Increased autonomy of maritime transport: Seafarers voices and practices

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MARMAN PhD 2023-2026:
Maritime Bridge Officers' Trust in Automated and Autonomous Technology: A Mixed-Method Study

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The main objective of the PhD thesis is to contribute to the understanding of **safety implications of increased automation in maritime transport**, through in-depth knowledge on **maritime bridge officers' trust in automated & autonomous technology**.

Supervisors: Trond Kongsvik, Aud Marit Wahl, Rolf Johan Bye

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Research papers

RQ	Paper
RQ1 *How does increased automation influence seafarers' professional practice?*	**Paper 1:** Aalberg, A. L. (2024). Seamanship in the Age of Automation: Reduced Practical Wisdom? Observations from Fieldwork on Automated Car Ferries in Norway. *Public Anthropologist*, *6*(2), 342-371.
RQ2 *What characterizes seafarers' trust in automated systems?*	**Paper 2:** Aalberg, A. L., Holen, S. M., Kongsvik, T., & Wahl, A. M. (2024). Does it do the same as we would? How trust in automated shipboard systems relates to seafarers' professional identity. Safety science, 172, 106426.
RQ3 *How do bridge officers' professional commitment relate to trust in autonomy?*	**Paper 3:** Aalberg, A. L. (2024). Pride and mistrust? The association between maritime bridge crew officers' professional commitment and trust in autonomy. *WMU Journal of Maritime Affairs*, *23*(4), 551-574.
RQ4 *What safety-related factors are important for automation and autonomy according to bridge officers?*	**Paper 4:** Aalberg, A. L. & Kongsvik, T. (In Review). How Can Maritime Automation and Autonomy be Safely Implemented? A Mixed-Method Topic Model of 1,009 Bridge Officers' Responses. *WMU Journal of Maritime Affairs*.

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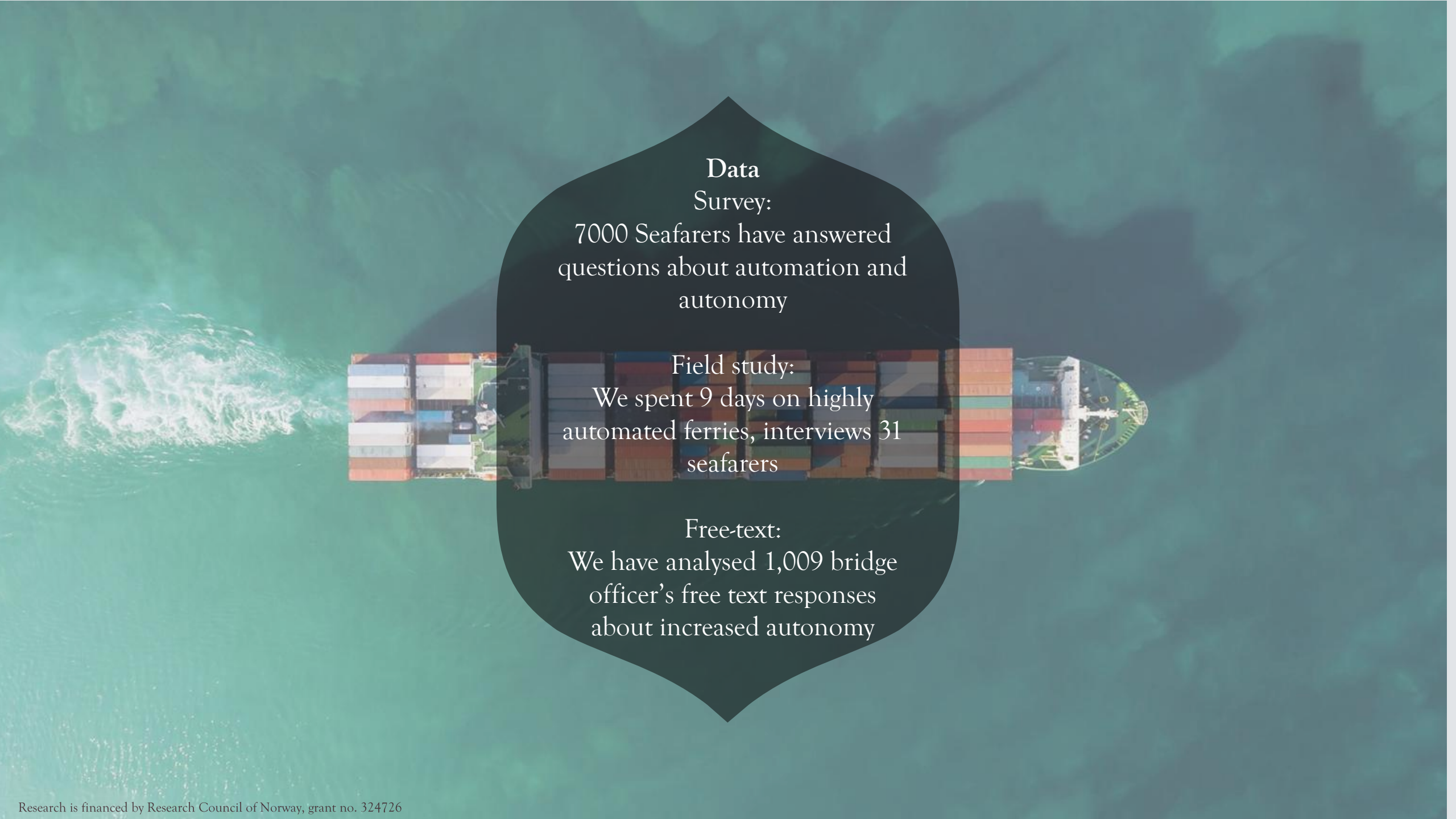

Data

Survey:
7000 Seafarers have answered questions about automation and autonomy

Field study:
We spent 9 days on highly automated ferries, interviews 31 seafarers

Free-text:
We have analysed 1,009 bridge officer's free text responses about increased autonomy

