



Norwegian University of
Science and Technology

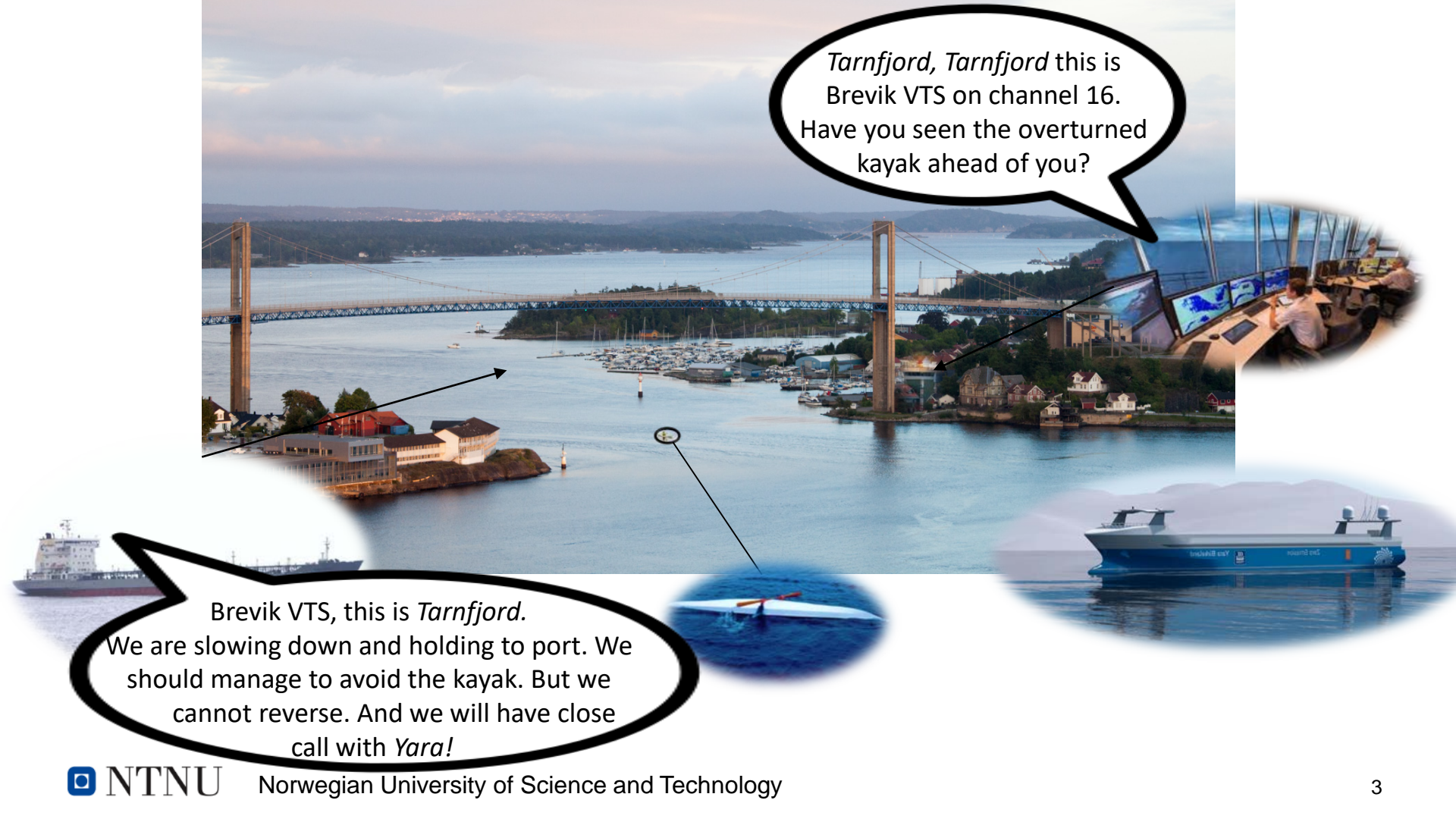
At least as safe as manned shipping?

