

A Study on East Asian Regional Electronic Navigational Chart Coordinating Center Establishment Strategy

Ho-Yoon Kim^{*†} · Se-Woong Oh^{**} · Woo-Sung Shim^{**} · Sang-Hyun Suh^{**}

^{*}, ^{**} Marine Safety & Pollution Response Research Department, Korea Ocean Research & Development Institute, Daejeon, 305-343, Korea

동아시아 전자해도 지역 공급센터 구축방안 연구

김호윤^{*†} · 오세웅^{**} · 심우성^{**} · 서상현^{**}

^{*}, ^{**} 한국해양연구원 대덕분원 해양안전·방제기술연구부

Abstract : International Maritime Organization made International Convention for the Safety of Life at Sea to require all ships to carry official charts, both paper and electronic, and is especially encouraging the use of Electronic chart display and information system (ECDIS). Recently, the argument that all Electronic Charts(ENC) displayed in ECDIS should be distributed through Regional ENC Coordinating Center is being raised within the IHO. The use of ECDIS was generalized, but the existing two RENCs in Europe are thought to be not enough. Especially, East Asian region, due to its rapid growth in economy and marine traffic, RENC is found necessary. This research establishes the legitimacy and strategy of East Asian RENC by defining the roles of RENC based on the IMO ECDIS Mandatory Carriage Requirement and RENC operation status through suggesting a "Phase-In" RENC model, which was built upon the strategy of East Asian Hydrographic Commission(EAHC).

Key Words : Electronic Navigational Charts, Regional ENC Coordinating Center, ECDIS, EAHC, East Asian RENC

요 약 : 국제해사기구(IMO)의 해상인명안전조약(SOLAS)은 모든 선박이 필수적으로 공인 종이해도, 혹은 전자해도(ENC)를 탑재해야만 한다고 명시하고 있으며, 특히 안전성이 검증된 전자해도 디스플레이 시스템인 ECDIS의 사용을 장려하고 있다. 국제수로기구 내에서는 이러한 ECDIS에 사용되는 공인 전자해도 자료가 지역전자해도 관리센터(RENC)를 통해 보급되어야만 한다는 주장이 커지고 있다. 전 세계적으로 ECDIS의 사용이 일반화되면서, 유럽에 현존하는 두 RENC만으로는 부족하다는 문제점이 제기되었다. 특히, 급격한 경제성장과 더불어 증가하는 아시아 지역의 통항량은 동아시아 RENC의 필요성을 증명하였다. 본 연구는 2012년에 발효되는 IMO의 ECDIS 강제탑재조건과 현재 RENC의 운영 상황을 바탕으로 RENC 역할의 정의함으로써, 동아시아 수로 위원회의 전략을 참고한 동아시아 지역 독자적 모델(Phase-In)을 통한 RENC 설립의 당위성 및 전략을 연구하였다.

핵심용어 : 전자해도, 지역 전자해도 관리센터, 전자해도 디스플레이 시스템, 동아시아수로위원회, 동아시아지역 전자해도 관리센터

1. Introduction

Safety of navigation and mariners is something that cannot be compromised, thus it is important that every ship is equipped with adequate aids for navigation, especially navigational charts. WEND(Worldwide Electronic Navigational Chart Database) is structured under the International Hydrography Organization to comply with the Safety of Life at Sea(SOLAS) Convention, which requires all ships to carry official, up-to-date charts.

In the 1st WEND Working Group Meeting held in Australia, October 2011, the principles of the WEND was

amended, which affected the entire realm of the maritime safety and navigation system. Some of the most essential contents is the support of Mandatory Carriage Requirements for ECDIS, the electronic chart display and information system according to Chapter V/19 of SOLAS. The data that becomes the basis of the ECDIS is official electronic navigational charts(ENCs). However, there are problems of ENCs worldwide. The ENCs produced from each country are inconsistent, low-quality, often unofficial, and the participation level of countries is poor. Consequently, the integrated effort of IHO member states, ENC producer states and coastal states is required in order to accomplish sufficient coverage of consistent, high-quality, available ENCs.