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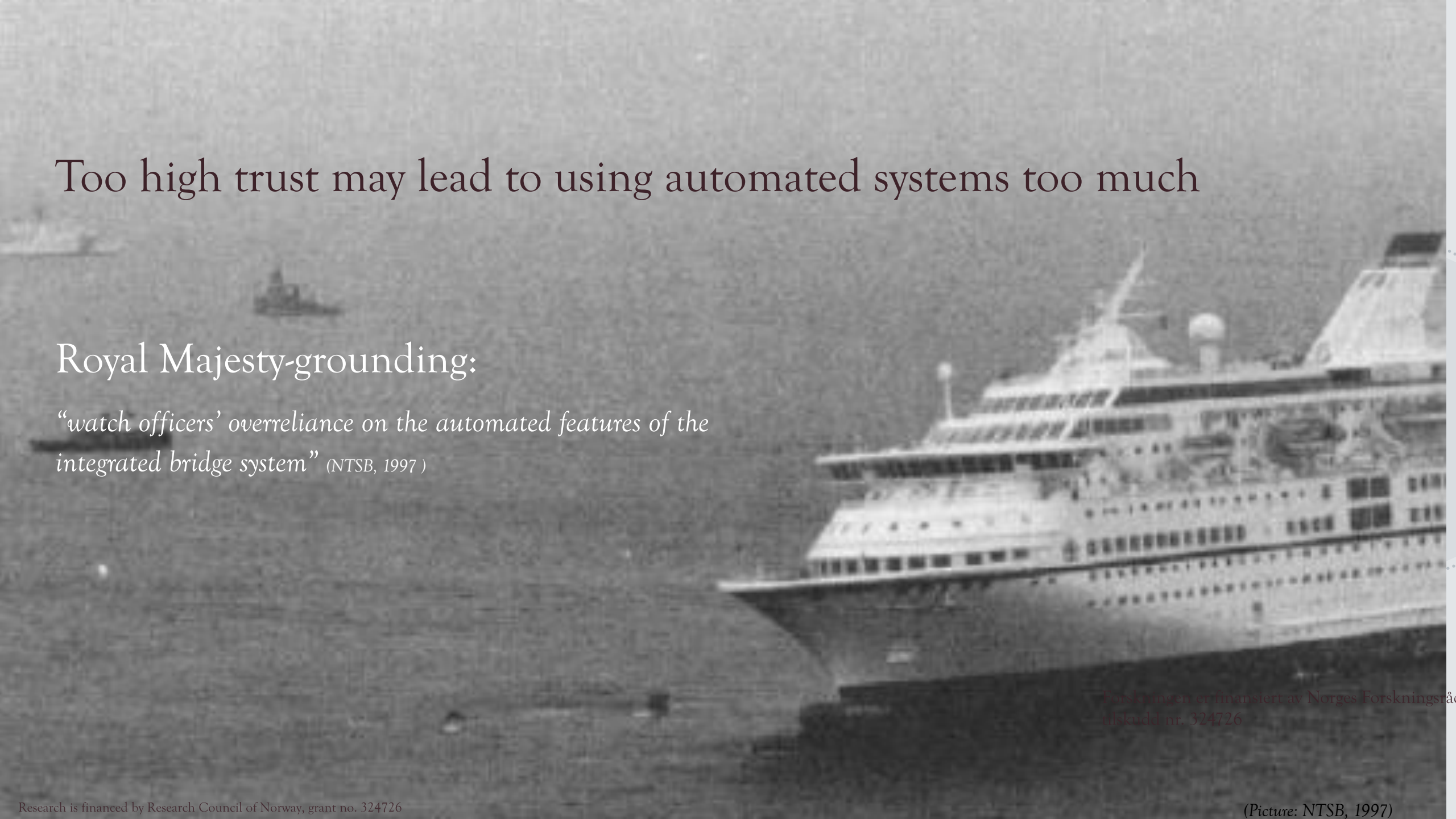
Too high trust may lead to using automated systems too much

Royal Majesty-grounding:

"watch officers' overreliance on the automated features of the integrated bridge system" *(NTSB, 1997)*



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(Picture: NTSB, 1997)

Of course, we do not want a low trust either

- E.g.. Leading to turning off systems that we need for safety

"Based on the statements of those who were questioned and the other evidence in the cases, the police believe it can be established that **the vessel's bridge watch alarm was not activated**, the police prosecutor states." (Dagsavisen, 2025 – NCL Salten grounding outside Trondheim 22.05.25)

(For the record: we do not know why it was turned off)

NCL Salten grounding
Photo: Stein Roar Leite / TV 2

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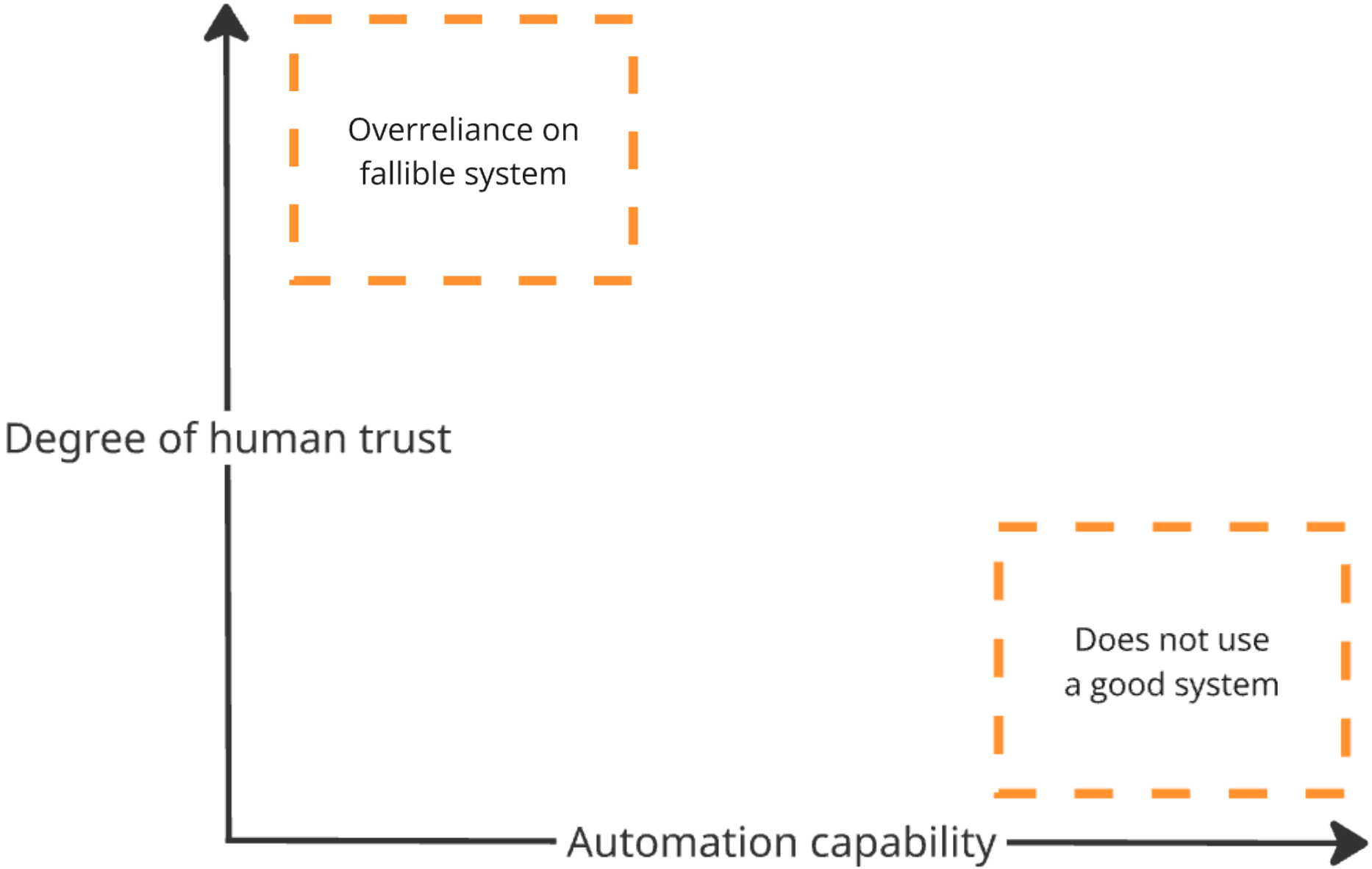