Autonomous shipping, safety and “human error”


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ESREL, June 21st 2018

The first autonomous ship accident





Tarnfjord, Tarnfjord this is
Brevik VTS on channel 16.
Have you seen the overturned
kayak ahead of you?



Brevik VTS, this is *Tarnfjord*.
We are slowing down and holding to port. We
should manage to avoid the kayak. But we
cannot reverse. And we will have close
call with *Yara*!

Yara remote control, are you following what is happening in the Brevik strait?

Yara remote control, this is Brevik VTS on channel 16. Please respond Yara!!

Brevik VTS, this is Yara. Did you call me? I had a coffee break..





Thank you, Yara!

Stop immediately! can't you see the kayak in front of you

What the hell is the tanker doing!!



No, the sun is completely blinding both my cameras and on the radar I only see the bridge

Yara Birkeland Operation



Operational area

- Herøya-Brevik – 7 nm
- Herøya-Larvik – 30 nm
- Within Brevik VTS area

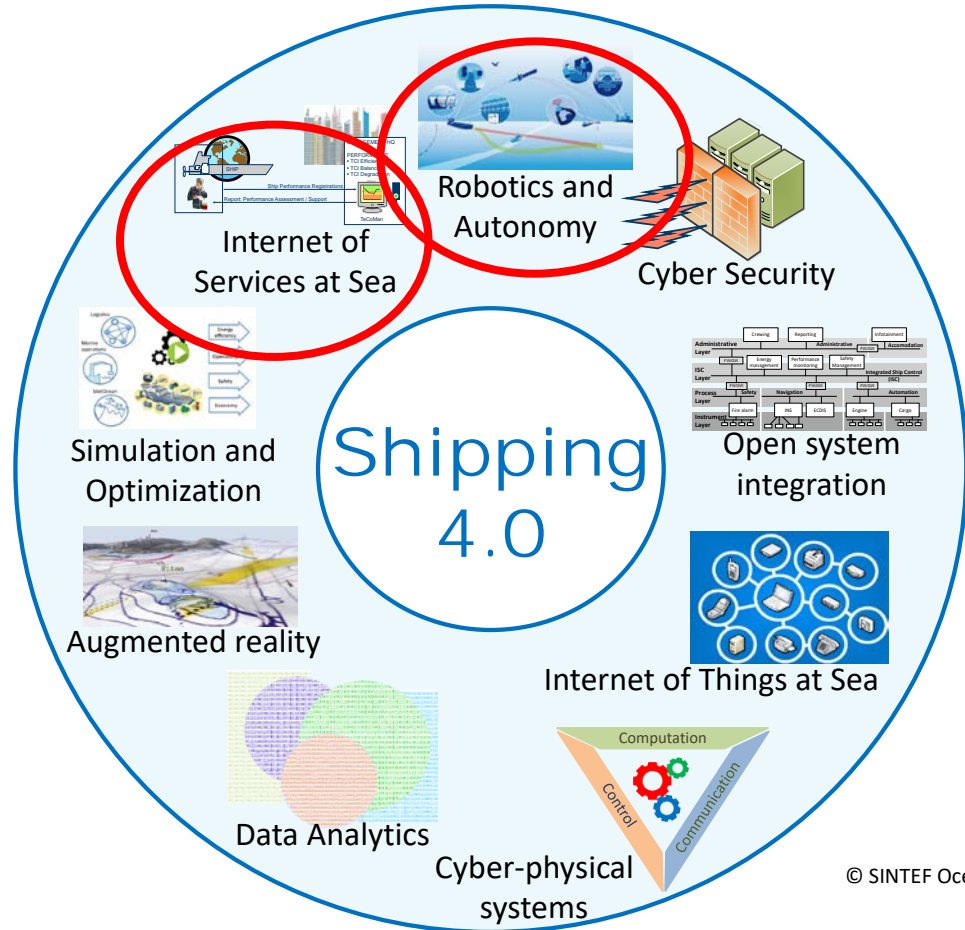
Features

- 100-150 TEU, 70m x 15m
- Batteries – Fully electrical

Staged implementation

- Manned the 1st year
- Remote the 2nd year
- Autonomous after 3 year

Shipping 4.0



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What is autonomy?

au•ton•o•my (ɑˈtɒn ə mi)

n., pl. -mies.