[†] Corresponding author : yoony207@kordi.re.kr, 042-866-3692

These cooperative arrangements constitute basically what is called 'Regional ENC Coordinating Center(RENC)' in the WEND conceptual model. They can be regarded as an extension of the cooperation between Hydrographic Offices (HOs) set out in the IHO Convention, with the specialization on ECDIS-related services(Hecht, 2009).

However, the immediate implementation of the mandatory carriage requirement from 2012 to 2018 is expected to result in higher international demand for ENC coverage and ECDIS, including more expanded role of the RENCs. Therefore, a new system should be implemented for there must be limitations with only two RENCs existing in Europe.

This paper discusses the strategy of establishing a new RENC, specifically, in East Asian region according to its necessity and effectiveness to improve the current ENC coverage status worldwide.

2. Definition of RENCs

2.1 Definition of RENCs

In order to understand the Regional ENC Coordinating Center, it is important to note the definition of ENC. IMO defines ENCs, or electronic navigational charts, as database that contains all the chart information necessary for safe navigation and may contain supplementary information in addition to that contained in the paper chart(e.g. sailing directions) which may be considered necessary for safe navigation.

This ENC data is stored and processed to be displayed onboard through Electronic Chart Display and Information System or ECDIS(Fig. 1).

The term RENC was coined in the IHO WEND principle as the Regional ENC Coordinating Center. RENCs are organizational entities where IHO members have established co-operation amongst each other to guarantee a world-wide consistent level of high quality data, and for bringing about coordinated services with official ENCs and updates to them (IHO, 2005). Simply put, RENC is one of the supply agencies of electronic navigation data services. It receives the inconsistent ENCs produced by individual HOs and uniform them to provide better quality service to the users. Also, RENCs exchange their data so that RENCs can deliver virtually worldwide data ENC coverage. They deliver their data services using data distributors, supplied on data CDs or online(Hecht, 2011).

Thus, the role of RENC can be divided roughly in to two categories: Quality assurance and distribution of ENC for ECDIS, including the required updating services.

Another important role that RENC may take over is to create the 'official ENC coverage' to run in the ECDIS system. Previously, to be considered 'official' chart data must meet two requirements:

- 1) One that it is authorized by a national government agency, normally the national Hydrographic Office
- 2) One that it meets the specifications of the IHO(Hecht, 2009).

However, the current members of the IHO are thinking over the possibility of putting RENC as a mandatory standard for official ENC data. Although it cannot be enforced since the idea itself is being opposed by several member states, it is difficult to deny that the importance of RENC is being emphasized.

2.2 Operation Status of RENCs

Currently, there are only two RENCs in operation. One is PRIMAR Stavanger operated by the Norwegian Hydrographic Office and the other is International Centre for ENCs (IC-ENC) operated by the British Admiralty. These two RENCs were formally a single RENC organization under the name of PRIMAR until 2001 due to financial difficulties, which Norway could not manage alone. Therefore, cooperation between hydrographic offices on issuing ENCs had been formally established through a bilateral agreement between UK and Norway, and a 'Cooperation Arrangement(COA)' between the Cooperating HOs(CHOs)(Hecht, 2009).

In 2002, these two RENCs separated since they take quite different methods to secure their operation budget. For instance, IC-ENC's distribution mechanism is based on a

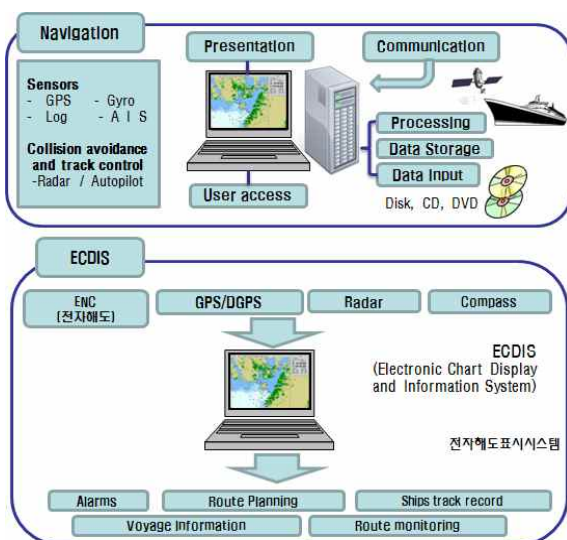


Fig. 1. Basic components of ENC and ECDIS.

limited number of Value-Added-Resellers(VARs) that are willing and capable to encrypt the data they receive from IC-ENC and to provide own-branded comprehensive services(Fig. 2).

