Best standardized nautical information for safe navigation in ports - the Port ENC!
Results of the integrated EU research project EFFORTS - work package 1.3 - Port ECDIS.

June 21th - 23th 2010, Quebec – Canada
The EFFORTS project

A general remark:

Port ECDIS was the EFFORTS work package synonym → we defined a proposal for new Port ENC (PENC) standard and data set!!
The EFFORTS project

Project acronym: EFFORTS
Project title: Effective Operation in Ports

The Subproject 1 “Navigation in Ports” aims at the improvement of safety and efficiency of navigation in ports considering decreasing manoeuvring space (vessel size in relation to fairways and basins) versus increasing traffic and vessel sizes.
The Port ECDIS story starts with the question:

„Why a Port ECDIS?!“
Ports are the hubs of global trade and the most challenging areas with the highest level of special requirements regarding safe and ease of navigation, manoeuvring, berthing etc. including the highest level of special requirements of Harbour Masters, pilots, ship's officers, transport execution and port maintenance have, that should be fulfilled by the Port Hydrographer!! That’s a real challenge!

Because safe and efficient arrival/departure for ships and their cargo is most crucial for ports!
Why a Port ECDIS – Port ENC?!

- Increase of vessel sizes,
- less harbour and manoeuvre space,
- Minimum Under Keel Clearance and
- special requirements for minimum dredging
- call for the highest level of accuracy and reliability of digital chart information for navigation in fairways and ports currently not being met by equipment according to SOLAS V Carriage requirements!
Why a Port ECDIS – Port ENC?!
Why a Port ECDIS – Port ENC?!

- less manoeuvre space
- bulk vessel berthing
Why a Port ECDIS – Port ENC?!

- less manoeuvre space
- bulk vessel
- turning and docking

Dieter Seefeldt
Why a Port ECDIS – Port ENC?! 

- Masters and pilots approaching a seaport use an **Electronic Chart Display and Information System (ECDIS)**, which **meets IMO/SOLAS V carriage requirements** by using official **maritime ENC’s** to obtain the required navigational information they need.

- The common **IHO ECDIS standard for maritime ENC’s** supports navigation in the open sea, coastal areas and in seaports (like the Port of Hamburg)

- The **Inland ECDIS standard** for **Inland ENC’s (IENCs)** was developed for navigation on inland waterways and uses the same accuracy and quality definitions like the **maritime ECDIS standard**

- but **without meeting the requirements ports have** regarding precise navigational, manoeuvring, berthing, turning, docking, maintenance, up to-date-ness, scale and accuracy aspects!
Why a Port ECDIS – Port ENC?!

Port ENC requirements for navigation, maneuvering and for the port maintenance go far beyond the current maritime ECDIS and Inland ECDIS standards regarding:

- up-to-dateness
- quality
- accuracy
- large scale charts
- chart features/objects and attributes
- and reliability

of hydrographic data (Bathymetry) and geographic data (Topography).
Why a Port ECDIS – Port ENC?!

- For Port operations, there are special requirements for
  - vertical and horizontal accuracy.
- This is achieved by
  - using modern sensor technology.

The same accuracy must be inherent in the underlying electronic charts.

- This type of source data (e.g., topography and hydrographic data) should be made available by the Port Authorities
  - using a standardized data format → Port ENC standard.
Why a Port ECDIS – Port ENC?!  

📍 At present, there is **no standard or extensions** considering the special requirements of port operations!

📍 That **call for a specific “Port ECDIS” → Port ENC.**

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A Port ENC is needed!! → result of the Port ECDIS questionnaire
Why a Port ECDIS – Port ENC?!

The **Port ENC standard** should be an

- independent but complementary standard to **maritime ENC and Inland ENC**.

The development of a **Port ENC standard** focuses on high precision operations in ports.

A **Port ENC** intended to align with the ongoing developments for **maritime** and **Inland ENCs**.

**Port ENC** data should serve as the missing link between **maritime** and **Inland ENCs**.
Why a Port ECDIS – Port ENC?! 

- Using a Port ENC as the base, it’s possible to overlay other types of information to improve the
  - interoperability of harbour-related tasks.
  - Ships – maneuvering and docking by Pilots using Portable Piloting Units (PPUs) including the Port ENCs
  - Port Authority – dredging and maintenance activities at channels, piers and terminal facilities can use the PENC
  - …
Why a Port ECDIS – Port ENC?!  

