CONGRESO
LECCIONES APRENDIDAS
DE GRAVES ACCIDENTES O INCIDENTES EN MANIOBRAS DE PRACTICAJE

19, 20 y 21 de abril de 2023|Cartagena de Indias

Autonomous shipping & human element

Naves autónomas y elemento humano

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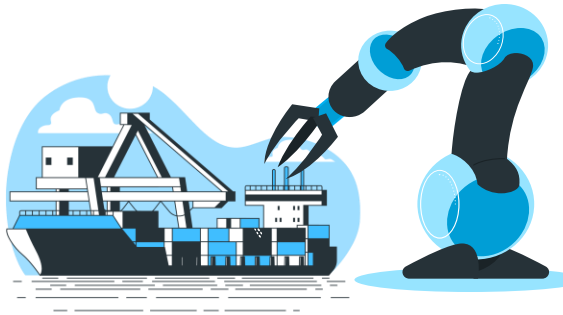

Let’s examine four statements:

1. Human error = cause of up to 96% of maritime accidents
2. Autonomous shipping = no humans
3. No humans = 96% less maritime accidents
4. 96% less accidents = no need to worry about liability

Human error

- ‘Human error’ - “an incorrect decision, an improperly performed action, or an improper lack of action (inaction)”.
- **A catch-all** determinant of maritime casualties when mechanical, architectural, or natural disasters could not be linked as the primary cause of an accident.
- Underlying causes leading up to an accident such as latent ‘**error provoking conditions**’ are frequently ignored.
- A study concluded that each collision is caused, on average, by a combination of **7 to 58 isolated factors**.

✖ Human error by itself is NOT a cause of up to 96% of accidents.

The picture is a lot more complex.

Sources: Human error isn't enough; Shipping safety; Accidents at sea

Autonomous shipping & humans

- Bureau Veritas Guidelines for Autonomous Shipping

Degree of automation		Manned	Definition	Information Acquisition	Information Analysis	Authority to make decisions	Action initiated by
A0	Human operated	Yes	Automated or manual operations are under human control. Human makes all decisions and controls all functions.	System Human	Human	Human	Human
A1	Human directed	Yes/No	Decision support: system suggests actions. Human makes decisions and actions.	System	System Human	Human	Human
A2	Human delegated	Yes/No	System invokes functions. Human must confirm decisions. Human can reject decisions.	System	System	Human	System
A3	Human supervised	Yes/No	System invokes functions without waiting for human reaction. System is not expecting confirmation. Human is always informed of the decisions and actions.	System	System	System	System
A4	Full automation	Yes/No	System invokes functions without informing the human, except in case of emergency. System is not expecting confirmation. Human is informed only in case of emergency	System	System	System	System

Autonomous shipping & humans

- **Dynamic autonomy** - a combination of modes for different functions; modes could also change depending on factors such as the location, phase of the voyage, connectivity, weather conditions etc.
- **Remote operation** – human operators in Shore Control Centres; remote pilotage testing undertaken at the Port of Kokkola in Finland.
- **Human-in-the-loop** – human agents have complete control over starting or stopping any action VS **human-on-the-loop** – oversight of the system, but without the need for any human pre-approval.
- Large vessels are unlikely to operate in a fully autonomous manner at all times, until a much more distant future.

✖ Autonomous shipping does NOT mean no humans.

But the nature of human involvement will change.

Autonomous shipping – risks (new & changed)

1

Mechanical defects

With no one to fix them.

2

Human factors in remote control

Challenges of remote operations; lack of human ‘redundancy’.

3

Cyber

Increasing digitalisation and interconnectivity – greater attack surface?

4

Algorithms & Artificial Intelligence

Faulty, biased, or malicious algorithms; AI unpredictability.

