S-100WG3-6.10

Paper for Consideration by S-100WG3

Creation of S-101 Datasets and lessons learned

Submitted by:	Republic of Korea (KHOA)
Executive Summary:	KHOA produced a prototype of S-101 ENC through the S-100 Testbed project. This document introduces the outcome of such development and experience gained from it.
Related Documents:	S-101 Product Specification
Related Projects:	IHO S-100/S-101 Testbed Project, KHOA S-100 Test Bed Project

Introduction / Background

To develop S-101 Product Specification (PS), S-101 PT, a subsidiary body of S-100WG, is developing the content of the PS, DCEG, Feature Catalogue, Portrayal Catalogue, Validation rules and Protection Scheme. Furthermore, S-57 to S-101 Converter and S-101 Simple Editor were developed with the S-100/S-101 Testbed project. KHOA is carrying out the S-100 Testbed project and it includes producing a prototype of S-101 ENC. In 2017, we created a prototype of S-101 ENC in Busan Port area and would like to share the experience gained from it.

Analysis/Discussion

Tool and procedure for producing the prototype of S-101 ENC

As for tools for developing S-101 ENC, there are S-57 to S-101 Converter by NOAA/Esri and CARIS Composer 3.1 which includes the function for editing S-101 ENC. KHOA research team defined the two procedures as below:

(1) Procedure 1

Tools	S-57 ENC Editor	⇒	NOAA/Esri S-101 Converter	⇒	S-101 Simple Editor
Step	Edit S-57 ENC		Convert S-101 ENC		Edit S-101 ENC
Note	Needs pre-work such as structuring		Edit mapping table for automatization		Edit S-101 features and attributes

(2) Procedure 2

Tools	CARIS Composer 3.1	⇒	CARIS Composer 3.1	⇒	CARIS Composer 3.1
Step	Create S-101 cell base		Convert S-101 (import and copy S-57 ENC)		Edit S-101 ENC
Note	Create cell coverage and meta information		Edit mapping table for automatization		Edit S-101 features and attributes

KHOA research team reviewed the two proposed procedures and developed the prototype of S-101 ENC using CARIS Composer 3.1 in procedure 2, taking into account S-101 DCEG is ongoing and much editing of S-101 ENC is needed.

Outcome of producing S-101 ENC prototype

KHOA planned to develop S-101 ENC prototype by comparing Feature Catalogue included in CARIS Composer 3.1 with S-101 DCEG thus followed the procedure below:

- Prepare S-57 ENC
- Edit and apply Feature Catalogue according to the latest DCEG
- Create new S-101 product profile
- Edit converting rules related to Feature Catalogue
- Import S-57 ENC data applied with converting rules
- Edit additionally according to S-101 DCEG
- Develop prototype of S-101 ENC

The prototype area was 15 S-57 ENC cells (band 6: 11 cells; band 5: two cells; band 4: two cells) at the Busan Port. The area is shown in Figure 1.

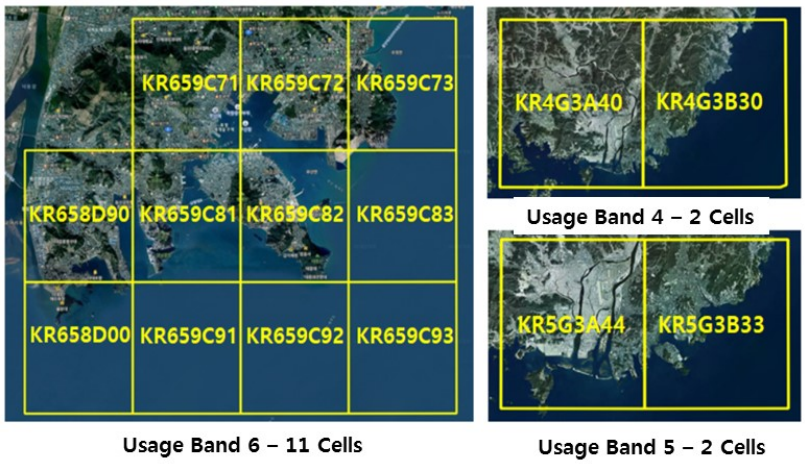

Fig. 1 Prototype area of S-101 ENC

Major issues with the creation of S-101 ENC

(1) Changing SOE (Skin Of Earth) features
There were changes to SOE features on S-101 ENC: Hulk, floating dock and pontoon in S-57 were changed from Group 1 to Group 2 and dock area and lock basin in S-57 were changed from Group 2 to Group 1 so editing was required.

