

Automated Ship Reporting System in the Context of e-navigation

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Abstract : Ship reporting systems are used to exchange information between ship and shore. To realize the digital ship reporting concept, the International Maritime Organization (IMO) recently developed revised guidelines and descriptions of Maritime Service for ship reporting systems in the context of e-navigation. To improve the existing ship reporting system, each Administration should follow the IMO guidelines for ship reporting system. The purpose of this paper is to identify follow-up measures to be taken by the Korean Government as a member State according to the recently developed IMO guidelines in the context of e-navigation, and to present the considerations for the implementation of follow-up measures in Korea. In this study, a ship reporting system in Korea was investigated to identify the considerations for the digital ship reporting system. Consequently, a digital reporting system and digital traffic clearance were proposed and considerations for ship reporting system are presented. This paper is expected to be helpful for the safe operation of ships by presenting the considerations necessary for the implementation of an automated and standardized ship reporting system.

Key Words : e-navigation, Ship reporting system, International Maritime Organization (IMO), Maritime services, Digital ship reporting

1. Introduction

Ship reporting systems (SRSs) are used to provide, collect and exchange information through radio reports at sea. Reported information is used for many purposes including Vessel Traffic Service (VTS), Search And Rescue (SAR) operations, weather forecasting and prevention of marine pollution (IMO, 2008).

To improve the safety of navigation and reduce human errors International Maritime Organization (IMO) developed the concept of e-navigation from 2006 to 2019. The implementation of e-navigation is crucial for the continuous safety and efficiency of ships and seafarers in a world undergoing unprecedented technology-driven change. A key aim of e-navigation is to ensure that the safety of ships and seafarers remains a top priority among the often uncoordinated technology-driven changes. The initial proposal for the development of an e-navigation strategy (MSC 81/23/10) recognized that a lack of standardization on board and ashore would lead to increased and unnecessary levels of complexity and incompatibility between systems (IMO, 2005).

IMO adopted the strategy for the development and implementation of e-navigation in 2008 (IMO, 2008) and the e-navigation Strategy Implementation Plan (SIP) at the 94th Maritime Safety Committee (MSC) in November 2014 (IMO,

2014). The SIP identified five priority solutions for e-navigation implementation and outputs to be completed by 2019 (IMO, 2018).

To address e-navigation solution for means of standardized and automated reporting, IMO revised the existing guidelines and criteria for SRS in 2017 (IMO, 2017). In addition, IMO completed the development of e-navigation by adopting the initial descriptions of e-navigation Maritime Services according to the e-navigation SIP in 2019. The revised guidelines and criteria for SRS require each contracting Government to implement the revised guidelines and criteria for their SRS considering the benefits of e-navigation (IMO, 2017).

In accordance with the revised SRS guidelines and the descriptions of e-navigation Maritime Services, each Administration should establish automated and standardized SRS to suit the e-navigation environment. However, most Administrations, including Korea, are not reviewing specific follow-up measures related to the automated and standardized SRS.

The purpose of this paper is to identify follow-up measures to be taken by the Korean Government as a member State according to the revised SRS guidelines and the descriptions of Maritime Services, which were recently developed by IMO in the context of e-navigation, and to present the considerations for the implementation of follow-up measures in Korea. To identify the implementation measures, documents for decisions and discussions related to SRS in the MSC and its Sub-Committee on Navigation, Communications, and Search and Rescue (NCSR) of IMO and the

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International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) were examined. In addition, to identify the considerations for the implementation of follow-up measures in Korea, the current legal status and practical procedures of SRS according to domestic laws and regulations were investigated.

In terms of SRS research in the context of e-navigation, the Ship Reporting Task Group (SRTG) is currently activated under the leadership of the United States within the scope of the Committee of Aids to Navigation Requirements and Management (ARM) in IALA. SRTG is developing a draft amendment to the IALA Guidelines on ship-to-shore reporting from a shore perspective (IALA, 2021). In Korea, no research has been conducted on the national SRS in the context of e-navigation.

As a result, this paper proposes follow-up measures to be taken by the Korean Government and considerations for the implementation of follow-up measures in Korea. The results of this study will be helpful in promoting the policies of each administration by organizing and providing the latest trends and main content regarding the development of guidelines for e-navigation-based SRSs. In addition, it is expected to be helpful for the safe operation of ships by presenting the considerations necessary for the implementation of an automated and standardized SRS.

