

# An Analysis on the Problems and Improvement of using ECS for Coastal Ships

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## ABSTRACT

The electronic chart system(ECS) is a navigational equipment with a simple electronic chart and is used in small and medium sized vessels such as coastal cargo ships, fishing boats. For the purpose of preventing marine accidents of oil tanker ships in the 1990s, the prohibition of passage of oil tankers was set up, and also forced to install the ECS to record and save the track of the ship at the same time. However, regulations for the installation of AIS (Automatic Identification System) for ships corresponding to the Ship Safety Act were newly introduced, and the enforcement regulations for the installation of ECS were deleted in 2009. However, the operators of small vessels such as barges in which there is no chart and operated without electric and navigational system, and fishing boats of less than G/T 50 tons, which are not the vessels to be installed AIS, are using the ECS as navigational equipment due to the convenience of operation. However, marine accidents such as collision, aground are occurring due to the lack of follow-up service for the customers of ECS and safety awareness of the ship operators. In this paper, we analyzed the case of marine accidents such as aground and collision caused by the misuse of ECS in the small and medium sized ships with the coastal area of the Republic of Korea. In addition, as an improvement measure to prevent marine accidents, we suggested some ways that construct a simple electronic chart updating system of the ECS, strengthening infrastructure, upgrading simplified electronic charts, and establishing management plans.

**Keywords:** electronic chart system, marine accidents, navigation equipment, maritime safety

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# 1. Introduction

The ECS is equipped with a simple electronic chart and receives orbit information transmitted from 24 satellites (GPS, Global Positioning System) to display a ship's position, bearing, time and speed. It's a kind of navigational reference equipment that provides the necessary information for safety navigation (National Oceanographic Research Institute, 2009). In order to prevent marine accidents of dangerous cargo ships in Korean coastal areas in the 1990s, an oil tanker passage prohibition zone was set up (Jeong, 2013). To record the ship's track ECS, as a recording device, was forced to install by the enforcement of the Maritime Traffic Safety Act.

Due to this background, most of the vessels were loaded on small ships of less than 30 tons or more than 5 tons which sailed the domestic coast as well as oil tankers. However, in accordance with Article 30 of the "Ship Safety Act" in 2008, the provisions for the installation of AIS(Automatic Identification System) were newly introduced, and it was applied to oil tanker ships, towing vessels with a gross tonnage of 50 tons or more, and the ECS enforcement regulations were deleted in May 2009.

However, operators such as small vessels and fishing boats less than 50 tons, which are not ships to which the ship position transmitter is installed, still use the ECS as navigational equipment due to their ease of use. The problem is that an ECS does not regularly update the simplified electronic chart due to the lack of follow-up management after the manufacturer's product sale and the lack of safety consciousness of ship's officer. Also the ECS with simple electronic chart installed at the time of purchase is used for many years.

In a previous study on the ECS, Kim(2004) studied the "Development of a small ship operator support system using fuzzy language representation" to provide a safe and optimal route to small-sized ships. Jeong(2013) suggests the case of marine accidents caused by careless use of the ECS in the "Measures to prevent marine accidents by GPS Plotter", and the necessity of legalization of the ECS and exemption of paper chart onboard. But this research has limitation for implementation.

Therefore, in this study, we review recent trends, advantages and disadvantages of the ECS, and examples of accidents caused by ECS, and suggest ways to improve the use of ECS for small ship operators including fishing boats.

## 2. Outline of ECS

An electronic chart system is navigational equipment for display of chart data. It does not generally meet the performance standards of Electronic Chart Display and Information System (ECDIS) by IMO regulation. But ECS is simple and convenient for using because the chart database installed in the display system can be showed to ship's operators. 30,000 small vessels registered in the Republic of Korea are using the ECS. In the Republic of Korea, 85% of the registered vessels are less than G/T 500 tons. Around 30% among the fishing vessels registered to the Korean govern-

ment are more than G/T 30 tons.

The general configuration of ECS shows in Figure 1. ECS consists of display, GPS antenna, and DGPS antenna, which can be connected to a user memory card, a water temperature meter, an external monitor and a transceiver, etc.

Figure 1. Configuration of ECS



The international regulations for electronic navigational chart(ENC) to be installed in the ECDIS are established by the International Standard Organization (ISO), the International Maritime Organization (IMO) and International Association of Marine Aids to Navigation and Lighthouse Authorities(IALA). But there are no regulations and rules for simplified electronic charts for ECS. So, the Radio Technical Commission for Maritime Services (RTCM) is working to make the standards for performance, guidelines of simplified electronic charts used in ECS. At present, the ECS is regulated separately by each country without standard.