Table 1. Changes to SOE features

S-57	Note	S-101	Note
Depth Area		Depth Area	
Dredged Area		Dredged Area	
Land Area		Land Area	
Unsurveyed Area		Unsurveyed Area	
Hulk	Group 1 → Group 2	Dock Area	Group 2 → Group 1
Floating dock	Group 1 → Group 2	Lock Basin	Group 2 → Group 1
Pontoon	Group 1 → Group 2		

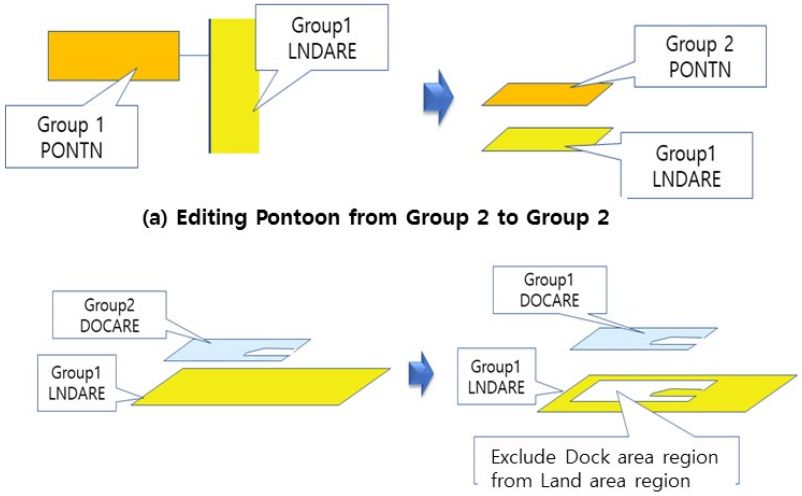

Fig. 2 Example of editing SOE feature types

(2) Data Coverage

M_COVR feature in S-57 shows the existence of data in cell area and is converted to data coverage in S-101. Meanwhile S-57 uses M_CSCL (compilation scale of data) feature and inputs it when including an area which has

different editing scale of cells so M_COVR and M_CSCL features are overlapped in Figure 3. In S-101 M_CSCL feature is converted to data coverage feature, thus M_CSCL area needs to be excluded from M_COVR area to ensure they are not overlapped.

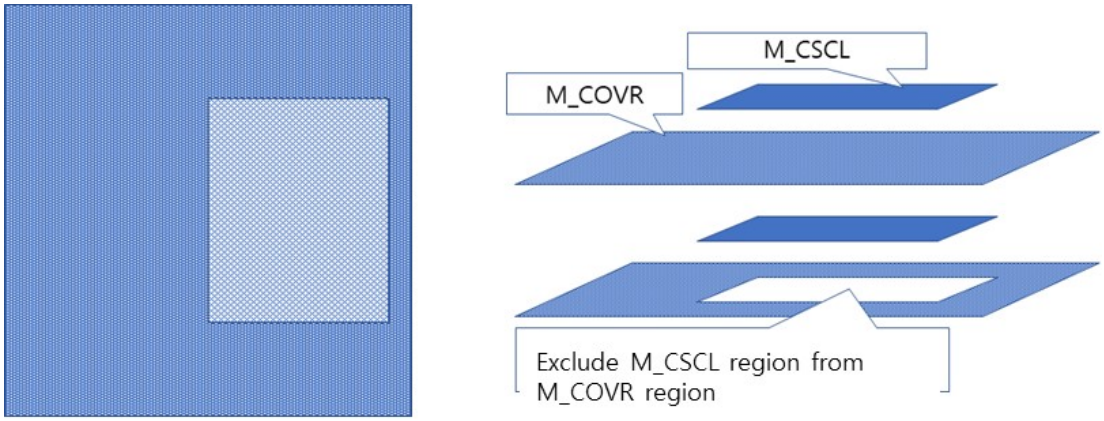

Fig. 3 Case of M_CSCL and M_COVR

(3) Feature types which need editing after converting S-57 to S-101 ENC

It was found out the following feature types require additional editing with S-101 ENC editing tool after converting S-57 ENC to S-101 ENC:

Table 2. Feature types requiring editing after converting from S-57 to S-101

S-101 ENC Feature type	Relevant S-57 Object types	Note
Data Coverage	M_COVR + M_CSCL	
Deep Water Route	Deep water route and Deep water route part are separated	
Fairway system	FAIRWY	
Information Area	CTNARE, etc.	
Island Group	LNDARE	
Range system	RECTRC, NAVLNE	
Span Fixed	BRIDGE	
Nautical Information	-	
Traffic Separation Scheme	TSSBND, TSSLPT, etc.	
Two-way route	TWRTPT	
Update Information	-	
Vessel Traffic Service Area	ADMARE	