- **Port ENC** data are not only used onboard but also in:
  - Vessel Traffic Management and Information Systems (VTMIS)
  - Route planning application
  - Marine Simulators (ship handling, tug simulator…), Training
  - Port Planning…
  - …

Besides ECDIS more and more applications have been developed, they are use ENCs (Electronic Navigational Chart) as backdrop information

And on base of ECDIS technology (GIS) it will be possible to link, combine or overlay other information to improve the interoperability of harbour related tasks.
IHO Standards (S-57 & S-44)
IHO Standards (S-57 & S-44)

- IHO Standards do not provide significant topographic source data for integration in ENCs.
- No dedicated accuracy requirements are defined that apply for different navigational purposes / categories (e.g., port operations)
- Within ENCs and Inland ENC’s, the IHO S-57 Zone of Confidence (ZOC) assessment is used to describe the quality of bathymetric data,
- but is not used for topographic data!
IHO Standards (S-57 & S-44)

Replace the existing ZOC table and the associated comments with the following:

**S57 ECDIS definitions (Zone of Confidence - bathymetry)**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Position Accuracy</strong></td>
<td><strong>Depth Accuracy</strong></td>
<td><strong>Seafloor Coverage</strong></td>
<td><strong>Typical Survey Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td><strong>ZOC</strong></td>
<td>± 5 m</td>
<td>=0.50 ± 1%d</td>
<td>Full area search undertaken. All significant seafloor features detected and depths measured.</td>
<td>Controlled, systematic survey high position and depth accuracy achieved using DGPS or a minimum three high quality lines of position (LOP) and a multibeam, channel or mechanical sweep system.</td>
</tr>
<tr>
<td>A1</td>
<td>10</td>
<td>± 0.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>± 0.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>± 1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1000</td>
<td>± 10.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ZOC</strong></td>
<td>± 20 m</td>
<td>=1.00 ± 2%d</td>
<td>Full area search undertaken. All significant seafloor features detected and depths measured.</td>
<td>Controlled, systematic survey achieving position and depth accuracy less than ZOC A1 and using a modern survey echosounder and a</td>
</tr>
</tbody>
</table>
## Minimum Standards for Hydrographic Surveys

*(To be read in conjunction with the full text set out in this document)*

<table>
<thead>
<tr>
<th>Reference</th>
<th>Order</th>
<th>Special</th>
<th>1a</th>
<th>1b</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 1</td>
<td>Description of areas.</td>
<td>Areas where under keel clearance is critical</td>
<td>Areas shallower than 100 metres where under keel clearance is less critical</td>
<td>Areas shallower than 100 metres where under keel clearance is less critical</td>
<td>Areas generally deeper than 100 metres where a general description of the sea floor is considered adequate.</td>
</tr>
<tr>
<td>Chapter 2</td>
<td>Maximum allowable THU 95% Confidence level</td>
<td>2 metres</td>
<td>5 metres ± 5% of depth</td>
<td>5 metres ± 3% of depth</td>
<td>20 metres ± 10% of depth</td>
</tr>
<tr>
<td>Para 3.2 and note 1</td>
<td>Maximum allowable TVU 95% Confidence level</td>
<td>( a = 0.25 ) metre ( b = 0.0075 )</td>
<td>( a = 0.5 ) metre ( b = 0.013 )</td>
<td>( a = 0.5 ) metre ( b = 0.013 )</td>
<td></td>
</tr>
<tr>
<td>Glossary and note 2</td>
<td>Full Sea Floor Search</td>
<td>Required</td>
<td>Required</td>
<td>Required</td>
<td></td>
</tr>
<tr>
<td>Para 2.1, Para 3.4, Para 3.5 and note 3</td>
<td>Feature Detection</td>
<td>Cubic features &gt; 1 metre</td>
<td>Cubic features &gt; 2 metres, in depths up to 40 metres; 10% of depth beyond 40 metres</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Para 3.6 and note 4</td>
<td>Recommended maximum Line Spacing</td>
<td>Not defined as full sea floor search is required</td>
<td>Not defined as full sea floor search is required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chapter 2 and note 5</td>
<td>Positioning of fixed aids to navigation and topography significant to navigation. (95% Confidence level)</td>
<td>2 metres</td>
<td>2 metres</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chapter 2 and note 5</td>
<td>Positioning of the Coastline and topography less significant to navigation. (95% Confidence level)</td>
<td>10 metres</td>
<td>20 metres</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chapter 3 and note 5</td>
<td>Mean position of floating aids to navigation (95% Confidence level)</td>
<td>10 metres</td>
<td>10 metres</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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- **S44 Ed. 5 new - Minimum Standards for Hydrographic Surveys - February 2008**
- **S57 ECDIS ZOC +/- 5m versus IHO S44 Special Order +/- 2m**
- **Mismatch between IHO S57 ECDIS Requirements and S44 Special Order!**