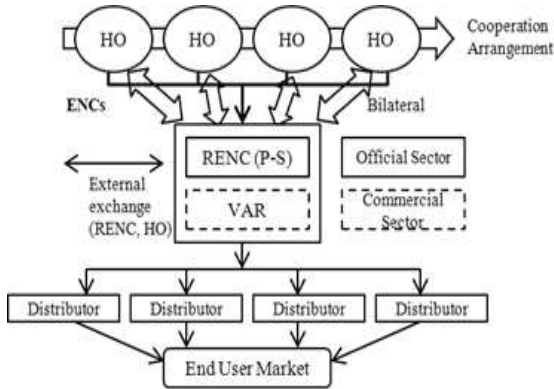


Fig. 2. Set-up for RENC PRIMAR-Stavanger(P-S) type.

PRIMAR, on the other hand, is based on a not-for-profit model. The cost is covered by the ENC sales and no governmental funding is received(IC-ENC, 2012). Instead, it combines the both functions of a RENC and VARs in one organization and supplies the encrypted service by itself through a network of distributors(Fig. 3).

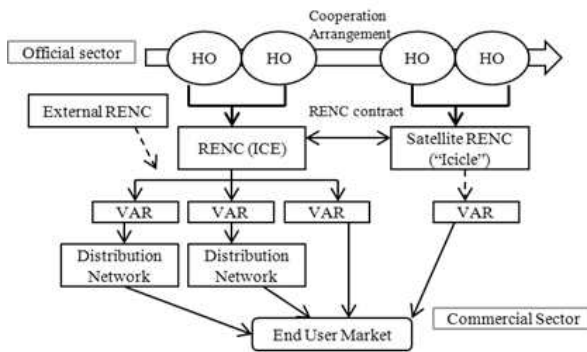


Fig. 3. Set-up of RENC of IC-ENC(ICE) type.

The two RENCs have been competing with each other with overlapping memberships and different operating systems. However, over the last two years, there has been both internal and external movement to develop a co-operating relationship between the two RENCs. Although the current RENCs were divided due to the difference in operation system and financial issues, the integration and cooperation between these organizations are found necessary because of the recent events regarding ENC coverage.

In addition, the concept of virtual RENC has been recently raised as well. In a virtual RENC, ENCs and their updates

would be directly delivered by the producing HOs to the end-users through commercial distributors without the actual “RENC” entity. Instead, a coordinating body would define the continuous national ENC data sets of the region and would ensure that all ENCs made available are harmonized(Huet, 2001).

Despite the existence of the two RENCs, there is a number of recurring issues related to ENC coverage, consistency and availability. There are gaps in coverage that is either neglected or too sensitive to be resolved in a short period of time. The areas where ENCs are unavailable to support international voyages include some States in the Caribbean frequented by cruise ships, sections of the coast of South America, the coast of China and some sections of the coastline in East Asia, sections of the coast of South America, sections of the coast of Africa, and numerous small Island States in the Pacific(IHB, 2009).

According to the IHO published RENC implementation (IHC, 2009), although the IHO reaffirmed its commitment to the WEND Principles at the 17th IHC, the progress in the implementation of RENCs has been slow.

First, less than half of IHO Member States apply the WEND principles through RENC membership, including the fact that only two RENCs have been formally established, although there are constant efforts being made in several regions on this issue. Also, both existing RENCs request HOs independently for providing world-wide coverage as opposed to the region-based WEND model(IHO website, 2012). The drawbacks of this situation are explained in the IHB report:

- ENCs which are not distributed through a RENC do not benefit from the holistic harmonization checks and feedback that RENCs can provide;
- ENCs which are not distributed through a RENC are only available to particular service providers and do not get the widest possible distribution.

