international e-Navigation underway 2016

‘Data supply chain certification’ - quality monitoring and indication for e-Navigation solution reliability

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Supported by Evelin Engler

Situational Awareness
Safeguarding needs enhanced Support

- **Increasing complexity of nautical task**
  - Higher traffic volume and densities
  - Reduction of navigable space
  - Larger ship size
  - Reduction of bridge teams
  - Economical and ecological pressure
- **Increasing data availability**
  - Higher number of situation relevant data types
  - More data sources (sensors, other ships, shore…)
  - Higher resolution of data provision (spatial, temporal)

Necessity to prepare information

- Selecting and linking of relevant data
- Evaluation and refinement of data
- Human Centric Approach for presentation of information

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Reliance of Ship's Navigation

Navigator vs System

© http://www.marineinsight.com/future-shipping

Historic
Traditional
Early systems (Radar...)
VTS Support
Advanced Bridge
ECDIS
Decision Support System
Advanced STMS
Remote Control
Autonomous Ships

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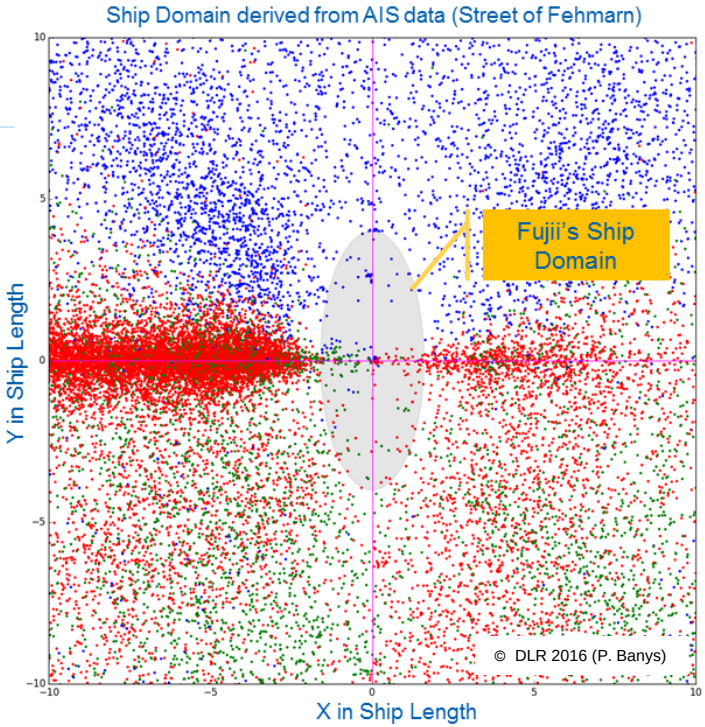
Avoidance of Collision & Grounding

dCPA/tCPA, Ship Domain (SD), and Ship Arena (SA)

- **Open Sea Conditions**
  - dCPA/tCPA are usual identifiers of collision risk between ships
    (distance/time to Closest Point of Approach)
  - SD is the safety area around a ship not to be violated (ships and obstacles)
  - Diversity of SD models result from determination & considered impacts
    (object of research)
  - SA describes the area around a ship to be monitored for SD protection
    (taking into account the needed time for collision avoidance actions)



- **Restricted Waters, Port Entries, Narrow Fairways,….**
  - dCPA/tCPA approach unusable due to restricted navigation area
  - Special SD taking into account specific conditions & maneuvers
    (navigational area and maneuver possibilities)

