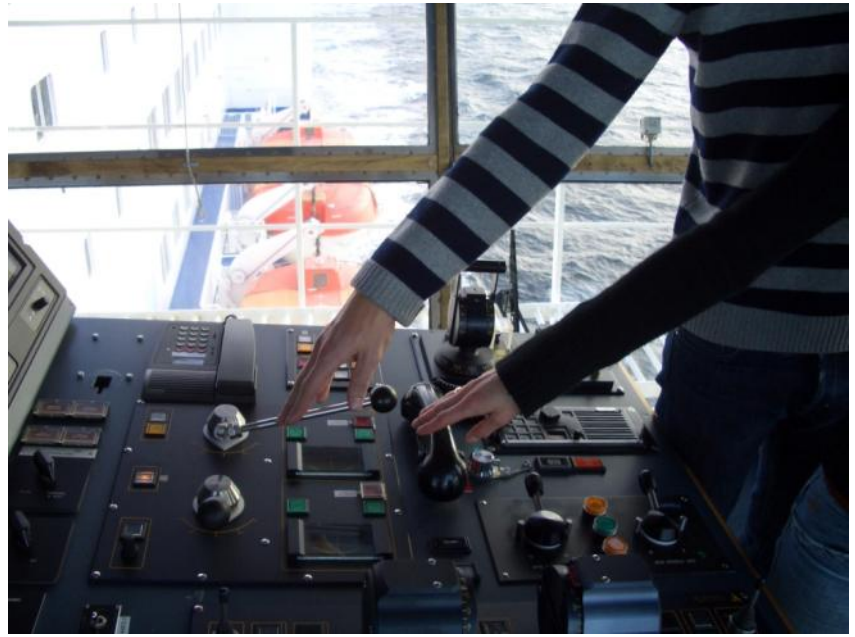
Western Norway University of Applied Sciences

Autonomous ships – the end of human error?

Maritime Human Factors

Shaping ships for people



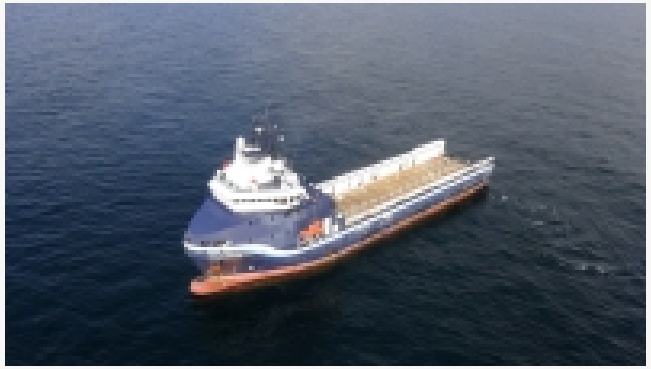
Margareta Lutzhoft
Western Norway University of Applied Sciences

Everyone is doing it…

- YARA Birkeland will begin operations 2019, and conduct fully autonomous operations in 2020.
- NYK, Japan's largest container line plans to test a remote-controlled vessel across the Pacific Ocean in 2019
- Rolls-Royce Autonomous Ship Research Center Opened in Finland Jan 2018
- Kongsberg Maritime with Automated Ships Ltd and Bourbon to finance a prototype offshore support vessel (Hrönn)
- BHP Billiton, Rio Tinto push for autonomous ships in the coming decade
- MOL and Mitsui to develop technological concept for an autonomous ocean transport system
- Rolls-Royce, DNV GL, NTNU And SINTEF Ocean establish simulation platform for creating future Ships

Wärtsilä tests remote vessel control from 8,000km
05 September 2017

- Wärtsilä reports that it has completed a successful test of a remotely controlled ship, operating the vessel from shore while on a different continent through a sequence of manoeuvres using a combination of Dynamic Positioning (DP) and manual joystick control.



Why autonomy?