With the implementation of Mandatory ECDIS Carriage Requirement from 2012 and the ENC coverage issues that threatens the safety of navigation demands a stronger, and wider role of RENC, most likely establishment of additional RENCs in non-European region.

2.3 Domestic ENC Distribution

ROK started to develop ENC domestically since 1995, when an accident happened to an oil tanker “Sea Prince” and

caused damage amount to 14 billion won(Approximately 12 million US dollars). This incident emphasized how necessary the new form of navigational safety system is and became the cause of intensive ENC development(KOHA website, 2011).

Currently, Republic of Korea is member and distributor of existing RENCs, both PRIMAR and IC-ENC. Moreover, ENC are published to the international sector but they also publish ENCs for their internal use and distributed for that purpose only through domestic routes.

As in Fig. 4, there are three core bodies that take part in the domestic ENC distribution in ROK. There are KHOA (Korea Hydrographic and Oceanographic Administration), a governmental organization, KOHA(Korea Oceanographic and Hydrographic Association), and two agencies: KODC(Korea Ocean Development Co. Ltd) and EMLX(E-Marine Logix, Hyundai). KHOA publishes the domestic ENC data and KOHA distributes them to the End User Service Provider. When the user desires Foreign ENC data, both KODC and EMLX would receive the necessary ENC from VARs under RENCs.

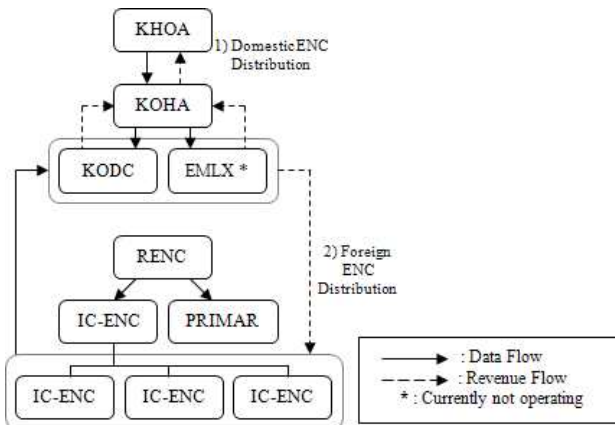


Fig. 4. ENC distribution system in ROK.

KOHA has completed developing the ENC coverage of coastal areas during 1995 to 1999 and started distributing in July, 2000. They are publishing new or updated ENC every year to maintain the up-to-date navigation data and are currently managing 335 cells of ENCs. However, in 2011, EMLX stopped the ENC distributing service, which resulted in the monopoly of KODC in the market.

At this current stage, ROK is still mostly depending on the European RENCs to distribute foreign ENCs, despite its heavy international marine traffic. They are constantly making effort to develop their own as a replacement but it is difficult without an independent East Asian ENC Coordination Center.

3. East Asian RENC Establishment Strategy

3.1 Significance

The necessity of RENC in East Asian region is called upon for following reasons:

1) Regional positioning RENC: The current RENCs are all concentrated in the European area; consequently, their geological position hinders the RENCs from fully understand and apply adequate measures of Asian region. Therefore, decentralization of RENCs concentrated in European region is necessary.

2) Traffic increase in East Asian ocean: East Asian countries are experiencing the most rapid economic growth and trade volume in the world. As the graph shows below, the volume of international trade among EAHC Member States is much higher compared to those of the European Union and the United States(Fig. 5).

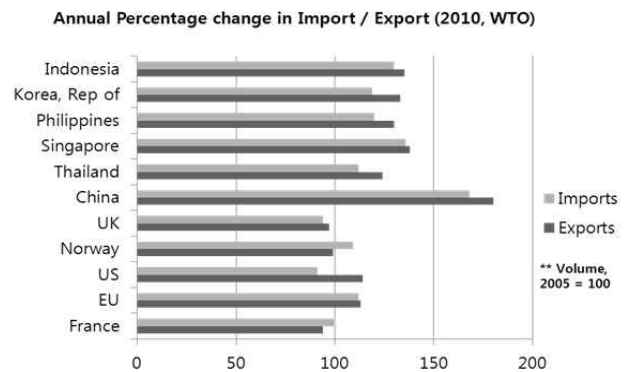


Fig. 5. Annual Percentage change in trade, 2010.