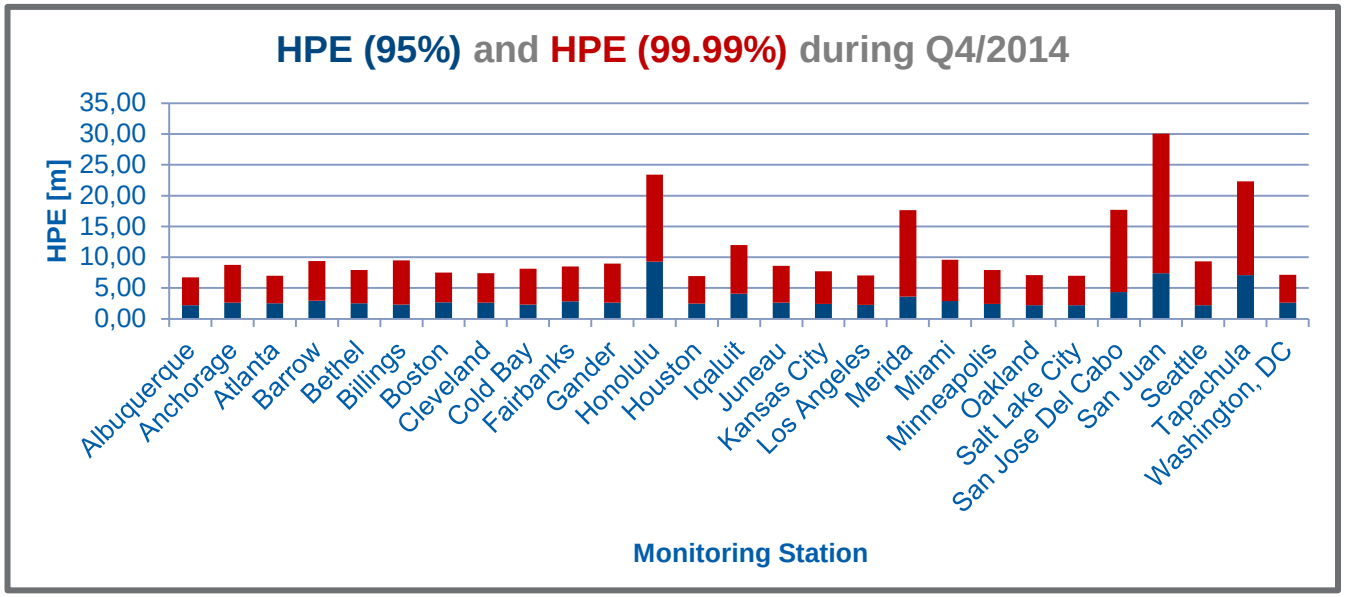
Dimension of Ship Domain
Influencing Factors

Ship Centric factors
- Ship size (length, width)
- Ship's static characteristics (wind susceptibility)
- Ship's dynamic characteristics (maneuverability…)

Voyage Centric Factors
- Cargo: dangerous goods
- Passenger
- Speed

System Centric Factors
- Human factors (navigator education, experience…)
- Ship Sensor error budget
- Data error budget (data quality indicator, CATZOC…)
- Data Supply Chain error budget

Example of error budget:
HPE of GPS SPS

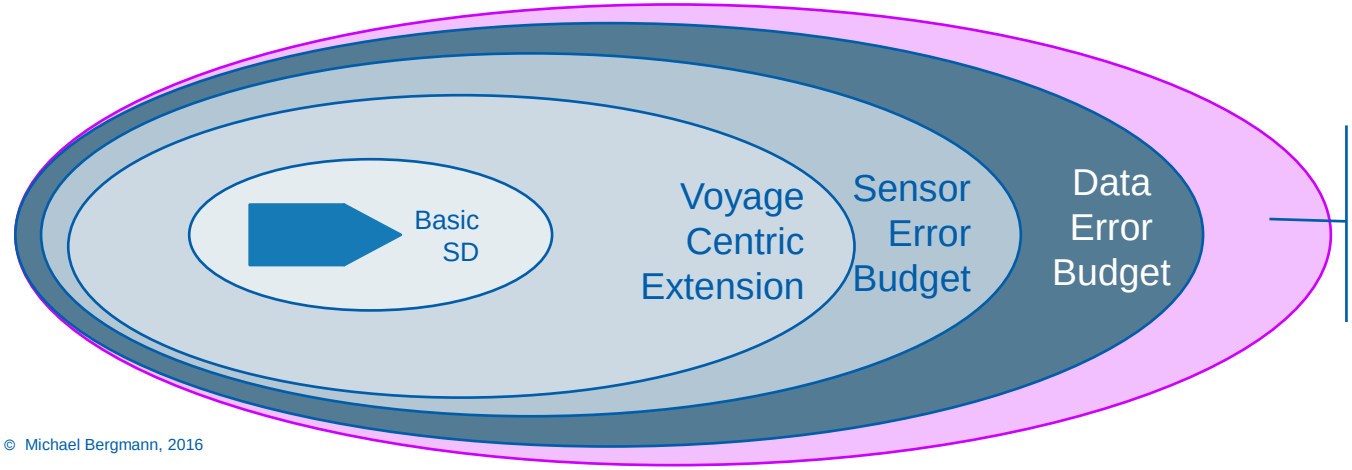


HPE: Horizontal Positioning Error
GPS: Global Positioning System
SPS: Standard Positioning Service

Determining the dimension of the individual Ship Domain

(1) Ship's size & characteristics define the dimension of the basic domain.

(2) Voyage centric factors are increasing the basic risk and require an extension.

