AUTONOME SKIP INTERNASJONALT: HVORDAN LIGGER NORGE AN?

NTVA, 25. april 2018

Ørnulf Jan Rødseth, Seniorforsker

SINTEF Ocean

From January 2017, a merger of:

- MARINTEK
- SINTEF Fisheries and Aquaculture
- SINTEF Environmental Chemistry

Not-for-profit, independent

Contract research

360 employees

Scandinavia's largest independent research organization

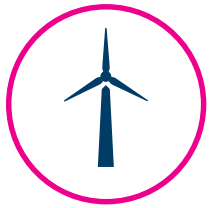
USD 390 million
Revenues

USD 60 million
International sales

SINTEF

Applied research, technology and innovation

Expertise from ocean space to outer space:


Renewable energy


Ocean space


Industry


Buildings and infrastructure


Materials


Micro-, nano- and biotechnology


Climate and environment


Oil and gas


Health and welfare


Society


Digitalization


Transport

SINTEF

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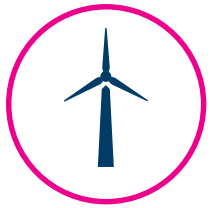
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Norsk Forum for Autonome Skip

- Established October 4th 2016
- Operated as a joint industry project at SINTEF Ocean.
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- 45 Institutional Members
  - Including Industry, authorities, class, insurance research, universities, ports …
  - 2 other institutions as personal members

NFAS Norsk Forum for Autonome Skip

http://nfas.autonomous-ship.org

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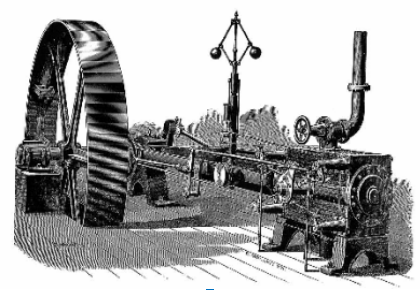
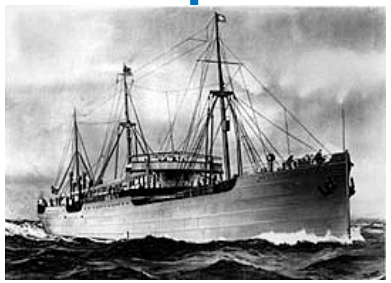
Increasing automation in all areas

The fourth shipping revolution is on



1800 1900 1970 2010

1. Mechanized Power



2. Mass Production

3. Computerized Control

4. Shipping 4.0

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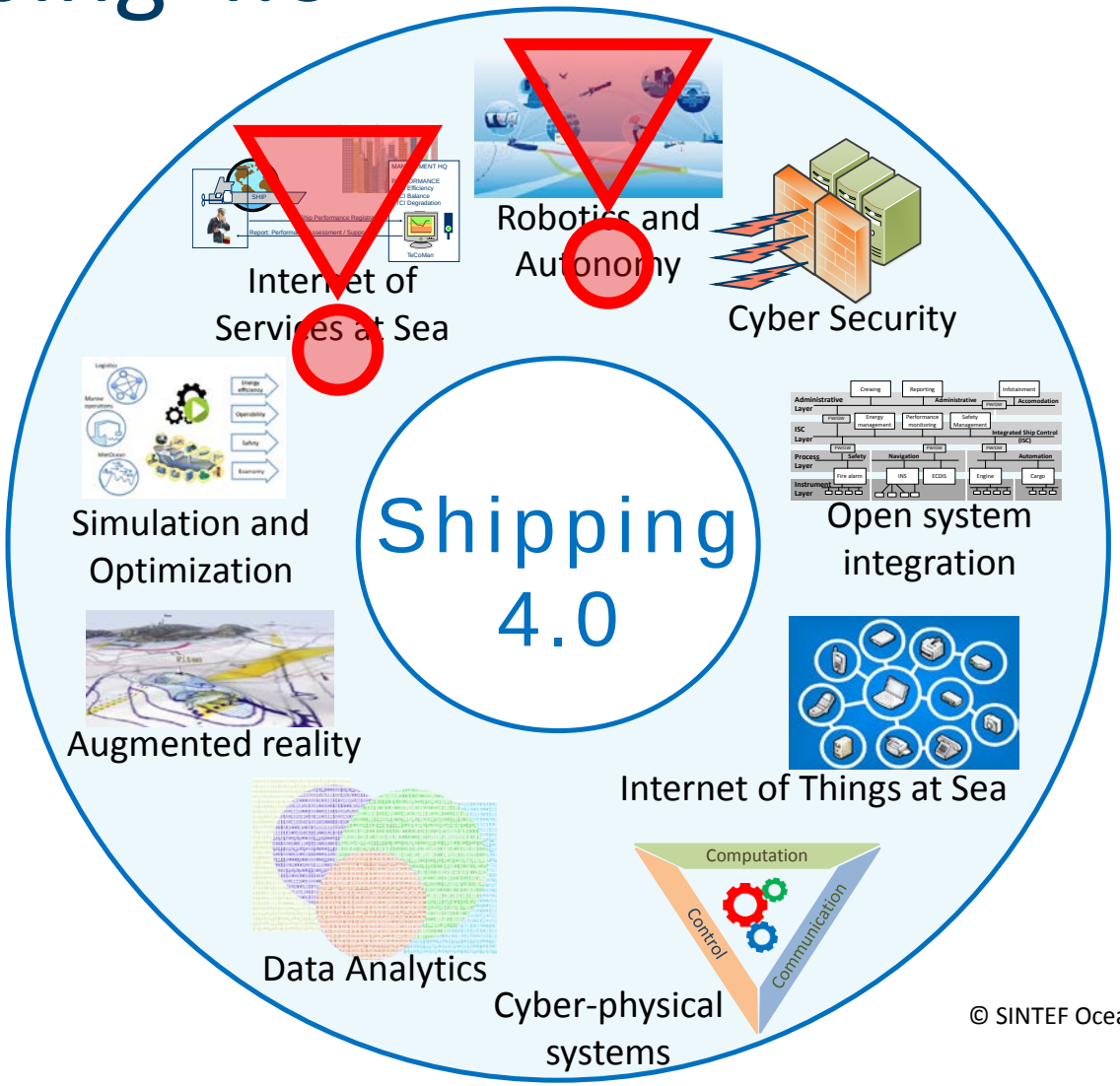
Shipping 4.0



Potential **game changers** in Shipping 4.0:

- Digitalization of commercial shipping processes
- Autonomous and unmanned ships