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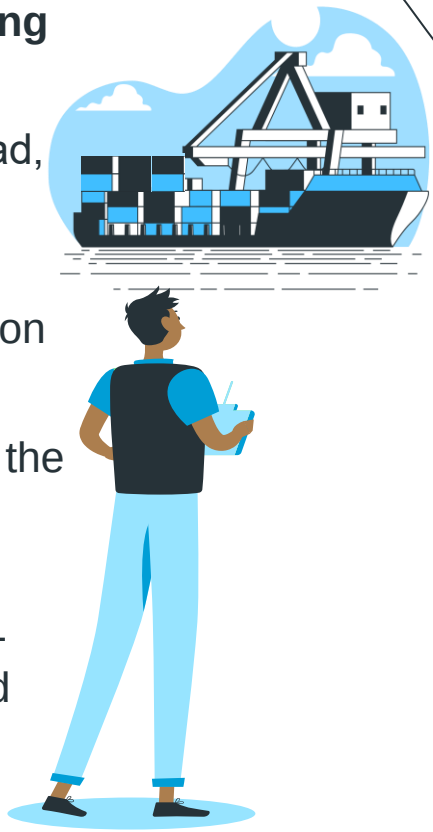
Mayflower story

- Mayflower AS, a 15-metre-long, crewless ship, tried to cross the Atlantic (from **Plymouth**, **UK** to **Plymouth, Massachusetts, US**) in a **fully autonomous mode**.
- Mayflower set sail on 15 June 2021, but after just **3 days** it developed **a mechanical fault** (a fractured metal component). As its AI could not fix it, it had to return to the base with help from **a manned recovery vessel**.
- Following several months of re-testing, it resumed its journey on 28 April 2022. However, then **a switch failed**, resulting in Mayflower having to be hauled back, again, on 9 May 2022. This time to the Azores.
- It recommenced its journey on 20 May 2022, however over the May 28-29 weekend, it developed **an issue with the charging circuit**. It had to be diverted to **Halifax (Canada)**, where it ended its journey.

Sources: IBM Mayflower in Canada; Mayflower Twitter account

Human factors in remote control

- Anecdotally, human onboard presence frequently contributes to **preventing maritime accidents**. Is there any data to quantify this…?
- Lack of onboard presence removes the **human redundancy** e.g. ‘log, lead, and lookout’ in cases of GPS spoofing.
- Remote monitoring with long periods of idleness can **reduce situational awareness** and **extend response times**. Not ideal when quick intervention is required…
- A 2021 survey among maritime pilots and crews shows that **over 86%** of the respondents are **concerned about remote pilotage**. It is also generally discouraged by the insurers, unless legally required.
- Some of the main concerns revolve around **communication** incl. Master-Pilot exchange, **limitations of technology**, **lack of ‘feel’ of the ship** and gradual deskilling.



Source: C. Blake ‘An analysis of the use of technology in remote pilotage operations’

Cyber

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35% Maritime organisations admit to falling victim to cyber attacks in the last 12 months

53% Maritime organisations feel vulnerable to data breach

92% Losses resulting from a cyber-attack may be uninsured

400% Increase in attempted malware attacks against shipping companies

900% Increase in reported attacks on the maritime industry's operational technology in the last 3 years

Increasing digitalisation and interconnectivity = greater cyber-vulnerability? TBC

Sources: Cyber security white paper; Safety and Shipping Review 2021; Shipping News

Algorithms & Artificial Intelligence

Flawed AI

Catastrophic forgetting – overwriting of old data. **Brittle AI**, unable to adapt outside of set assumptions.

→ **AI lacks common sense**.

Corrupt & malicious AI

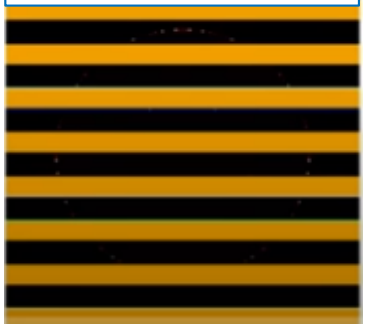
From **biased** input data or **intentional** manipulation.

Black Box AI

Outputs by complex algorithms defy simple explanations. The decisions reached are not easily traceable and, at times, entirely **incomprehensible**.