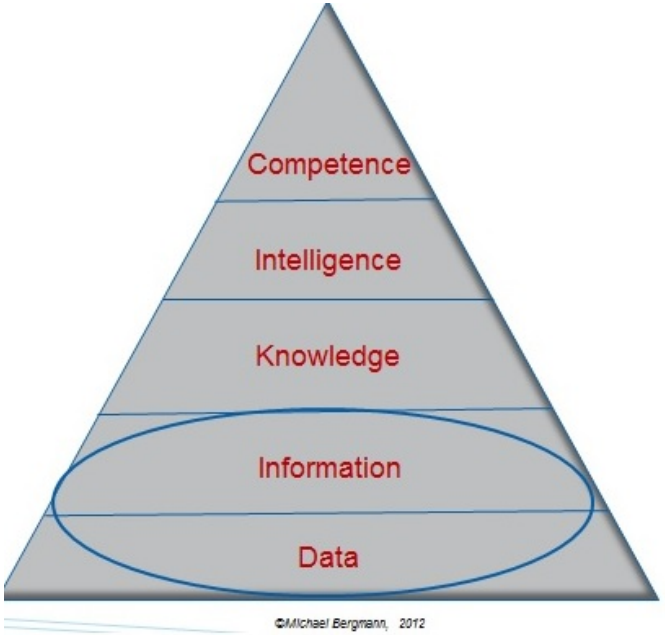


(3) Each component used for decision support (Radar, ARPA, Compass, ENCs…) contributes to SD's confidence.

(4) In integrated systems (ECDIS, INS) the data error budget may be accumulative.

Situation Awareness
Data are the key element !

- Data needs to be converted into information.
- Human Centered Design (HCD) intents to present information in digestible way.
- High error budgets in database cannot be rectified by the best systems.
- Data quality needs to be a prime focus area.



Predicted error budget (meters)

Parameter	Est. StDev.
GCP error	1.00
Residual processing	0.50
Residual satellite	3.60
Feature capture	0.40
Terrain induced error	2.45
Est. Total error	4.51

© Jeppesen, 2005: Data Validation Project

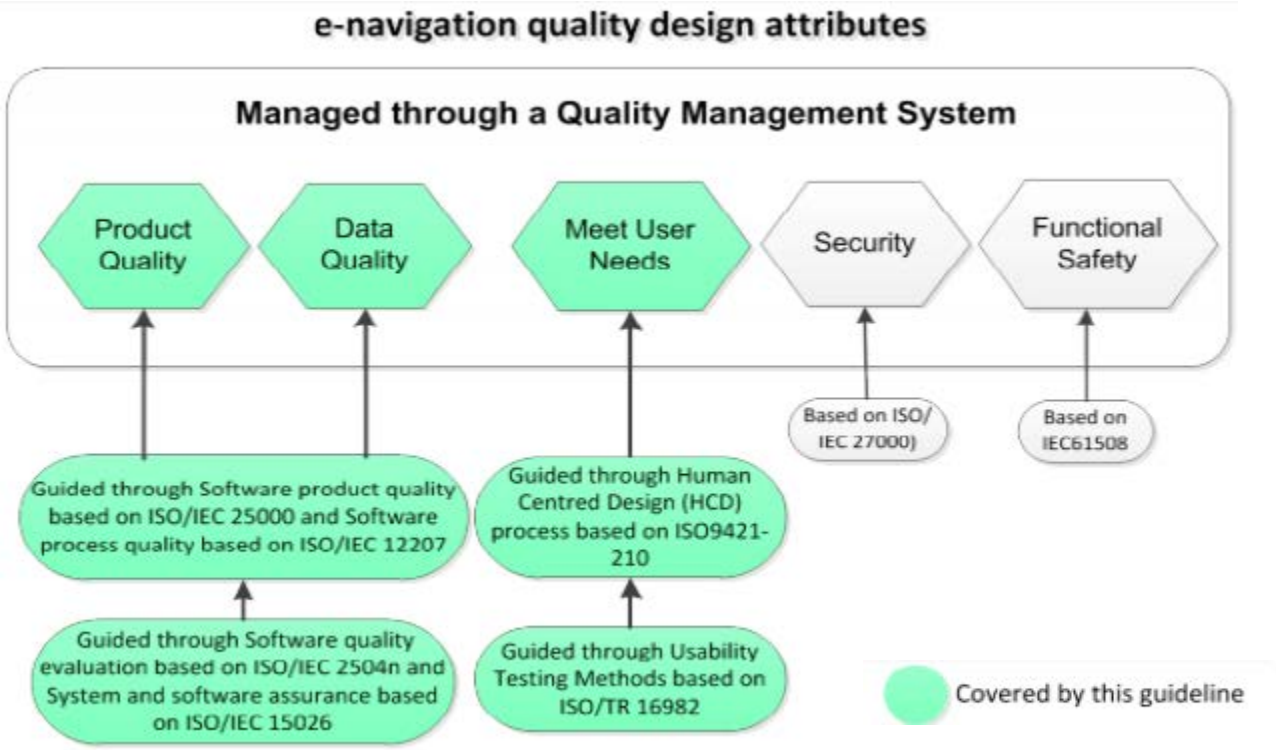
Example

QuickBird is a high resolution satellite owned and operated by DigitalGlobaL.