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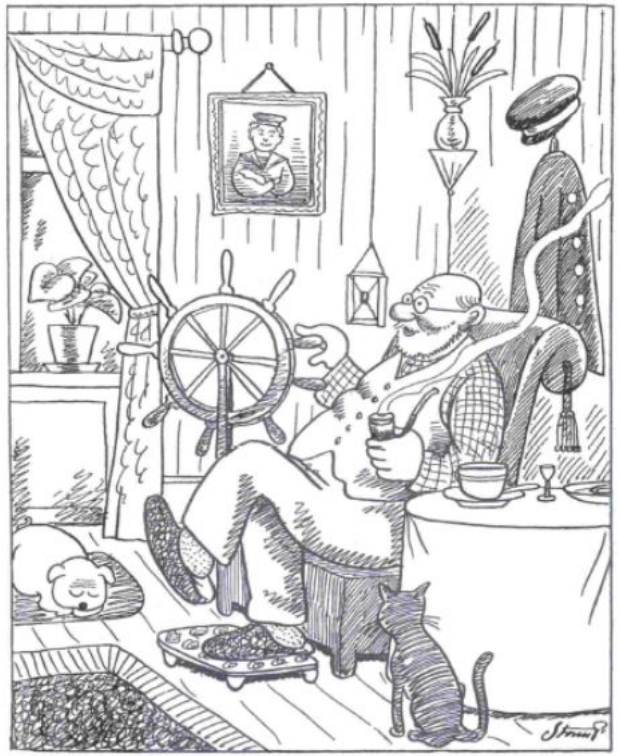
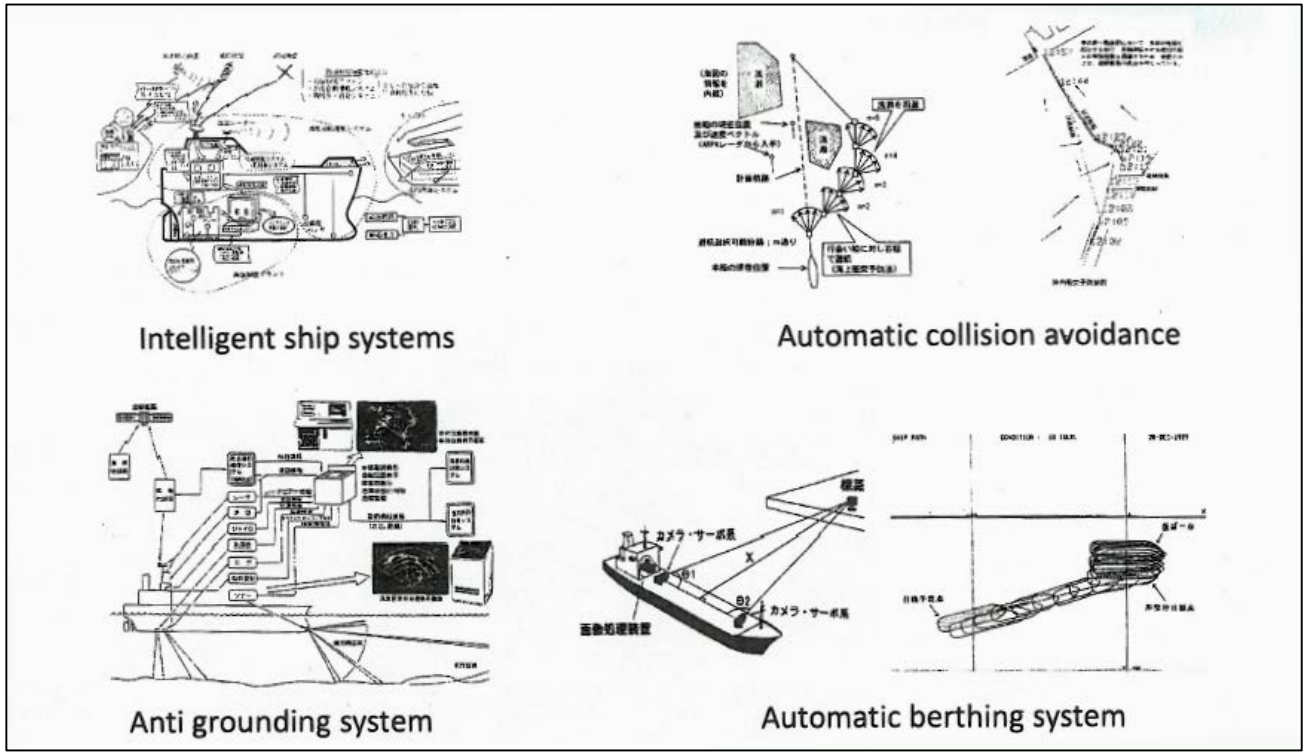
Hva er et autonomt/ubemannet skip?

Unmanned ships are not new …



For fremtiden behøver kaptajnen ikke at sejle med skibet. Fjernstyres skibet pr. radio, kan han sidde hjemme og besørge arbejdet.

Storm P. 1968



Various papers in "Bulletin of the Society of Naval Architects of Japan", Vol 721-729

Japan 1982-1988: Highly reliable intelligent ship project

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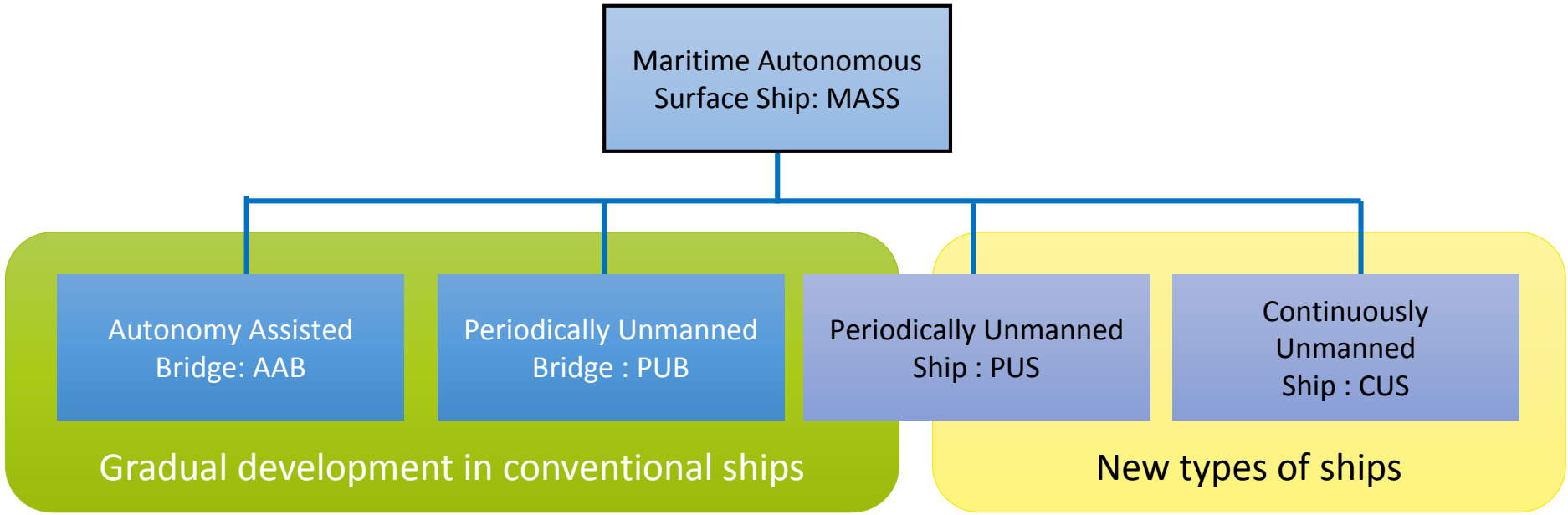
Types of autonomous ships – manning levels



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Developments towards unmanned ships

Today's technology

Improved decision support

Periodically unmanned bridge

Various special ships, like small passenger ferries or car-ferries, military applications

Small local transport vessels

Larger, dedicated transport chain

Fully unmanned inter-continental ships

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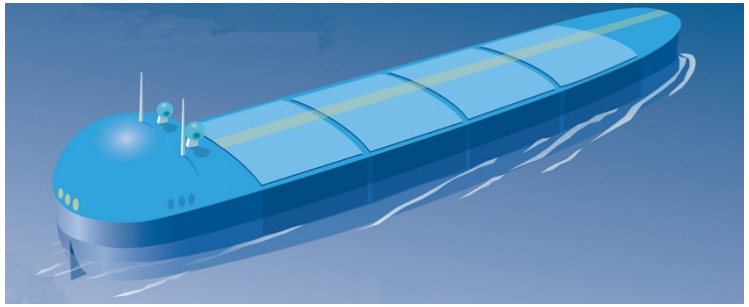
Completely unmanned gives largest benefits!