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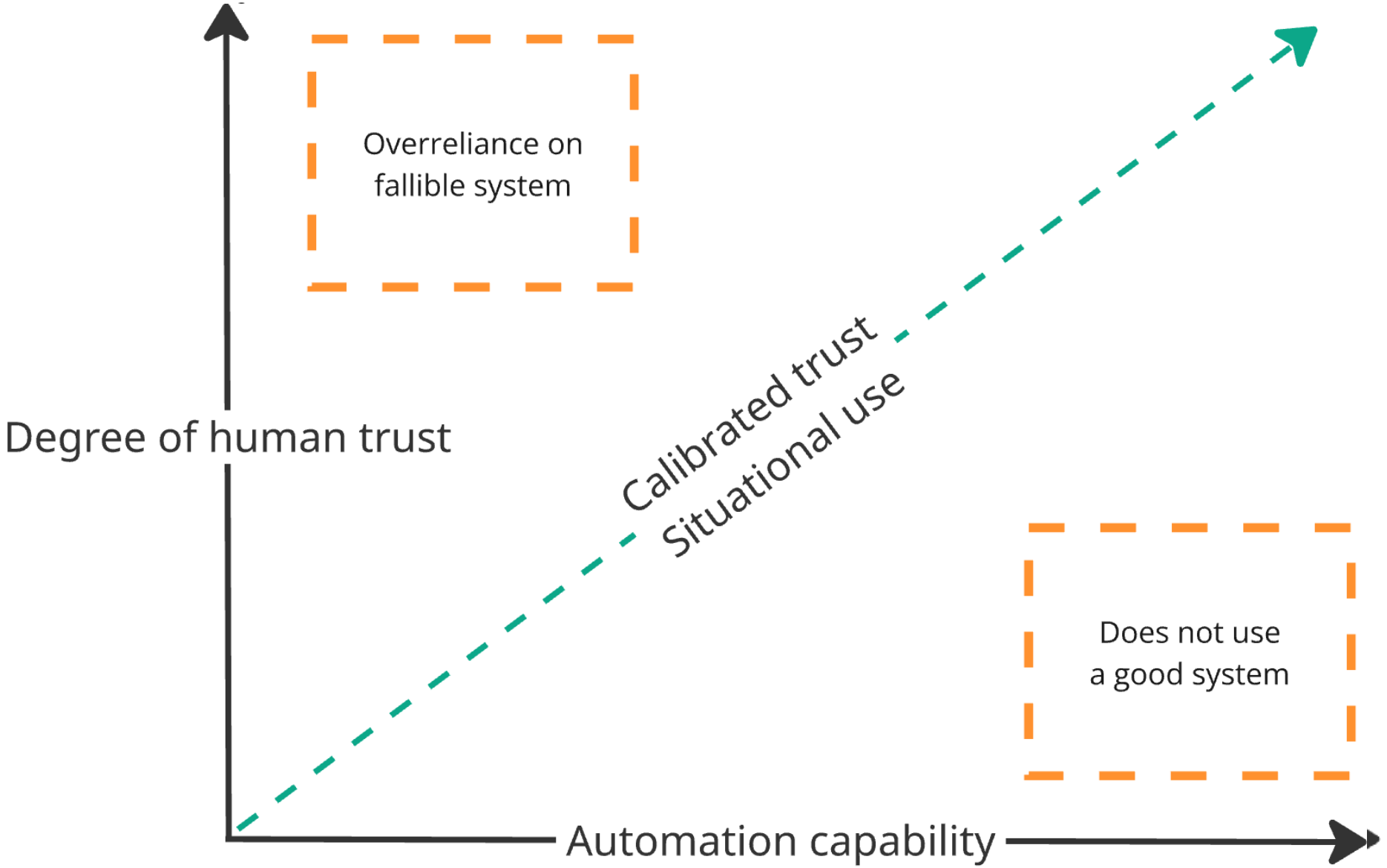
Basert på Lee and See (2004)



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Basert på Lee and See (2004)

1 - Seafarer's voices regarding automation and autonomy 6897 responses from Norwegian ships in 2023

In collaboration with Sjøfartsdirektoratet Norwegian Maritime Authority safetec

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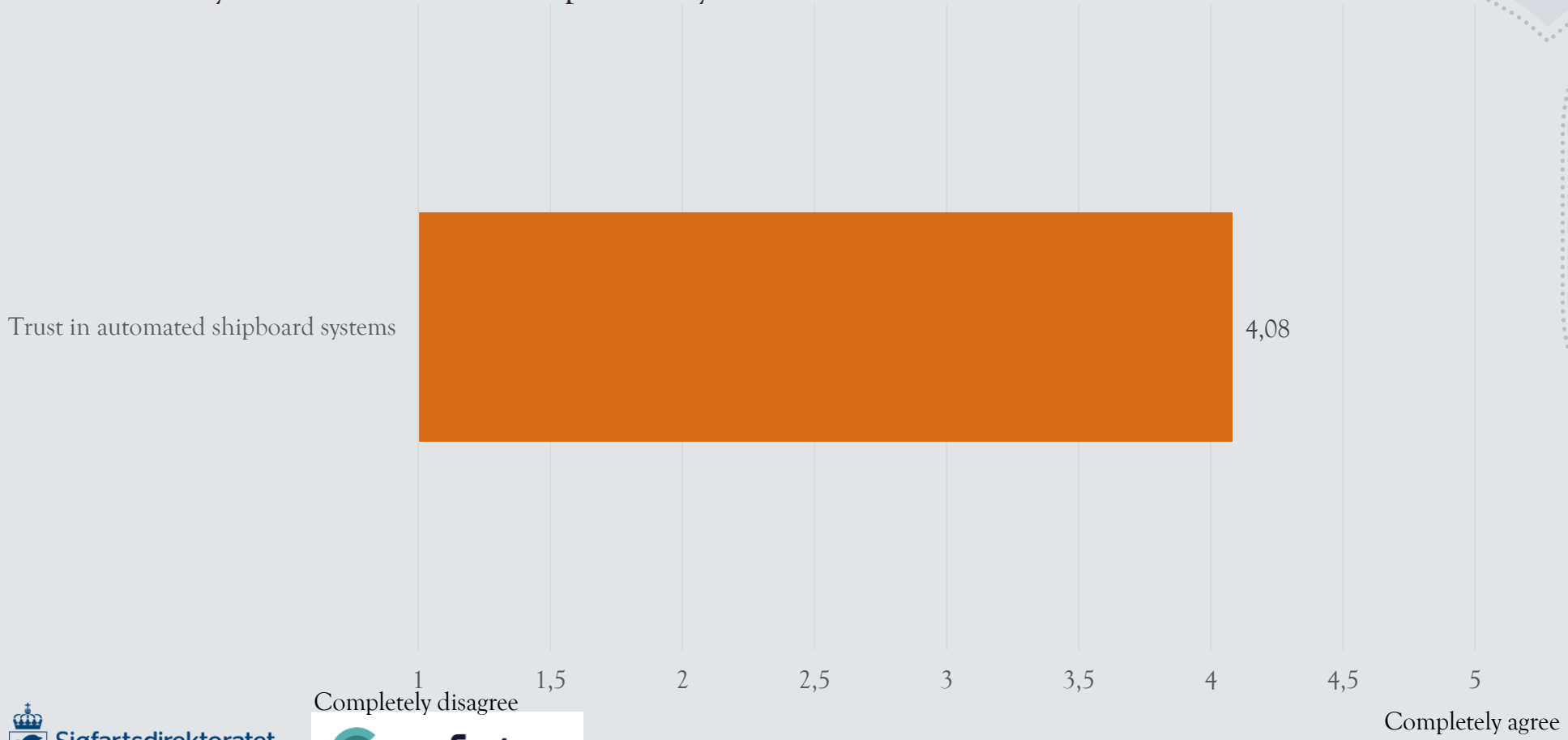
Bridge officers report to trust existing automation on board (N= 2,016) such as