- Safety (Human error)
- Cost saving
- Environment/fuel
- Crew safety
- The narrative
- Sexy tech

Source: Rolls-Royce and pinterest…

What does it mean?

- Levels of autonomy?
  - Automation
  - Remote control
  - Autonomous?
- Manned, minimum crew, unmanned?
- The systems view
  - Technology vs. socio-technical

It’s not levels, it’s methods of control

(Method 5) Autonomous

The UMV will sense environment, define actions, decide and act. On-board system invokes functions without informing the operator

(Method 4) Monitored

On-board system invokes functions without waiting for (or expecting) a reaction from the operator.

(Method 3) Delegated

Authority to invoke functions is transferred to on-board system. The operator has the option to object (veto) intentions declared by the UMV during a certain time.

(Method 2) Directed

UMV has degree of on-board cognitive capability and suggest one or several actions. The authority to make decisions is with the operator.

(Method 1) Operated/remote control

Cognitive functionality is within the human operator. The operator makes all decisions, directs and controls all vehicle and mission functions.

Human Factors

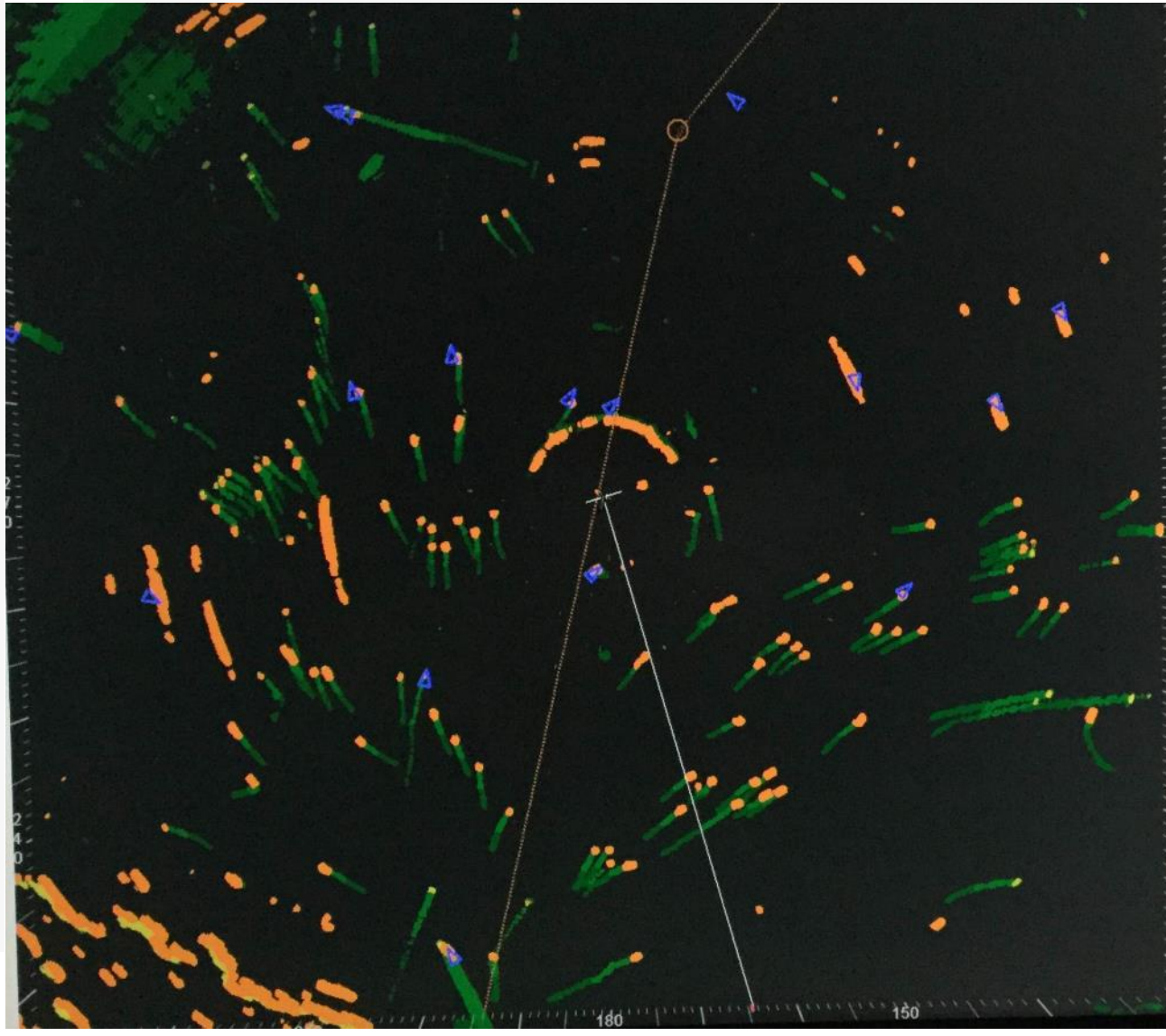
Reliability will be reached by minimizing the possibility for human error…approximately 75% of accidents are human inflicted (One Sea)

