

## Integrating maritime technology and humans

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### How many systems must a mariner understand?

“In case of failure in one part of an integrated navigational system, it shall be possible to operate each other individual item of equipment or part of the system separately.”

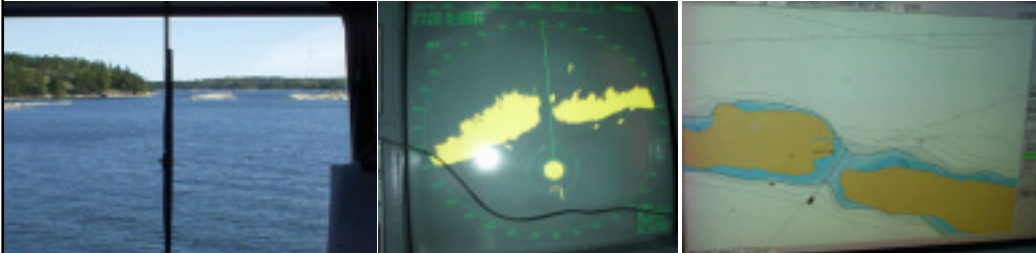
SOLAS V: 19

Data from	How	Number of subjects
Mariners onboard	Informal, contextual	~40 <small>15 ships</small>
Shipping companies, teachers, pilots, manufacturers, etc.	Formal, Informal	~70
Class, IMO, NI, Maritime Authorities etc.	Discussions	~30
Mariners, maritime stakeholders	Polling, discussions	116

## Integrated systems

- » Seamless, integrated systems aggravate the problems of automation
- » Integration hides work
- » Integration is a barrier to work
- » Mariners work to include themselves
  - » “Integration work”

## Integration work



- Information presentation
- Humans and machines
- Rules, regulations and practice
- Learning and practice

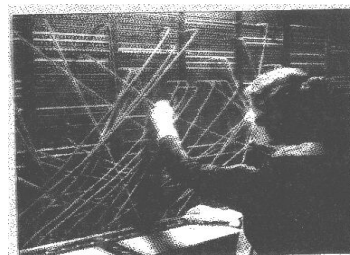
Digital Ship, Oslo June 2005 © M. Lützhöft VTI

## Integration work

**L:** there...I hope nothing else shuts down now...was it just this one?

**F:** yees [a bit hesitantly]

**L:** you never know with these integrated systems...



*"Integration is so much more complicated than plugging the black boxes together."*

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## Machine intelligence

**“The machine will still be literal-minded on its highest level, and will do what we have told it to do rather than what we want it to do and what we imagine we have told it to do.”**

(Wiener, 1985)

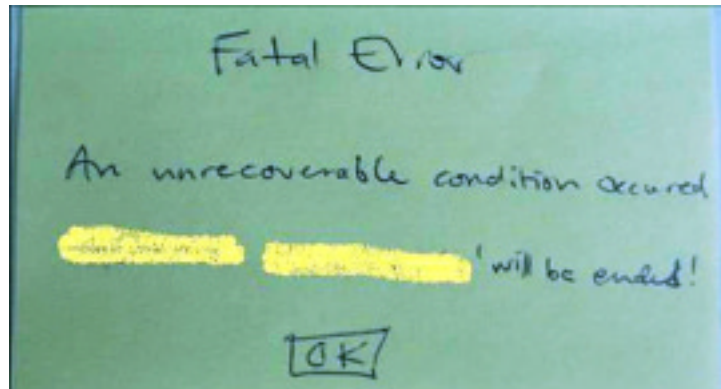
**“When you’re learning the system...at first you don’t understand how it’s meant to work, but then you start thinking backwards, like a computer”**

(Officer on merchant ship)

## Officers say:

**“I’d like to learn more...but there is no time...and what if it breaks?”**

**“When something goes wrong we don’t know if it’s a handling error or a system malfunction.”**



## Manufacturers say:

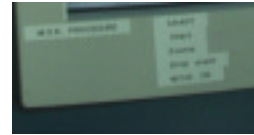
**“It is becoming increasingly difficult to get people to sit down and find the problem. Complaints are often too generic. We need more input.”**

## Man Over Board: No time to lose

- » New electronic chart system: Position registering function
- » 5 steps to register
- » Must also start turning the ship, alert the captain and crew, sound alarms and launch the MOB lifebuoy...

### The solution?

- » Dymo tape
- » Other systems: button-push registering



## Trust

**X:** “we used this display, which showed the ship’s symbol on the chart, we were leaving a port in thick fog, and the symbol should follow the course line. The symbol started moving to starboard, and we should compensate to port. But nothing else showed we were turning. The rate-of-turn indicator, the compass and the radar all showed something else. The technology should be a support and confirm what you know is true. But when the brain gets these two signals you have to figure out what you can trust, and there is little time and little space. The symbol kept moving and we saw that the GPS had lost its signal. The first time it happened I was really scared, but now I have learnt. It’s weird when you see the heading turning towards a pier, but when you look out of the window the ship is not moving. Now when it’s fog I’d rather not use it, I don’t trust it anymore...I just use the compass.”