Such as «I can rely on the automated shipboard systems»



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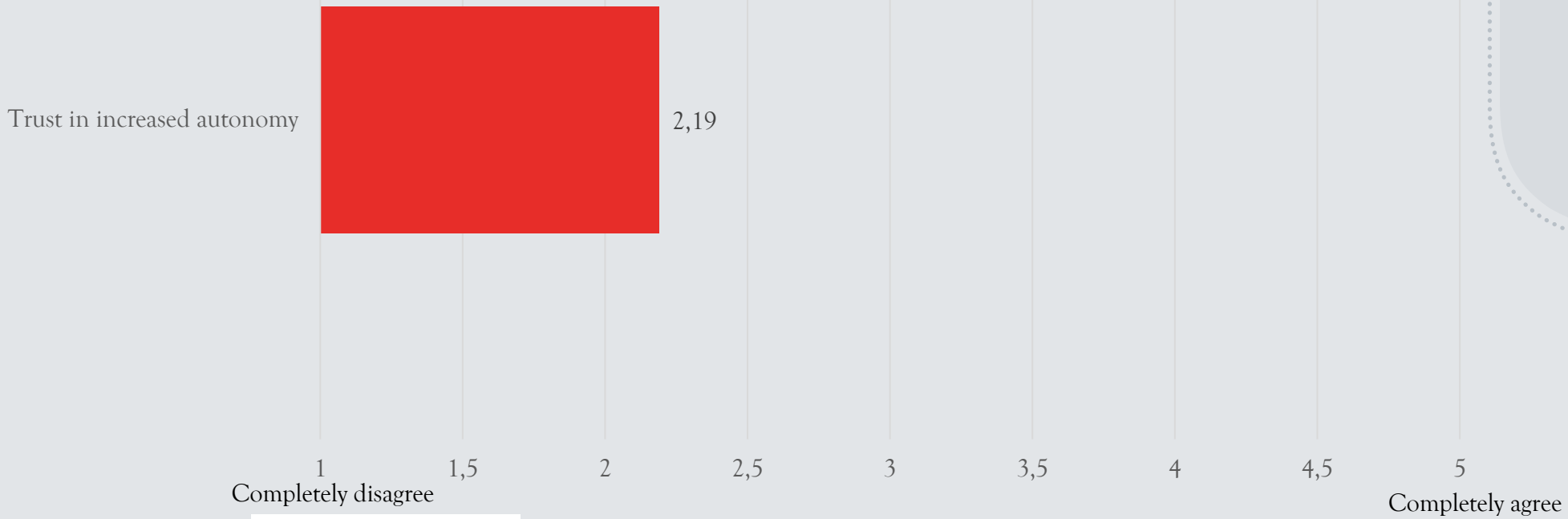
What about increased autonomy?

(6987 seafarers)

Seafarers on domestic ferries, high-speed crafts, small fishing vessels, and work- and service vessels report lowest trust

«I believe that autonomous (self-driving) vessels will make seafaring safer»
«Increased automation on board will contribute positively to safety»



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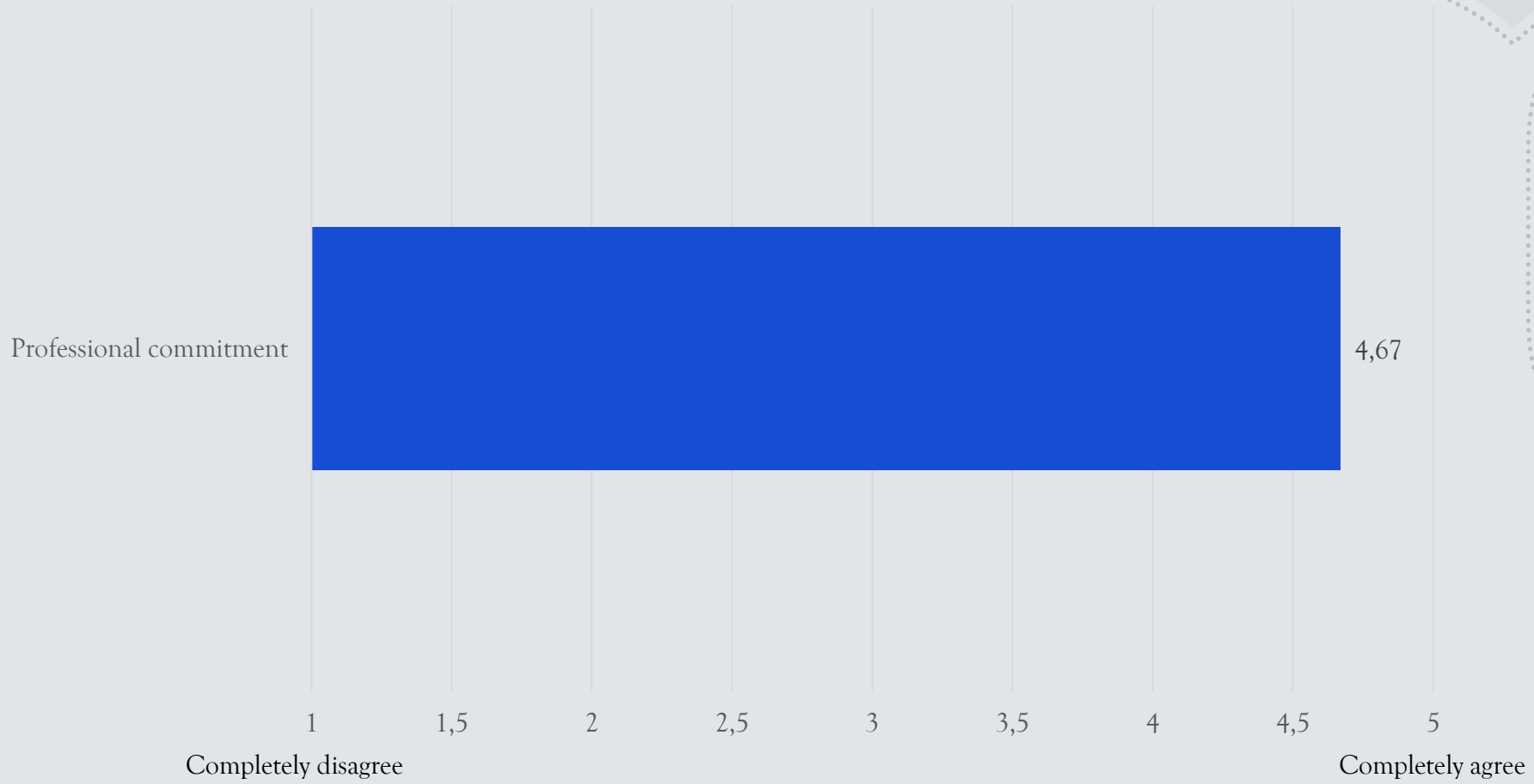
Around 50 % have maxed out «pride»!