A school bus

Also a school bus

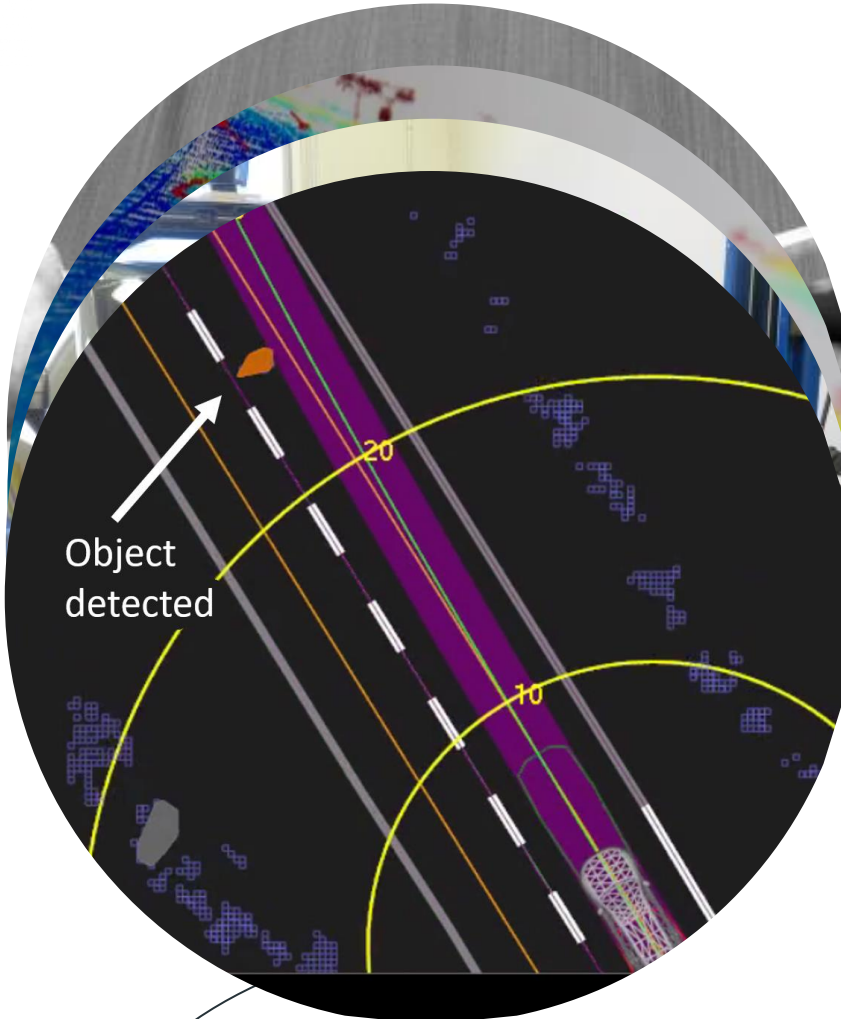


A building

Sources: Deep Neural Networks are Easily Fooled; The Corruption Risks of AI

Uber story

- In the evening of 18 March 2018, Elaine Herzberg was pushing a bicycle across a four-lane road in Tempe, Arizona (US).
- At that point, the approaching Uber test vehicle had been operating **in autonomous mode for 19 minutes**. The human ‘back up’ driver was given approx. **1 second to react** before the impact.
- Herzberg was struck by the vehicle and later died in hospital.
- The vehicle’s AI was unable to determine Herzberg was a person due to her walking the bicycle, as the bicycle's **metal parts and shopping bags** were in front of her. The system interpreted her presence as that of another vehicle that was expected to give way.



Sources: The New York Times; Death of Elaine Herzberg

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✖ Lack of humans onboard is UNLIKELY to reduce accidents by 96%.

Liability considerations

- Varying levels of autonomy and **multiple actors**: autonomous system, shore control centre, pilot, manufacturer etc.
- **Remote pilotage** – complex dynamics of shared control - any possible override? If not, who has **conduct** and who is **in command**? What is the legal status of each actor?
- Remote operations, human-in-the-loop, human-on-the-loop all result in **decreasing causal efficacy of the human agent,** as the level of autonomy increases. Is this reflected in the liability framework?
- Establishing **product liability** will be **extremely challenging**, especially in cases of **'defective' AI**. Fault is an inherently human concept – is there a causal link to pursue the data provider, designer, manufacturer, programmer, developer? Or is it an inexplicable, black box case?

✖ We definitely need to worry about liability.

Source: The Artificial Intelligence Black Box and the Failure of Intent and Causation

As per our discussion:

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Thank you!

Any questions?