Paper for Consideration by S-100TSM6

S-57 to S-101 Converter Update

Submitted by:	Esri
Executive Summary:	This paper summarizes the status of the S-57 to S-101 Converter version 1.0.30 as of TSM6.
Related Documents:	Version 1.0.30 of the converter is baselined against S-101_PS_1.0.0_20180814.pdf, S-101_DCEG_1.0.0_20180814.pdf and S-101_FC_1.0.0_20180906.xml.
Related Projects:	IHO S-100 Test Bed and S-101 Project Team

Introduction / Background

In 2010 Esri was tasked with the development of the S-57 to S-101 Convert. This jointly funded project with NOAA has continued over multiple releases of the software to coincide with developments of the S-100 and S-101 standards by TSMAD/S-100WG.

Version 1.0.30 of the S-57 to S-101 Converter associated with this paper was developed against the S-101_PS_1.0.0_20180814.pdf, S-101_DCEG_1.0.0_20180814.pdf and S-101_FC_1.0.0_20180906.xml. The feedback from this group will be considered when finalizing the next release to coincide with the December 2018 release of S-101 Edition 1.0.0.

The S-57 to S-101 Converter plays an important role in the S-100/S-101 Test Bed project and will allow hydrographic offices to quickly convert their existing S-57 ENC datasets to S-101 compliant datasets for distribution once the S-101 product specification is approved.

The converter is freely available to all working group and IHO members and can be distributed publicly upon request. Upon approval of the S-101 product specification by IHO and member states, the S-57 to S-101 Converter will be formally handed over to IHO for distribution.

Analysis/Discussion

Version 1.0.30 of the S-57 to S-101 Converter is the latest version to be released to the S-100/S-101 Test Bed Project team when this paper was submitted. Additional versions will be made available if critical issues are discovered.

The following describes the updates to the S-57 to S-101 Converter.

Implemented Requirements

1. Quality of Bathymetric Data
   - Updated conversion guidance based on DQWG presentation *HOW TO PROVIDE MEANINGFUL QUALITY OF BATHYMETRIC DATA INFORMATION IN S-1....pptx* that will be presented at the next DQWG meeting (Feb 2019).
   - S-57 CATZOC values map to S-101 attribute category of temporal variation - Class A1 -> 1, A2 -> 2, B -> 3, C -> 4, D -> 5, U -> 6
   - New attribute data assessment was added. All converted features get the default value of 1 – assessed.
   - The value of POSACC will now be converted to the horizontal position uncertainty – uncertainty fixed attribute and uncertainty variable factor will not have a value.
   - The value of SOUACC will now be converted to the vertical uncertainty – uncertainty fixed attribute and uncertainty variable will not have a value.

- DQWG is corresponding with Jeff Wootton on uncertainty fixed + uncertainty variable. If guidance changes then and update will be made to the converter.

2. Support Files
   - Uses the support file naming logic in section 11.4.1 of S-101_PS_1.0.0_20180814.pdf.
   - If TXTDSC, NTXTDS or PICREP contain a support file name, then the attribute will be updated to contain the new S-101 name whether that support file exists or not.
   - If the support file is found during conversion, then the support file will be renamed and copied to the output location.

3. Min/Max Display Scale attributes
   Both minimum and maximum display scale attributes were enumerations. They are now integer values. The expected values for S-101 have been hardcoded in the converter. The same step up/down logic that was used in previous releases remains the same.

4. Updates to Dataset Identification field (DSID)
   The following fields have been updated.
   - *ENED = 1.1
   - *PRSP = INT.IHO.S-101.1.0
   - *PRED = 1.0
   - DSAB (Dataset Abstract) – omitted according to S-101 so it is not in the header.

     *fields that are now configurable and part of the new S57toS101Configuration.xml

5. Nautical Information Type
   Previous version had this as Supplemental Information Type. Mappings have been updated to reflect this change.