Such as «I am proud to be a seafarer»



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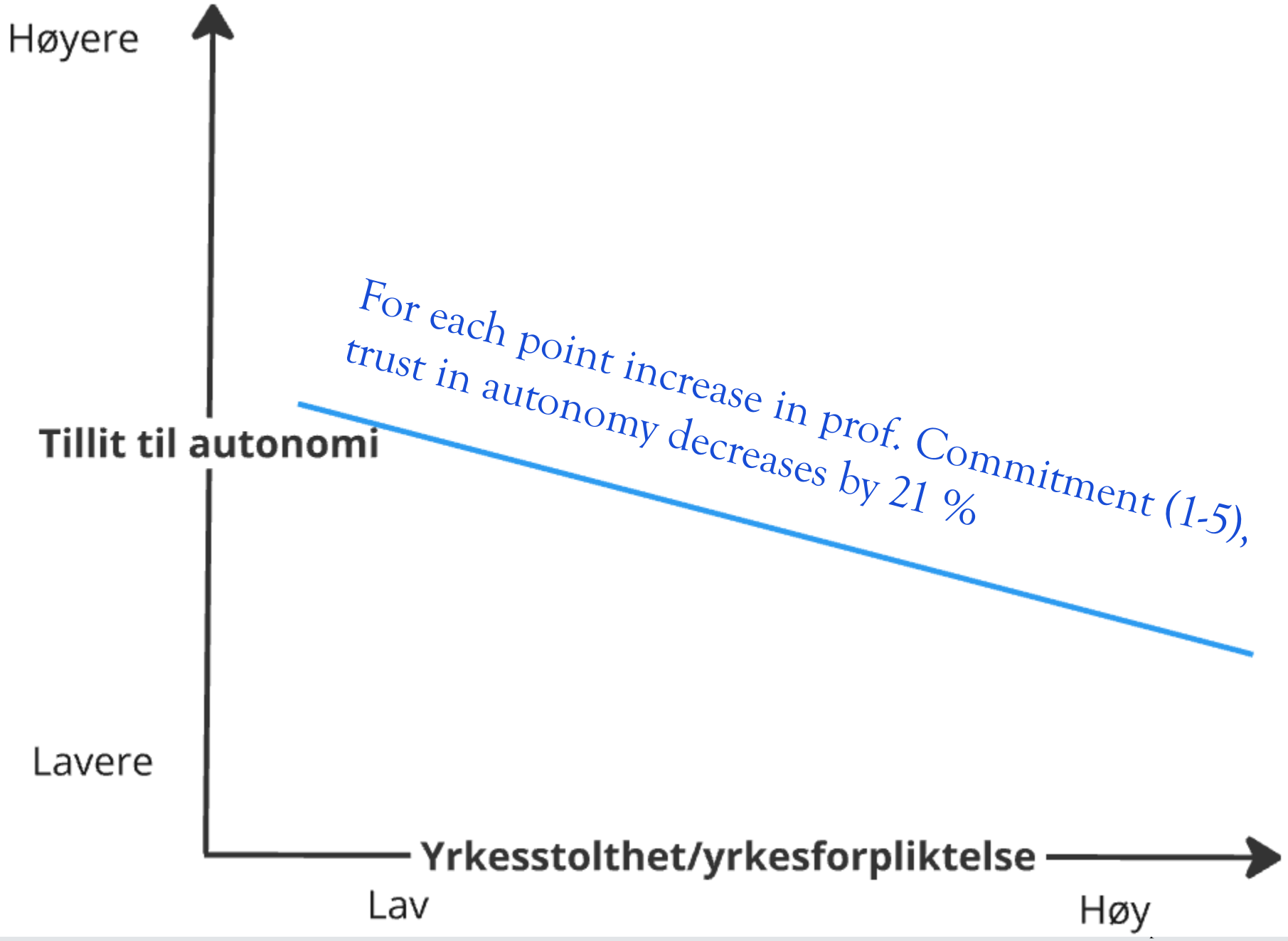

Controls:

- Age
- Ship type
- Experience level
- Nationality
- Trust in automation
- Manning level
- Gender
- Company management

istrust? The association between maritime bridge
ent and trust in autonomy. WMU J Marit Affairs
(2024).