2. Development of SRS guidelines

2.1 Development of e–navigation strategy

In the strategy for the development and implementation of e-navigation, one of the core objectives of e-navigation is to facilitate communications, including data exchange, ship to ship, ship to shore, shore to ship, shore to shore and among other users (IMO, 2008). During the process of development of e-navigation strategy, the user needs for automated reporting functions and effective communications were identified.

User needs required that e-navigation should provide automated and standardized reporting functions for optimal communication of ship and voyage information. This includes safety-related information to be communicated amongst all users. Reporting requirements should be automated or pre-prepared to the extent possible both in terms of content and communications technology. To meet user needs, information exchange should be harmonized and simplified to reduce reporting requirements (IMO, 2008).

In addition, a clear need was expressed for an effective and robust means of communications for ship and shore users.

Shore-based users require an effective means of communicating with vessels to facilitate safety, security and environmental protection, and to provide operational information (IMO, 2008).

2.2 e–navigation Strategy Implementation Plan

The basis of the SIP is the 5 e-navigation solutions listed in Table 1. Solutions S2, S4 and S5 focus on the efficient transfer of maritime information and data among all appropriate users: ship-ship, ship-shore, shore-ship, and shore-shore. In particular, S2 (means for standardized and automated reporting) is based on effective and robust means of communication (IMO, 2018).

As part of each of the above e-navigation solutions, several sub-solutions and necessary tasks were identified to further the development and implementation of e-navigation solutions. The required regulatory framework and technical requirements for the implementation of Solution 2 were identified as tasks in the SIP. The SIP also requires that the guidelines on single-window reporting be updated (IMO, 2018).

Table 1. Five Prioritized e-navigation Solutions

Solutions	Contents
S1	improved, harmonized and user-friendly bridge design
S2	means for standardized and automated reporting
S3	improved reliability, resilience and integrity of bridge equipment and navigation information
S4	integration and presentation of available information in graphical displays received via communication equipment
S5	improved communication of VTS Service Portfolio (not limited to VTS stations)

On the other hand, 16 Maritime Services (MSs) were identified as a means of providing electronic information in a harmonized way, which is an improved provision of services to vessels through e-navigation. The proposed list of MSs includes Vessel Shore Reporting (VSR) as MS number 8.

2.3 Proposal to revise SRS guidelines

As the MSC 94 approved the e-navigation SIP, 6 outputs have been identified and prioritized, based on the original 18 tasks for the 5 agreed solutions from the approved e-navigation SIP. A revision of the guidelines and criteria for SRS (Resolution MSC.43(64), as amended) relating to standardized and harmonized electronic ship reporting and automated collection of onboard data for reporting was proposed (MSC 95/19/8) as an output regarding S2 (IMO, 2015).

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The background was that SRSs and reporting requirements were used to provide, gather or exchange information through radio reports. E-navigation Solution 2, regarding automated ship reporting, is one of the most important solutions to reduce the mariners' workload and the amount of time spending on preparing and submitting reports to shore-based authorities. To achieve this, reports should be automatically generated to the extent possible from on-board systems (IMO, 2019). However there was no harmonized standard for ship reporting by electronic means and a considerable burden was placed on the ship to complete different paper forms for different identities ashore, such as customs, immigration, and cargo manifests. As a result, MSC 95 decided to develop the "Revised guidelines and criteria for SRS (Resolution MSC.43(64))", with a target completion year of 2017 under the agenda of NCSR Sub-Committee.

2.4 Revised SRS guidelines

According to the work programme of NCSR, the revised guidelines and criteria for SRSs was adopted on June 16 2017 at the MSC 98th meeting. In the Resolution, IMO encourages Governments that operate approved SRSs to consider automated electronic reporting means recognized by IMO when reviewing their SRSs. As the revised guideline was adopted, the previous Resolutions MSC.43(64), MSC.111(73) and MSC.189(79) were revoked (IMO, 2017).