## Trust

A captain at the Nautical Institute IBS conference (2003) said:

**“It’s hard to argue with a nice ECDIS, fed with a cheap GPS.”**

## Ruthlessness

**S: “We call the autopilot our electronic helmsman, and then depending on which mode you’re in, it does what we say but it is completely ruthless in track mode...it could run over things...”**



## Ruthlessness

**N:** "...I've passed a waypoint and am not on track yet...and now! He [the trackpilot] skipped it, in a critical situation I can be prepared to change course, and he skips it, he doesn't say anything about 'I don't care about your previous course'...you can see it but...it happened to me a couple of years ago, but you always check so I had to use the joystick [to get to the right course], but it could be dangerous..."

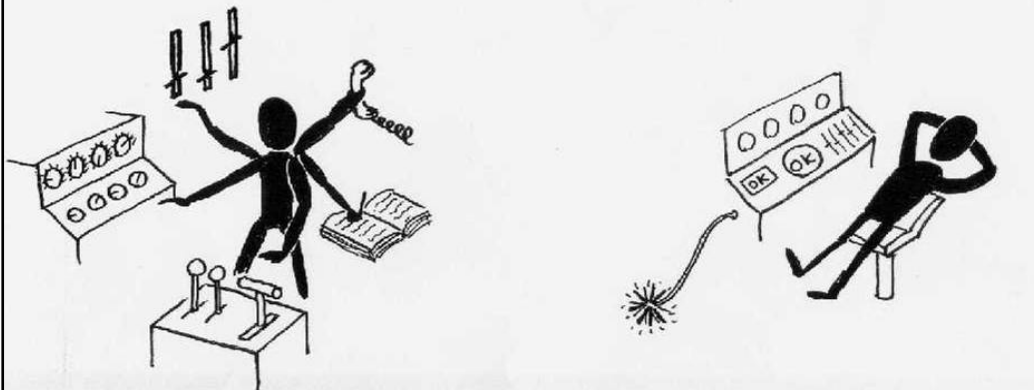
## Resistance?

- » **A:** it's very conservative, and it's always hard to make changes, here [ships generally] it's even harder.
- » **S:** I can't believe it's come this far, what did people say in the beginning...?
- » **A:** there was some resistance...but not much, really, it came in steps somehow...

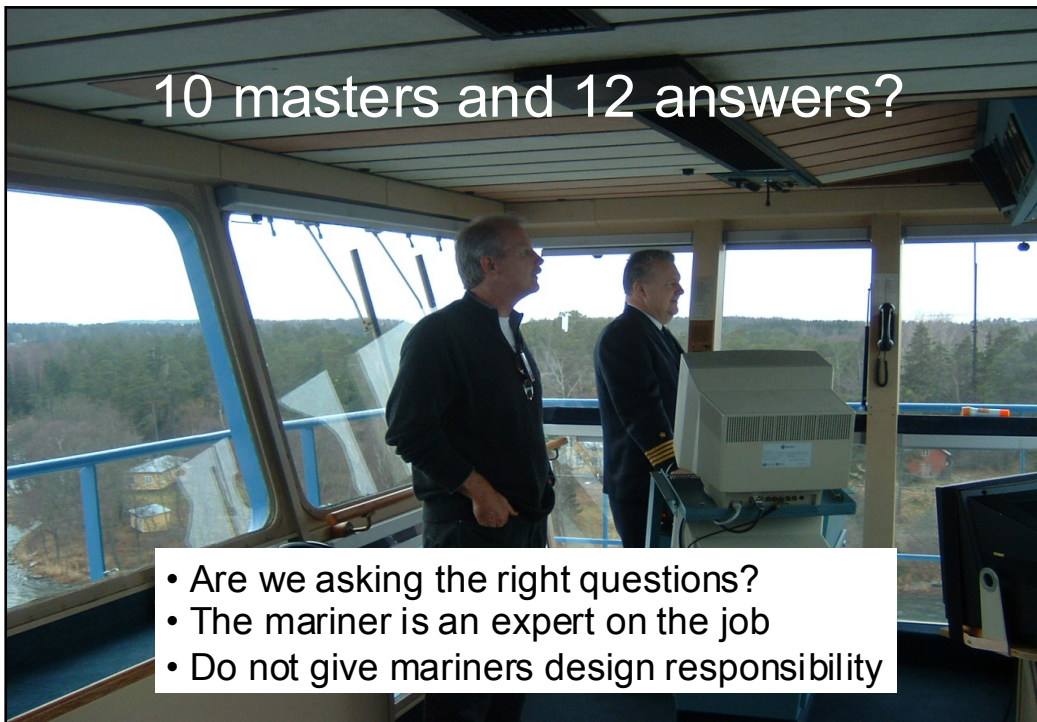


## Workload management

O: "You can't just sit here and relax...you have to look the whole time"



10 masters and 12 answers?



- Are we asking the right questions?
- The mariner is an expert on the job
- Do not give mariners design responsibility

## What shall we do...?

- » Involve mariners
  - » Watch them work
- » Training
  - » Introductory & lifelong learning
- » Reskilling without deskilling
  - » Take your time – human-technology teambuilding
- » Keep up with HF research
  - » Trust/ruthlessness, over/underload