- Used for the Port of Hamburg

- Quay walls, bridges, locks etc. ?!
IHO Standards (S-57 & S-44)

One example is the official ENC of Hamburg.

- Produced and issued by BSH (Federal Maritime and Hydrographic Agency / Germany),
- it meets all the relevant ENC related standards and fulfills the requirements for maritime navigation,
- but the ENC is too small in scale,
- does not have any bathymetric detail,
- not showing up-to-date information
- and poorly defined horizontal accuracy for topographic features such as quay walls, piers, pontoons, etc.
Comparison
HPA Basis Port ENC - BSH ENC

BSH ENC-cell Port of Hamburg
Federal Maritime and Hydrographic Agency
name: DE521500.000
date: 27.05.2005
scale: 1:15 000 → small scale!!
accuracy:
S-57 Object Class: M_QUAL
attribut: CATZOC = B (3) ±50m
IHO Standards (S-57 & S-44)

Comparison the official maritime ENC and the Port ENC

<table>
<thead>
<tr>
<th>Differences</th>
<th>East (m)</th>
<th>North (m)</th>
<th>Distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed marks / navigational aids</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>-0,01</td>
<td>0,01</td>
<td>0,01</td>
</tr>
<tr>
<td>MIN</td>
<td>-0,19</td>
<td>-0,62</td>
<td>0,02</td>
</tr>
<tr>
<td>MAX</td>
<td>0,15</td>
<td>0,56</td>
<td>0,62</td>
</tr>
<tr>
<td>Quay wall corner</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>-4,75</td>
<td>-3,65</td>
<td>7,79</td>
</tr>
<tr>
<td>MIN</td>
<td>-13,93</td>
<td>-17,15</td>
<td>2,42</td>
</tr>
<tr>
<td>MAX</td>
<td>6,84</td>
<td>4,35</td>
<td>17,67</td>
</tr>
<tr>
<td>Pontoon corner</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>1,60</td>
<td>-2,89</td>
<td>8,05</td>
</tr>
<tr>
<td>MIN</td>
<td>-11,00</td>
<td>-11,69</td>
<td>3,84</td>
</tr>
<tr>
<td>MAX</td>
<td>10,42</td>
<td>19,74</td>
<td>22,30</td>
</tr>
</tbody>
</table>
IHO Standards (S-57 & S-44)

- Comparison the official maritime ENC and the Port ENC

- Result:
  - the official maritime ENC is not suitable for special operations within the port area
  - the official BSH - ENC has a different purpose to meet (usage band 5 - harbour)!
The EFFORTS Work Package 1.3 - Port ECDIS - tasks
The EFFORTS Work Package 1.3 - Port ECDIS - tasks

**Task 1 – Potential user requirements** – structured questionnaire

**Task 2 - Port ENC - Technical specification**
- accuracy; precision of topography and aids of navigation; special new Port ENC objects (features and attributes); precise 3D depth information using Digital Terrain Models (DTM) technologies; 3D reference DTM (the Channel Reference Model CRM)

**Task 3 – Prototype of a Port ENC**
- Port ENC dataset of the Port of Hamburg, including precise Port ENC chart data, so named gridded bathymetry (in BAG format), bathymetric ENC's (bENC) and a 3D channel reference model (CRM).