http://www.satimagingcorp.com/gallery

HCD and SQA Guidelines
Reducing system error budget

- HCD and SQA Guideline recommends standards for system quality to reduce system error budget



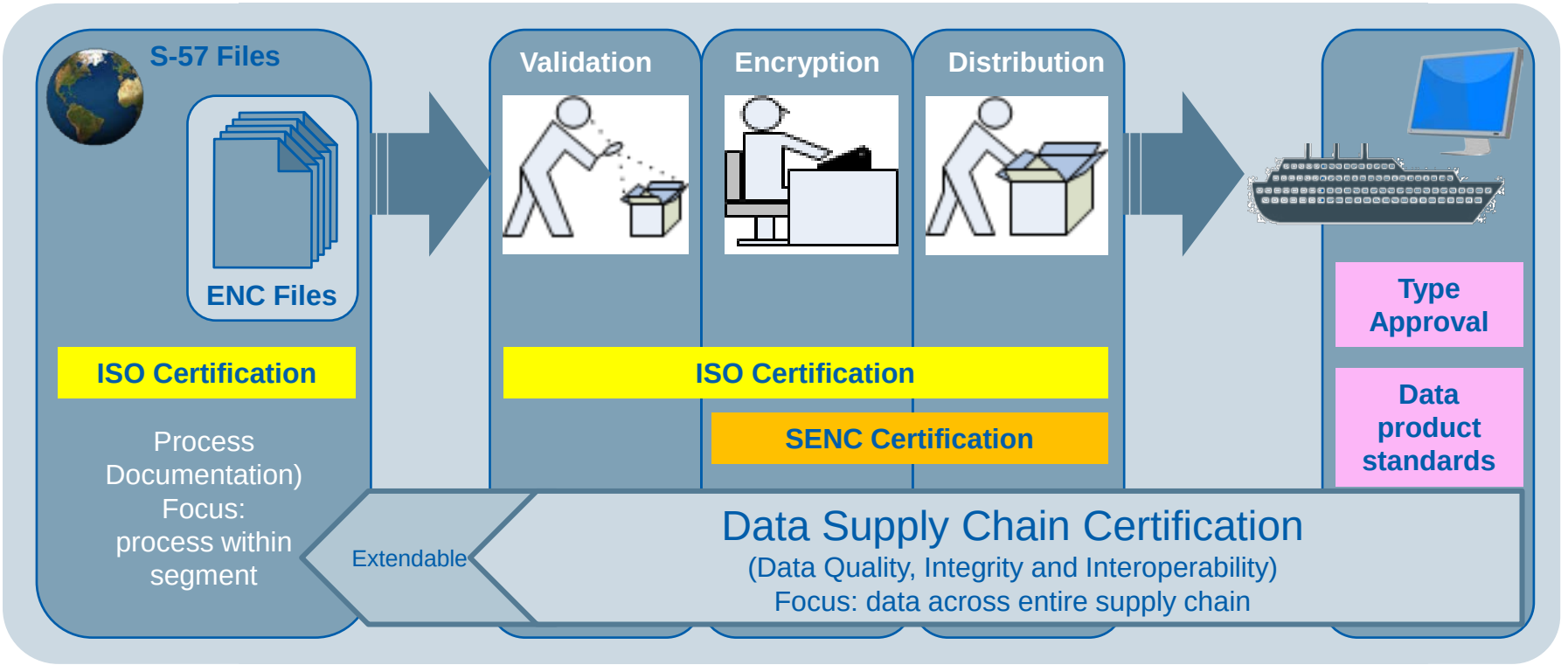
IMO Guidelines on Human Centred Design and Software quality assurance (SQA) in e-navigation

- It addresses need on data quality but doesn't specify data quality standards

Data Supply Chain Certification
Reducing data supply error budget

From data quality standards for data creation…..

….. to Data Supply Chain Certification covering the full supply chain and reducing overall data error budget.



The Data Supply Chain Certification proposed to IHO is build on the experience of the aviation industry. DO-200A is defining the maximum accumulative error rate (10^{-8} for critical data) throughout the supply chain.

