heading, CPA, TCPA display
Voice Module	- channel's Composition: 3 MIX and 1 VHF voice for playing sound of broadcasting and communication. - volume adjust function	
Navigation Data Module	date and time	- save the UTC time and local time data as XX:XX:XX - all data should be link with time.
	navigation data	※ every voyage data is saved in every 10 second. - position latitude and longitude XX.XX.XX(N,S), XXX.XX.XX(E,W) - ship's speed: speed on ship's log XX.X(Knot) - ship's heading: true bearing display XXX.X(T) - depth: depth on echo sounder(m) XXX.X Exception; if it is ft, it is changed "m" - rudder indicator: starboard XX (indicator: XX) port -XX (indicator: XX) - engine status : ahead XX (indicator: XX) astern -XX (indicator: XX) - wind speed and direction: relative wind speed and direction exception) If wind speed is more than 150 knots, it is not express. wind direction : XX.X(R) wind speed : XX.X(Knot)

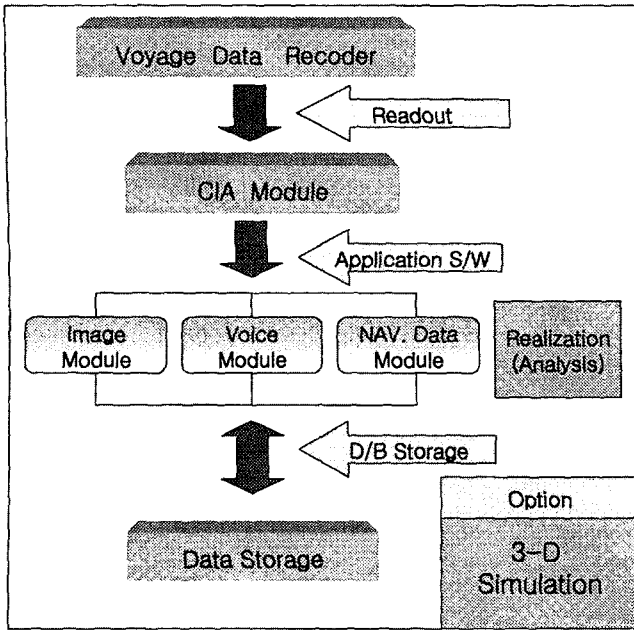


Fig. 3 VDRAS software figure

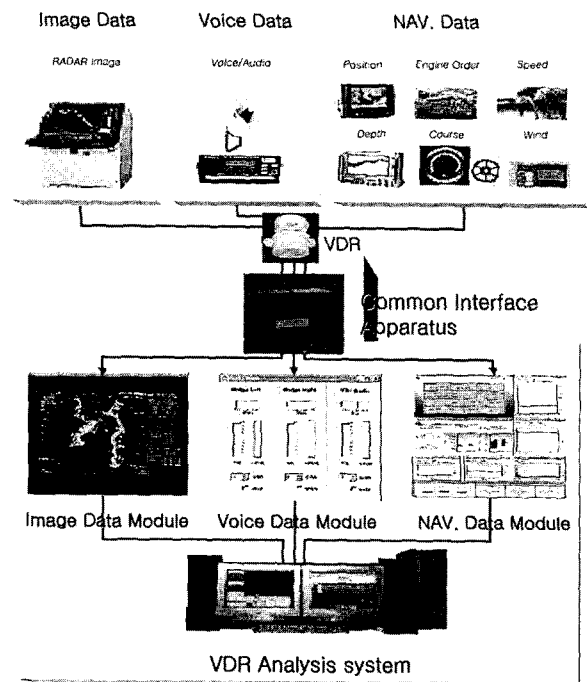


Fig. 4 The image of analysis image

If data in capsule are not used, it is useless for the marine casualty analysis. Therefore, an interface must be set up between each level.

Software is composed of readout, save and reproduce level like the composition of analysis system.

Application software needs to divide data withdrawn by CIA Module for readout data in VDRAS as Image Module, Voice Module and Data Module. Also, each data type need window base software to store, and through this, the analysis system is revived. The software composition figure is shown in Fig. 3.

1. Data type of module

The 14 types of Data stored in VDR are saved in each module as image and voice type through application software in CIA Module. Storage types are shown on table 2;

The image form assembled into analysis system's software composition and data module figure are shown on Fig. 4.

3.4 Expected positive effect from the VDRAS

The VDRAS proposed in this study can decode the voyage data of VDR produced by different manufacturers, reproduce the condition at the time of casualty and perform necessary checks allowing undertaking of necessary investigation. The positive effect to be expected from the proposed VDRAS are as below.

The first is the exact reproduction of condition at the casualty spot. VDRAS provides onboard data such as rudder response status, engine order status, watertight door status through voice recording; communicated message of bridge and engine room; communication with outside; and other data such as surround environment through radar image. As a result, VDRAS can reproduce casualty in a exact fashion allowing investigators or commissioners to easily confirm the condition at the time of casualty and to avoid the mess and miscalculation due to the shaky statements of witness.

The second is the examination of exact cause behind the casualty. For example, the inquiry into collision involving two vessels with no witness, investigators or commissioners have to rely on the statement from the personnel related with the casualty. In this case, the statements collected may not always be accurate due to false statement. However, with the VDRAS, the correct causes behind marine casualty may be obtained swiftly. KMST found that reproducing the casualty by using the data of VDR could make investigators or commissioners to obtain the causes behind the casualty and find parties responsible.

The third is the practice of efficient and scientific examination for judgment. As VDRAS provides necessary data and calculation for examination of causes behind the casualty, more scientific and systemic judgement is expected to be practical.

The fourth is the enhancement of the counter-measures for the marine casualty. The aim of KMST is not just on delivering judgment on the marine casualty. KMST also provides the maritime industry with the information of causes behind the casualty and counter-measures to prevent future casualties. With VDRAS, people can learn more effectively about the casualty and more near-miss accident, and how to deal with them.

5. Conclusion

This study, proposed a VDR analysis system is which has a unique function to reproduce the marine casualty in part or in whole with 14 voyage record such as speed, direction of vessel, radar, image and voice recording, etc. that are directly related to the casualty. VDRAS supports the marine casualty analytic, scientific and reasonable data as a briefing type.

The effects of the proposed system are as follows :

① exact reproduction of condition at casualty spot, ② the examination of exact reason behind the casualty, ③ the establishment of efficient and scientific judgment, ④ the prevention of marine casualty.

Reference

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