(4) Items requiring editing due to deleted features and attributes

It was found out some items require pre-editing due to deleted feature and attribute types after converting S-57 ENC to S-101 ENC:

Table 3. Items requiring editing due to deleted features and attributes

S-57 Feature	Content	Deleted Attributes	Solutions
M_SREL	Name of fair sheets	Feature	Information Type
TESARE	Territorial sea of the ROK	INFORM NINFOM	Insert country acronym 'KR' in Nationality attribute of Territorial sea area feature
FOGSIG	Send a signal every 15 seconds (English & Korean)	INFORM NINFOM	Signal period Signal sequence Can present as 'multiple attributes'
All of Geo Feature	Update information	SORIND SORDAT	Replace attribute information with 'Update Information' feature information

	Additional explanation	INFORM NINFOM	Replace attribute information with 'Natural Information' feature information
CTRPNT	Triangulation point and the height of mountain	CTRPNT feature	Replace with Land Elevation feature and input the height of mountain and name

(5) Outcome of reviewing cautionary notes

Warnings on ECDIS were excessively sent out due to overuse of Caution Area feature. To coordinate this, information which does not require ECDIS warnings is made into Information Type feature. Having surveyed the status of using CTNARE in Korean ENCs, it was found out they included information on magnetic anomaly, cautions on changes to tidal current and bathymetry, fishing nets and marine farms. Corresponding information was replaced with features and information which does not require ECDIS warnings was matched with Information Type feature.

Table 4. Examples of analyzing cautionary notes and their solutions

Cautionary notes	Content	S-101 Feature type
Magnetic anomaly	Caution (around Musudan, irregular local magnetic anomaly at magnetic declination of 2° W appears sometimes)	Local Magnetic Anomaly + Nautical Information
Changes to tidal current	Tidal currents near A and B are high tide but after three hours they become low tide and flow to SE for three hours and to NW for the rest of hours.	Tidal stream panel data + Nautical Information
Prohibiting fishing activities	Mines were buried in No. 9 Russian sea area during the WWII thus anchoring and fishing activities are prohibited.	Information type
Traffic safety specific area	Traffic safety specific area	Information type
Changes to river and estuary bathymetry	Depth and sand bar near Nakdongpo can change due to earth and sand coming from Nakdong River.	Information type

(6) Features requiring editing due to changes to collection features

In S-57 11 features and relationships in Table 5 need to be set using C_AGGR and C_ASSO features but in S-101 collection feature types have become many so editing work has increased.

Table 5. Status of applying S-57 Collection features

Relationships Features	Collection Features	ROK Status
Mooring trots	C_AGGR	X
Measured distances	C_AGGR	O
Traffic Separation Schemes systems	C_AGGR	O
Navigation lines and tracks	C_AGGR	O
Navigation lines, tracks and dangers	C_ASSO	X
Synchronised lights	C_ASSO	X
Airfield, airport, (runway, control, etc.)	C_ASSO	X
Tide, tidal stream (non-harmonic prediction – time series or harmonic prediction)	C_ASSO	X
Anchorage	C_ASSO	X
Fairway	C_ASSO /C_AGGR	X
Radar beacon	C_AGGR	X

Table 6. S-101 Collection features to be edited

S-101 Collection Feature type	Content	Editing or not
Additional Information	Connect geographical feature with information feature	O
Aids To Navigation Association	Connect navigational aids such as lighthouses	O
ASL Aggregation	Connect islands fairways and the features among them	X
Bridge Aggregation	Connect bridges and the features among them	O
Caution Area Association	Connect navigation systems applied with cautionary information	X
Deep Water Route Aggregation	Connect deep fairways and the features in the areas among them	O
Fairway Aggregation	Combine fairways which consist navigation systems	O
Fairway Auxiliary	Combine fairways and their preliminary fairways	X
Island Aggregation	Connect islands in a group of islands given one name	X
Pilotage District Association	Combine pilotage areas with their pilot boarding points	X
Range System Aggregation	Connect navigational lines and their aids to navigation	O
Spatial Association	Connect spatial types and spatial quality information features	X
Structure/Equipment	Connect structures and navigational auxiliary equipment features	X
Text Association	Connect geographical features and the position of texts on maps	X
Traffic Separation Scheme Aggregation	Connect traffic separation schemes or their features	O

(7) Other editing items

- Aids to navigation: Structure/Equipment was set as defined in DCEG of S-101. Light numbers in S-57 ENC were NOBJNM, OBJNAM, INFORM and NINFOM and were inputted without consistency most of the times. Therefore all features for the light numbers were reviewed and were inputted in Feature Name/name in S-101 ENC features.