1. independence or freedom, as of the will or one's actions.
2. the condition of being autonomous; self-government or the right of self-government; independence.
3. a self-governing community.

[1615–25; < Greek]

“CITE”  Random House Kernerman Webster's College Dictionary, © 2010 K Dictionaries Ltd. Copyright 2005, 1997, 1991 by Random House, Inc.

Dependent on:



Complexity



Manning level
on ship and
shore.



Automation
level (on ship
and shore).

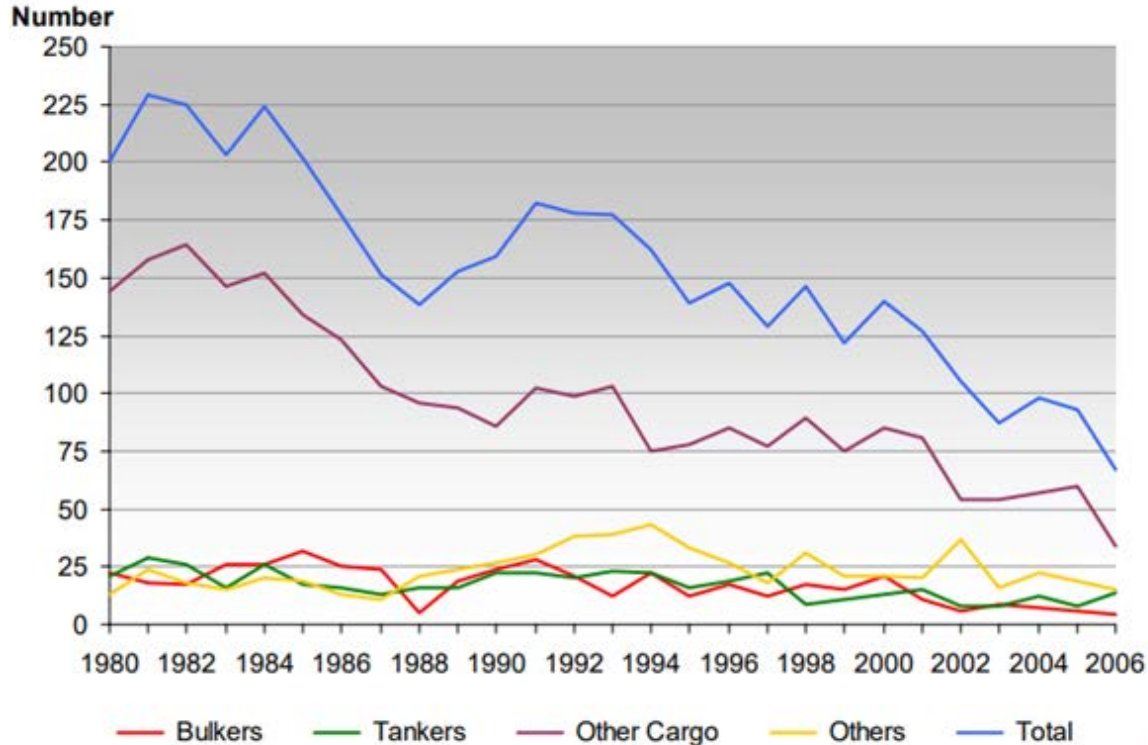


What
function(s) are
automated.



Voyage phase.

Maritime safety through time



Year	number of ships	totally lost per year
1980		225
1996	12 000	150
2016	33 000	33

Source: UNCTAD 2017

Source: LMIU, losses as reported in Lloyds List

Maritime safety today

Accident causes 2012-2016 (IUMI 2017)

50% weather

20% grounded

10% fire or explosion

10% machine failure

5% collision

Maritime safety today

A study of 6091 major accident claims (Dhillon 2007)

- 62% of the claims were attributable to “human error”
- «Human error» contributed
 - 84-88% of tanker accidents
 - 79% of towing vessel groundings

Over 80% of marine accidents are caused or influenced by human and organization factors.

