


• ONLINE SERIES

Autonomous Ship Reality

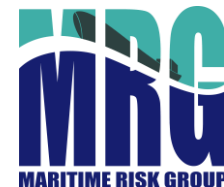
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3 Days Online Event

Will the seas of the future be dominated by autonomous ships?

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Maritime industry and automation

“The application of technology, programs, robotics or processes to achieve outcomes with minimal human input”

IBM

“[...] the more advanced a control system is, so the more crucial may be the contribution of the human operator”
(Bainbridge, 1983)

“Automation changes the task it was meant to support ; it creates new error pathways, shifts consequences of error further into the future and delays opportunities for error detection and recovery.”

(Lützhöft and Dekker, 2002)



What is an autonomous ship anyway?

Maritime Autonomous Surface Ship (MASS) is defined as a ship which, **to a varying degree, can operate independent of human interaction** (MSC. 100/5)

Degrees of automation and human presence (MSC 101/5/4)

- 1: Ship with automated processes and decision support
- 2: Remotely controlled ship with seafarers on board
- 3: Remotely controlled ship without seafarers on board
- 4: Fully autonomous ship

Automation:

the implementation of processes by automatic means, under specified conditions can function without human intervention

Autonomous ship:

uses automation to operate without human intervention (on one or more ship processes), for the full duration or in limited periods of the ship's operations or voyage

Crewless ship:

a ship with no crew on board

- MSC 102/5/18 (2020)

Where are we with autonomous ships?



2012 2013 2017 2018 2019 2020 2022 > 2025



DNVGL - ReVolt
Concept Study



Falco Demo
Aim at large-scale operation



Autonomous Short Sea Shipping



Yara Birkeland
Starts manned operation



Zhi fei
Autonomous container feeder



Mayflower
Completes trans-Atlantic crossing



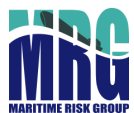
Sunflower Shiretoko
750 km autonomous sailing