No accommodation

Less power

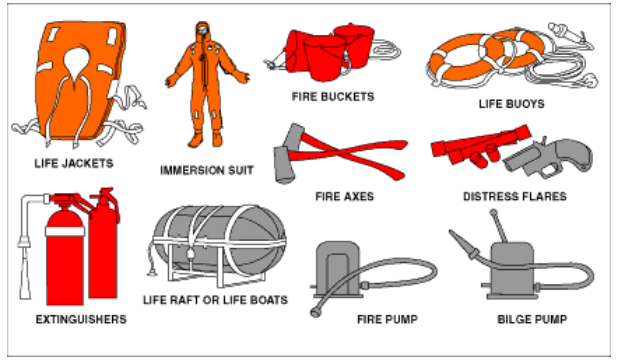
More cargo

No crew

No crew related costs

Enables completely new

transport system concepts



No safety equipment

New constructions

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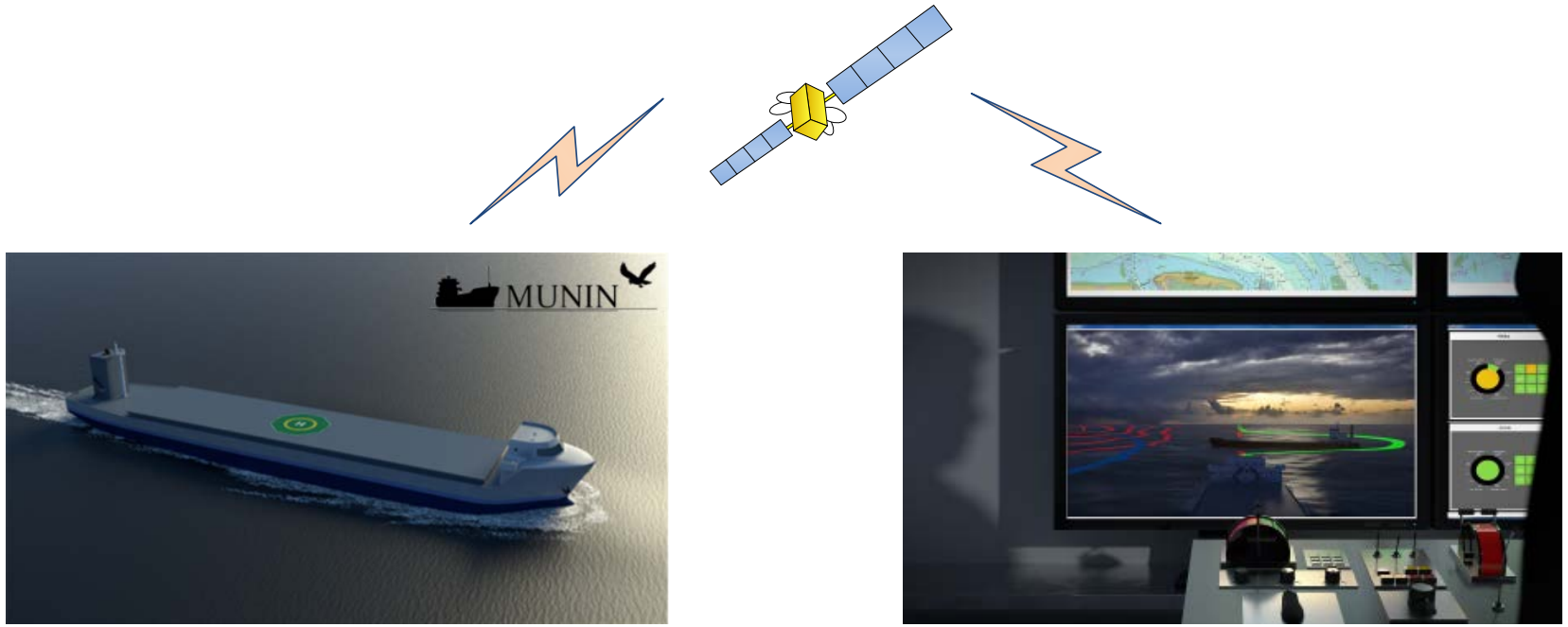
Shore Control Centre (SCC) is normally needed



There is normally a human in the loop!

- Simplifies technology, increases safety and security
- Simplifies transitions from todays legislation to unmanned operation

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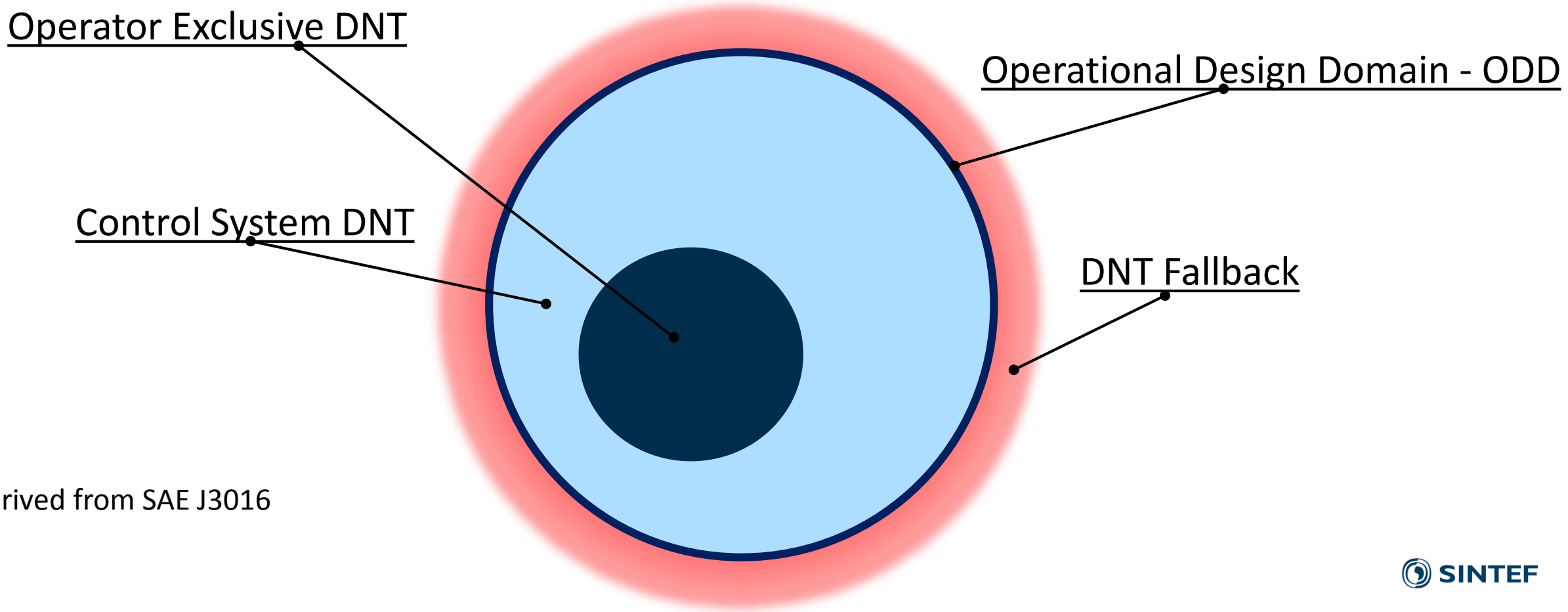
Operational Design Domain – ODD, Dynamic Navigation Task – DNT



