# IUMI 2018

Partnership Between Seafarers and Technology For Safe Maritime Operations

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# INTRODUCTION

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# INTRODUCTION TO MARITIME SAFETY

PAST AND PRESENT

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AUDIENCE POLLING QUESTION 1

# 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 LTI’s on the day of the disaster in the Gulf of Mexico.


- 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

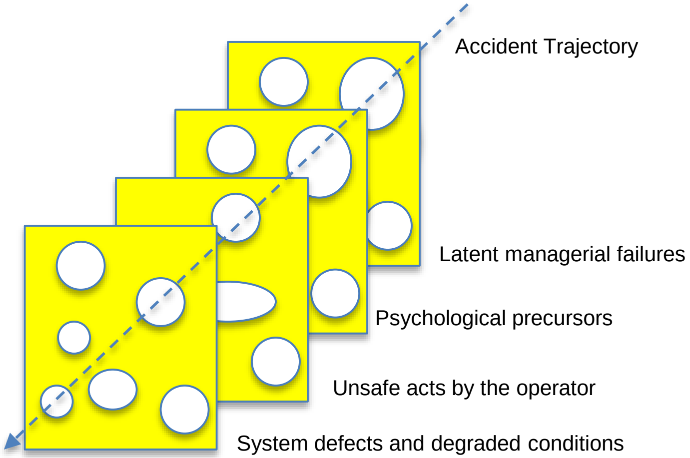
- into this context you place technology
    - informing decisions in real time
    - accepting and making control inputs

- culture is key to improving system safety outcomes
- free flow of information - incidents and near misses.

# INTRODUCTION TO MARITIME SAFETY

## THE SWISS CHEESE MODEL

- 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

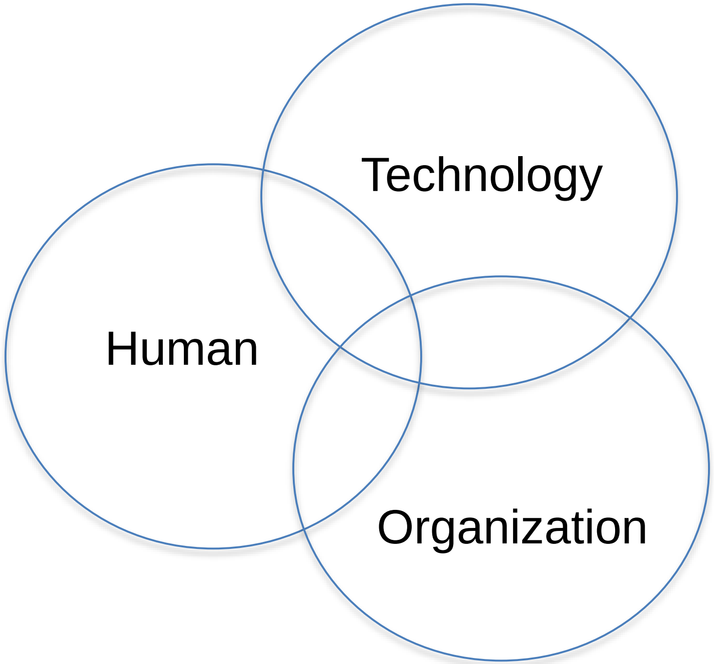



***Reason's 'Swiss Cheese model' of accident causation***

# INTRODUCTION TO MARITIME SAFETY

## Socio-Technical Systems

- 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.

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# THE HUMAN ELEMENT

OVERVIEW

AUDIENCE POLLING QUESTION 2

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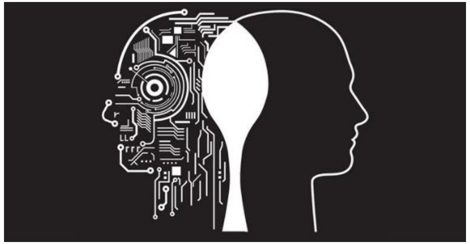
# THE HUMAN ELEMENT

## BUILDING TECHNOLOGY SYSTEMS FOR PEOPLE


- 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

AUDIENCE POLLING QUESTION 3

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# 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

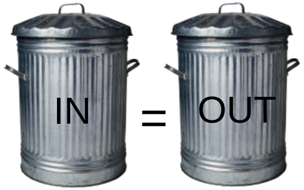
# DESIGNING TECHNOLOGY FOR SAFETY

## ALERTS AND ALARMS

- 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
  - ECDIS depth alarms
  - route checking
- often these functions are not used

# DESIGNING TECHNOLOGY FOR SAFETY

## DATA QUALITY




- 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

# TRAINING

## TECHNOLOGY USERS

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# TRAINING

## TECHNOLOGY USERS

- 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

CASE STUDIES

AUDIENCE POLLING QUESTION 4

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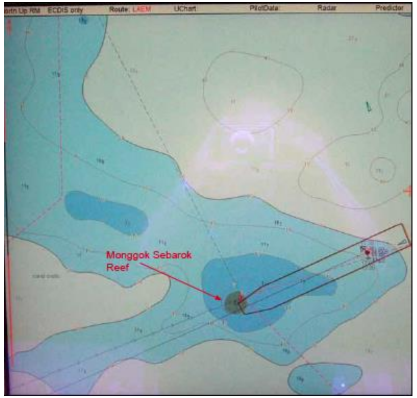
# TECHNOLOGY ASSISTED ACCIDENTS

## TO NAME A FEW RECENT INCIDENTS

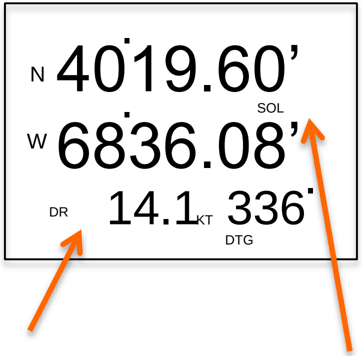



- Pride of Canterbury (2008)
- Performer (2008)
- Cortesia (2008)
- Maersk Kendal (2009)
- Thames (2011)
- Ovit (2013)

# TECHNOLOGY ASSISTED ACCIDENTS

## ROYAL MAJESTY

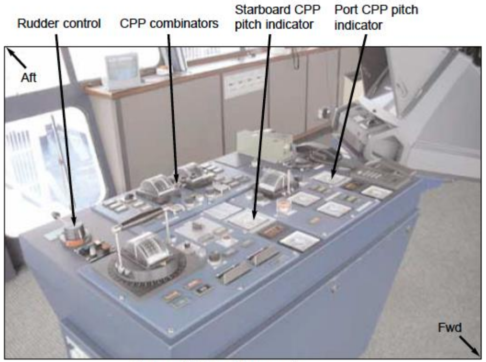
- leaving Bermuda, all navigation equipment was operational
- shortly after, GPS antenna cable failed, GPS loses signal
- GPS reverts to ‘Dead Reckoning’ mode
- alert 3mm high letters and cryptic (SOL and DR)
- single chime for 1 second and no integration to other alarms
- other barriers (depth sound, 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



# TECHNOLOGY ASSISTED ACCIDENTS

## P & OSL AQUITAINE

- 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




Starboard bridge wing console

# SUMMARY

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# 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

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# THANK YOU

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