According to the IHO, the overall world tonnage is 500 million, excluding the non-IHO Member States. Meanwhile, the East Asian Hydrographic Committee(EAHC) is responsible of 215 tonnages, which is approximately half of the entire world tonnage. These 9 countries of East Asian region are some of the greatest recipient of ECDIS and the system including the RENCs, but at the same time, they should be the most important provider of nautical information.

As the graph shows, the volume of the international trade of EAHC member states is much bigger compared to those of the European Union and the United States. One can expect the same result in marine traffic volume as well. This economic trend is one of the top reasons that require East Asia to have greater responsibility in maritime safety and ENC coverage, including development of navigational technology.

3) Coverage issues: there are unresolved gaps and overlaps in the regional ENC coverage that should be taken care of (Fig. 6). Not only the ENC gaps of some of the major ports and coast of China, there are issues of overlapping ENCs concentrated in East Asia. These should be resolved urgently, for it may be come a threat to the safety of navigation.

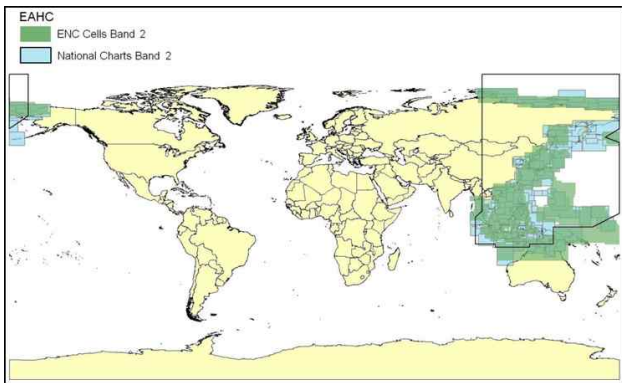


Fig. 6. EAHC ENC gap analysis for WEND-WG.

4) Identified Anomalies of ECDIS reported: Recent reports on identified anomalies while operating ECDIS raised serious safety issues that require strict quality management and ECDIS maintenance. These anomalies have potentially significant implications for safety of navigation when using ECDIS as the primary means of navigation. The main problems include:

- Significant hazards not displayed in Standard Display mode
- Warning alarms not activated (e.g. Grounding, Ship Wreck, Obstruction)

The solution on the maintenance and updating of complex computer-based ECDIS is required.

5) Capability: From resource to technology, there is constant capacity building effort being made, such as EAHC and ROK's fund donation and contribution to CBSC, workshops.

The East Asian region is gradually, showing progress in overall hydrographic and cartographic area, although its level is not reaching the speed of its economy and marine transport volume. However, constant effort has been made to build adequate capacity for full ENC coverage and quality, which led to necessity of an independent RENC in East Asia.

3.2 Establishment Plan and Strategy

3.2.1 Conditions for Proposing RENC

There are several conditions for proposing an RENC. First it needs a leader and a coordinator who possess relative expertise in the RENC or hydrography organization, in order to progress the EARENC establishment scheme. Other technical conditions regarding the management system, mechanism, quality assessment process, commercial distribution, and capacity building should be considered thoroughly for its future operation and participation of other member states and potential users is needed (Oei, 2005).

3.2.2 Formal EARENC model

There have been opinions and attempts to develop a RENC in the East Asian region. There were no actual RENC established, but EAHC has previously achieved ENC production, merging, quality assurance and updating through South China Sea (SCS) ENC.

According to the SCSEAHC, South China Sea Electronic Navigational Charts East Asia Hydrographic Commission, SCS is one of the world's busiest international sea lanes. More than half of the world's supertanker traffic passes through the region's waters. Over half of the world's merchant fleet (by tonnage) sails through the SCS every year.

They have established a Task group to carry out small scale ENC production covering the SCS. This was the first successful cooperation project of EAHC to resolve the lack of official and high quality small scale ENCs of the SCS. Based on this experience, at EAHC-RENC workshop 2005, a RENC model for East Asia was suggested.