Derived from SAE J3016

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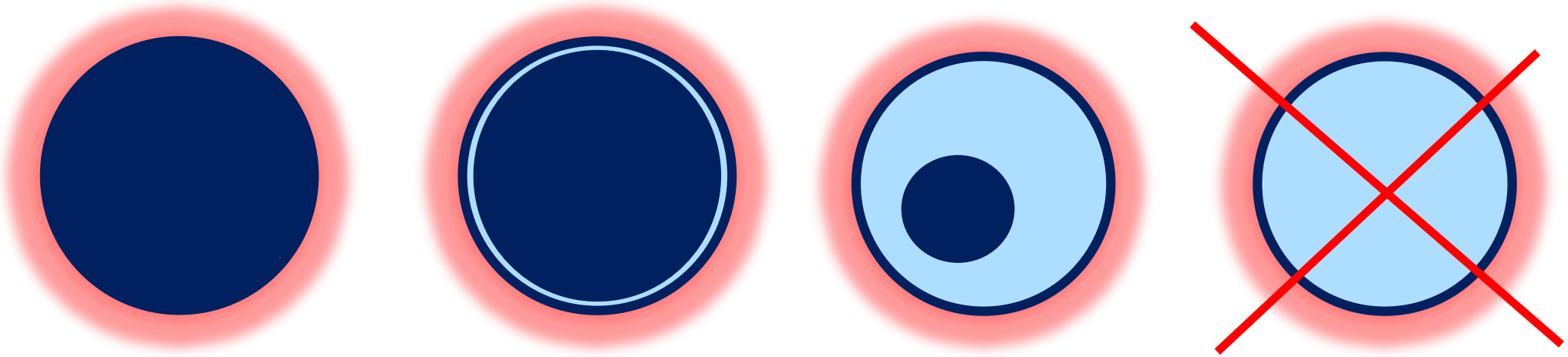
Main autonomy levels

1. Operator controlled: Decision support and advice to operator. Operator decides.

2. Automatic: Automated operation – stop at deviation, continuous supervision.

3. Constrained/Partly autonomous: Autonomous within limits, continuous supervision.

~~**4. Fully autonomous:** Autonomous and without supervision.~~



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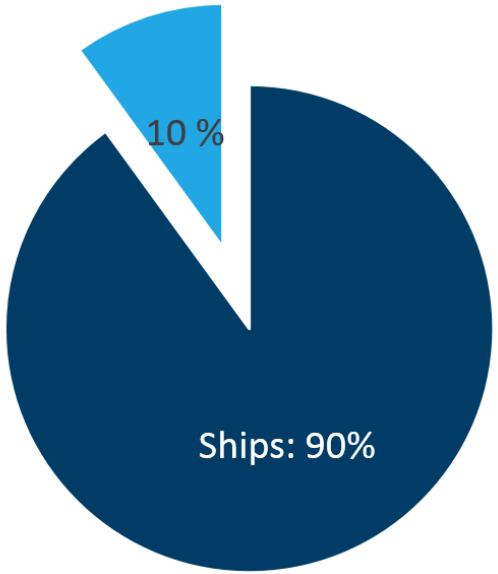
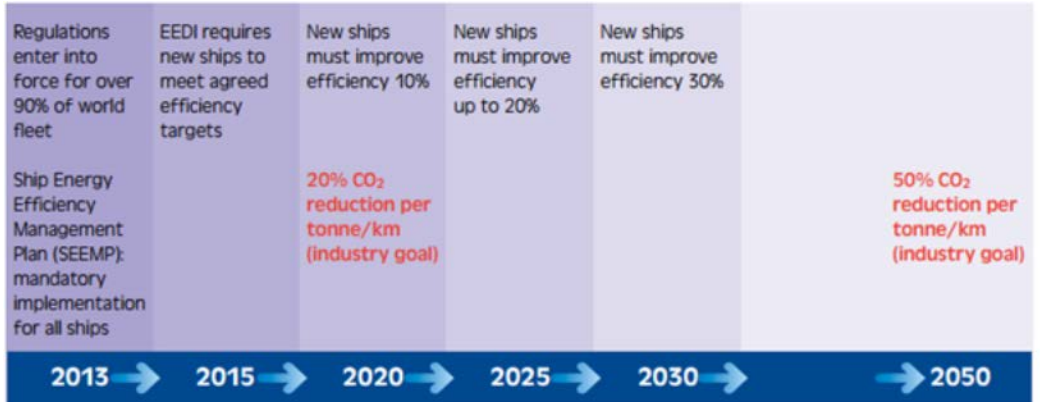
Hvorfor Norge?

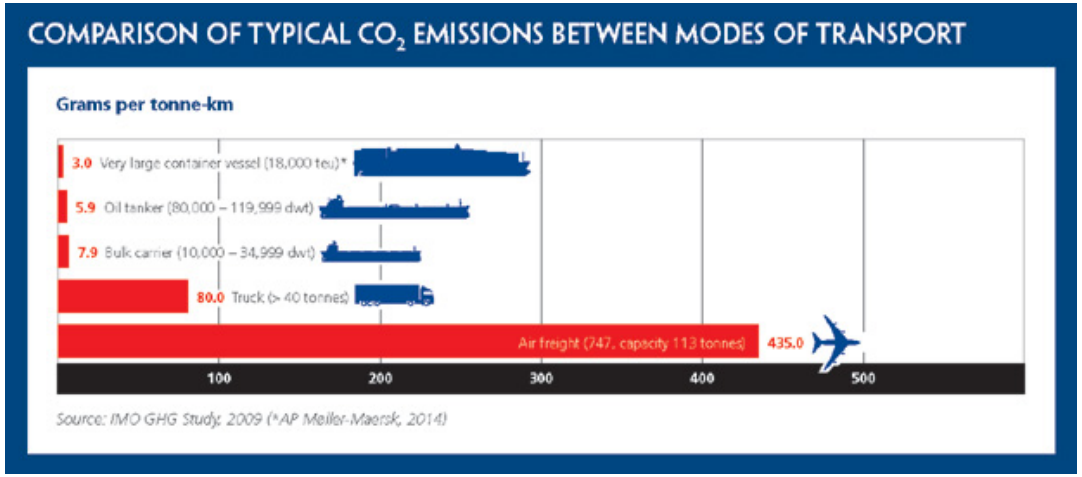
Ship transport: The life-blood of world trade



90% of world trade



… but aim is to make it 50% more effective by 2050



Extremely efficient

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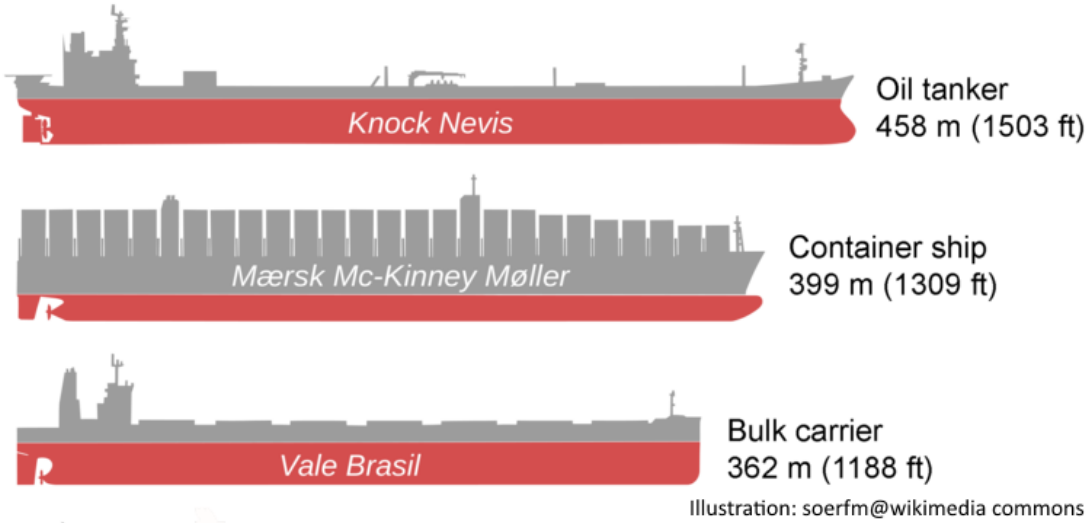
Why autonomous ships ?