«Human error» contributes to 89–96% of ship collisions.

Example



Source: UK MAIB 2016

What is «human error»?

“human error” is not a cause but a result of other factors such as poor design, poor planning, poor procedures, etc.

- *“Human variability”*



Photo: Steven Day, AP

Can automation increase safety?

Why automation can make ships safer

- Decline in accidents due to more robust and reliable systems:
 - Dynamic positioning, satellite based navigation, autopilot, track pilot and other technologies
- Automation address human shortcomings like:
 - Fatigue, attention span, information overload / underload, normality bias etc.

Can automation increase safety?

Why automation can make ships less safe

- Automation needs to be programmed and can therefore only solve simple or *complicated* problems → challenging in a *complex* maritime environment
- Moving «human error» to other parts of the system: design, monitoring, maintenance etc.
- What about «human recoveries», near accidents averted by crew?

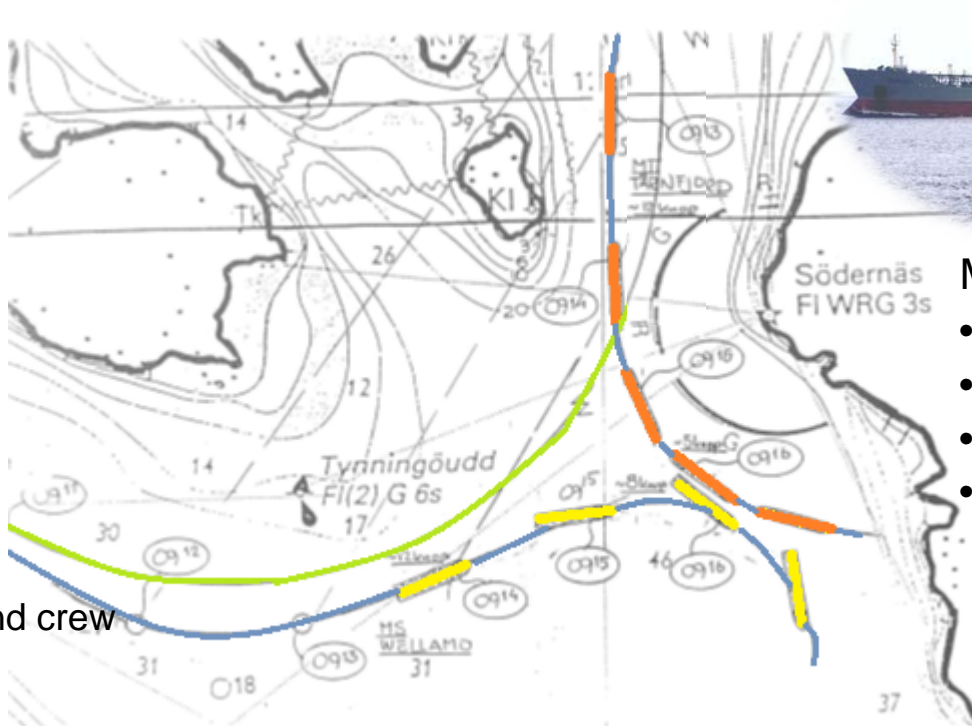
Example of near accident averted by crew