### 3. Status of development of simplified electronic charts

#### 3.1 Foreign case analysis

##### 3.1.1 Jeppesen Marine (C-MAP)

The C-MAP company in Norway was absorbed by Jeppesen, and the existing C-MAP products are sold as Jeppesen marine. Jeppesen marine is a global provider of simplified electronic chart services tailored to the needs of merchant vessels, accounting for 95% of the market share of vector-based simplified electronic charts around the world. The charts produced by this company are stored in the C-Card according to the region, and the manufacturer of the ECS such as GPS plotter can use the C-MAP without any burden of making and upgrading.

##### 3.1.2 ERC(Electronic Reference Chart)

The ERC is published by the Japan Waterway Association, licensed by the Japan Maritime Security Agency, and is currently being supplied to small ships throughout

Japan. The ERC data is stored in the IC memory card recognized by a certain protocol. The data storage format is a binary file created by the Japan Waterway Association. It is stipulated that the ERC should be used for Japanese ships in the coastal area of Japan.

### 3.1.3 PEC(Personal Electronic Reference Chart)

PEC is designed to be able to view the same file format and the same information as ERC on a PC. It is provided as CD-ROM by digitizing information as same as ERC.

### 3.1.4 Blue Chart

It is a portable electronic chart made by TRANSAS, a manufacturer of electronic chart, of Russia. It is built together with global positioning system(GPS) and supplied globally by GARMIN, a global GPS company. Blue Chart data is provided as a programmed Data Card or Map Source CD.

## 3.2 *Domestic case analysis*

Domestic ECS have mainly built-in electronic charts for equipment manufactured by each company. The electronic charts for ECS were digitized from paper charts or process electronic charts and numerical charts produced by the National Oceanographic Research Institute as needed. In the Republic of Korea, there are some companies for manufacturing of ECS. In case of company A, this company is a manufacturer of marine navigational equipment. They manufacture their own simplified electronic charts for using in their ECS, and account for 70~80% in the domestic market for ECS. In case of company B, they also manufacture navigational equipment which ECS with a function of fish finder. And they are developing a simplified electronic chart for installation on ECS such as GPS plotter.

When the navigational chart is newly issued or revised by the National Oceanographic Research Institute (KOSEF), the checking point to make a simplified electronic chart are as follows: coastal line, dangerous rock, depth contour, dangerous materials and so on. In addition, ECS is providing the location of ship as well as various information and function such as shoal of fish, image of engine room by CCTC and external speaker and alarm. Also, in order to update the existing products, the equipment had to be removed from the ship and updated on the land. But, recently, it is possible to update easily with SD card (Secure Digital Card) without the support of landside. In addition, some of the ECS manufacturers are updating free of charge for products purchased within 5 years.

## 4. Analysis of merits and demerits for ECS

### 4.1 Merits of ECS

Most small ships' wheelhouse is very narrow and has not separate to chartroom and do not have updated charts. Also, since the captain is not only engaged in sailing but also engaged in fishing, and is the only person on duty alone while on the ship, it is very difficult to confirm the establishment of the navigation plan and the compliance with the route.

In terms of navigation of these small vessels and the environmental aspects of the vessel operator, the advantages of using the ECS are as follows.

- ① Simplified electronic chart appears on the screen, so ship's operator can easily check information such as position, obstacles without using a paper chart.
- ② Ship's officer can create voyage plan by inputting the start position and the destination by using the menu button. And also it can save the route and use it again if necessary.
- ③ It's possible to store the ship's track, which can be used to identify the cause of the accident when a marine accident occurs.
- ④ In addition, ECS is providing navigation information as well as possible to add functions such as traffic function and engine room monitoring, thus enhancing the convenience of the operator.
- ⑤ ECS with various functions is cheaper than other navigation equipment such as radar, AIS, autopilot and so on.

Because of these advantages, despite having legal force, most small vessels which navigate coastal area of the Republic of Korea installed ECS such as GPS plotter.

### 4.2 Demerits of ECS

The disadvantages of using the ECS are follows due to problems in the usage environment rather than the technical shortcomings of the equipment itself.

- ① If not take an active interest in ECS by ship's operator, it's difficult to update the latest simplified electronic chart because of time and cost.
- ② Because ECS is not mandatory navigational equipment, the manufacturers of ECS, the Ministry of Oceans and Fisheries and the Korea Water Works Association have not prepared up-to-date rules for simplified electronic charts.
- ③ ECS manufacturers have the technology and interest for making simplified electronic charts. But the navigational charts of coastal area for small ships by survey are not enough to develop simplified electronic charts.

The merits and demerits are summarized in Table 1. In case of merits for ECS, firstly, ECS have simple operation and understanding to collect or set the information by ship's operator. Secondly, it's suitable equipment to narrow wheelhouse environment. Lastly, In spite of similar functions, ECS is cheaper than ECDIS which using normally on merchant ships. On the other hand, in case of demerits of ECS, firstly, it's incon-

venience to update of simplified electronic chart because of not providing of materials. Secondly, there is a lack of infrastructure for large-scale navigational chart and fishery chart. Lastly, operators have blind faith about ECS due to the shortage of related knowledge and education.