Critical design factors



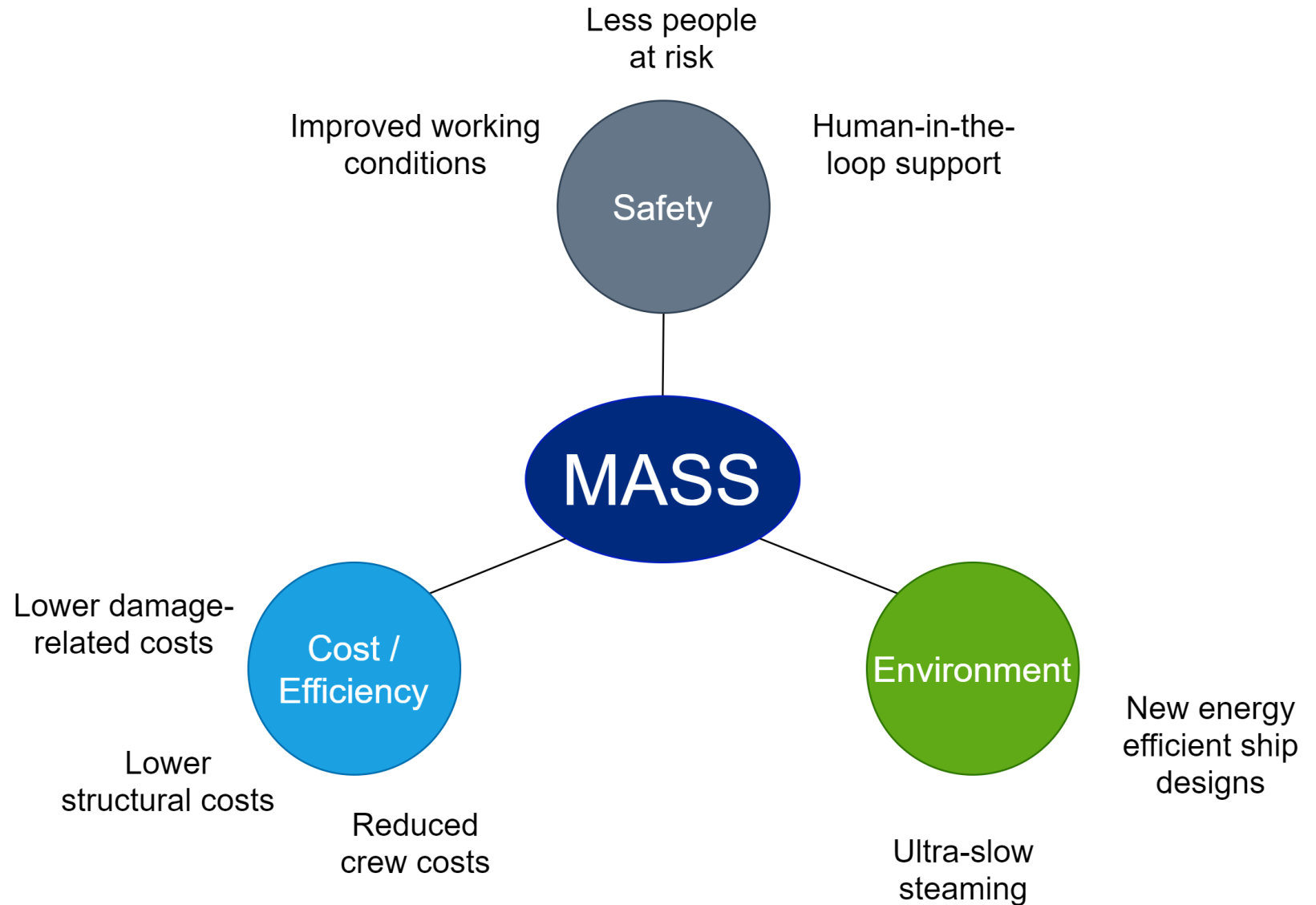
Svitzer Hermod
Remote Control



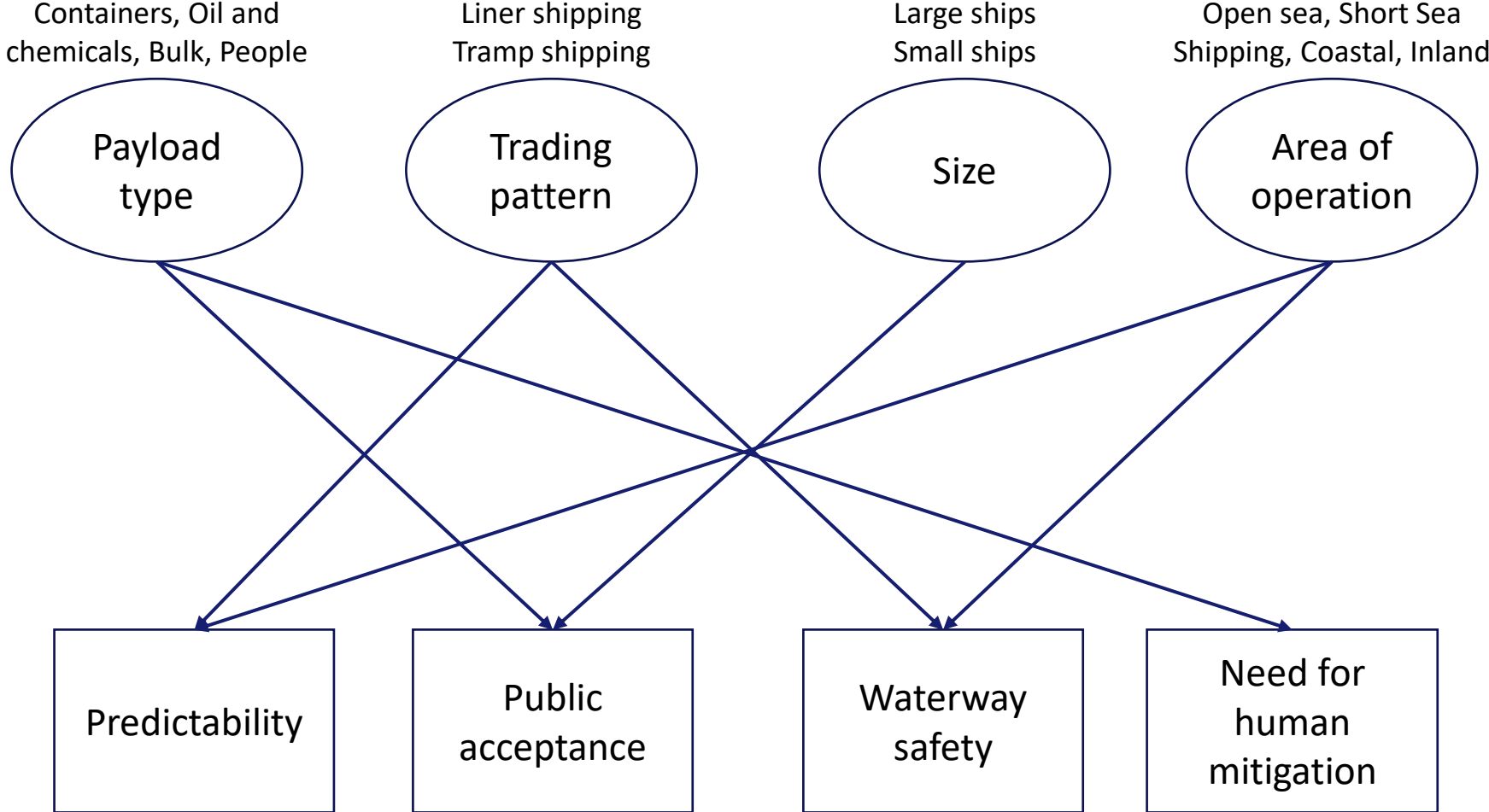
Why do we need autonomous ships?