Automate operations that computers do better: 3D



Defeat economy of scale

Lower emissions

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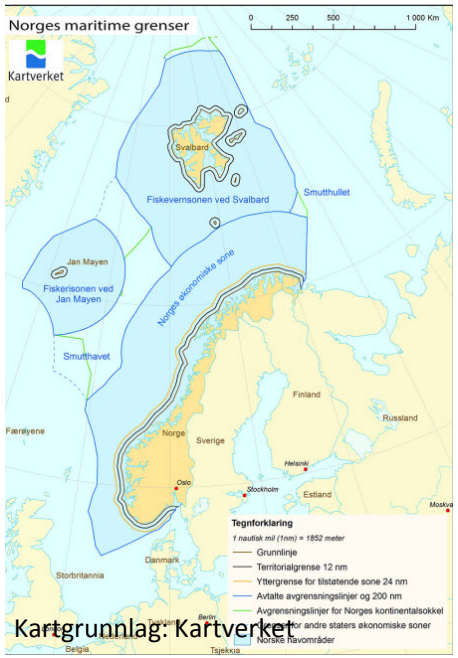
Why Norway?



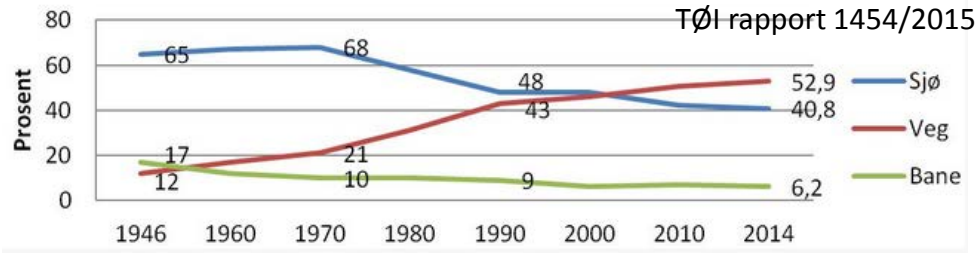
Kartgrunnlag: Kartverket

Coast: 100 000 km
Mainland: 85 000 km
Sea border: 2650 km

A complete maritime cluster.

Maritim Verdiskapingsbok 2015, Maritimt Forum, Norge

14% of value creation from businesses
38 % of export (ex HC)



TØI rapport 1454/2015

Still a big role in inland cargo transport – that needs to be increased

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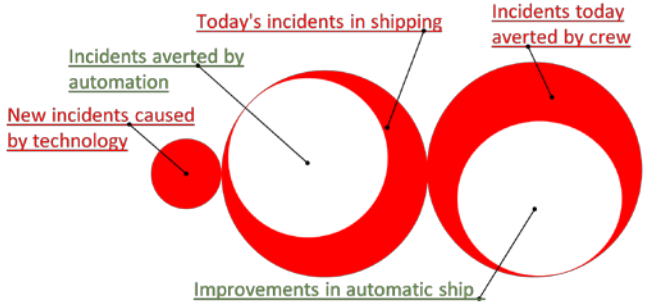
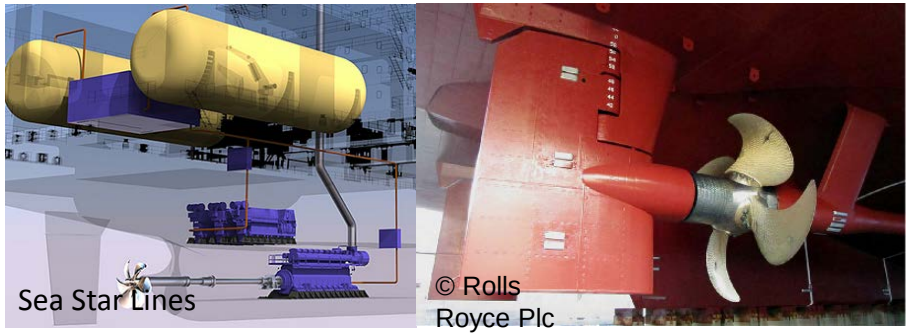
Hvor kommer de først?

Why not autonomous ships?

More expensive sensors and control system – cyber security

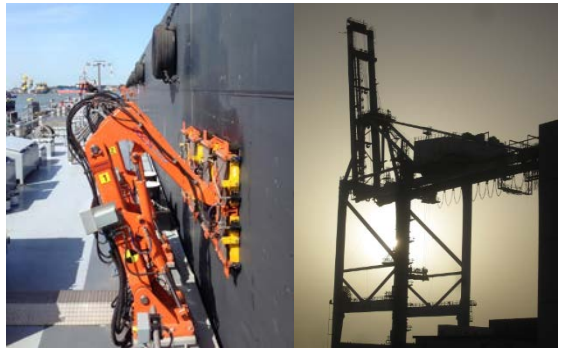


Unclear risk picture and higher safety requirements



No crew onboard: No HFO, more redundancy, more costly maintenance

Continuously manned shore control centre



More and automated shore infrastructure

Long time until international legislation is in place.

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This rules out tramp/voyage charters!

Because:

- Need special infrastructure in port
- Need trained personnel
- Need agreement with port state and port
- Modifying this type of ship is too expensive

However, these factors will change with time!

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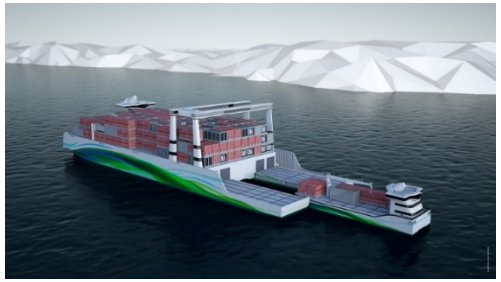
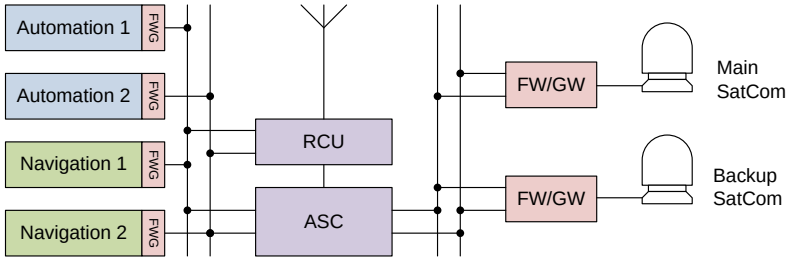
We need a sound business case!