6. New dataset file naming
   Uses the new dataset file naming logic in section 11.3.2 of S-101_PS_1.0.0_20180814.pdf. The dataset name can be overwritten by using the new S57toS101Configuration.xml

7. New S57toS101Configuration.xml
   S57toS101Configuration.xml replaces the minmaxdisplayscaleoverride.xml. It contains the same minimum and maximum display scale override options as well as some additional features
   - Global Settings – will be used for each dataset

```
<GlobalSettings>
    <Comments>Global settings will be used for each dataset even if they are not listed under DatasetConversionOverrides.</Comments>
    <S101DSID>
            <Field label="ENED" value="1.1"/>
            <Field label="PRSP" value="INT.IHO.S-101.1.0"/>
            <Field label="PRED" value="1.0"/>
    </S101DSID>
</GlobalSettings>
```

   - Dropped from S-101 – listed of dropped values to help provide information messages in the log file.

```
<DroppedFromS101>
    <Comments>DroppedFromS101 lists S-57 features and attributes that have been dropped and will not be converted. This list supports the log file and does not override the Feature Catalogue.</Comments>
    <S57Feature acronym="T_HMON"/>
    <S57Feature acronym="T_NHMN"/>
    <S57Feature acronym="T_TIMS"/>
    <S57Feature acronym="TS_PNH"/>
    <S57Feature acronym="TS_PRH"/>
    <S57Feature acronym="TS_TIS"/>
    <S57Feature acronym="ICNARE"/>
    <S57Feature acronym="CTRPNT"/>
    <Comments>If theseSpecificValues is left blank then the attribute is dropped, otherwise only those values will be ignored.</Comments>
```

```
<Comments>If forTheseFeaturesOnly is left blank then the attribute will be dropped from all features. If populated, then only those features will have the attribute and theseSpecificValues dropped.</Comments>
<Comments>You can specify S-57 acronyms or S-101 feature names as listed in the feature catalogue.</Comments>
<S57Attribute acronym="CATTSS" theseSpecificValues="" forTheseFeaturesOnly="ISTZNE,TSELNE,TSSBND,TSSCRS,TSSLPT,TSSRON,TSEZNE"/>
<S57Attribute acronym="CLSDEF" theseSpecificValues="" forTheseFeaturesOnly="NEWOBJ"/>
<S57Attribute acronym="COLOUR" theseSpecificValues="" forTheseFeaturesOnly="SpanFixed,SpanOpening,SBDARE"/>
<S57Attribute acronym="COLPAT" theseSpecificValues="" forTheseFeaturesOnly="SpanFixed,SpanOpening"/>
<S57Attribute acronym="CONDTN" theseSpecificValues="" forTheseFeaturesOnly="SpanFixed,SpanOpening"/>
<S57Attribute acronym="CONVIS" theseSpecificValues="" forTheseFeaturesOnly="AIRARE,SpanFixed,SpanOpening"/>
<S57Attribute acronym="DRVAL1" theseSpecificValues="" forTheseFeaturesOnly="CBLSUB"/>
<S57Attribute acronym="DRVAL2" theseSpecificValues="" forTheseFeaturesOnly="CBLSUB"/>
<S57Attribute acronym="EXCLIT" theseSpecificValues="" forTheseFeaturesOnly="LightFogDetector"/>
<S57Attribute acronym="EXPSOU" theseSpecificValues="" forTheseFeaturesOnly="SOUNDG"/>
<S57Attribute acronym="HORACC" theseSpecificValues="" forTheseFeaturesOnly="Bridge"/>
<S57Attribute acronym="HORCLR" theseSpecificValues="" forTheseFeaturesOnly="Bridge"/>
<S57Attribute acronym="LITVIS" theseSpecificValues="" forTheseFeaturesOnly="LightFogDetector"/>
<S57Attribute acronym="MARSYS" theseSpecificValues="" forTheseFeaturesOnly="BOYINB,LIGHTS"/>
<S57Attribute acronym="NATCON" theseSpecificValues="" forTheseFeaturesOnly="OBSTRN,OFSPLF,PONTON,SpanFixed,SpanOpening"/>
<S57Attribute acronym="NATQUA" theseSpecificValues="" forTheseFeaturesOnly="UWTROC,LNDRGN,OBSTRN"/>

<S57Attribute acronym="ORIENT" theseSpecificValues="" forTheseFeaturesOnly="LightAllAround,LightFogDetector,M_NSYS,RDOSTA"/>
<S57Attribute acronym="PUBREF" theseSpecificValues="" forTheseFeaturesOnly="M_NPUB"/>
<S57Attribute acronym="QUASOU" theseSpecificValues="" forTheseFeaturesOnly="DEPARE,SWPARE"/>
<S57Attribute acronym="SCAMIN" theseSpecificValues="" forTheseFeaturesOnly="COALNE,DEPARE,DeepWaterRoute,DOCARE,IslandGroup,LOKBSN,M_NSYS,RangeSystem,SpanFixed,SpanOpening,TrafficSeparationScheme,TwoWayRoute"/>
<S57Attribute acronym="SECTR2" theseSpecificValues="" forTheseFeaturesOnly="LightFogDetector"/>
<S57Attribute acronym="SECTR1" theseSpecificValues="" forTheseFeaturesOnly="LightFogDetector"/>
<S57Attribute acronym="SORDAT" theseSpecificValues="" forTheseFeaturesOnly=""/>
<S57Attribute acronym="SORIND" theseSpecificValues="" forTheseFeaturesOnly=""/>
<S57Attribute acronym="SYMINS" theseSpecificValues="" forTheseFeaturesOnly="NEWOBJ"/>
<S57Attribute acronym="TECSOU" theseSpecificValues="" forTheseFeaturesOnly="M_QUAL,SWPARE"/>
<S57Attribute acronym="VALNMR" theseSpecificValues="" forTheseFeaturesOnly="LightFogDetector"/>
<S57Attribute acronym="VERDAT" theseSpecificValues="" forTheseFeaturesOnly="Bridge"/>
</DroppedFromS101>
```