**Task 4 – Testing of prototype(s)**
- Tests on board of a HPA survey vessel; test using a PPU on board of a container vessel, functional tests onboard of a Trailer Suction Hopper Dredger (TSHD) and during docking process of a cruise liner.
The EFFORTS Work Package 1.3 - Port ECDIS - tasks

- Task 5 – Defining requirements for follow-up developments and standardization (Port ENC - Roadmap).
  - The Port ENC can be used as base information within a PORTIS (Port Information System) which also includes AIS, Radar, VTMIS, Route Planning, dredging information, river and port basin maintenance information, current and velocity, tidal information etc. Follow-up work to enhance the prototype, widen its application and organise standardisation was described.
  - Port ENC can also be used in Marine Simulators (ship handling, tug simulator…)

- The outcome should be a proposal and comprehensive concept as basis and input for European / international standardization proved by validation and functional tests in the Port of Hamburg.
The EFFORTS Work Package 1.3 - Port ECDIS results
The EFFORTS Work Package 1.3 - Port ECDIS results

Gradation of the S-57 ENC products

- Standard exist
  - maritime ENC (ENC)
    - Product ID 1
  - Inland ENC (IENC)
    - Product ID 10
    - +
  - Port ENC (PENC)
    - new objects/features

Port ENC (PENC)
- Product ID 20
- ++
The EFFORTS Work Package 1.3 - Port ECDIS results

Port ENC components

- Precise ENC
- Gridded Bathymetric Model [BAG]
- Channel Reference Model [CRM]
- Port ENC Overlay Chart
- Bathymetric ENC (bENC)

maritime ENC Objects
Inland ENC Objects
Port ENC Objects

As part of the EFFORTS project, there are a number of new port specific objects, as well as requirements for the accuracy of these objects. These new requirements will ensure that the Port ENC makes the most accurate data available to the port users.

The use of gridded bathymetry, channel outlines and channel depth model data will allow the users of the Port ENC to have an accurate and up to date 3D information of the depth situation within the port. This will improve both, safety of navigation as well as port maintenance.
The EFFORTS Work Package 1.3 - Port ECDIS results

- D 1.3.1 Potential users and requirements (structured questionnaire, study)
- D 1.3.2 Port ENC specification (documents)
- D 1.3.3 Port ENC prototype (software and dataset)
  - including a Port ENC viewer
- D 1.3.4 Tests with Port ENC prototype (based on basic dataset) and evaluation of tests (report)
- D 1.3.5 Port ENC follow-up requirements (document)
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.1 Potential users and requirements (structured questionnaire, study)

Result:

- All the answers are reflecting exactly the impression we had and why we are thinking, a precise Port ENC is necessary and a benefit for port navigation, manoeuvring and maintenance work!
- For Port operations a new port related dataset, a Port ENC, is needed and required (known request and the result of the Port ECDIS questionnaire).
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.1 Potential users and requirements (structured questionnaire, study)

What is left uncovered?

- **high accuracy charts** (for using RTK-DGPS, local RTK - DGPS services deliver cm accuracy, position must fulfil or be better than IHO - S44 Special Order)
- **large scale information** (1:500 up to 1:5000) with up to date information including special objects / features for port navigation and operation such as e.g. fenders etc.
- **3 D possibilities** (Grid / Raster / TIN)
- a designed / constructed channel **reference model (CRM)** e.g. for dredged areas.
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.2 Port ECDIS (Port ENC) specification (documents)

Definition of present Data Quality in Standards used for ENC data (S57 versus S44 standard)

Study about data quality in the following standards:

- IHO maritime ECDIS
- Inland ECDIS
- IHO S44 - Standards for Hydrographic Surveys
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.2 Port ECDIS (Port ENC) specification (documents)

Port ENC Feature Catalogue - description of the Port ENC features

Port ENC Feature Catalogue

Edition 1.0
The EFFORTS Work Package 1.3 - Port ECDIS results

Port ENC bathymetric data quality – suggestion → CATZOC → accuracy

Object Class: **Accuracy of ENC data**

Acronym: m_aenc

Set Attribute_A: batacc; topacc;
Set Attribute_B: INFORM; NINFOM; ntxtds; txtdsc;
Set Attribute_C: RECDAT; RECIND; SORDAT; SORIND;

The attribute batacc is from the type “enumerated”. There is one attribute value, this value is based on the IHO Standards for Hydrographic Surveys (Special Publication N° 44 Ed.5) and be called Special.