New logistics

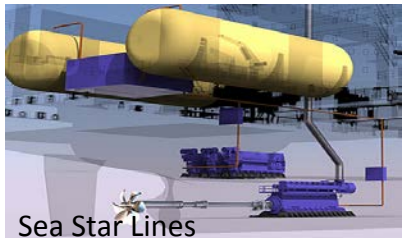


Improved operations

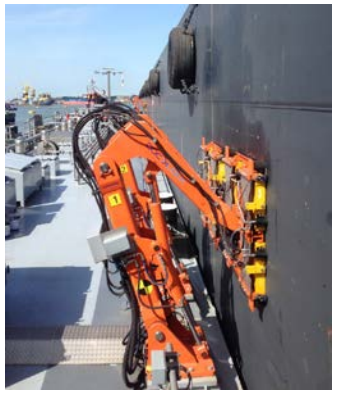
Some reduced costs



More complex ship systems



Reliability: No maintenance on board



Shore Infrastructure

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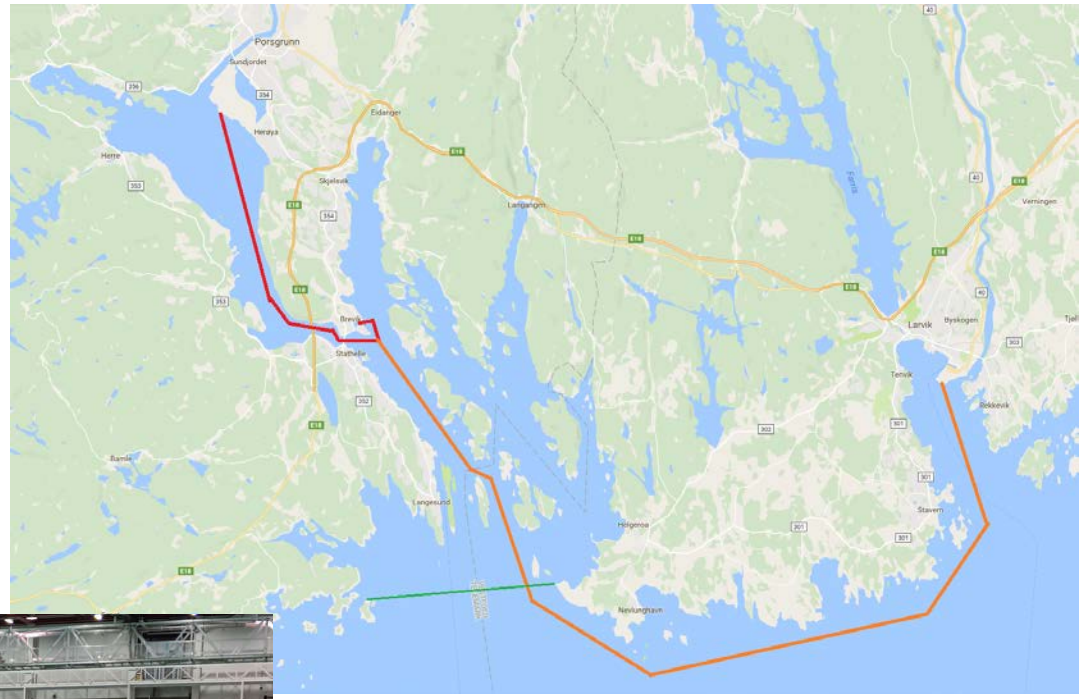
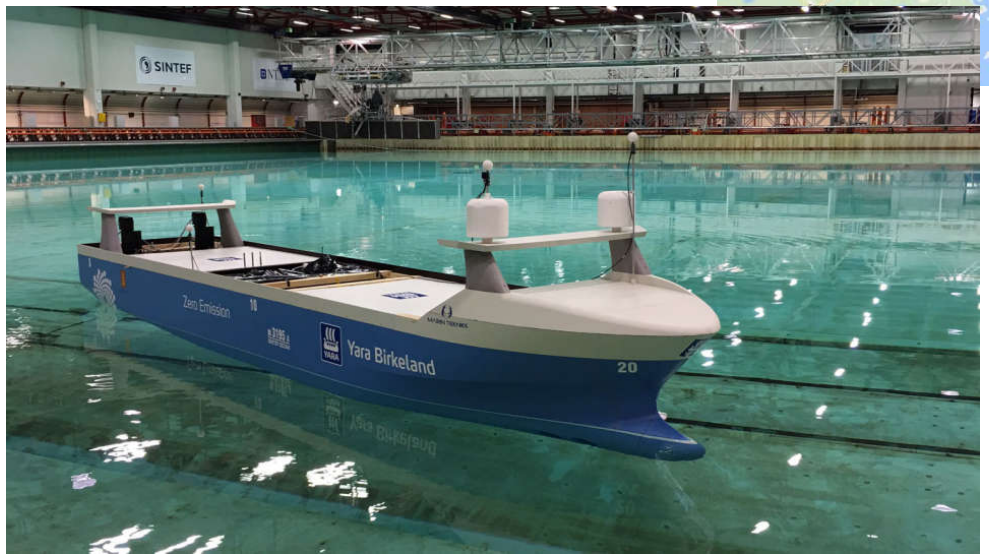
Yara Birkeland

- Yara fertilizer
- Kongsberg partner
- Replaces 40 000 truck trips a year





- Features
  - 100-150 TEU, 70 m x 15 m
  - Batteries – Fully electrical
- Staged implementation
  - Manned after 1 year
  - Remote after 2 year
  - Autonomous after 3 year
- Operational area
  - Herøya-Brevik – 7 nm
  - Herøya-Larvik – 30 nm
  - Within Brevik VTS area

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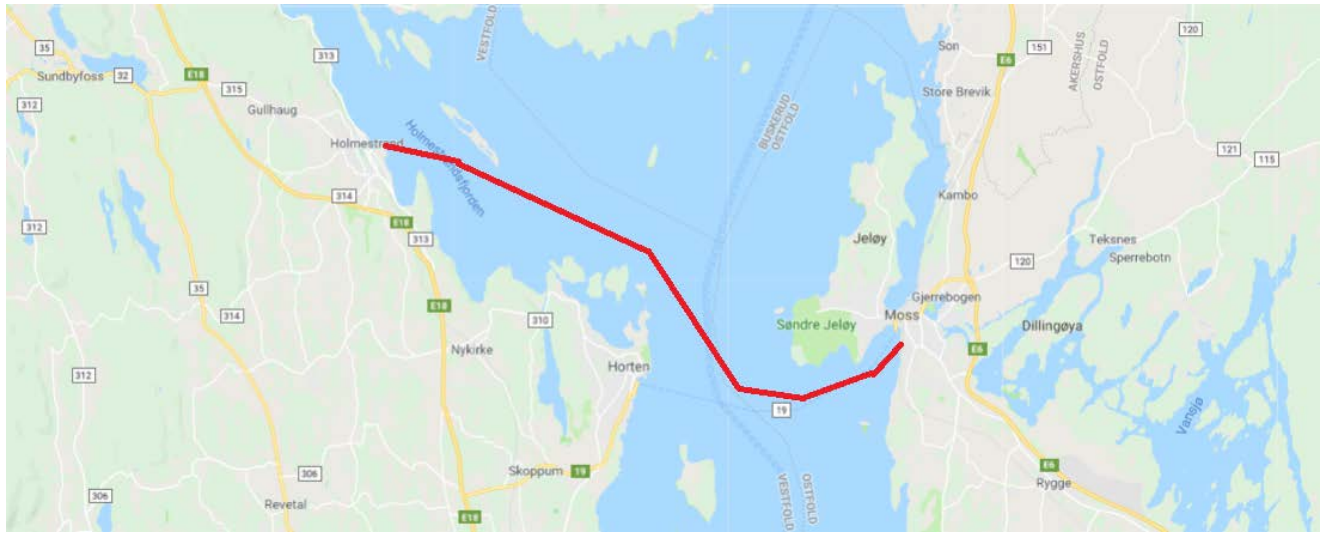
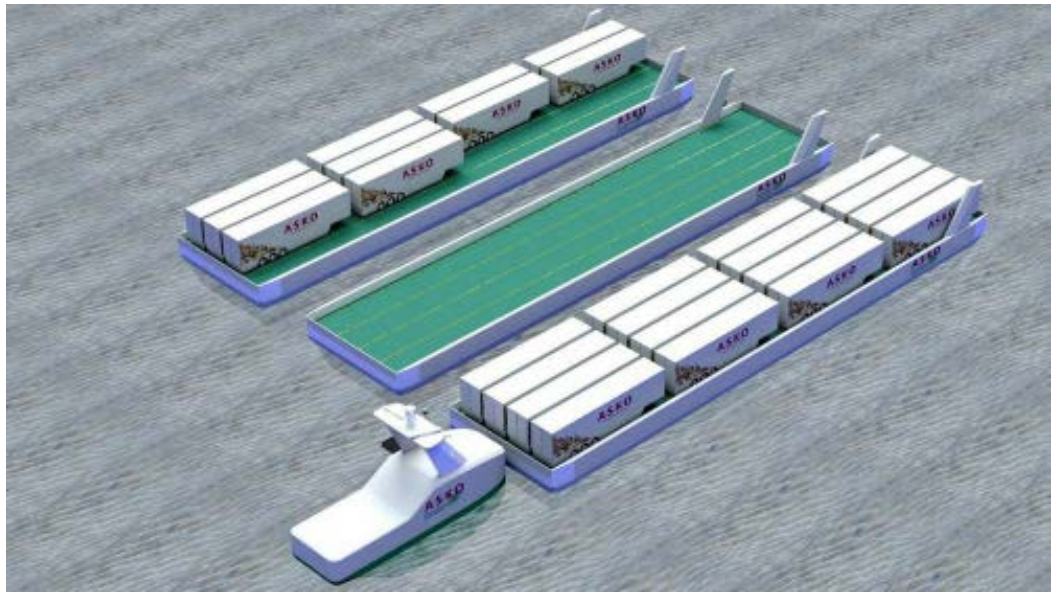
Cargo ferry - ASKO