- Dataset conversion overrides – allows you to override the dataset name as well as minimum and maximum display scale values for data coverage features.

```
<DatasetConversionOverrides>
    <Comments>DatasetConversionOverride must be repeated for each S-57 Dataset you want to override.  Just copy and past the entire block.  Blank values will be ignored.</Comments>
    <Comments>S57Datasetname is required to trigger overrides.</Comments>
    <DatasetConversionOverride S57DatasetName="">
        <S101DSID>
            <Comments>Allowable DSID overrides for dataset listed in s57name.  Blank values will be ignored.</Comments>
            <Field label="DSNM" description="Dataset File Identifier" value=""/>
            <Field label="DSTL" description="Dataset Title" value=""/>
            <Field label="DSED" description="Dataset Edition" value=""/>
        </S101DSID>
        <MinMaxDisplayScaleOverride>
            <Comments>Allows you to override existing S-57 DSPM CSCL compilation scale values.</Comments>
            <Comments> MinimumDisplayScaleOverride is used to calculate the Data Coverage feature's minimum display scale.  All Data Coverage features get the same minimum display scale value.</Comments>
            <Comments>If value is not in the allowable list of Minimum Display Scale values as defined by S-101, then it will step up to the next value in the list.  For example, a value of 80000 will step up to 90000.</Comments>

            <CSCL_MinimumDisplayScaleOverride value=""/>

            <Comments>MaximumDisplayScaleOverride is used to calculate the Data Coverage feature's minimum display scale when the feature is created from an existing S-57 M_CSCL feature only.</Comments>
            <Comments>Enter the S-57 M_CSCL feature's CSCALE value in the CSCALE field and then its override value.  Repeat for all M_CSCL features of different CSCALE values that you want to override.</Comments>
            <Comments>If the value is not in the allowable list of Maximum Display Scale values as defined by S-101, then it will step down to the next value in the list.  For example, a value of 80000 will step down to 45000.</Comments>

            <CSCALE_MaximumDisplayScaleOverride  CSCALE=""  value=""/>

        </MinMaxDisplayScaleOverride>
    </DatasetConversionOverride>
```

8. Updated logfile

Note: FOR REASONS OF ECONOMY, DELEGATES ARE KINDLY REQUESTED TO BRING THEIR OWN COPIES OF THE DOCUMENTS TO THE MEETING

The logfile generated by the S-57 to S-101 Converter will contain information, warning and error messages.

- Information messages such as *Info: Attribute SORDAT for feature COALNE dropped from S-101 feature Coastline* are driven by the S57toS101Configuration.xml. Information messages are meant to help users know what has been dropped and help QC the Feature Catalogue and DCEG.
- Warning messages such as the following are meant to identify issues that are preventing data from being converted correctly.
    - *Warning: Unable to bind SpatialQuality to the Spatial Type converted from S-57 vector record VI0000000044.*
    - *Warning: Unable to map S-57 enumeration code 4 for attribute BCNSHP for feature BCNLAT (US118318561800035) to S-101 attribute beaconShape for feature BeaconLateral.*
    - *Warning: Unable to copy support file "US5AK4OA.TXT" referenced in TXTDSC for feature FE0000003962. File not found at path "C:/Backup/DevelopmentNot4Box/S57Datasets/converter ".*
- Error/failure message will also be logged if dataset is unable to be converted.

There is also a python script named summarize_log.py that will be delivered. This will allow you to summarize your log file results and remove any duplicate messages for testing.

Outstanding Requirements

The following items are planned to be supported for the release of S-101 Edition 1.0.0.