<table>
<thead>
<tr>
<th>ID</th>
<th>Meaning</th>
<th>Max. allowable THU</th>
<th>Max. allowable TVU</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Special</td>
<td>±2 m</td>
<td>a = 0.25 m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b = 0.0075</td>
</tr>
</tbody>
</table>

Tab.1: allowable uncertainty for bathymetric data

S44 Ed. 5 (new)
Minimum Standards for Hydrographic Surveys
February 2008
Hydrographic survey

Hamburg Port Authority
The EFFORTS Work Package 1.3 - Port ECDIS results

Port ENC geo-/topographic data quality – suggestion ➔ CATZOC ➔ accuracy

<table>
<thead>
<tr>
<th>ID</th>
<th>Meaning</th>
<th>Object class</th>
<th>Positional accuracy</th>
<th>Vertical accuracy</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Zone A</td>
<td>(BCNCAR), (bncnar), (BCNISD), (bncisd), BCNLAT, bcnlat, (BCNSAW), (bcnsaw), (BCNSPP), (bcnsp), bridge, chlohd, cfrseg, DRYDOC, FLODOC, flodoc, CATCON, gatcon, HULKES, hulkes, lokbsn, MORFAC, PIPFNT, pipohd, PONTON, ponton, PYLONS, SLCONS, slcons, berthis, BUISGL, HREFAC, hrbfac, LNDMRK, NAVLNE, (RADIEN), RADSTA, RESARE, resare, (RSCSTA), RTPBCN, SILTNK, sistat, sistaw</td>
<td>± 0,1 m</td>
<td>± 0,1 m</td>
<td>Fixed object relevant for berthing, docking and lock passage</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Zone A</td>
<td>(BCNCAR), (bncnar), (BCNISD), (bncisd), BCNLAT, bcnlat, (BCNSAW), (bcnsaw), (BCNSPP), (bcnsp), bridge, chlohd, cfrseg, DRYDOC, FLODOC, flodoc, CATCON, gatcon, HULKES, hulkes, lokbsn, MORFAC, PIPFNT, pipohd, PONTON, ponton, PYLONS, SLCONS, slcons, berthis, BUISGL, HREFAC, hrbfac, LNDMRK, NAVLNE, (RADIEN), RADSTA, RESARE, resare, (RSCSTA), RTPBCN, SILTNK, sistat, sistaw</td>
<td>± 0,5 m</td>
<td>± 0,5 m</td>
<td>Fixed object relevant for navigation (maneuvering, turning, towage)</td>
</tr>
</tbody>
</table>
The EFFORTS Work Package 1.3 - Port ECDIS results

Port ENC geo-/topographic data quality – suggestion → CATZOC → accuracy

<table>
<thead>
<tr>
<th>ID</th>
<th>Meaning</th>
<th>Object class</th>
<th>Positional accuracy</th>
<th>Vertical accuracy</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Zone B</td>
<td>(BCNCAR), (bcncar), (BCNISD), (bcnisdi), BCNLAT, bcnlat, (BCNSAW), (bcnswa), (BCNSPP), (bcnsp), bridge, chtohd, cliseg, DRYDOC, FLODOC, flodoc, GATCON, gatcon, HULKES, hules, hulk, MORFAC, PILPNT, pipohd, PONTON, ponton, PYLONS, SLCONS, slcons</td>
<td>± 0.5 m</td>
<td>± 0.5 m</td>
<td>Fixed object relevant for berthing, docking and lock passage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>berths, BUIGL, HRBFAC, hrbfac, LNDMKP, NAVLINE, (RADLNE), RADSTA, RESARE, resare, (RSCSTA), RTPBCON, SITNKS, sittal, sistaw</td>
<td>± 2.5 m</td>
<td>± 2.5 m</td>
<td>Fixed object relevant for navigation (maneuvering, turning, towage)</td>
</tr>
</tbody>
</table>

Tab. 2: The characteristic of the attribute “Accuracy of topographic data”
The EFFORTS Work Package 1.3 - Port ECDIS results