Fig. 7 below depicts the main functions of RENC as quality assurance, management, updating, and distribution. The function to resolve ENC anomalies was added to the original model since it is considered to be an essential function of RENC potentially.

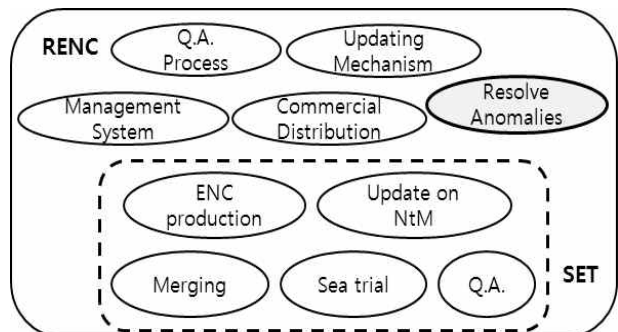


Fig. 7. EAHC-RENC model.

3.2.3 “Phase-in” Model

Regarding the current situation, including the limitation in budget, distribution network, or other resources, it is realistically impossible to expect a fully-operating East Asian RENC immediately. However, there is an urgent necessity of RENC to resolve ENC gap and overlap issues. Therefore, it is recommended for East Asia to implement a new RENC model: “Phase-In Model”(Fig. 8).

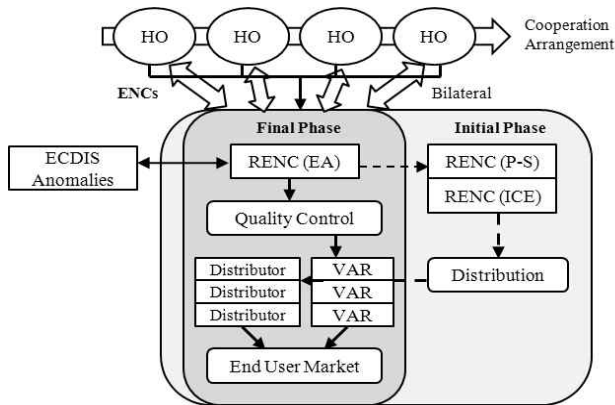


Fig. 8. “Phase-in” model of EARENC.

In this model, as its name implies, an RENC takes a step-by-step implementation of RENC functions following a prioritized order, which is from quality control to distribution.

Initially, EARENC will focus mainly on the quality control of ENC coverage. It is important to acknowledge the current status and analyze the main issue that East Asia is facing. Quality Management should be the most prioritized task that the EARENC should perform. ENC gap and overlap is a serious problem around the certain areas of East Asia(e. g. South China Sea etc.) and for the sake of navigation safety, it is an issue that should be solved as soon as possible. In order to accomplish this, the RENC should concentrate immensely on the issue of quality control of the current ENC coverage.

Distribution of data is relatively a less important issue, and moreover, establishing a stable, wide distribution network requires time. In the initial stage of EARENC, it is difficult to expect a distribution network that could satisfy the users around the globe. Therefore, the RENCs are called upon to cooperate. EARENC will concentrate on assessment and unification of ENC coverage, and send it to the existing RENCs, PRIMAR and IC-ENC, which already established their own distribution channel over time. This way, it increases the efficiency by enabling the EARENC to concentrate on resolving the most serious issues regarding quality management and concern less about the task of

distribution. However, this is only a transitory method until the second phase.

During the second phase, when the RENC establishes its own adequate distribution channel over time, it will gain its own independence and distribute ENCs through its own channel, most likely on-line. Complying with this model, EARENC will be able to solely concentrate on the very core functions of RENC.

It is important to define the model that EARENC is going to follow during the second phase. While it is independent from the other RENCs, at the same time, it requires cooperation with VARs and distributors. So whether to follow the model of IC-ENC or PRIMAR is an important issue to consider. If the EARENC concentrates mainly on the quality management, the best suitable model will be that of IC-ENC. Regarding the problem of distributing within the RENC such as PRIMAR may not be the best option since they are opposite to each other. It is costly and time consuming to do the task that they did not specialize in. It may be more efficient and less costly. Therefore, instead of functioning both as quality management and distribution, all together, it is better to establish a distribution network consisted of VAR, which is the model that IC-ENC is currently adopting. However, EARENC cannot simply replicate the network system of IC-ENC distribution system since it will overlap and be redundant for the users. It is essential to differentiate it from the existing system, through a regionalization process for the adequate model for East Asia.

