Software Quality Assurance guidelines for e-navigation systems

04 April 2014
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Agenda

- SQA needs of e-navigation systems
- IMO progress
  - NAV58, NAV59 and SIP
- Scope of SQA
- Considerations to be improved
- Expectations
- Conclusions
SQA needs of e-navigation systems

- Properties of e-navigation systems
  - Information system composed of software components, data/information and its structure, network protocol as well as hardware components
  - Qualified e-navigation software service for all stakeholders
    - Onboard as well as shore-side users - Masters, pilots, fishermen and recreational boaters, ports
    - Federal, government partners, maritime user community, private companies
Outlining the need to include software quality assurance as part of the ongoing e-navigation gap and cost-benefit analysis process that has to be conducted.

Covering the concept of SQA, the reason why e-navigation considers SQA and practices in other areas such as military and automobile.
NAV59/6/2 (Development of draft SQA guidelines for e-navigation)

- Safety and SQA
- Scope of specification
- Definition of e-navigation SQA
- Means for application of ISO standards
- Relationship with HCD, Usability and CMDS
- Means for certification of SQA
SIP progress - deliverables

Gap Analysis

Risk Analysis
Formal Safety Assessment

Solutions
- 9 solutions
- Proporitised

RCOs
(Risk Control Options)

Considering specific RCOs to develop system of each solution
During the FSA, a number of Risk Control Options (RCOs) in order to assess safety

- **RCO 1:** Integration of navigation information and equipment including improved *software quality assurance*
- **RCO 2:** Bridge alert management
- **RCO 3:** Standardized mode(s) for navigation equipment
- **RCO 4:** Automated and standardized ship-shore reporting
- **RCO 5:** Improved reliability and resilience of onboard PNT systems
- **RCO 6:** Improved shore-based services
- **RCO 7:** Bridge and workstation layout standardization
Five e-navigation solutions have been prioritized as part of the present SIP (Strategy Implementation Plan)

- **S1**: improved, harmonized and user-friendly bridge design;
- **S2**: means for standardized and automated reporting;
- **S3**: improved reliability, resilience and integrity of bridge equipment and navigation information;
- **S4**: integration and presentation of available information in graphical displays received via communication equipment;
- **S9**: improved Communication of VTS Service Portfolio
<table>
<thead>
<tr>
<th>Solution</th>
<th>Sub-Solution</th>
<th>RCO</th>
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<tbody>
<tr>
<td>S1</td>
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<tr>
<td>Improved, harmonized and user-friendly bridge design</td>
<td>S1.1 Ergonomically improved and harmonized bridge and workstation layout.</td>
<td>RCO 7 Bridge and work station lay-out standardization</td>
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<td>S1.4 Standard default settings, save/recall settings, and S-mode functionalities on relevant equipment.</td>
<td>RCO3 Standardized mode(s) for navigation equipment</td>
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<td>S1.5 All bridge equipment to follow IMO BAM (Bridge Alert Management) performance standard</td>
<td>RCO2 Bridge alert management</td>
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<td>S1.6 Information accuracy/reliability indication functionality for relevant equipment</td>
<td>RCO1 Integration of navigation information and equipment including improved software quality assurance</td>
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<td></td>
<td>S1.7 Integrated bridge display system (INS) for improved access to shipboard information</td>
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## SIP progress-Solution to RCO