- Notices to mariners: Create notices to mariners for each feature as 'Update Information' feature according to S-101 ENC production standard and set the relationship between the feature and Update Information Aggregation'.

- Bridge: As for Span Fixed and Span Opening features which indicate the height value of a bridge from the same position as a bridge, set the relationship between the bridge and Bridge Aggregation

- Cautionary notes: As for cautionary notes which do not need warnings to mariners, change Caution Area to Information Area feature

- Recommended fairway: When Navigation Line and Recommended Track show recommended fairways, create Range System which is a new feature of S-101 ENC and set Range system Aggregation relationship

- VTS line: When there are two channels of COMCHA (Communication Channel) both ways in S-57 ENC, they are separately inputted using semicolons like [**];[**], whereas in S-101 ENC, attributes can be created depending on the number of channels. So they were inputted with a different format and unnecessary attribute information was deleted.

- Speed measuring area: Create Navigation Line, a feature for presenting speed measuring area, and Beacon, a new feature of S-101 ENC, as Range System and set the Range System Aggregation between them.

- Traffic Separation Scheme: As for fairways applied with traffic separation scheme, create relevant features and Traffic Separation Scheme (No Geometry) feature, enter appropriate attribute information and set relationship.

- Aids to Navigation Association: Set relationship between aids to navigation and navigation system for the areas with navigation systems (Two-way Route, Traffic Separation Scheme, etc.).

  Two-way Route: If one two-way route is inputted as more than two features by different angles, create those features and Two-way Route (No Geometry) feature, enter appropriate attribute and set relationship.

- Change to the naming standard for external reference files: As the naming standard for external reference files has been changed from eight digits to ten digits, the name of external reference file of Nautical Information which is inputted as additional information in S-101 ENC was changed.

Considerations for production consistency in S-101

We identified the following considerations for consistency when entering ENC attribute information in S-101 ENC editing process:

- CATLIT attribute of Lights type: Among attributes of LIGHTS used as aircraft warning lights, the ones with CATLIT and without were mixed. Since LIGHTS are classified as general lights, aircraft warning lights and fog detection lights in S-101, entering attribute of existing S-57 ENC is required.

- Entering light numbers: Light numbers add international or domestic numbers to INFORM and NINFOM but there is no consistency. Standardizing the light numbering system is necessary.

- Pilot boarding area: Pilot boarding areas or points need to be entered as PILBOP but as for the Masan Port, they are entered as ADMARE.

- Varying cautionary notes: Cautionary notes are created as different objects even if they mean the same depending on spacing, upper or lower case, and whether there are full stops or not. There need to be standardized cautionary notes.

- Fair sheets: Fair sheet information is occasionally entered in both M_SREL and M_QUAL depending on the editor, resulting in unnecessary duplication.

- Buildings: When entering building names, some are entered with function which shows rough type of buildings and which does not. Symbols are presented differently depending on function of BUISGL.

- RESARE: The name of restricted area should be changed to OBJNAM. Current INFORM is additional information so it is entered as Additional Information in S-101.

- RADAR information: The signal interval of radar information is entered as attribute in SIGSEQ but is also duplicated in INFORM attribute.

- Seabed: It was found out WATLEV attribute for point type seabed was unnecessary.

- M_NPUB: Delete unnecessary chartlet/chart information or M_CSCL.

- M_CSCL: If there is M_CSCL information of a scale outside the range of the scale of band 6 (0~7,499), there could be problems with presentation on ECDIS or data coverage in S-101.

Conclusions

KHOA produced the prototype of S-101 ENC in the Busan Port area as part of the S-100 Testbed project. We believe considerations identified such as editing SOE feature could be solved if improvements were made to S-57 to S-101 Converter and editing tools.

Recommendations

It is regulated that there should be less than three data coverage in one S-101 ENC cell, while M_COVR and M_CSCL in S-57 is changed to data coverage in S-101 at the same time. Since S-57 ENC of the ROK includes many of M_COVR and M_CSCL, it makes it very difficult to comply with the requirements on data coverage in S-101. It is recommended to discuss the requirement of having three data coverage in S-101.

S-101 Project Specification development team and the S-100 Testbed project team are invited to review the outcome from developing the prototype of S-101 ENC stated in this document.

Action Required of S-100WG

The S-100WG3 is invited to:

a. Note this paper