Uniqueness of this model is that it is designed under the assumption of RENC-to-RENC cooperation and depends on the other RENCs. Also, it has clearly defined the role and purpose of the organization and is aiming to specialize in the certain essential function. This way, it is possible to ultimately provide specialized high-quality service to the users.

In addition, as the ECDIS anomalies are recently brought up as an urgent issue that should be resolved, it was considered effective to connect the function of quality control to resolving anomalies during ECDIS operation.

3.3 Expected Complications

The problem that the EARENC might face is the transitory process from the Initial Phase to the Final Phase, since there will be complications or confusions while switching its distribution system. The related authorities should provide a specific guideline beforehand regarding this issue so the transition process can be implemented smoothly without confusion.

Other challenges that EAHC foresee include:

- Harmonization and distribution of ENCs
- Immediate implementation of Mandatory Carriage of ECDIS
- Educating the Users
- Uniformed Pricing

These problems may be resolved either domestically or internationally with external support. Most importantly, this strategy requires the full support from the remaining other RENCs. Without their cooperation, this model cannot be initiated in the first place. Therefore, this process requires the support from IHO, HOs, member countries, and RENCs. According to phrase 6 of CONF.EX4/INFODOC.2, IC-ENC and PRIMAR offer their assistance to any IHO Member State or group of IHO Member States wishing to set up a separate RENC at a later stage and in phrase 7, it is stated that new RENCs should be established, if possible, in alignment with RHCs and should operate as additional regional nodes of a RENC-to-RENC worldwide network.

At the same time, EAHC should be open to any advice from the IMO and IHO, including the member states and existing RENCs on the matter of establishing the EARENC. Since East Asia lacks the experience of establishing and operating a RENC, it is essential to adopt the experiences that the other countries are willing to share.

In the domestic realm, it is important to arouse decision makers' attention to the importance of RENC establishment. Active participation of government authority should be an immense support for continuing the EARENC scheme. This includes the participation of other government authorities of East Asian region as well. In order to achieve this, regional HOs should appeal to the government and high authorities for their interest in this project.

In the case of ROK, the government may consider being the leading role in the project, by collecting the consent from the EAHC member states and inviting them to the meeting table to proceed with the plans in a realistic manner.

However, there are positive opinions regarding the success of EARENC establishment. According to Dr. Oei of EAHC, the possibility of EARENC is fairly high since EAHC has already succeeded in many critical issues that require regional cooperation.

Especially, the success of South China Sea Project proved that the member states have shared vision, commitment and cooperation, establishing quality assessment and updating procedures, and links with users(Oei, 2005).

4. Conclusion

The Mandatory Carriage Requirement of ECDIS in 2012 is expected to change the entire mechanism regarding navigation in open waters, whereas RENC has become a necessary component in order to provide the official ENC data.

The distribution of official ENC and its quality management is covered by only two RENCs in Europe, and in order to manage the ECDIS worldwide, there is limitation consequently. Regional decentralization, increasing marine traffic and unsolved ENC gaps in Asian ocean required establishment of a new RENC in East Asian region. Also, anomalies were reported during the use of ECDIS and resolving this issue is one of the functions that the newly built RENC should have.

There have been optimistic views on the possibility of EARENC since EAHC has already succeeded in various issues that require regional cooperation and hydrographic technology. However, despite the previous attempts of EAHC to establish a RENC in East Asian region, it was never accomplished.

In order to make the scheme plausible, active cooperation of the Member States and adequate mechanism, such as the "Phase-in" model, are required.

This is a project that would not only benefit the users of the East Asian region but the entire navigators and related users worldwide. This should be considered as a long-term project and as the navigation technology evolves, additional studies will allow the mariners to respond immediately to the rapid changes that occur in the coastal area as well. Overall, the top priority is to concentrate on the quality management of the current ENC coverage for its consistency and accuracy, protecting both safety of the mariners and marine environment.

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