Port ENC encoding guide
- representation and
- symbolisation

Encoding Guide for Port ENC

Edition 1.0
The EFFORTS Work Package 1.3 - Port ECDIS results

Port ENC encoding guide

Contents

A. Introduction
- Background
- Use of this Encoding Guide

B. General Guidance
- Accuracy of Data
- Compilation Scale and Coordinate Multiplication Factor
- Use of other data types

C. PENC Meta Information
- C.1 PENC Meta Features
- C.1.9 Accuracy of ENC data

G. Ports, Waterways
- G.1 Bridges, Tunnels, Overhead Obstructions
- G.1.11 Clearance Segment
- G.2 Hydraulic Structures in General
- G.2.8 Flood protection wall
- G.2.9 Quay ladder
- G.2.10 Fender line
- G.3.22 Double Bollard
- G.4 Locks, Barrages, Exceptional Navigational Structures
- G.4.9 Dredge Field

I. Depths
- I.1 Depths in Fairways and Areas
- I.1.10 Outline of External Model
- I.1.11 Channel Section

M. Areas, Limits
- M.1 Anchorage Areas and Berths
- M.1.5 Berths

O. Buoys, Beacons and Daymarks, Notice Marks
- O.5 Equipment Features
- O.5.1 Connection rod
- O.5.2 Radar Reflector
The EFFORTS Work Package 1.3 - Port ECDIS results

- Port ENC encoding guide ➔ CATZOC ➔ accuracy
  - representation and
  - symbolisation

Port ENC highest quality level

Port ENC second highest quality level

<table>
<thead>
<tr>
<th>ID</th>
<th>bathymetric</th>
<th>topographic</th>
<th>S-52 representation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Tab.3: S-52 representation for the meta object “Accuracy of ENC data”
The EFFORTS Work Package 1.3 - Port ECDIS results

- **Port ENC encoding guide**
  - representation and
  - symbolisation

<table>
<thead>
<tr>
<th>Graphics</th>
<th>Encoding Instructions</th>
<th>Object Encoding</th>
</tr>
</thead>
<tbody>
<tr>
<td>PENC Symbolisation</td>
<td>A) The fender line and fenders should be associated using a C_ASSO collection object (refer to &quot;The Use of the Object Catalogue for ENC&quot; 15. Collection objects).</td>
<td><strong>Object Encoding</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Object Class</strong> = sicons (L)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(M) cat=lc = [21 (fender line)]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(O) SCAMIN = [12000]</td>
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<td></td>
<td>(C) SORDAT = [YYYYMMDD]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(C) SORIND = (Refer to IEGH EG 1.3.1, Section B, General Guidance)</td>
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<tr>
<td></td>
<td></td>
<td>(C) verdat = [3 Mean Sea Level], 5</td>
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A theoretical line that shows the pilot the connection between the leading edges of the fenders for mooring and berthing manoeuvres. (HPA, Port ECDIS Requirements 1.3).
The EFFORTS Work Package 1.3 - Port ECDIS results

- new Port ENC objects (examples)

- connection rod and radar reflector

- bridge clearance
The EFFORTS Work Package 1.3 - Port ECDIS results

new Port ENC objects (examples)

- quay ladder
- fender
- double bollard

- berth name & nominal depth
- fender line
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- new Port ENC objects (examples)

Dredge field
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- Port ENC product specification

Product Specification for Port ENCs

Edition 1.0
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.4 Tests with Port ECDIS (Port ENC) prototype (based on basic dataset) and evaluation of tests (report)

Remark:
- All the tests running very successful
- Delivering very promising results
- Demonstrating the outstanding quality and accuracy of the developed Port ENC!!
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.4 Tests - PPU and accuracy test on board of survey vessel Deepenschriewer II
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.4 Tests - PPU and accuracy test on board of survey vessel Deepenschriewer II
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.4 Tests - PPU and accuracy test on board of survey vessel Deepenschriewer II

"bow – print"
The EFFORTS Work Package 1.3 - Port ECDIS results

- D 1.3.4 Tests - PPU and accuracy test on board of survey vessel Deepenschriewer II
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.4 Tests - functional test during docking manoeuvre

7Cs ORCA Master
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.4 Tests - functional test during docking manoeuvre