The revised guideline is associated with the regulation V/11 of the International Convention for the Safety of Life at Sea (SOLAS), 1974, and should be complied with by contracting governments when planning and proposing SRSs to IMO for adoption and subsequent implementation. Such adopted SRSs will be mandatory for all ships, certain categories of ships, or ships carrying certain cargo. In addition to the adoption of mandatory SRSs, IMO may also review and recognize the SRSs of a recommendatory nature, and contracting governments are encouraged to submit such systems to IMO in accordance with SOLAS regulation V/11. Such systems will be recommended by IMO for voluntary use in international waters if they comply as closely as practicable with SOLAS regulation V/11 and these guidelines and criteria (IMO, 2017).

The revised guidelines include the following content:

- definitions;
- general considerations for adopted SRS;
- criteria for planning, proposing, and implementing adopted SRSs by contracting Governments; and
- criteria for assessment of proposals for adoption and review of adopted SRSs by the Organization.

The revised guidelines mentioned that communication should be conducted in conformity with Resolution A.851(20) on ship reporting. However Resolution A.851(20) does not provide means of communication for SRSs (IMO, 1997). Based on e-navigation principles, SRSs should be automated using available electronic means, as recognized by IMO (IMO, 2019).

3. Maritime Service for ship reporting

3.1 Initial descriptions for Maritime Services

After extensive work over a long period of time since the development of an e-navigation strategy was proposed in 2006 at the MSC 81st meeting, the initial descriptions of MSs in the context of e-navigation (MSC.1/Circ.1610) were completed in 2019. The first version of the initial descriptions of MSs was expected to be periodically updated, taking into account developments and related work on harmonization (IMO, 2019).

3.2 Maritime Services for ship reporting

E-navigation Solution 2 "means for standardized and automated reporting" is addressed by MS 8 VSR. It is described that MS 8 provides information from shore to ship for two reporting regimes. The first regime is VSR, implemented for pre-arrival reporting. This service can cover information and guidelines related to reporting formalities and instructions (i.e., when, what and how) to a specific port. In addition, this service can be extended to the full exchange of information required in a single window SRS (IMO, 2019). The second regime is linked to a transit in an area where the SRS is established. In SRS areas, shore authorities can provide more automated and efficient reporting systems by using technologies, such as Automatic Identification System (AIS) and VHF Data Exchange System (VDES), in combination with common data structures and product specifications (IMO, 2019). Resolution MSC.433(98) on Guidelines and criteria for SRSs, recalls that communication between a shore-based authority and a participating ship should be limited to information essential to achieve the objectives of the SRS.

In the documents describing the MS 8, it is reaffirmed that the purpose of the MS is to:

- secure submission and distribution of reports required by shore-based authorities in the harmonized standard and in the required timeframe;
- reduce the administrative burden on board the ship and ashore;
- reduce the number of human errors and missing information by automating the reporting processes as much as possible; and

- provide real-time access to information to relevant stakeholders in a secure manner.

In addition, the description of MS 8 provides operational approach, user needs, associated technical services and relation to other MSs. For this, electronic systems for ship reporting should use the same protocols and product specifications, in a single window solution, to send digital pre-arrival information such as the FAL forms and other regional/national requirements, as defined in the SOLAS regulation V/11.2 for SRSs.

4. Ship Reporting System in Korea

4.1 Vessel Shore Reporting

In Korea, in accordance with the Act on the Arrival, Departure, etc. of Ships, the Port Management Information System (PORT-MIS) provides Electronic Data Interchange (EDI) and Single Window for vessel arrival reports (KLIC, 2021a). Vessels scheduled to enter port connect to PORT-MIS and submit a port arrival report form by their shipping companies or agents through the Internet. In the port arrival report, information necessary for port operation such as vessel specifications, arrival/departure date and time, last/next port of call, final destination and whether to use a tug or pilot is mainly input. Since all declarations of entry of ships entering and exiting ports are made through the Internet by shipping companies or agents, there is no need for direct reporting from ship by mariners (MOF, 2022).

However, the arrival/departure time (berthing time), which is basis on the charge for port facilities usage of ships, is manually entered in the VTS center, so it needs improvement. In the VTS center, the VTS operator or dispatched personnel from port authority writes a separate control log and is manually entering it in PORT-MIS.