**Table 1.** Comparison with between merits and demerits of ECS

Merits	Demerits
Information collection and route setting by simple operation with keyboard Easy to understanding information for ship's operator with graphic mode Suitable for narrow wheelhouse of small-sized vessel (display size is around 10 inch) Low price with various function (normally 3,000,000~5,000,000 Korean won)	Inconvenience for updating of simplified electronic chart In operation, high possibility of blind faith in ECS and can cause accident A lack of infrastructure for large-scale chart and fishery chart

### 4.3 Status of marine accident by improper use of ECS

As shown in Table 2, there are 19 accidents such as aground, collision related to using of ECS directly and indirectly through the analysis of 557 judgment cases by the Korea Maritime Safety Tribunal from 2011 to 2014. The number of aground was the highest at 13 cases, followed by collision (3 cases), contact (2 cases), and other accidents such as breakwater contact (1 case).

**Table 2.** Marine accidents due to usage error of ECS

Classification		2011	2012	2013	Total
Number of judgment		203	159	195	557
Type of marine accidents	Aground	2	6	5	13
	Collision	1	2	-	3
	Minor collision	-	-	2	2
	Others	1	-	-	1
	Sub-total	4	8	7	19

Source: Korea Maritime Safety Tribunal

With the development of the technology of making a simplified electronic charts, the errors, which mean the gap between simplified chart and electronic navigational chart(ENC) have been reduced compared to the past. However, there is still a possibility of error due to accumulation of charts such as large-scale chart 5000:1. In addition, although the accuracy of the simplified electronic charts has been higher than that in the past, there are still distance errors compared to ENC in the specific area such as narrow channel. So, these errors became the cause of marine accidents.

The cause of marine accidents by ECS can be divided into aground and collision. Aground accidents often involve fishing boats and small ships sailing in coastal water

area rather than general cargo ships. Most of them are aground on reefs due to the lack of modernization and use of not updated simplified electronic charts installed on the ECS such as GPS plotters. Ship's operators have to pass the obstacle with sufficient distance when sailing because there are potential errors due to the digitalization of large-scale chart. But ship's operators have blind faith about ECS without related knowledge or information.

In case of main reason of collision accident, a ships' operator sets a start point and a destination point using an ECS, and an accident occurs that collides with another ship due to negligence of look-out, drowsiness driving with alarm turned off or blind faith.

In this paper, to prevent the accident related use of ECS, I suggested usage improvement of ECS as follows.

## 5. Usage improvement of ECS and Conclusion

Although the ECS is widely used as navigation equipment in small ships or fishing boats due to its relatively low price and convenient use, it has been confirmed that marine accidents are continuously occurring because the latest introduction problems are not solved.

Therefore, in this study, I suggests realistic and practical short-term and mid to long-term improvement plan for the enhancement of reliability and prevention of marine accidents in the use of ECS.

### 5.1 Short-term proposal

#### 5.1.1 Manufacturer part: establishment of update system of simplified electronic chart for ECS

In order to present the latest electronic charts installed on the ECS at present time, the active interest and consciousness of the fishing vessels and the small vessel operators are important. Since there are no compulsory regulations for the latest introduction, there are many ships that use simplified electronic charts that are not updated. Therefore, before the laws and regulations governing the management of the ECS are made, it is necessary to make the ship operators aware of the importance of the latest update of ECS. In addition, it's required to actively cooperate with the manufacturer of ECS, the National Federation of Fisheries Cooperative and the regional office of Oceans and Fisheries to make the latest introduction work.

#### 5.1.2 Public administration part: designated "update-month" by local office of Oceans and Fisheries or the National Federation Fisheries Cooperatives

The Korea Coast Guard, the Regional office of Oceans and Fisheries and the National Federation Fisheries Cooperatives, which manage and supervise the safe

operation of the fishing vessels jointly, have designated the "Important Update Month of the ECS" to alleviate the burden on the ship owners and operators. It is necessary to induce the company to improve the credible image and publicity effect of the manufacturer by providing A/S.

## *5.2 Long-term proposal*

### 5.2.1 Public administration part: strengthen infrastructure for large-scale chart for small to medium-sized vessel

The National Oceanographic Research Institute had completed the development of electronic charts in the coastal areas of Korea until 1999 and has been supplying it since July 2007. The manufacturer of the ECS is developing simplified electronic charts based on the electronic navigational charts. However, it can be said that electronic charts, which were made by the Korean government are focused on cargo ships. Small vessels including fishing vessels mainly navigate in coastal water where there are many obstacles on the route rather than general cargo ships. Therefore, even if the technology for the production of simplified electronic charts is developed, there is still a possibility that an error may occur. Therefore, the National Oceanographic Research Institute needs to make large-scale chart larger than 5000 : 1 for improving the navigation safety of small ships by carrying out surveying on the coastal sea area where small and medium sized vessels are sailing.

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