- Move from operation to…
  - Design
  - Build
  - Manage
  - Monitor
  - Maintain
  - Recycle

Systemic issues

…a smart environment, … intelligent devices … read Big Data, analyze, communicate with each other and … make decisions independently. (One Sea)

- 50.000 ships still conventional?
- Rogue ships, dead ships
- Co-exist, communicate and solve problems?
- Bandwidth…Inmarsat <7

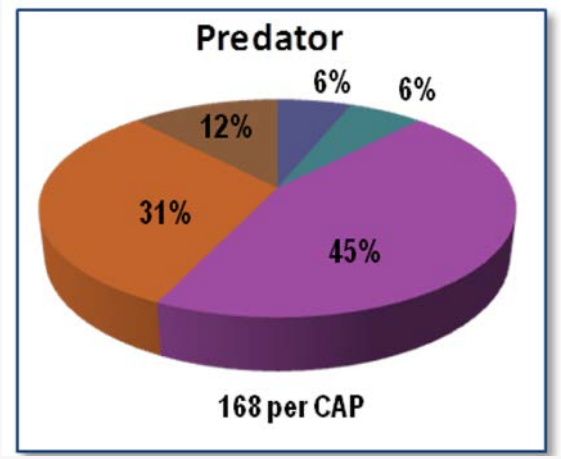


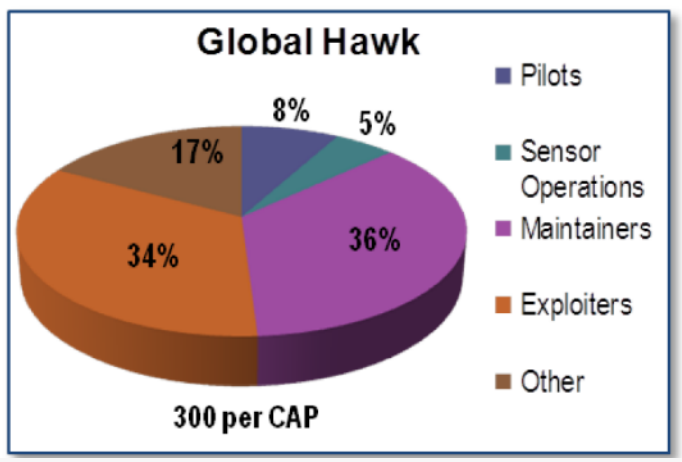
Reduced manning…

- 3 persons for one ship – 3 shifts, do the maths

Source: Rolls-Royce

Unmanned?





Sources: USAF & DoD

What haven't we done?

