A Conversation About

The Benefits and Risks of Electronic Devices in Shipping

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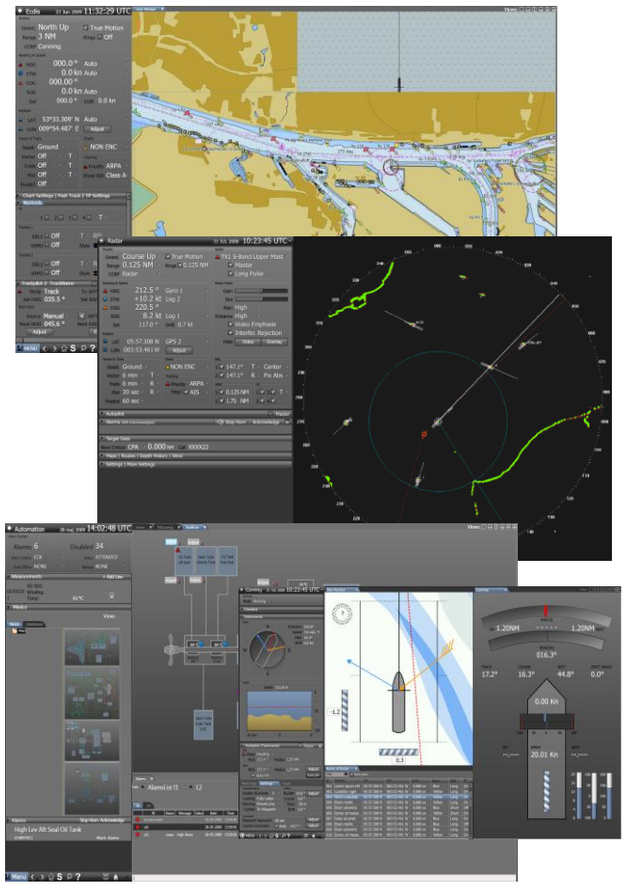
‘The Benefits and Risks of Electronic Devices in Shipping’

Why this (strange) title?

Think for a minute about the non-electronic ship…

Electronics in shipping…This we would miss…

- 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…)



Electronics in shipping…the conclusion

- 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 <u>are</u> 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 & DISC series of EC sponsored projects 1992-2004.
- 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

A closer look at the benefit side…

- 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)

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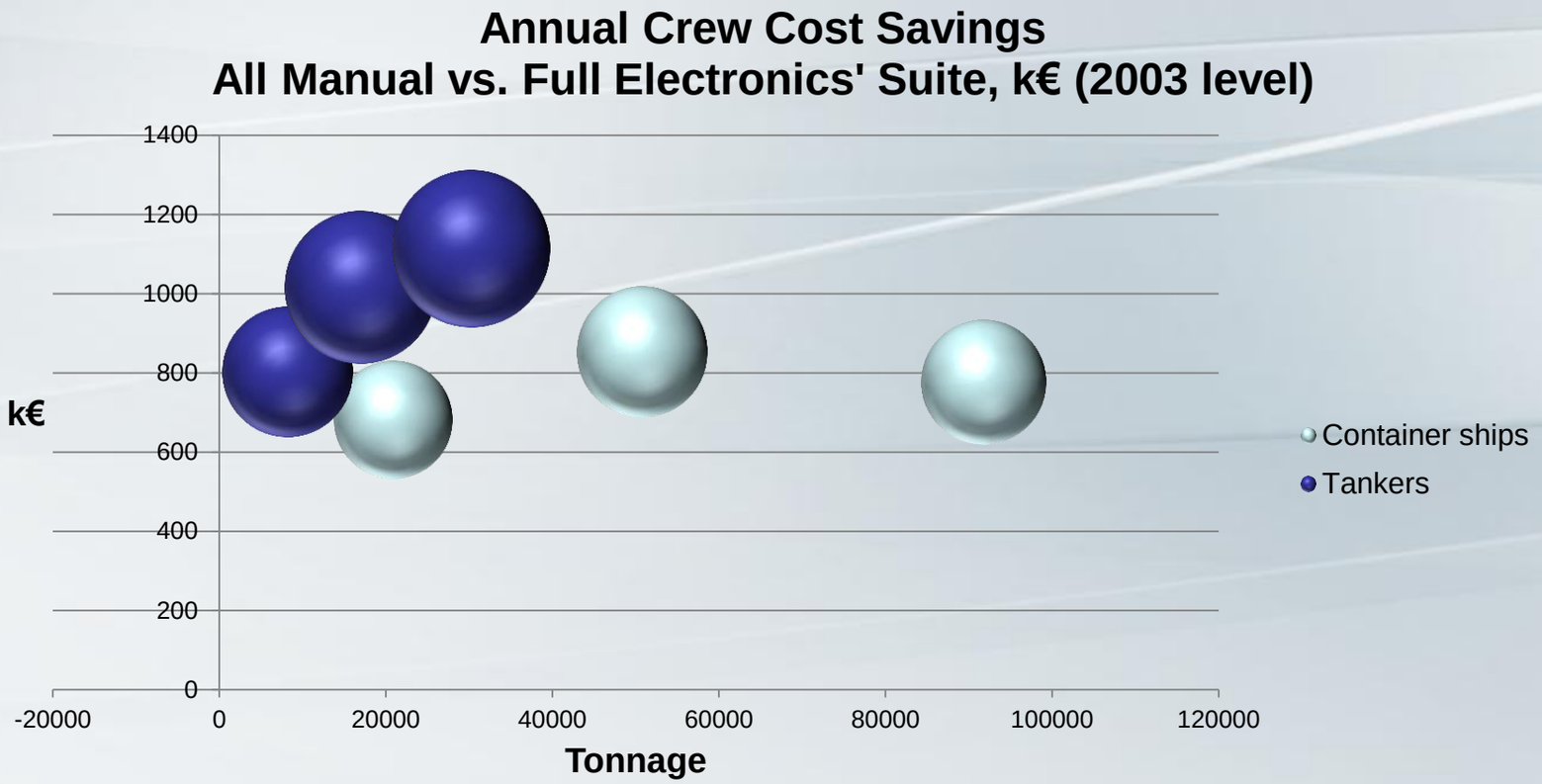
A closer look at the benefit side…