In Korea, 'Single Window' is a concept that unifies reporting to multiple organizations into a single window, and is used as a different concept from reporting automation and electronic reporting by FAL Convention. A Single Window refers to a one-stop civil document submission system that can simultaneously submit civil documents related to ship entry and departure and cargo import/export to relevant authorities through a communication network once submitted in Korea (An, 2011).

4.2 Ship Reporting System

According to the Maritime Safety Act and the Vessel Traffic Service Act, when a vessel intends to enter and leave the VTS area in Korea, a report shall be made to the VTS Center through a

VHF radiotelephone (KLIC, 2020; 2021b). When the vessel enter the VTS area, the vessel shall verbally report to the VTS Center through the VHF radiotelephone at the reporting point in accordance with the VTS reporting guidelines.

The SRS is operated by the VTS Center in the Korea Coast Guard. Failure to report to the VTS center will result in penalties, such as fines in accordance with relevant laws and regulations.

4.3 Implications and Improvements

A comparison of VSR and SRS in Korea is shown in Table 2. Korea's VSR is automated in an electronic way through 'Single Window', so there is no need for improvement because it does not impose a workload on the vessel. However, since SRS reporting to the VTS is being implemented verbally through the VHF radiotelephone, there is an administrative burden on the mariners of entering and leaving vessel.

Because the contents of the VTS report are information that can be automatically checked through the AIS, it can be automated if an additional information system is installed on shore side.

Table 2. Comparison of VSR and SRS in Korea

	Vessel Shore Reporting (VSR)	Ship Reporting System (SRS)
Grounds (IMO)	Guidelines for Maritime Single Window (FAL.5/Circ.42, 2019)	SOLAS Ch.V Reg.11 Res.MSC.433(98) - Guidelines and criteria for ship reporting systems
Grounds (national law)	Act on the Arrival, Departure, etc. of Ships	Maritime Safety Act Vessel Traffic Service Act
Reporting contents (IMO)		1. ship's name 2. call sign 3. IMO number 4. position * Res.MSC.433(98)
Reporting contents (national law)	1. ship's particular 2. date of arrival/ departure 3. last port of call/ destination 4. ship owner(agent) 5. berth 6. voyage records 7. cargo description 8. number of crew 9. number of passenger 10. purpose of calling 11. voyage 12. quarantine 13. number of entering 14. tariff for port facility use 15. request for pilot/tug	1. Arrival report - date, time, berth - passing time of reporting point 2. Departure report - date, time, berth - passing time of reporting point 3. Shifting report - place, date and time
Communications	Internet	VHF Radiotelephone

5. Proposal for Automated Ship Reporting

5.1 Automated Vessel Shore Reporting

Automated VSR is already in place in Korea. Furthermore, Korea has a well-established PORT-MIS system capable of single-window reporting, thus, all reports on entry of ships entering and leaving ports are made through the Internet on shore by shipping companies or agents, and there is no case of direct reports from ships. However, because the ship's berthing time is manually entered in the VTS center, it is only necessary to adopt measures to automatically recognize the berthing/unberthing time by linking with the AIS data.

5.2 Automated Ship Reporting System

(1) Digital reporting system

To reduce the administrative burden of verbal reports, reports from the vessel to the VTS Center should be converted from voice to digital. According to the revised guidelines for SRS, the communication system should enable the shore-based authority and the participating ship to exchange information. Communication should also be clear and simple and avoid imposing an undue burden on masters, officers of the watch and pilots. The initial report required from a ship entering the area should generally be limited to the ship's name, call sign, IMO identification number (if applicable), and position. These data can be automatically digitally identified by the VTS Center through AIS and PORT-MIS; therefore, there is no need to report directly from the ship through the VHF radiotelephone.

Similarly, arrival, position and movement reports should be converted to a digital format instead of a verbal report. Therefore, an information exchange application that can exchange AIS information, PORT-MIS, and ship data should be installed in the VTS Center. Fig. 1. illustrates the concept of a digital ship reporting tool to realize automated and standardized SRS in an e-navigation environment.