M/S Wellamo

- 1000 passengers and crew
- GT: 20.581 tons
- 168 m

Source: www.shipspotting.com



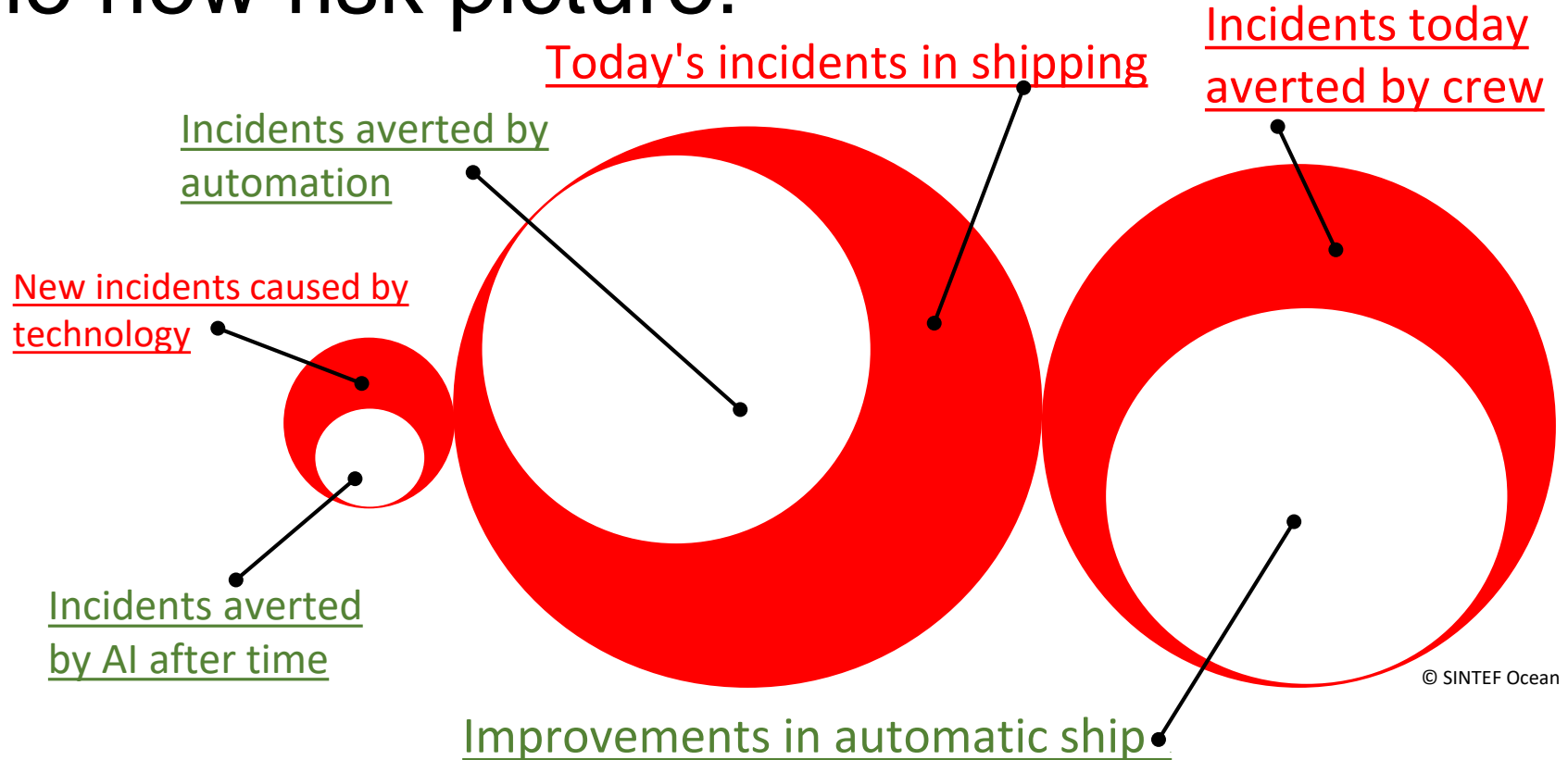
M/T Tarnfjord

- 18 crew
- 20.000 tons of gasoline
- GT:12.926 tons
- 165 m

Source: www.shipspotting.com

Source: SHK 1992

The new risk picture!



Conclusion

Will autonomous shipping be at least as safe as traditional manned shipping?

→ Today's risk picture vs the autonomous risk picture



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- Unknown size of the bubbles to the right.
- Will the net result be low enough for societal acceptance of the new ship types?
- Constrained autonomy: remember the **human in the loop!**
- New types of risk analysis to address the new risk picture:
 - human centred risk analysis, use of dynamic risk assessment, and other real time tools that can be used on the ship or in the shore control centre.