<table>
<thead>
<tr>
<th>Solution</th>
<th>Sub-Solution</th>
<th>RCO</th>
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<tbody>
<tr>
<td>S3</td>
<td>Improved reliability, resilience and integrity of bridge equipment and navigation information</td>
<td>RCO1</td>
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<tr>
<td></td>
<td><strong>S3.1</strong> Standardized self-check/built-in integrity test with interface for relevant equipment (ex.: bridge equipment)</td>
<td>Integration of navigation information and equipment including improved software quality assurance</td>
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<td>S3.2</td>
<td>Standard endurance, quality and integrity verification testing for relevant bridge equipment, including software</td>
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<td><strong>S3.3</strong> Perform information integrity tests based on integration of navigational equipment – application of INS integrity monitoring concept</td>
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<td><strong>S3.4</strong> Improved reliability and resilience of onboard PNT information by integration with internal and external systems</td>
<td>RCO5</td>
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<tr>
<td></td>
<td>Improved reliability and resilience of onboard PNT systems</td>
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<tr>
<td>Solution</td>
<td>Sub-Solution</td>
<td>RCO</td>
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<tr>
<td>S4</td>
<td>S4.1.2</td>
<td>RCO1</td>
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<td></td>
<td>Standardized interfaces for data exchange should be developed to support transfer of information from communication equipment to navigational systems (INS)</td>
<td>Integration of navigation information and equipment including <strong>improved software quality assurance</strong></td>
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<td></td>
<td>S4.1.3</td>
<td>RCO6</td>
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<td>Provide mapping of specific services (information available) to specific regions (e.g. maritime service portfolios) with status and access requirements.</td>
<td>Improved shore-based services</td>
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<td></td>
<td>S4.1.6</td>
<td>RCO1</td>
</tr>
<tr>
<td></td>
<td>Provide quality assurance process to ensure that all data is reliable and is based on a consistent common reference system (CCRS) or converted to such before integration and display.</td>
<td>Integration of navigation information and equipment including improved software quality assurance</td>
</tr>
</tbody>
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Current status

- SQA guidelines for e-navigation systems
  - Submitted to
    - NAV correspondence group report
    - Annex 6
To ensure that **software requirements** from relevant **regulations**, from applicable **standards**, and from **stakeholders** are fulfilled throughout the **life cycle** of an **e-navigation system** and the life cycle of any **related data** used within software.
the stages and activities spanning the life of the software/data product - from the conception of its requirements to the termination of its use;

The life cycle covers the stages of conception, analysis, design, operation, maintenance and termination.
Software Quality Models

- **Product Quality**
  - ISO/IEC 9126-4, ISO/IEC 25010
  - GS (Rep. of Korea)

- **Data Quality**
  - ISO/IEC 25012, ISO/IEC 25024

- **Quality in Use**
  - ISO/IEC 25060

- **Process Quality**
  - ISO/IEC 12207, CMMI, SPICE
  - SP (Rep. of Korea)

*Life cycle related:*
- ISO/IEC 15288
- ISO/IEC 15026
Software Quality Models

Product quality model

- Functionality
  - Are the required functions available in the software?
- Portability
  - How easy is it to transfer the software to another environment?
- Maintainability
  - How easy is it to modify the software?
- Efficiency
  - How efficient is the software?
- Reliability
  - How reliable is the software?
- Usability
  - Is the software easy to use?

ISO/IEC 9126
Software Quality Models

- Quality-in-use model

![Diagram of Quality-in-use model]

- Effectiveness
  - Effectiveness

- Efficiency
  - Efficiency

- Satisfaction
  - Usefulness
  - Trust
  - Pleasure
  - Comfort

- Freedom from risk
  - Economic risk mitigation
  - Health and safety risk mitigation
  - Environmental risk mitigation

- Context coverage
  - Context completeness
  - Flexibility
Software Quality Models

- Data quality
  - Applied to ensure the qualified data involved in software
    - used by software
    - software produces
  - Depending on the specialties of e-navigation systems, data quality might be important issue.
    - Some of software problems caused by data issue
Software Quality Models

Process quality

- Developing S/W
- Qualified process
- Qualified S/W
Considerations to be improved

- Applying Quality Models
  - Specific SQA guidelines
    - For onboard/shore-based
    - For Specific equipment
  - Sustainable amendments
    - By practices
    - By stakeholders’ requirements
Considerations to be improved

- Relevant concepts
  - HCD (Human Centred Design) and U-TEA (Usability Testing, Evaluation & Assessment)

Links between the SQA, HCD and U-TEA guidelines

Source: Draft HCD guidelines on e-navigation systems
Considerations to be improved

- Relevant concepts
  - **S-100** will support a great variety of data sources, products and services
  - CMDS

![Diagram showing various concepts related to S-100 and CMDS]

Source: IHO
Expectations

- To provide the benefits for all stakeholders, regarding on software/system/software service and data used in software through the life cycle
  - Customers can be served qualified software/data.
  - Providers can verify their qualified software/data.

- e-navigation SQA will support the two types of viewpoints by how to dealing with.
Conclusions

- SQA process will be designed in detail.
- Key activities will be developed for the SQA process.
- Practices will be developed for support the SQA process.
Thank you very much.