(2) Digital traffic clearance

Traffic clearance should be achieved through digital information exchange between the ship and the VTS Center in advance. The description of MS for the Traffic Organization Service of VTS exemplifies the case of vessel departure clearance in e-navigation environment (IMO, 2019). When the vessel is ready to sail, it sends its planned departure time digitally to the VTS, which is presented in the VTS application. The application alerts the operator to upcoming traffic conflicts and advises on a solution, which is assessed by the VTS. The VTS operator takes action and digitally instructs the vessel to delay planned departure. The instructions are graphically displayed in applications, and acknowledged by the vessel and the VTS operator provides delayed departure information to other traffic via digital and/or verbal means for vessels that cannot receive information digitally. For this, an application that can digitally send departure information to the Electronic Chart Display and Information System (ECDIS) or Integrated Navigation System (INS) is required in the navigating bridge of the ship, and an application that can exchange information with the ship should be installed at the VTS Center.

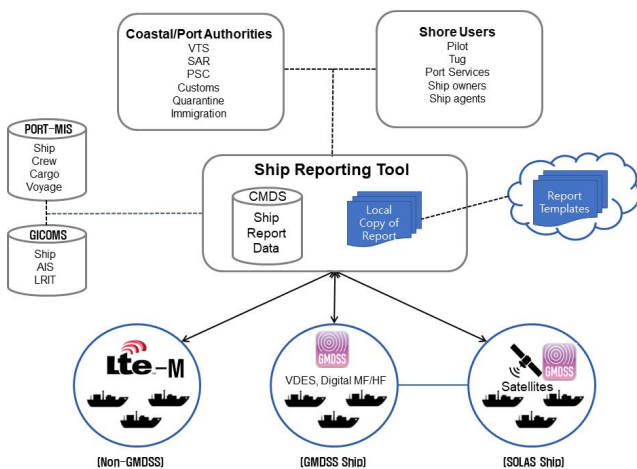


Fig. 1. Concept of Digital Ship Reporting Tool.

5.3 Further considerations

(1) Communication network

It is necessary to improve the communication network for the operation of SRS. In the communication method, the communication network environment for e-navigation MSs and the status of Global Maritime Distress and Safety System (GMDSS) modernization being developed by IMO should be considered. Currently, the communication means used in SRS are VHF, AIS, an Internet-based reporting system, email, fax, SATCOM, a mobile phone, and a combination of these. It is expected that digital GMDSS communication networks, such as VDES and Digital MF/HF will be available in the future according to GMDSS modernization plan. However, because the transmission capacity and data format are different for each system, the possibility of

developing a standardized protocol along with product specifications to automate the collection of data from ships and transmission to land authorities is a practical issue. Above all, because the Long Term Evolution for Maritime (LTE-M) method of maritime mobile communication network that can communicate 100 km offshore has been established in Korea (An, 2015), it is necessary to use LTE-M in SRS.

(2) Regulations and guidelines

Regulations and guidelines for the operation of e-navigation-based digital SRS using the LTE-M should be established. In Korea, through the Korean-style e-navigation development project, Korean e-navigation MSs are being implemented based on the LTE-M communication network since 2021. However, MSs related to the SRS are not yet been implemented in Korea. For the operation of the LTE-M-based automatic reporting system, the regulations for the operation of SRS should be revised, and guidelines on the data format and transmission method of the reporting system should be prepared.

6. Conclusion

E-navigation aims to provide a digital information environment to mariners to enhance the safety of navigation. To realize a digital information environment, the development of an e-navigation has been conducted in the scope of IMO over the last decade. Various guidelines and recommendations for performance standards have been developed to implement e-navigation SIP.

In an effort to implement an e-navigation strategy, IMO addressed a solution for means for standardized and automated reporting. Each Administration is invited to follow the IMO's guidelines for SRS in order to realize the e-navigation. This paper identified follow-up measures to be taken by the Korean Government as a member State to meet the requirements of IMO on SRS and presented the considerations to be concerned with the implementation of follow-up measures in Korea.

Since automated and standardized ship reporting is very important for the safe navigation of ships and reduction of the burden of mariners, the Administration of each country should establish and operate an SRS suitable for their own circumstances according to the IMO guidelines. To design a Korean-style ship reporting tool, it is necessary to investigate user requirements of target stakeholders, such as mariners, VTS operators and pilots.

Further research work is required to investigate such user requirements and system design.

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