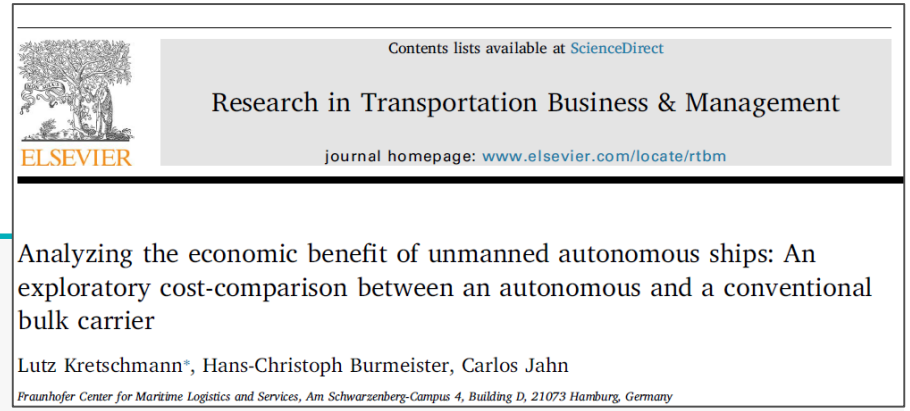
Some big issues

- Next gen users will manage?
  - Next gen tech is faster…
- When worlds meet
  - Tugs, pilots, mooring, VTS…
- Regulations
  - Colregs, STCW, SOLAS, UNCLOS, MLC, ISPS, MARPOL…
  - IMO scoping

Source: http://www.ctsdaily.net/

Cost benefit autonomous bulker case

- Cost of owning and operating the bulker
- 25-year period, 4.3M USD lower than for a conventional
- Assuming identical cargo capacity, required freight rate is 3.4% lower than conventional vessel.
- Besides cost savings associated with reducing crew levels … brings additional benefits due to changes in ship design.



Contents lists available at ScienceDirect

Research in Transportation Business & Management

journal homepage: www.elsevier.com/locate/rtbm

Analyzing the economic benefit of unmanned autonomous ships: An exploratory cost-comparison between an autonomous and a conventional bulk carrier

Lutz Kretschmann*, Hans-Christoph Burmeister, Carlos Jahn

Fraunhofer Center for Maritime Logistics and Services, Am Schwarzenberg-Campus 4, Building D, 21073 Hamburg, Germany

- Crew
- Shore control centre
- Maintenance in port
- Reduced fuel
- Air resistance
- Light ship weight
- Hotel electrics
- Boarding crew in port
- Deckhouse
- Technology and redundancy (+10%?)

What is missing from the cost-benefit?

- Shore centre – cost of competence
- IT
  - Programming, software, AI
  - Satellite/bandwidth
  - Data storage
  - Protect, prep recovery
  - Maintain and update
- Engineering
  - What is the cost of redundancy?
  - Is engineering ready?
  - Maintenance?
- Who is trusted with testing, validation?
- What will insurance cost?

What haven't we done?

- Security & environment
  - The big switch
  - Piracy
  - Hacking
    - Is training the solution?
  - Search and rescue
  - Sensitive sea areas

Source: https://blog.sensecy.com/tag/automatic-identification-systems/

What haven't we done?

- Safety and human error
  - Operation from a distance – how make risk tangible to operator
  - “Ship sense”

  - Where is safety culture?
  - Where do the procedures go?
  - Who will be blamed now?

Summary

- Technology moves on
- Legal framework
- Cost-benefit case incomplete
- Security
- Environment
- Organisation and safety
- Job design

- ∑ HUMANE project

Source: shutterstock

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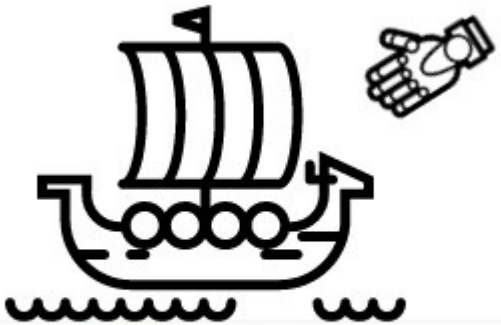
HUMANE
Human Maritime Autonomy Enable



Margareta Lützhöft
Department of Maritime studies

What is the project about?