Onboard ENC – (inaccurate)  Port ENC – (precise)
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.4 Tests - functional test onboard of a TSHD (Trailer Suction Hopper Dredger)
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.4 Tests - functional test onboard of a TSHD (Trailer Suction Hopper Dredger)
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.4 Tests - functional test onboard of a TSHD (Trailer Suction Hopper Dredger)

same position!!
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.4 Tests - PPU (Marimatech) test onboard of a Container vessel (VLCC)

Container Vessel → Yang Ming Uberty (Lenght 333.5m - Breadth 42.8m - Draught: 11.0m).
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.4 Tests - PPU test onboard of a Container vessel (VLCC)
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.4 Tests - PPU (Marimatech) test onboard of a Container vessel (VLCC)
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.4 Tests - PPU (Marimatech) test onboard of a Container vessel (VLCC)
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.4 Tests - functional test as base information in a VTMIS (ATLAS MS)
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.4 Tests - functional test as base information in a VTMIS (ATLAS MS)
The EFFORTS Work Package 1.3 - Port ECDIS results

- Innovative aspects
The EFFORTS Work Package 1.3 - Port ECDIS results

Innovative aspects

- The new standard takes into account the different accuracy definitions of S57- ECDIS / Inland ECDIS and also of IHO S44 – Standards for Hydrographic Surveys and defines a new Port ENC accuracy definition / class.
- Metaobject Accuracy of ENC data – $m_{aenc}$ and
- the characteristic of these Metaobject = combined bathymetric and topographic accuracy meta objects –> $batacc$ and $topacc$)

<table>
<thead>
<tr>
<th>ID</th>
<th>bathymetric</th>
<th>topographic</th>
<th>S-52 representation</th>
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</tr>
<tr>
<td>1</td>
<td>2</td>
<td></td>
<td>Zone B</td>
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</tbody>
</table>

Tab.3: S-52 representation for the meta object “Accuracy of ENC data”
The EFFORTS Work Package 1.3 - Port ECDIS results

**Innovative aspects**

- The proposed Port ENC standard has a far higher density of information, allowing more precise navigation / manoeuvring et cetera.

- The proposed Port ENC standard introduces additional data models and includes information not available in current standards,
  - like 3D - gridded bathymetry (in BAG format) and
  - 3D - channel reference model (CRM) and supports the
  - bENC (bathymetric ENC)

- allowing new usages. New data representations allow for new visualization methods (3D) and new functionality for better data analysis.
The EFFORTS Work Package 1.3 - Port ECDIS results

Innovative aspects

The Port ENC – could be a core component for e-Navigation

DRAFT STRATEGY FOR THE DEVELOPMENT AND IMPLEMENTATION OF E-NAVIGATION

1 DEFINITION AND SCOPE

1.1 E-navigation is the harmonized collection, integration, exchange, presentation and analysis of marine information on board and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment.

1.2 E-navigation is intended to meet present and future user needs through harmonization of marine navigation systems and supporting shore services.
The EFFORTS Work Package 1.3 - Port ECDIS results

- Implementation of results within the port industry and beyond
The EFFORTS Work Package 1.3 - Port ECDIS results

Implementation of results within the port industry and beyond

Harbour Masters, Pilots and Captains of the arriving and departing vessels, Port Authorities, TUG operators and other organisations, they work on port water area related maintenance tasks (e.g. dredging…), they all need and can use the higher accuracy and additional information of the Port ENC.

They can navigate and work more easily, safely and precise within the PENC covered area (river, access channel, port basin, turning basin…).

The new within the Port ENC presented information fills the current ECDIS - Inland ECDIS data lack.
The EFFORTS Work Package 1.3 - Port ECDIS results

Implementation of results within the port industry and beyond

- If more and more data becomes available in the proposed PENC standard, the data can be used for numerous other GIS driven approaches like:
  - Vessel Traffic Service (VTS), Vessel Traffic Management and Information System (VTMIS)
  - IALA - PAWSA (Port and Waterways Safety Assessment)
  - Integrated Navigation Systems (INS) – Portable Pilot Units (PPU’s)
  - Risk Management – Accident Analysis
  - Port planning / strategy
  - Port Maintenance (dredging, embankment monitoring ….)
  - Tug and maritime simulation
  - Route planning
  - Harbour Rescue Coordination
  - Port services (stowage, logistics, public transport management etc.)
  - …..
The EFFORTS Work Package 1.3 - Port ECDIS results

the Port ENC & the Port ECDIS viewer - examples

This software must not be used as an aid to navigation.