58% (EMSA, 2018) to 75% (Allianz, 2017) of marine accidents are caused by human error.

Initially, autonomous ships would be meant to reduce these accidents



Should all ships be autonomous?



Should all ships be autonomous?

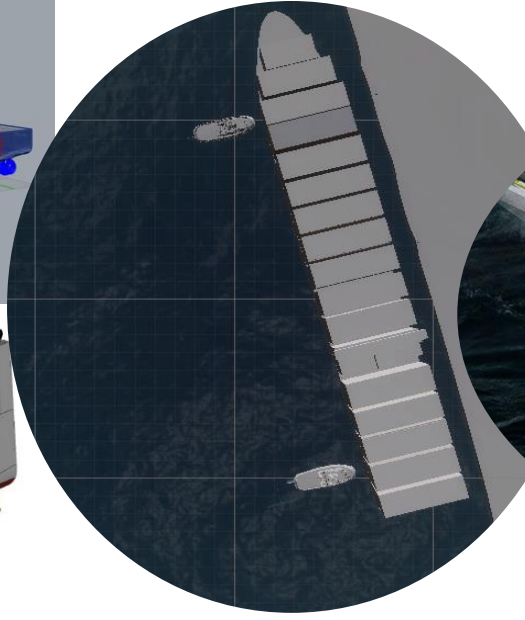
Short Sea Shipping

Port tugboat ops.

Inland Waterways

Maritime Drones

Urban Transport



Risk and autonomous ships



Perceived safety is one of the most significant concerns and is inversely proportional to autonomy levels!

Survey for autonomous urban ferries (Goerlandt and Pulsifer, 2022)



Identifying (credible) accident scenarios



Risk as the expected consequences

$$R = \langle s_i, p_i, x_i \rangle$$

Where s_i : scenario description, p_i : scenario probability, x_i : consequence of scenario

(Kaplan and Garrick, 1981)

Risk and autonomous ships

Conventional and autonomous ships may not be exposed to the same risks!

