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Partnership Between Seafarers and Technology For
Safe Maritime Operations
GERD BERNER
gerd.berner@intraspect.com.au
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INTRODUCTION
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INTRODUCTION TO MARITIME SAFETY
WHAT KIND OF SAFETY?

• seafaring is a challenging and dangerous occupation.
  • challenges include separation, long hours, high workload, fatigue, stress, motion, noise…..

• process safety is a different problem to personal safety:
  • personal safety often measured in Lost Time Injuries (LTI)
  • process safety failures sometimes require an accident report!

• Deepwater Horizon won an award for zero LTIs on the day of the disaster in the Gulf of Mexico.
INTRODUCTION TO MARITIME SAFETY
HUMAN FACTORS BASICS

• no one means to have an accident
• local rationality states that people try to do a good job
• decisions made sense at the time with available information
• front line staff don't have one single objective – constant complex trade-offs

• into this context you place technology
  • informing decisions in real time
  • accepting and making control inputs

• culture is key to improving system safety outcomes
• free flow of information - incidents and near misses.
• consider the systems as a whole
• accidents are results of flawed processes
• human responses and organisational dynamics
• boundaries (defence in depth) include:
  • human capabilities
  • engineered solutions
  • governance
• Swiss Cheese model represents the alignment of multiple failures to cause an accident
• safety critical systems are largely ‘socio-technical’ incorporating technology, humans and the organisation.
• technology can have hidden flaws or opaque operating rules that contribute to an accident.
• operators need to understand the rules, constraints and limitations of the technology system.
THE HUMAN ELEMENT
OVERVIEW

AUDIENCE POLLING QUESTION 2
• the objectives:
  • design tasks and equipment to fit the operators and involve the users
  • S-Mode and E Navigation (IMO)
  • considering variation between operators
  • develop intuitive displays and controls
• the realities:
  • uneven workload distribution - long periods of monitoring followed by peaks during an incident
  • awareness supervisory role is not consistent with human capabilities
  • automation doesn't remove errors, it creates different kinds of errors
THE HUMAN ELEMENT
DESIGNS MUST CONSIDER

- failure to understand the limitations of technology
- operator resistance
- unwanted behavioral adaptation
  - overreliance / vigilance issues
  - risk compensation (safety consumed not banked)
- de-skilling due to automation impacts:
  - willingness to take manual control
  - ability to solve problems when automation fails
DESIGNING TECHNOLOGY FOR SAFETY
HUMAN COMPUTER INTERFACE

• standardise
• controls and displays - minimum of mental transformation
• awareness of biases
  • western left-to-right reading
  • clockwise increasing on analogue gauges.
• keep operators in the control loop – for emergency response
• awareness that same equipment may go onto a range of different vessels
• design question - do integrated technologies form a cohesive solution?

ISO 11064:2013 - Ergonomic design of control centres
ISO 9241:2018 - Ergonomics of human-system interaction
ISO 17894:2005 - Ships and marine technology
• size and significance of alerts and alarms
  • salience matched to criticality
  • prevent operator overwhelm
• abstraction of data an issue (opaque to operators)
• system monitoring the right parameters
• opportunity to increase the intelligence of alerts
• modern technology provides sophisticated monitoring
  • cross track deviation alarm
  • waypoint alarms
  • guard zones
• often these functions are not used
• bad data sources often feature in accidents - particularly full authority systems (aviation)
• Royal Majesty grounding – GPS data invalid
• operators require system understanding when working with an automation problem
• industry challenges
  • transitory staff
  • delivery of training across a diverse and distributed fleet
  • catering for all necessary languages
• training content
  • how to train for abnormal operations
  • which scenarios (there are an infinite number!)
  • best modes for delivery
• manufacturers
  • ensure clarity in equipment documentation and training (rules, constraints, limitations)
  • share information across industry
TECHNOLOGY ASSISTED ACCIDENTS
TO NAME A FEW RECENT INCIDENTS

- Pride of Canterbury (2008)
- Performer (2008)
- Cortesia (2008)
- Maersk Kendal (2009)
- Thames (2011)
- Ovit (2013)
TECHNOLOGY ASSISTED ACCIDENTS
ROYAL MAJESTY

• leaving Bermuda, all navigation equipment was operational
• shortly after, GPS antenna cable failed, GPS loses signal
• GPS reverts to ‘Dead Reckoning’ mode
• alert 3mm high letters and cryptic (SOL and DR)
• single chime for 1 second and no integration to other alarms
• other barriers (depth sound, cross check position independently)
• position fix alarm - autopilot had off course alarm, but both had the same GPS data feeds so this was nullified
• GPS flagged ‘invalid’ data, but other devices still trusted it
• vessel 15 miles off track for arrival & mistakes entrance buoy
• vessel runs aground approaching Nantucket
prior to arrival at dover, Controllable Pitch Propeller (CPP) hydraulic pump had a partial failure
low pressure did not trip an alarm but propeller pitch did not respond to controls – **NO ALARMS SOUND**
CPP pitch indicator indicated correctly, however bridge team did not identify the problem
no Engine Control Room (ECR) gauge for CPP hydraulic pressure
navigators work practice is not to check the pitch indicators frequently (do it by feel of control levers).
vessel collides with wharf
SUMMARY

- process safety has different requirements from personal safety; it needs consideration throughout the vessel lifecycle.
- subscribe to human factors principles – no one means to cause an accident.
- blame-free culture is key – incident and near-miss data prevents future accidents.
- accidents may result from technology/human/organisational dynamics.
- view human error as a symptom, not a cause.
- when designing systems, analyse how the users do their work and design for them.
- automation doesn’t remove error, it creates new types of error.
- know that humans are bad at monitoring automation.
- leverage all the technical barriers that are available.
- fix specific tactical issues, but take a strategic view.
- use salient alerts and alarms.
- provide great training.
REFERENCES

Sidney Dekker and S Dekker. The field guide to understanding human error. 2006.


THANK YOU