Research and development for e-Navigation

8th ASEF Conference

26-28 November 2014
Contents

- Background
- e-Navigation strategy
- Work description
- Research and development of e-Navigation
- Conclusion
More than 70% of the world’s surface is covered by water

Almost 80% of the total cargo tonnage relies on ship transportation

Around 50% of accidents have navigational causes
Background

Maritime traffic accidents:
- Collision
- Grounding
- Oil spill
- Piracy
Larger and faster ships, greater congestion and reduced manning levels have all provided the impetus for maritime field development.
e-Navigation Strategy

As defined by the IMO:

“e-Navigation is the harmonised collection, integration, exchange, presentation and analysis of maritime information onboard 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.”
<table>
<thead>
<tr>
<th></th>
<th>Electronic</th>
<th>Enhance</th>
<th>Effective</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Efficient</td>
<td>Economic</td>
<td>Essential</td>
</tr>
<tr>
<td></td>
<td>电子</td>
<td>经济</td>
<td>重要</td>
</tr>
<tr>
<td></td>
<td>高效</td>
<td>优秀</td>
<td>喜欢</td>
</tr>
<tr>
<td></td>
<td>Easy</td>
<td>Excellent</td>
<td>Enjoy</td>
</tr>
<tr>
<td></td>
<td>容易</td>
<td>优秀</td>
<td>喜欢</td>
</tr>
</tbody>
</table>
e-Navigation Strategy

Regulatory activities affecting e-Navigation

There are already several ongoing activities within IMO, IHO, IEC and other organizations which are highly related to the key components of e-Navigation. Some examples:

- IMO Resolutions A.817(19), MSC.64(67), MSC.86(70), Performance standards for electronic chart display and information systems;
- IMO NAV52, Agenda item 4, Revision of the performance standards for INS and IBS;
- IHO S52, Specifications for chart content and display aspects of ECDIS;
- IEC 61174, Electronic chart display and information system (ECDIS);
- IEC 62288 Displays for the Presentation of Navigation Related Information.
e-Navigation Strategy

- e-Navigation would utilize existing and new navigational tools and standards within the digital technology environment in a holistic and systematic manner. Use of a structured systems engineering approach:
  - Prototyping including test-beds
  - Requirements capture and management
  - Design
  - Development
  - Verification, Validation and Testing
  - Deployment
  - Operations
e-Navigation Strategy

Short Term
- IBS/INS
- GPS, BDS…
- VHF, MF, AIS
- ECDIS
- Radar

2014

Medium Term
- IBS/INS
- Multi-GNSS
- WiMax, 4G
- S-57 to S-100
- METO

2018

Long Term
- e-IBS/INS
- S-100 PS
- e-Loran
- Next generation AIS
- New technology radars
- IMU
- MSP

2025
Work Description

- BeiDou Satellite Navigation System (BDS, COMPASS) Development

Diagram showing the development timeline of the BeiDou Satellite Navigation System from 2000 to 2020.
China's Beidou navigation system makes breakthrough:

- The IMO has ratified the performance standard of a receiver of the shipborne BDS. This is the first BDS to be standard approved by an international organization.

- China's independently-developed Beidou differential navigation satellite system has improved to centimeter level, a major breakthrough in marine application.
Work Description

- BeiDou system

Radio Beacon-Differential Beidou Navigation Satellite System (RBN-DBDS)

User terminals of BeiDou system
Description of Work

- BeiDou&GPS Navigation Receiver

- Main receiver unit
- Power supply unit
- Double mode antenna
- Human interface
Since the end of 2010, south China's Hainan province has spent 79 million yuan to install navigation equipment on 6,000 locally-registered fishing boats.
We will continue to promote BeiDou Satellite Navigation System’s application at maritime field, to establish BeiDou ground-base enhancement system, with IEC, IMO and other international organization to consummate BeiDou Standards, promote BeiDou application and industrialization development.
Work Description

- Fiber-optic Gyrocompass system

- Main compass
- Repeater compass
- Bearing repeater compass (Outside unit)
- Distribution unit
- Control and display unit
Work Description

- Electronic chart equipment -- The system supports IHO S-57/S-63, VCF and CM93.

Vertical type

Desktop type

Hand-held type
Work Description

- Autopilot equipment—The autopilot has the automatic control function for heading and track.

Panel module on the wheel house console
Work Description

- Monitoring & Alarm System (MAS)
Work Description

- Multi-function system--Combining the capabilities of Radar, ECDIS and Conning stations into one unit.
Work Description

- The modern Bridge--The Integrated Bridge System is based on up-to-date designs which meet existing and proposed international standards for functionality, operation and ergonomics, defined by IMO and IEC.

First generation

Second generation
Work Description

National standard

Industry standard

Enterprise standard
Work Description

The products have already got the certificate of conformity of China Classification Society (CCS) and Germanischer Lloyd (GL), and widely in ocean fishing vessel, oil tanker, bulk carrier, grain ship and coast guard ship, maritime surveillance ship and other types of official ships.
## Work Description

### Product approved

<table>
<thead>
<tr>
<th>Number</th>
<th>Product name</th>
<th>Certificate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ECDIS</td>
<td>GL/CCS</td>
</tr>
<tr>
<td>2</td>
<td>BNWAS</td>
<td>CCS</td>
</tr>
<tr>
<td>3</td>
<td>ECS</td>
<td>CCS</td>
</tr>
<tr>
<td>4</td>
<td>Electromagnetic log</td>
<td>CCS</td>
</tr>
<tr>
<td>5</td>
<td>Monitoring &amp; alarm system</td>
<td>CCS</td>
</tr>
<tr>
<td>6</td>
<td>Autopilot</td>
<td>CCS</td>
</tr>
<tr>
<td>7</td>
<td>Fiber-optic Gyrocompass system</td>
<td>GL/CCS</td>
</tr>
<tr>
<td>8</td>
<td>BeiDou&amp;GPS Navigation Receiver</td>
<td>CCS</td>
</tr>
<tr>
<td>9</td>
<td>Conning display system</td>
<td>CCS</td>
</tr>
<tr>
<td>10</td>
<td>Track control system</td>
<td>CCS</td>
</tr>
</tbody>
</table>

Certificate of type approval
Research and development of e-Navigation

- Prototype system development
  - Beacon light integration based on Beidou
  - 3D view and presentation of objects
  - Full coverage depth information
  - Ship-side situation awareness
  - Integrated PNT System
Research and development of e-Navigation

- e-NAV demonstrate project
  - Yangshan Port e-NAV test bed
  - Tianjin Port e-NAV demonstrate project
  - Zhujiang Port e-NAV project
Ships are required to carry a GNSS receiver or a terrestrial radio-navigation receiver.

Investigating how multiple systems can be integrated on the bridge in respect to system availability and integrity

New radar technology

Communications & navigation equipment integration

Fusion of objects; mainly AIS and radar

Second generation AIS and AIS basestation system

S-100 and product specifications
Conclusion

- Inertial Navigation, lower-cost MEMS technologies
- Single window and S-Mode (“Standard” Mode)
- Design and build a new series of navigation support systems
- Some non-linear integration techniques — such as the EKF, UKF, and particle filter.
- Communication between ship-ship, ship-shore and shore-shore
- Maritime Cloud, Big Data and Internet of Things
- The ship side e-Navigation platform and test bed
Conclusion

Thank you for your attention!