1. LOKBSN and DOCARE
   During S-100WG PT1 meeting in Tokyo 2016, it was agreed that new geometries will be created by the converter to cut holes in the existing S-57 SOE to allow for LOKBSN and DOCARE features to become G1 features in S-101.

2. Newly identify encoding logic
    - For Floating dock features, should HORCLR map to horizontal clearance width? [JW] Yes. This is a direct one-to-one mapping for FLODOC features (the definitions in S-57 and S-101 are identical). Unfortunately, the IEHWG have already utilized the Alphacode field for horizontalClearanceWidth in the Registry (they use "horclw"). I have, however, submitted a proposal to include HORCLR as an alias, and indicated as such in the DCEG. Not sure, however, how this will impact on other features where HORCLR maps to horizontalClearanceValue.
    - For Dry dock features, should HORCLR map to horizontal clearance width? [JW]Yes. As for above.
    - Should NPLDST and PILDST attributes for PILBOP get mapped to a pilotage district association if populated. If both attributes are populated then to associations will be created. If not, then we drop that information since NPLDST and PILDST have no mapping in the FC. [JW] PILDST and NPLDST should map to the complex attribute **feature name**, sub-attribute **name** on a **Pilotage District** surface feature, which is associated to the **Pilot Boarding Point** feature(s) using the association name **Pilotage District Association**. The problem here is that in S-57 PILBOP is not (as far as I know) encoded in S-57 as an area feature to define the extent of a pilotage district - it is generally encoded as point, so there is very little (if any) likelihood of an area feature that can map to a **Pilotage District** feature, which can only be of type surface. I have amended the Aliases in the DCEG for sub-attribute **name** on **Pilotage District** to PILDST and NPLDST, and added OBJNAM as name and NOBJNM, NPLDST and PILDST as Aliases for simple attribute **name** in the Registry. Not sure how this is going to work though.

Feature/Information associations

Type	Association Name	Association Ends					
		Class	Role	Mult	Class	Role	Mult
Comp	Pilotage District Association	Pilot Boarding Place	Consists of	1,*	Pilotage District	Component of	0,1

- Should attribute COMCHA for PILBOP get mapped to an additional information association if populated. If not, then we would drop that information since there is no mapping in the FC. [JW] COMCHA when populated for a PILBOP should map to an information type Contact Details, attribute communication channel, which is associated to the Pilot Boarding Place feature using the association name Additional Information. Note that the Additional Information is essentially just a pointer to associate the Contact Details to the Pilot Boarding Place.

Feature/Information associations

Type	Association Name	Association Ends					
		Class	Role	Mult	Class	Role	Mult
Comp	Pilotage District Association	Pilot Boarding Place	Consists of	1,*	Pilotage District	Component of	0,1
Asso	Additional Information	Pilot Boarding Place	Information provided for	1,*	Contact Details	Provides information	0,1

3. Updates to Feature Catalogue required

With the release of S-101_FC_1.0.0_20180906, some items were identified that require changes for the S-57 to S-101 Converter to properly convert those features without manually changing the feature catalogue. Currently with version 1.0.30 of the converter there is a supplemental feature catalogue S-101FC_1.0.0_20180910_esri.xml that contains the following alias added:

- CATPRA
- SDISMX
- M_QUAL
- RESARE
- M_ACCY

The following items were reported to the working group to be resolved in the next published Feature Catalogue.

- Information type Spatial Quality must be bound using Spatial Association. Spatial Association is missing from FC.
- Attribute - Measurement distance maximum missing alias SDISMX
- Attribute - Measurement distance minimum missing alias SDISMN
- Attribute - Category of offshore production area missing alias CATPRA
- Feature Recommended track is referencing depthRangeMaximumValue when it should reference depthRangeMinimumValue according to the DCEG
- Add Alias RESARE to feature Restricted Area Navigational and Restricted area regulatory
- There is also a potential issue with the FC if the DCEG is wrong with Buoy Installation. In the DCEG there is a remark to use attribute vertical length but that attribute is not listed.

DCEG REMARK
Remarks:
- *If it is required to encode a buoy that has more than one colour, the attributes colour and colour pattern must be encoded, according to the rules laid out in clause X.X.*
- *If it is required to encode the total vertical length, including any equipment features (for example light), of the buoy above the water level, it must be done using the attribute* ***vertical length****.*

Guidance Required

1. RESARE encoding logic
   RESARE features can now map to two different S-101 features (Restricted area navigational or Restricted area regulatory). S-57 attribute RESTRN (list field) maps to 101 attribute restriction. Each S-101 feature has an exclusive list of restriction values. When an S-57 RESARE feature contains RESTRN values for both S-101 features – what should happen?
   - Currently the converter will just convert all RESARE features to the first S-101 feature in the Feature Catalogue with alias = RESARE and note in the logfile which enumerations are getting dropped.