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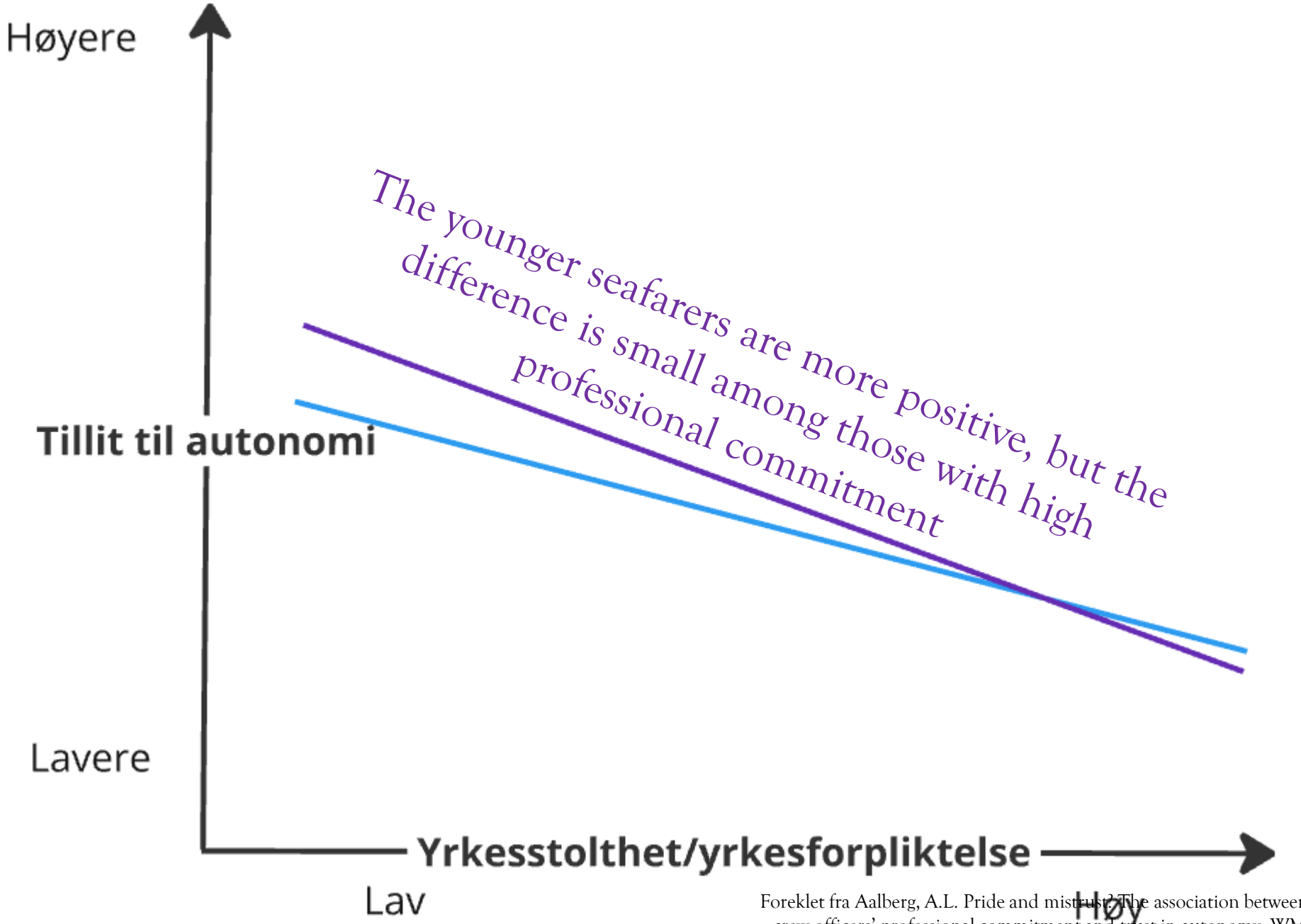

Foreklet fra Aalberg, A.L. Pride and mistrust? The association between maritime bridge crew officers' professional commitment and trust in autonomy. WMU J Marit Affairs (2024).

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Afraid to lose their jobs?

- We did not ask about job security
- Not apparent among ferry crew in qualitative study
- International research does not show much sign of job insecurity (Bogulawski, 2022)

- Stereotype that seafarers have high resistance to change

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2 – How seafarers developed trust in maritime automated shipboard systems (field study)

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Auto-crossing and auto-docking

The ferry follows a predefined route and automatically adjusts course and speed to remain on that route, unlike conventional autopilots.

No collision warning or evasive manoeuvre, so «full» attention is required.

At end of transit, system stops at a specific waypoint prior to docking, if no one intervenes a bridge alarm.

If auto-docking is installed, this can be activated in the transition from transit to dock.

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Car ferry connections studied

Connection	Propulsion	Crossing time	Traffic	Days spent[a], Interviews[b], Informants	Capacity[c] of vessels
1	Battery-electric with diesel back-up	~ 25 min	High	3 days, 12 informants, 11 interviews)	~150-200 cars ~500-600 pax
2	Battery-electric with diesel back-up	~ 10 min	Low	3 days, 10 informants, 11 interviews	~100-150 cars ~300-350 pax
3	Battery-electric with diesel back-up	~ 20 min	Medium	3 days, 8 informants, 11 interviews	~ 70-100 cars ~350-450 pax

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Informants

Background	Category	Informants
Position on board	Captain	12*
	Chief Officer	2
	Officer of the Watch	4
	Chief Engine Officer	8
	Motor Mechanic	1
	Able bodied seafarer	4
	Apprentice	1
Age	20-40	13
	41-60	15
	61-75	4
Gender	Male	31
	Female	2
Total		33

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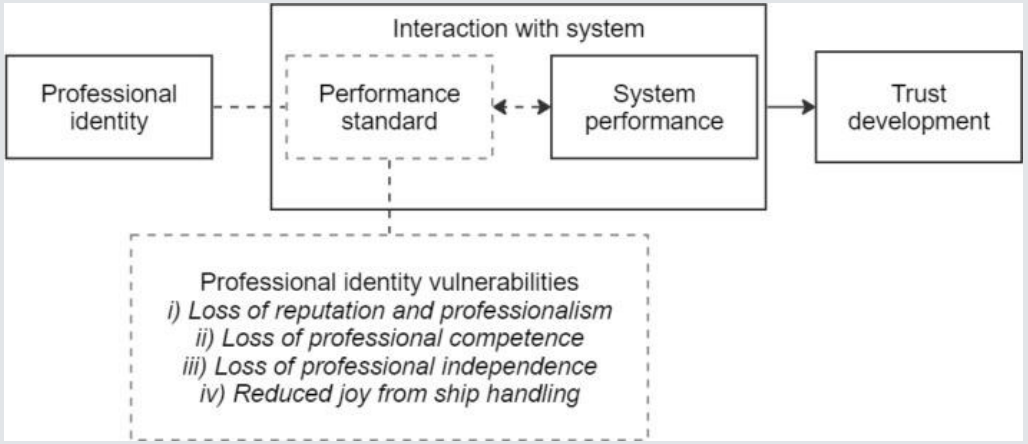
Findings & Discussions

- Seafarers exhibited a **high level of trust** in autocrossing and autodocking, sometimes **relying excessively** on the systems.
- Trust developed **gradually** as **hands-on experience** was obtained of an **adequate system performance**
- **Norms** rooted in professional identities formed as a mental **performance standard**
- A mental **weighing** of potential **vulnerabilities** and **positive results**
- A tool – **a resource for action** - instead of a means of control!



«Does it do the same as we would?»

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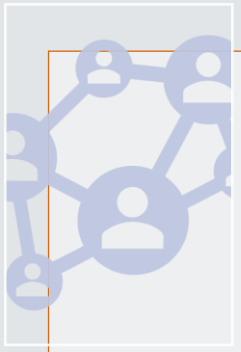
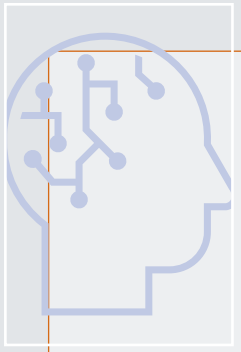
Potential negative outcomes when using automation



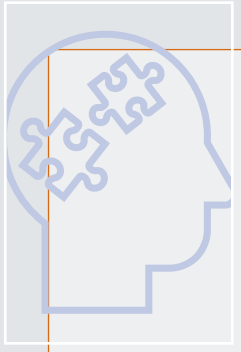
Loss of reputation and professionalism?