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A closer look at the benefit side…

- 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)

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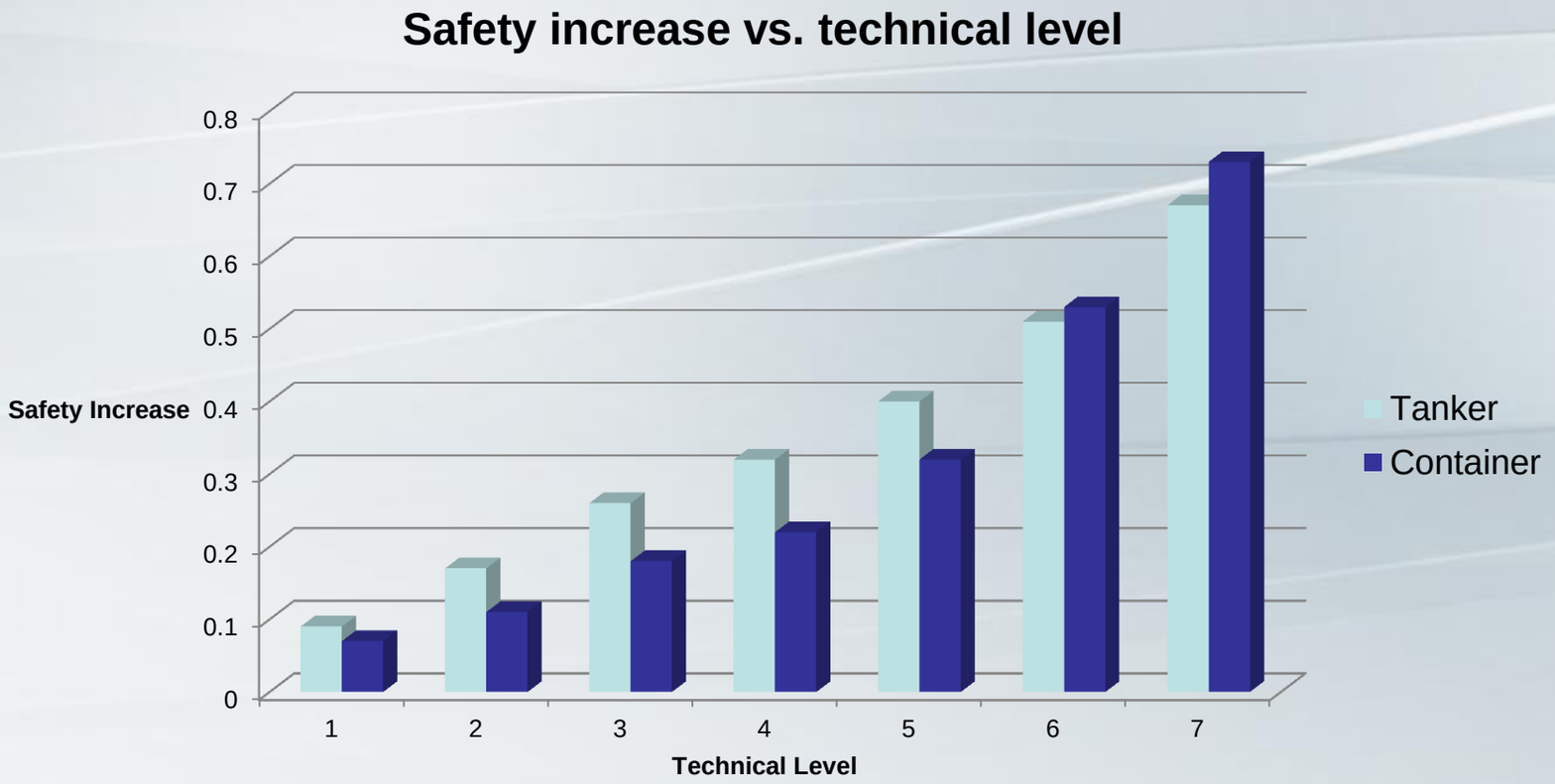
A closer look at the benefit side…



The benefits…

- 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…?

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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)

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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.

A closer look at the risk side

- 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.

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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;

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To take home…Braze yourselves for impact ☺

Unless addressed, exactly the same aspects appears to be relevant to coming eNavigation systems...

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Mitigation…

- 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.

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Thank you

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Closing the Circle…

- 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