- Knytte sammen lager øst/vest av Oslofjord
- Tre "push-barge"
- En "push-tug"
- En tømmes/fylles på hver side





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Autonomous Ship Transport at Trondheimsfjorden (ASTAT)

- Short voyages
- 12-50 TEU
- Inland, fjords/sheltered
- Low cost: Wait in port
- Legs 4-12 hours
- Port cranes
- Automated berthing
- Batteries

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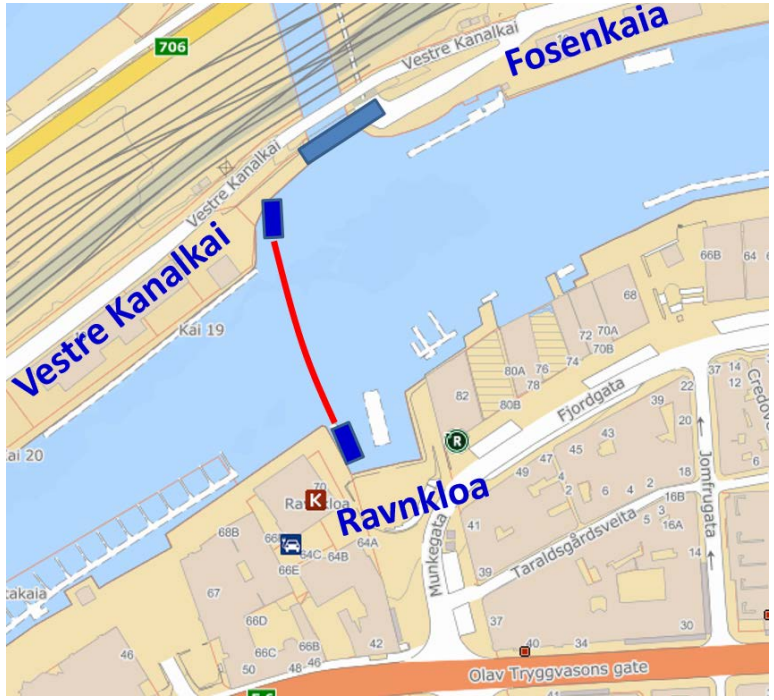
Milli-Ampere – urban waterway

NTNU
Kunnskap for en bedre verden

NTNU AMOS
Centre for Autonomous Marine Operations and Systems

Photo: NTNU – First sea trial 11/11-2017

- On-demand passenger ferry
- Max 12 persons + bicycles
- Electrical propulsion, battery
- Inductive charging at quay



Linking center of Trondheim to seaside and rail station

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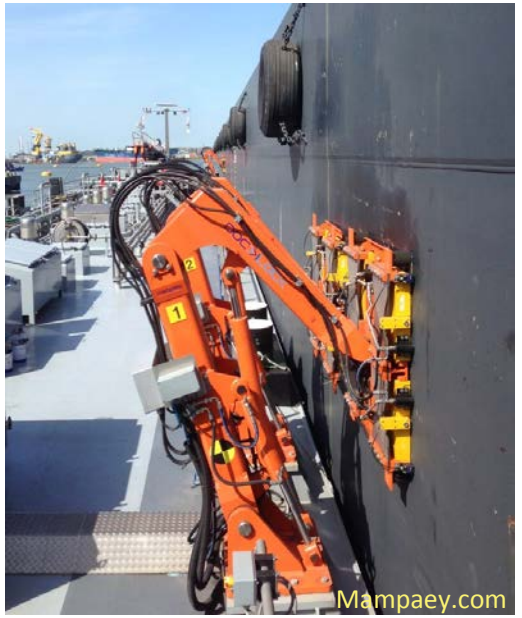
Automated highway ferries



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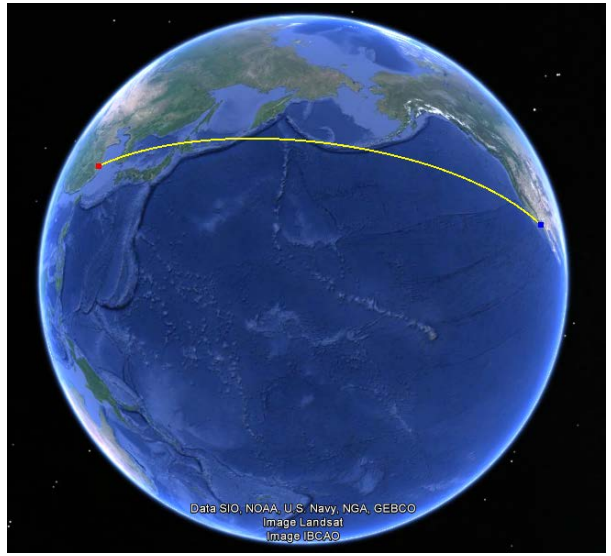
Deep sea is feasible, but not first mover ?

- 10 000 TEU container vessel
- Shanghai – Los Angles
  - Two states involved
  - 6000 nm, open sea
  - No channels
  - Short port approach
  - Remote control to port
- Dual propulsion systems
- Two stroke diesels
- Biofuel, methanol …



… but, autonomous ships are <u>not</u> conventional ships without crew.