- Passengers could think *'What is he doing up there?"*
- Automated system is not sailing according to «good seamanship»



Loss of professional independence?

On automation versus autonomy: *It is the angle… It is a huge difference from a tool to… Just to take over [control]. […] I am sure that most see it as positive if it is a tool"*



Loss of professional competence?

"Auto-docking might do it just as well [as us], but if something fails and we have never sailed manually, one does not have the feeling the day one has to take over"

Loss of joy from sailing manually?

"Whether it is a wonderful cloudless sky, a calm day – or if it is a full storm – it's one of the most joyful things I do. And it is clear to me now that more and more of it will disappear".

These elements pertains to the professional identity of seafarers

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Experiencing **positive results** of automation

*Increased perceived **safety redundancy***

Automation stops the ferry in case of e.g. acute illness

*Extended **repertoire of tools** to apply*

Increased adaptive capacity, e.g. during fog.

*Optimizing **work-related goals**: time, fuel, workload*

"[When] you need a little extra focus, you can use it and all of us [on the bridge] have two sets of eyes that we can focus one hundred percent (100%) on [watch-keeping], because we know it's going to sail to where it is going unless we have to give way because a boat is coming [...]. Therefore, the system is absolutely a top notch."

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5: Seafarers' improvisations
A dilemma for resilience of future automation

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Recall that

- When approaching the dock, the system sounds an alarm for manual takeover
- If no takeover is done, the system emergency stops at a designated area, similar to a dynamic positioning system.
- Since the ferry did not have a dynamic positioning system, this feature could come in handy.
- Safety procedures: **“in the case of *any* alarm from the auto-crossing system, the navigator shall take over control”**

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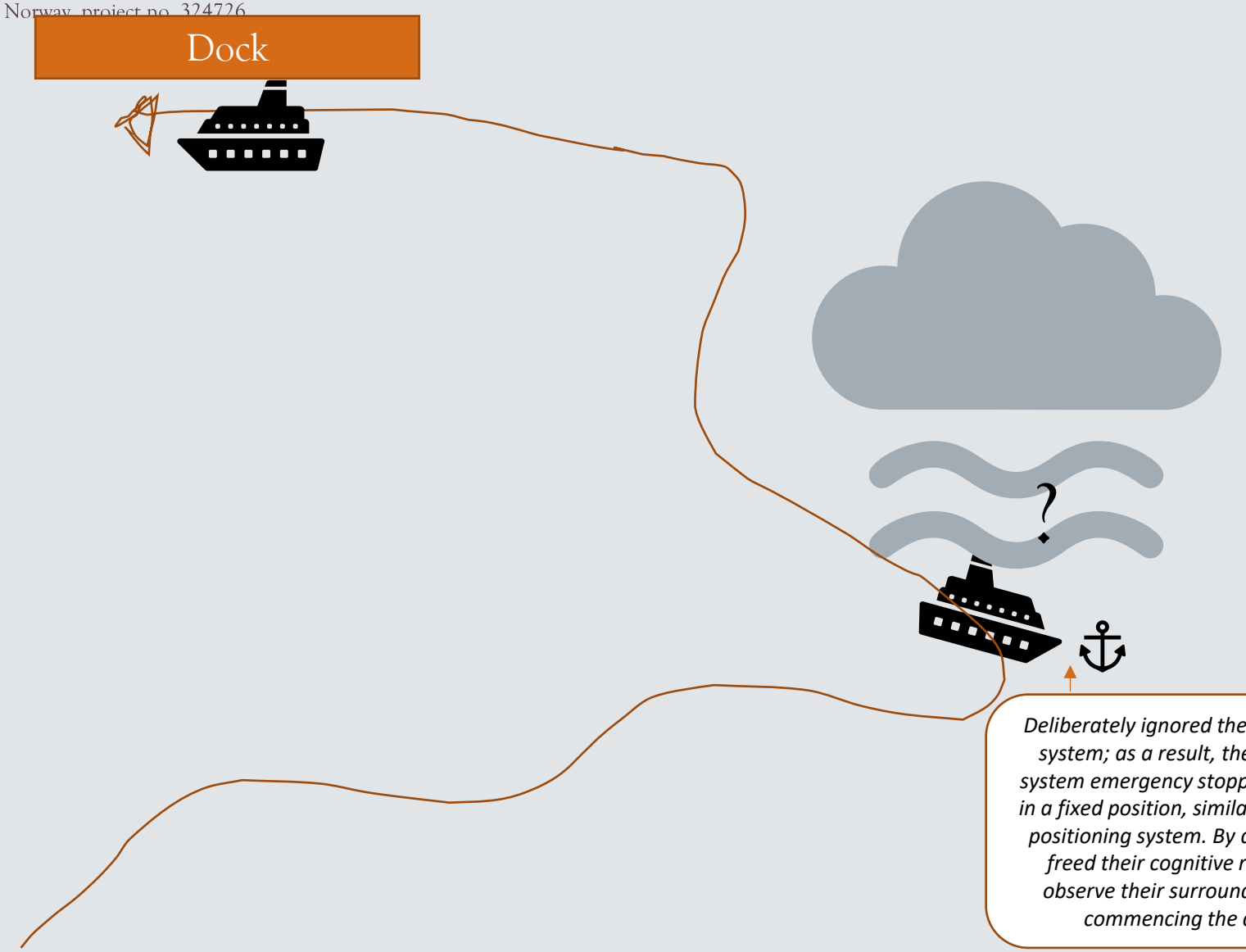

Deliberately ignored the alarms of the system; as a result, the automated system emergency stopped and stayed in a fixed position, similar to a dynamic positioning system. By doing so, they freed their cognitive resources to observe their surroundings before commencing the docking

Adaptation: «Clever» use of the emergency stop inherent in the automated system to reduce stress in fog – a demonstration of adaptive capacity, or unsafe drift?

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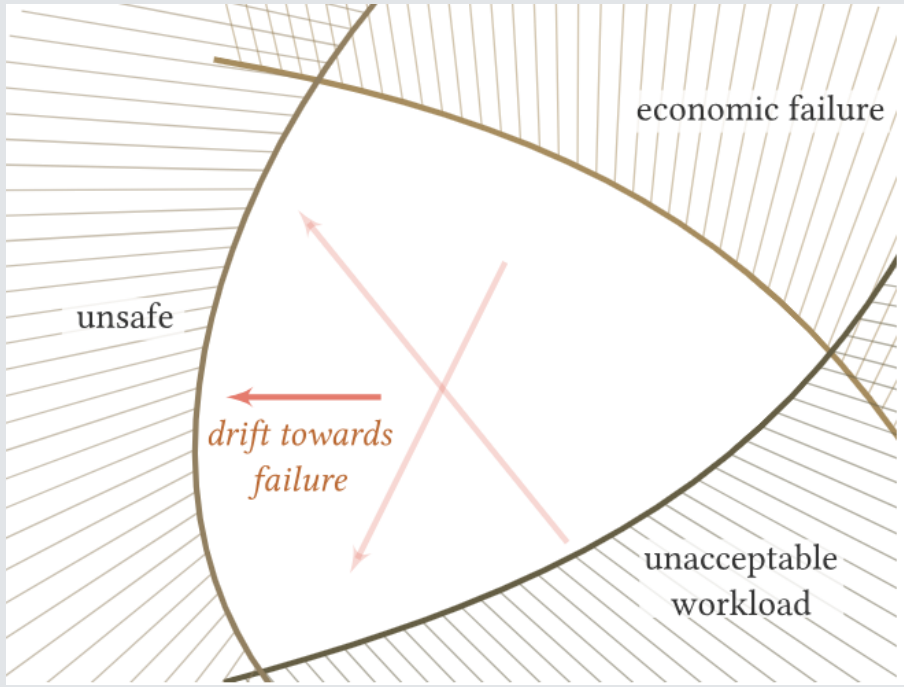
Are the improvisations migration, drift, – or adaptive capacity, stretch?