2. National Language
   For countries that use a national langue in their datasets can it be assumed that a converted dataset could use that same national language value for all necessary features in that dataset? Would the national language value change per dataset for an agency?
   - Currently the converter does not populate Language for NINFOM and NOBJNM.

3. S-57 Bridge Association
   During S-100WG PT1 meeting in Tokyo 2016, it was agreed that C_AGGR in S-57 would be used to provide a special mapping for bridges. One specific use case has been identified as a current limitation of the conversion process. In this use case the pylon area feature is shared by more than one bridge. The individual bridge and pylon features are correctly converted as individual features as with all other bridge use cases but the Bridge Association is created once for all bridges sharing the pylon. Figure 1 shows an example of this in S-57. This new A_AGGR value would identify which shared features should be combine during the conversion process.

Figure 1: Area pylon shared by multiple area bridge features

4. Discovery Metadata
   Is there is a requirement for converted data to have a MD<>.xml file created for each converted dataset as was created in the 2015 test datasets? If yes, then where is that defined in the S-101 product specification?

5. Dataset Reference Date (DSRD) – should it be converter date or existing date in S-57 header?
   Should the value for DSRD come from the data the S-57 dataset was converted or should it come from the S-57 Update Application Date [UADT] or the Issue Date [ISDT]?
   - Currently DSRD is set to the ISDT of the last applied update file

6. Null attributes
   We will convert null attributes if the 101-attribute's multiplicity is 1. If 0,1 or 0,… then we will not convert the null attribute over and it will be dropped.

Testing

As of this paper all NOAA ENC datasets as of September 8th, 2018 have been converted. Additional testing and detailed comparisons between S-57 and S-101 datasets will continue. Due to limited access to official datasets, feedback from other member states is critical.

SevenC's provided a testing license for S-101 validation but that has not been utilized yet. Esri plans to use the beta software and encourages others to use SevenC's or their own validation software to help identify any gaps in the conversion process.

Recommendations

1. Create mapping document based on new DCEG guidance that does not align 1:1 with Feature Catalogue mappings. Esri believes that this would not only be beneficial to the converter but to all users of S-101. Jeff Wootton of IHB has already volunteered to do the work if approved by this group.
    - Identify dropped features, attributes and enumerations
    - Identify feature/attribute combinations that now map to something new (depth no bottom found)
    - Identify attributes that now map to associations
    - Other examples?
2. Document S57 to S101 Converter logic which is hardcoded. This will help identify items for the mapping document as well as help test and evaluate the process the entire migration process form S-57 to S-101.
3. Encourage ENC producers and distributors to convert their ENC datasets using the latest version of the S-57 to S-101 Converter and provide their log file summary to the S-100TSMWG. This will help identify any issues with the converter and help identify gaps with the S-101 Feature Catalogue, DCEG and conversion process.
4. Have ENCWG approve encoding guidance to create a C_AGGR feature in S-57 ENC for bridge features that share the same pylon.

Items to Recognize

Esri wishes to recognize the following points while developing the S-57 to S-101 Converter.

- It was agreed during TSMAD 29 that S-57 Object and Attribute acronym values will be added to the Feature Catalogue Alias field for use by the converter.
- New information and warning messages have been added to the log file to help identify gaps in the S-101 Feature Catalogue, DCEG and conversion logic.
- During S-100WG PT1 meeting in Tokyo 2016, it was agreed that new geometries will be created by the converter to cut holes in the existing S-57 SOE to allow for LOKBSN and DOCARE features to become G1 features in S-101.

Conclusions

The latest version of the S-57 to S-101 Converter is a simple way for ENC producers and the S-100/S-101 Test Bed project to produce S-101 datasets according to the current baseline. It also provides some additional capabilities to help identify gaps with the S-101 Feature Catalogue and DCEG documents, as well as potential limitations in the S-57 ENC datasets that require more discussion before the operational version of S-101 is published.

RESARE might be the tip of the iceberg scenario that will require additional guidance to convert correctly to S-101. If this is true, then it becomes a race against time to properly identify those use cases. Will validation software be enough to catch them if missed?

Action Required of S-100TSM6

The S-100TSM6 is invited to:

a. Endorse version 1.0.30 of the S-57 to S-101 Converter for the current baseline
b. Note the Items to Recognize
c. Discuss proposed recommendations
d. Provide official guidance on outstanding items for conversion