The EFFORTS Port ECDIS Viewer was designed and developed exclusively as a demonstrator. The idea is to give an impression how Port ECDIS data can be visualized and how Port ECDIS data can help to make Operations in Ports more effective.

In no event shall the manufacturer be liable for any other damages whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information, or other pecuniary loss) arising out of inability to use, or the use, of the Software, even if the manufacturer has been advised of the possibility of such damages. In any case, the manufacturer's entire liability shall be limited to the amount actually paid by you for the software.

The manufacturer disclaims all warranties, either expressed or implied, including but not limited to implied warranties of fitness for a particular purpose, with respect to the Software, the accompanying manual(s) and written materials.

Moreover General Terms and Conditions of SevenCs GmbH (as of July 2009) must be accepted when using this software.
Port ENC
Base Chart
Port ENC
Base Chart
Port ENC
Base Chart
Gridded Data [BAG]
absolute depth
Dieter Seefeldt
The EFFORTS Work Package 1.3 - Port ECDIS results
the Port ENC & the Port ECDIS viewer - examples

Gridded Data [BAG]
safety depth

Port ENC
Base Chart
Port ENC
Base Chart

Channel
Reference
Model
3D – view
Bathymetry
3D – view Channel Reference Model
3 D – view
Bathymetry versus CRM
The EFFORTS Work Package 1.3 - Port ECDIS results

D 1.3.5 Port ECDIS (Port ENC) follow-up requirements (document)
The EFFORTS Work Package 1.3

D 1.3.5 Port ECDIS (Port ENC) follow-up requirements (document)

If you have some additional requirements or new ideas, please let us know!!
The EFFORTS Work Package 1.3 - Port ECDIS results

We informed about the project:

- IHO - International Hydrographic Organisation
- IMO - International Maritime Organization
- Open ECDIS Organisation
- Inland ENC Harmonization Group
- EC - European Commission - Directorate-General Energy and Transport
- UN/ECE - Economic Commission for Europe of the United Nations
- CCNR - Central Commission for Navigation on the Rhine
- DC - Danube Commission
- IAPH - Head Office (Tokyo) - International Association of Ports and Harbors
- IAPH - Europe Office (Rotterdam)
- IHMA - International Harbour Masters’ Association
- EHMC - European Harbour Masters’ Committee
- PIANC - International Navigation Association
- BMVBS - Federal Ministry of Transport, Building and Urban Affairs, Germany
- IALA - International Association of Marine Aids to Navigation and Lighthouse Authorities
- IMPA - International Maritime Pilots Association
- EMPA - European Maritime Pilot's Association
- EMSA - European Maritime Safety Agency

The EU Project - Port ECDIS - Development of a new enhanced ENC standard for use in ports and harbours.

Why a Port ECDIS?!
Masters and pilots approaching a seaport usually use an Electronic Chart Display and Information System (ECDIS) to obtain the required navigational information they need. The common ECDIS standard supports navigation in the open sea and coastal areas, the Inland ECDIS standard was developed for navigation on inland waterways. The chart requirements for manoeuvring big ships in narrow fairways (harbour access channels) and harbours and for the port maintenance go far beyond the current ECDIS standard in scale, accuracy, chart objects and attributes (“project catalogue”, in future “feature catalogue”) and...
The Port ENC – proposal for a new standard
The Port ENC – proposal for a new standard

⚠️ The successful result of the EFFORTS work package 1.3 - Port ECDIS could be only a

⚠️ proposal and comprehensive concept for a new Port ENC standard!!

⚠️ It can be currently only a first step!
Final statement

It must be reliable and clear, that the harbour master, the pilot, the captain and all other user can trust the topographic and bathymetric information within the Port ENC!

So the Port ENC can be used as reference system for navigation!

"If the vessel sails on land the positioning of the vessel is inaccurate, not the Port ENC!"
Developing a Port ECDIS - a challenge mastered!!

¡Thank you for your attention!!
Kontaktdaten

on behalf of the

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