A Conversation About

The Benefits and Risks of Electronic Devices in Shipping

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'The Benefits and Risks of Electronic Devices in Shipping'

Why this (strange) title?

Think for a minute about the non-electronic ship...
• Navigation:
  – Sensors: Position, Heading, Speed, Water depth, Environmental information…
  – Applications: Radar, ECDIS, Conning, AIS, VDR, Autopilot, Track Control…

• Automation (Platform management; Alarm, Monitoring, Control):
  – Sensors for all sorts of physical measurements (pressure, temperature, flow, contents, movement…)
  – Actuators to carry out commands (valves, pumps, motor starters, engine controllers…)
  – Applications: Propulsion, Power Management, HVAC, Emergency Shut-down, Safety management, Damage management, Auxiliary systems, Cargo systems…

• Communications:
  – External communications (HF, VHF, Satellite; Voice, Data)
  – Internal communications (Public address, Talk-back, Phones…)
• Without electronics, we would be back to S/S Martha (aka S/S Aslaug).
• In other words…Romantic, but impractical!

• The benefits of electronics are very clear, which includes:
  – A very significant influence on crew size; and crew cost.
  – A positive safety implication.

• There are however risks: Poor usability and poor understanding of the context-of-use.
WHAT ARE (SOME OF) THE BENEFITS?
ATOMOS IV: The highly integrated ship…

- ATOMOS IV precondition: Retrofitting ships with well-designed, well-engineered integrated ship control systems, in compliance with
  - The applicable IMO performance standards
  - The associated IEC test standards
  - A system design according to IEC 17894
  - A Human-centric design according to IEC 9241-210
• ATOMOS IV Crew size model (Lyridis & Psaraftis): A model that predicts crew size and crew cost (in 2003 EUR) for EC ships as a function of technological level.

• Input parameters
  – Ship type
  – Ship size
  – Machinery size
  – Flag
  – Technological level (from all-manual to all-integrated)
A closer look at the benefit side…

Annual Crew Cost Savings
All Manual vs. Full Electronics' Suite, k€ (2003 level)

-20000 0 20000 40000 60000 80000 100000 120000
k€
0 200 400 600 800 1000 1200 1400

Tonnage

- Container ships
- Tankers
• ATOMOS IV Safety Analysis (Venturino & Raffetti): A model that describes the variations in ship safety as a function of the ship technological level.
  – Ship type
  – Ship size
  – Machinery size
  – Flag
  – Technological level (from all-manual to all-integrated)
A closer look at the benefit side…

Safety increase vs. technical level

Safety Increase

Technical Level

Tanker

Container
According to the ATOMOS results, the benefits of a full suite of integrated electronics onboard are:

- An annual crew cost savings of 800 – 1200 k€
- A safety increase of 65 – 75%
BUT WHAT ARE THE RISKS...?
A closer look at the risk side

- Let the experience speak: a survey of accident and incident-reporting where 'electronics' may play a role (private communications from Dr. Sherwood-Jones):
  - RMS Queen Mary 2 (while approaching Barcelona 23 September 2010)
    - Explosion in a capacitor; black-out; inoperable warning system.
    - Finding: Improved detection devices, improved alarm design and prioritizing.
  - M/V Crown Princess (Atlantic Ocean off Port Canaveral, FL, USA, 18 July 2006)
    - 24 deg. heeling caused by improper manual control of steering wheel.
    - Finding: Lack of crew training, reduction of ship controllability due to shallow water, improved warning design.
A closer look at the risk side

- **M/V CFL Performer** (English East Coast, 12 May 2008)
  - Grounding on the Haisborough Sand.
  - Finding: Lack of ECDIS training.

- **M/F Collaroy** (Port of Sidney, Australia, 19 September 2005)
  - Collision with wharf, due to a component failure in the unique remote propulsion control system (affecting both main and back-up systems).
  - Finding: Lack of system knowledge; lack of training in Bridge/ECR take-over procedures (and ESP: poor understanding of system requirements).

- **M/T Prospero** (Milford Haven, UK, 10 December 2006)
  - Collision with wharf, due to loss of the almost unique podded propulsion system control.
  - Finding: Lack of training, improved alarm design (and ESP: poor understanding of system requirements)
A closer look at the risk side

- **M/V Savannah Express (Southampton, UK, 19 July 2005)**
  - Ramming linkspan following engine failure (loss of astern power).
  - Finding: Long chain of events involving novel design, sensor failure, inadequate repairs, lack of system understanding, lack of training.

- **M/V LT Cortesia (English Channel, 2 January 2008)**
  - Grounding on the Varne Bank.
  - Finding: Improved training in voyage management and ECDIS, improved lookout, improved BRM.

- **M/V Royal Majesty (Rose & Crown Shoal, Nantucket, US, 10 June 1995)**
  - Grounding on the Rose and Crown Shoal following navigational error
  - Finding: Lack of training, poor alarm design, poor bridge performance.
- M/F Queen of the North (BC, Canada, 22 March 2006)
  - Striking Gil Island, drifting, and subsequent sinking.
  - Finding: Lack of attention, lack of watch-keeping standards, lack of proper use of navigation equipment.
- USCG Cutter Mackinaw (Grand Haven, MI, USA, 12 December 2005)
  - Striking the sea wall after doing a sudden 90 degrees turn.
  - Finding: Inexperience with controls of a novel azimuth thruster propulsion arrangement.
- M/F Pride of Canterbury (off Deal, Kent, UK, 31 January 2008)
  - Grounding on a charted wreck in poor weather conditions.
  - Finding: Lack of ECDIS training, improper system settings.
Suggestions about risk…

- Four issues appears to feature infamously in the foregoing:
  - Lack of crew training;
  - Lack of crew understanding of unique/novel systems;
  - Design flaws in unique/novel systems (by inexperienced designers);
  - Inadequate alarm/warning design;
Unless addressed, exactly the same aspects appears to be relevant to coming eNavigation systems...
• Mitigation: Human-centric Design.
• The point is this: HCD provides…
  – Intuitive systems requiring little or no training;
  – An understanding of the context-of-use from the start of the design. This means getting needs and requirements right.
• A cultural change is however required: Usability must be demanded, designed and delivered to the end-user.
• A plan to institutionalize usability in eNavigation is required.
eNavigation Underway 2013

Thank you

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• Anyone wondering?…: How does this fit with the ATOMOS IV prediction of increased safety with high levels of technology?
• Fine!
• ATOMOS IV Preconditions
  – A system design according to IEC 17894
  – A Human-centric design according to ISO 9241-210