4 areas

- Hardware reliability & cyber security
- Skill sets, competence and knowledge
- Legal implications
- Organisational & job design issues

Why?

- Most of the technology is in place…?
  - Some bits are missing
- We all want safe and efficient shipping
  - How do we support and enable?

So why is HUMANE needed?

- A lot of …

- Need more…

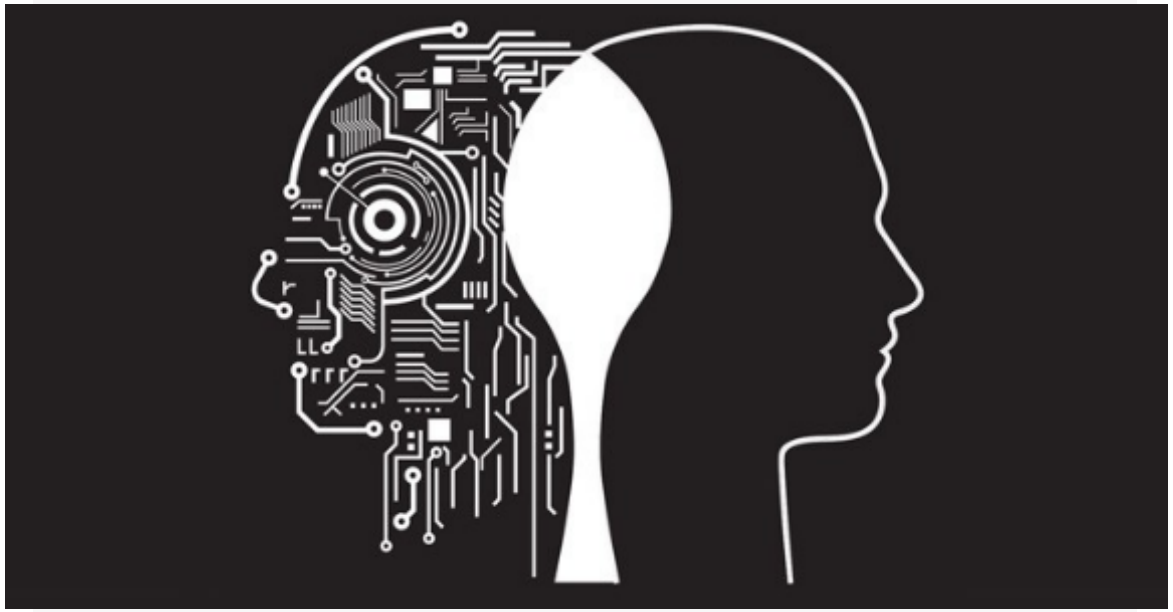
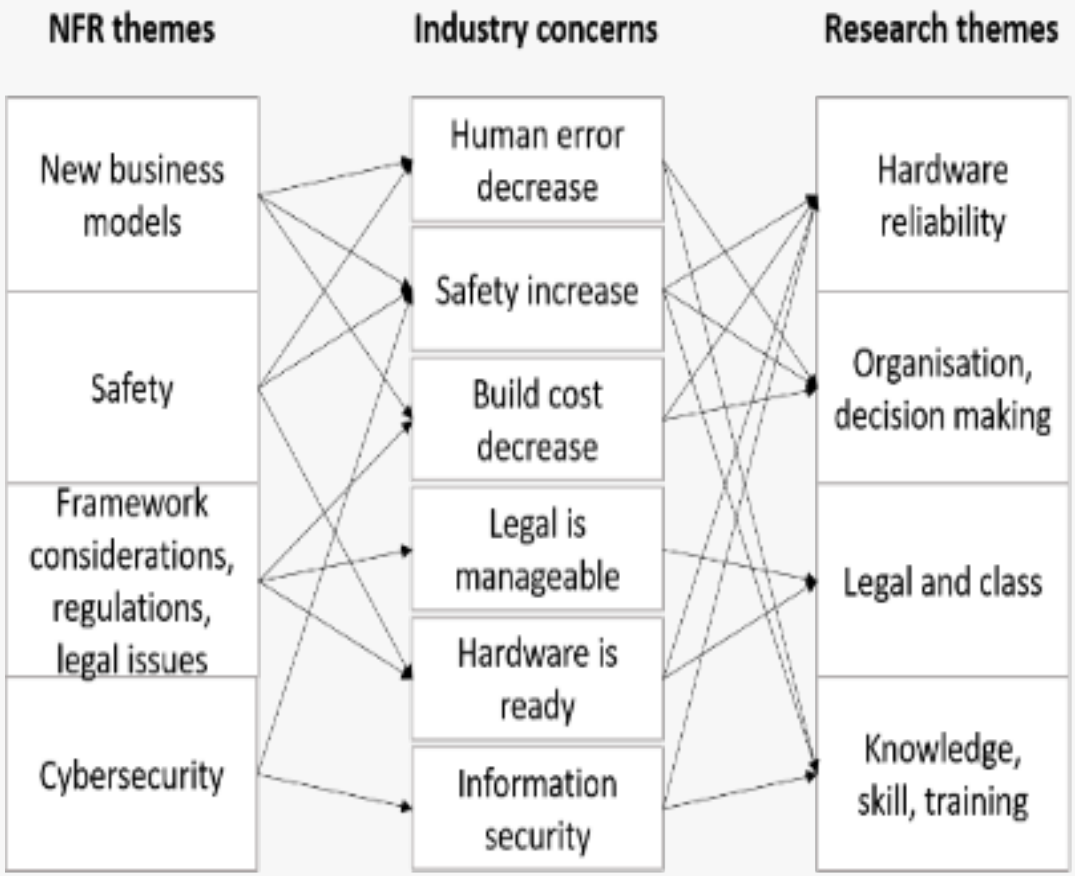