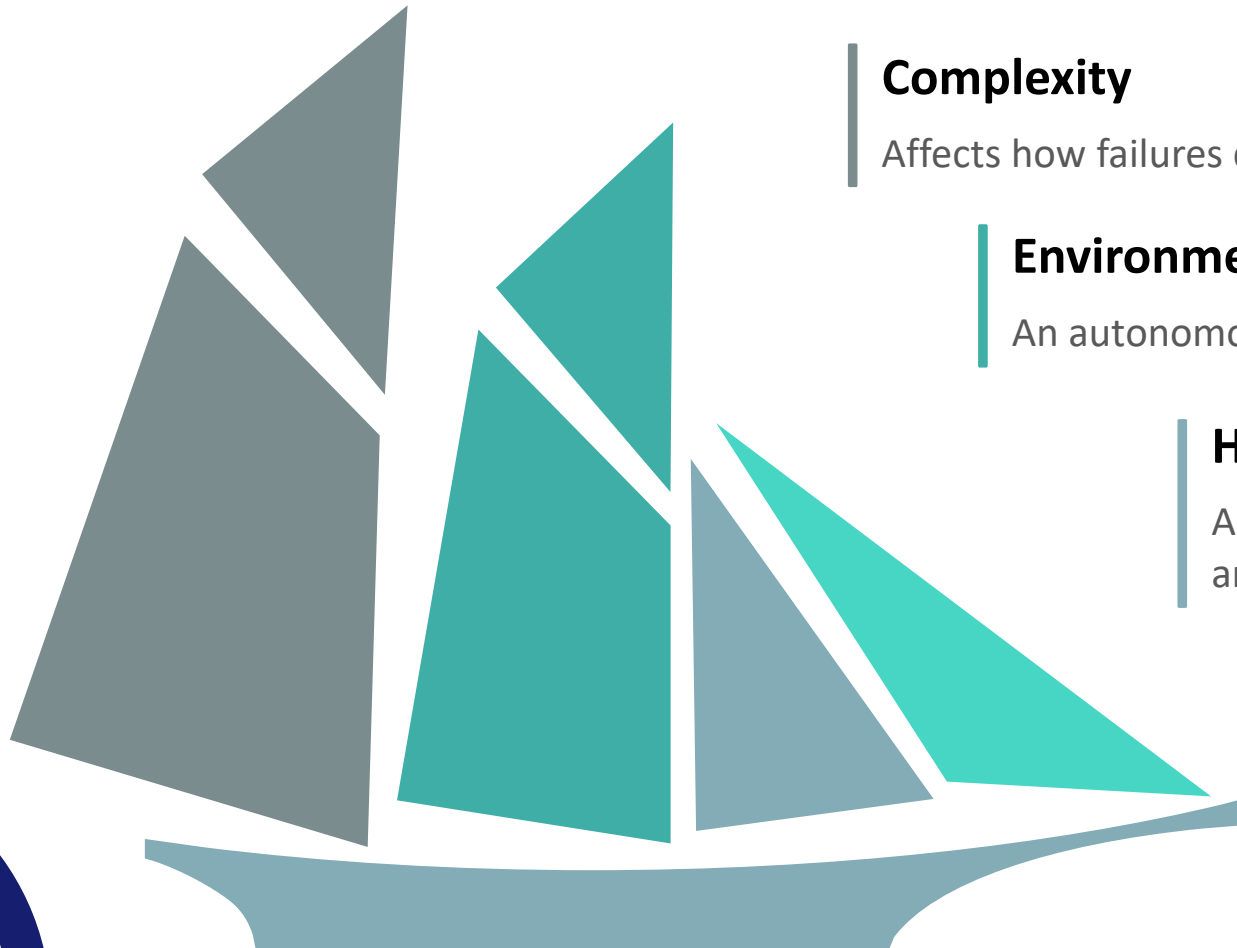
(Ventikos and Louzis, 2019)

Experience from other industries (e.g. automotive, aviation, nuclear)

<p>Unknown-Knowns</p> <p>Mixed traffic interactions Response capacity of remote operators (complacency) ...</p> <p>Awareness</p>	<p>Known-Knowns</p> <p>How fires on ships develop Factors that affect grounding accidents ...</p>
<p>Unknown-Unknowns</p> <p>Risks we cannot yet imagine!</p>	<p>Known-Unknowns</p> <p>How routine maintenance will be conducted without crew onboard ...</p>

Risk and autonomous ships

We cannot only rely on trying to identify scenarios for accidents that have not yet happened!



Complexity

Affects how failures develop into accidents

Environment

An autonomous ship is part of a system with which it interacts

Human Involvement

Autonomous ships will have to collaborate with humans and share risk awareness

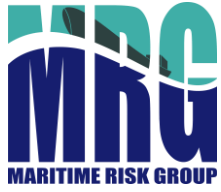
Data and knowledge

- Assess risk based on how the system works, not only by how it fails
- Go beyond calculating accident probabilities

Will the seas of the future be dominated by autonomous ships?



Most likely no...the consensus is that autonomy will be application-specific, but in any case it needs to be safe!



**Thank you very much for your
attention!**

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MOSES

Thank you for your attention!

If you have any questions or require further information, please contact us:

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