As automation increases – will improvisations lead to more brittleness?

Do seafarers «know what they are doing» with increasingly complex systems?



risk.-engineering.org, adapted from Rasmussen (1997)

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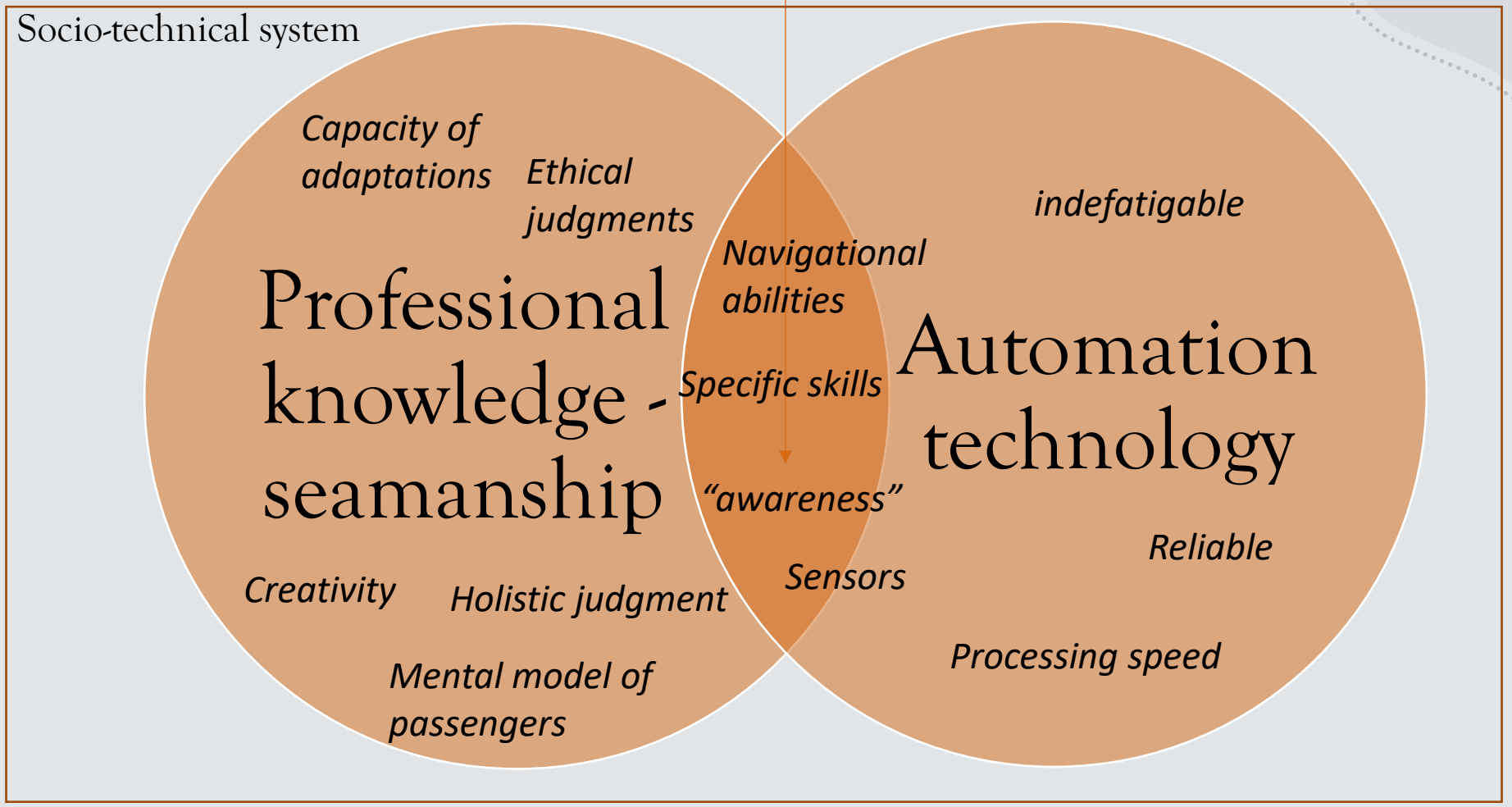
So far, best of both worlds?

Increased redundancy in certain actions, navigation and "situation awareness"

Automated systems, used with competence and adequate trust, extends the repertoire of the professional?



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Do increased automation and autonomy «conquer» a long-lasting space where practical wisdom thrives – in ship operations –

by reducing the *space*: **discretion** of professionals, increased **agentive power** of technology,
and reducing the *fundament* for human creativity: reducing **situational cues**, dissolving **communities of practices**, and reduced **experiential learning**?

Is it a **necessary trade-off** in meeting with an increasingly digitalized, **complex** world? Or - can we find a way to keep the «**best of both worlds**» - to increase robustness, reliability, resilience?

If so, where do we set the boundary for human discretion?

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«Social» seamanship versus hard-coded rules

- Some captains told us that they might end up in "objective" danger in concrete scenarios by blindly following the leeway rules. This was due to the established practice, in the specific waters, of giving way to a large cruise ship. Indeed, finding a better solution than maintaining rights, despite COLREG, was an informal convention. One captain noted:

"They [the cruise ship] are more or less expecting us to wait [even though we are the stand-on vessel]. It is much easier for a ferry to turn than a cruise ship."

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1009 free-text responses from seafarers on Norwegian vessels

Free-text response (N = 1,009)

"What factors do you think are important to manage in order to ensure that increased automation is not at the expense of safety?"

Dealing with the unknown

Inattention

Collaboration onboard

Situational awareness

Competence

Ownership

Standards, rules, regulations

Human-machine interface

Conventional traffic vs autonomy

Responsibility

Standardization of equipment

Predictability

Hacking issues

Overtrust and overreliance

Seamanship

Easy manual takeover

Testing

Handling emergencies

Process of implementation

Loss of senses

Redundancy

Maintenance

Optimization

Passenger acceptance

Robustness in harsh weather

Reliability and quality

Manning on board

Lack of local knowledge

Structural topic modelling (N = 1,009)