Image source: https://www.transportation.gov and Unesco

HUMANE focus areas

- Industry concerns and expectations need to be examined
- Many interconnections between the NFR themes, the research themes and industry expectations
- One concern from industry may not be addressable by one scientific approach.
- For example, the expected safety increase would need to be examined on all levels, hardware, organisation, legal issues and knowledge demands.



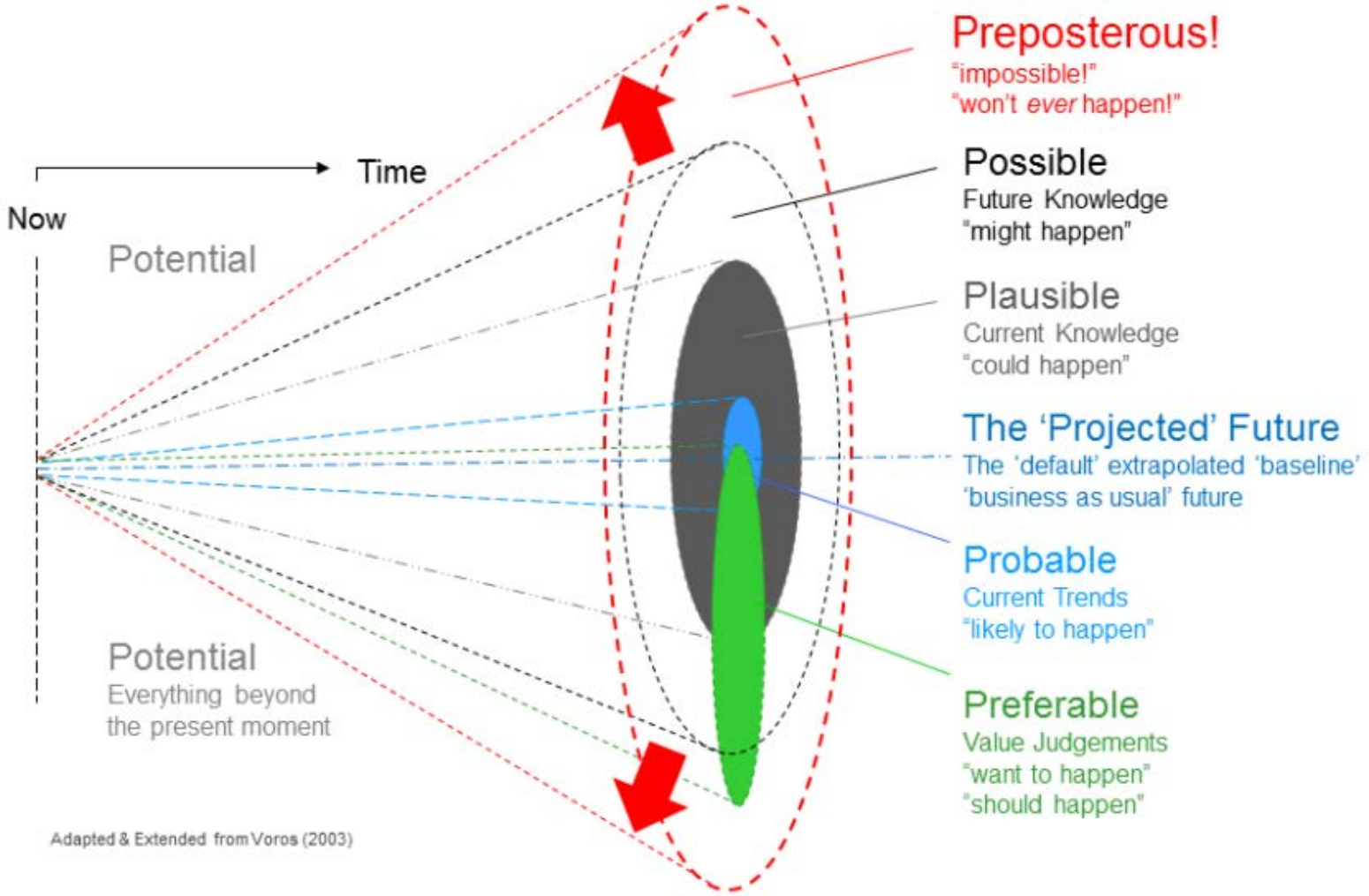
The HUMANE participants

- Western Norway University of Applied Sciences, HVL (project leader)
- NTNU Trondheim, Ålesund and Gjøvik
- University of Southeast Norway, USN/HSN
- The Arctic University of Norway, UiT
- BW Gas
- Kystverket
- Sjøfartsdirektoratet
- Lloyd’s Register
- Wärtsilä
- Process Contracting Ltd

- Invited experts
  - Legal
  - Organisational
  - Economy
  - Hardware
  - Software and cyber security
  - Human Factors
  - Maritime

The “futures cone”

This will be used for the forecasting workshops, as a basis for designing scenarios…



Source Joseph Voros

How do you study the future?

Forecasting workshops with experts and stakeholders

1. Cases will be identified and chosen from projected, possible, plausible futures…

For example

- a coaster with no crew, remote control, no legal changes needed
- ocean trade, minimum crew onboard, revised legal framework

2. Forecasting
   - Collecting insights
   - Making sense of it
   - Exploring scenarios
   - Communicating, storytelling

3. Tests and simulations
   - Play out consequences
   - Identify needs and effects

- Results include
  - Description of risks & opportunities, and activities stakeholders should/could be doing
  - Method for organisational level decision support

Image source. https://www.moonstone.co.za/ and shutterstock

Process Contracting Ltd