Maritime Data Quality Aspects

Based on RTCA DO-200A in Aviation

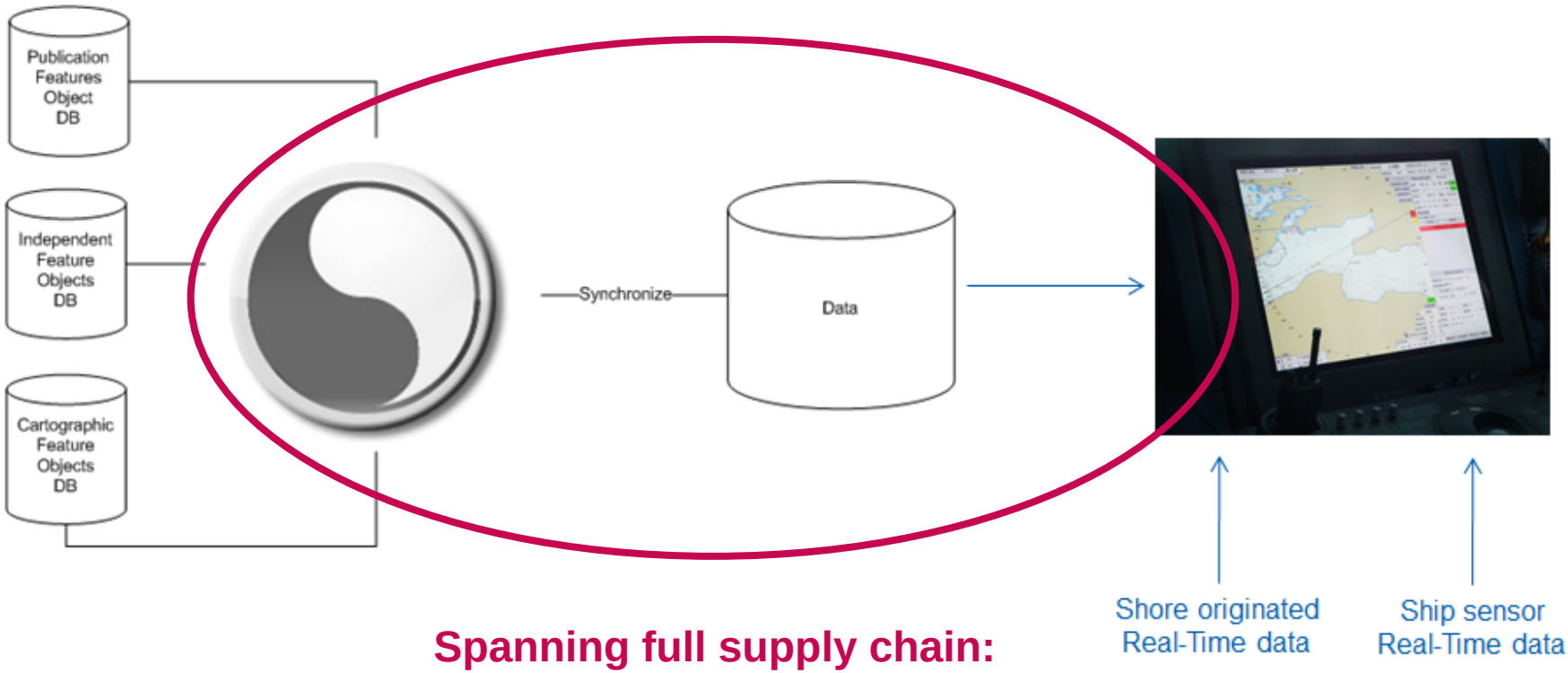
1. Accuracy
2. Resolution
3. Assurance Level
4. Traceability
5. Timeliness
6. Completeness
7. Format

8. Data Integrity throughout the Supply Chain

DSCC in Integrated Systems

e-Navigation implementation

Data Production | Data Integration | Data-Product Implementation | Information Visualization



Spanning full supply chain:
Data Producers -> End Users

Conclusions

- **In the ever more complex environment navigators need support by integrated systems to ensure Situational Awareness.**
- **The concepts of "Ship Domain" and "Ship Arena" are appropriate approaches to evaluate the situational centric risk.**
- **Generally, the qualification of SD approach for reliable decision finding requires**
  - more research to better define the different factors influencing the ship domain (static/dynamic); and
  - the provision of means to determine and monitor error budgets within integrated systems.
- **In particular,**
  - human factors may need an improved quantification of errors & risks;
  - standardized data quality indicators are needed (e.g. see IHO DQWG);
  - DSCC (static/dynamic) needs to be established to ensure the reliable data supply error budget and to indicate the level in during delivery.

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THANK YOU !

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