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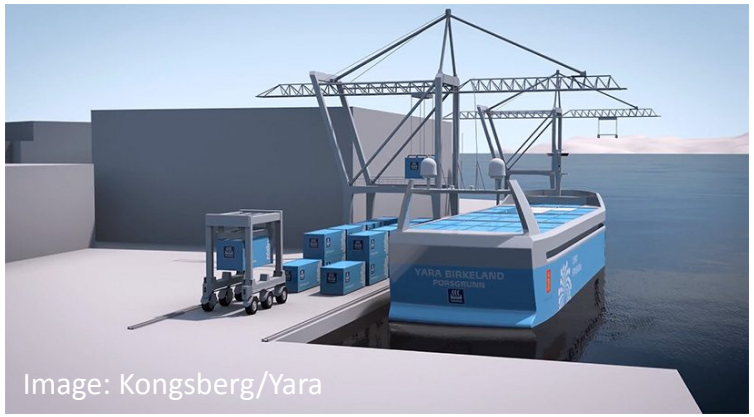
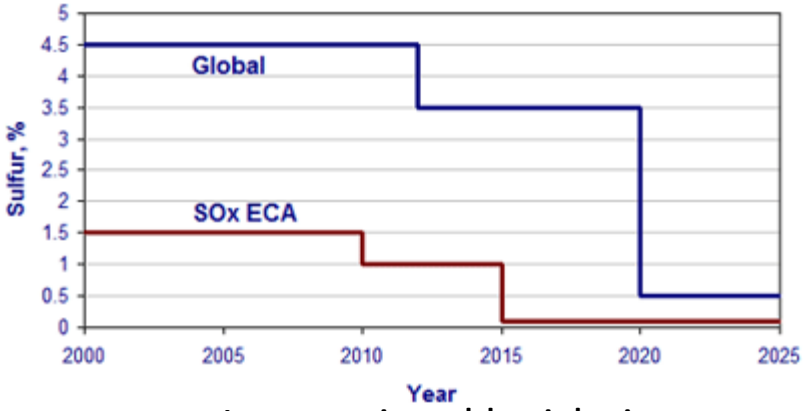
External factors may help !

Subsidies: NOx-fund



Public infrastructure investments



International legislation

Regional restrictions: HFO in Arctic

Member
Green Business Certified

Green businesses

Black swans: Cost of new energy carriers

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Autonomous ships are changing the game!

Focus on transport chain:
The ship is only a part

Cost of ship becomes less important
than total cost of operation

Roles become merged: Cargo owner,
logistics provider, ship owner

Less need for conventional
ship operation expertise

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Stor nasjonal interesse og støtte

Norwegian authorities are very supportive

Autonomous Vessels

Feb 2016: Technology towards 2030 – autonomous Vessels ?

KYSTVERKET
NORWEGIAN COASTAL ADMINISTRATION

Sjøfartsdirektoratet
Norwegian Maritime Authority

Sjøfartsdirektoratet ønsker å vær verdensledende innenfor ny teknologi





NIS NOR 16.05.2017 Seminar autonome skip Grimstad 2017-05-15 *Den foretrukne maritime administrasjonen*

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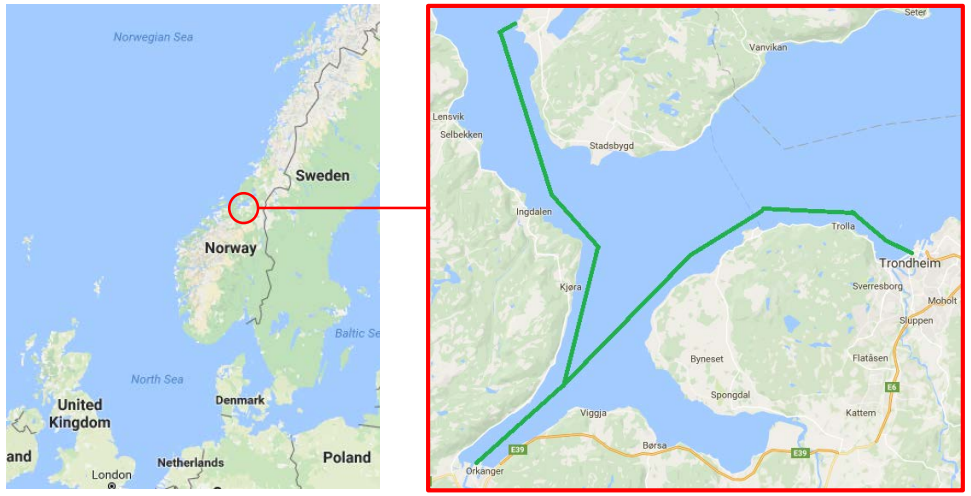
Test area Trondheimsfjorden



- Established September 30th 2016
  - Industry, university, research
  - Port of Trondheim
  - Norwegian Maritime Administration
  - Norwegian Coastal Administration
- Area covers Trondheimsfjorden
  - Permits
  - Instrumentation and communication
  - Exchange of experience

http://navtar.no/

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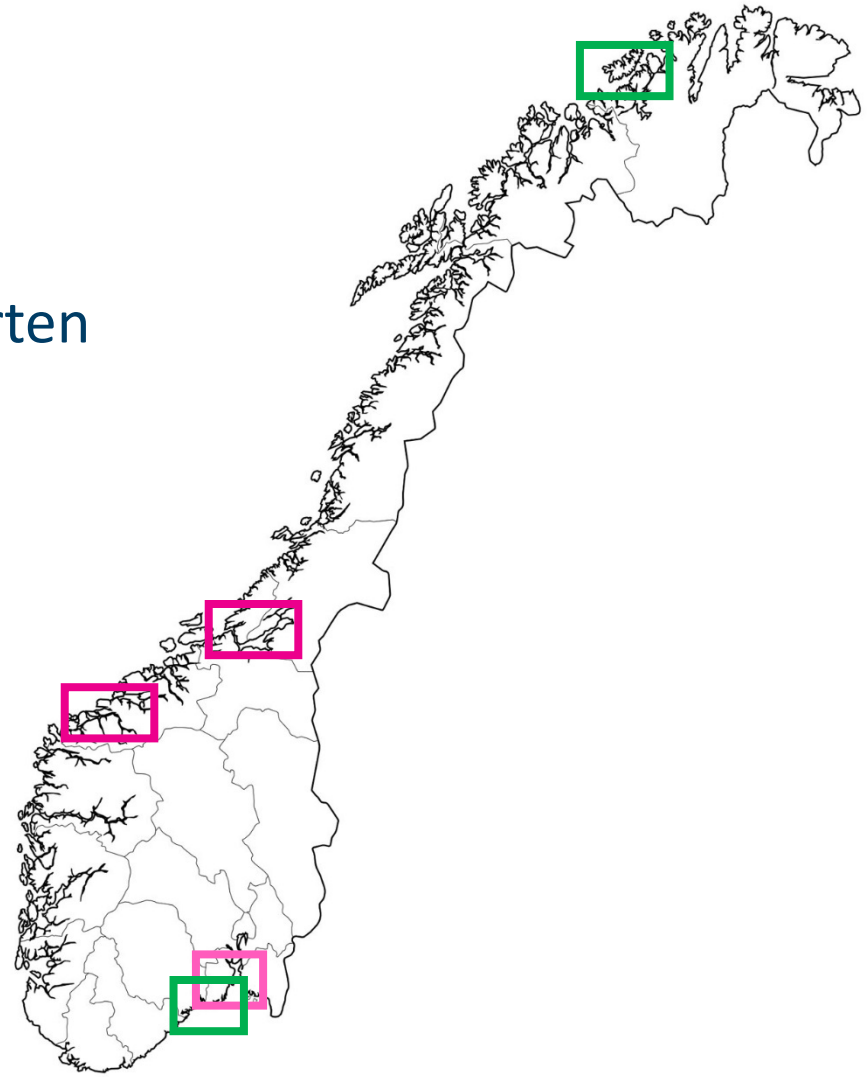
Test areas - status

- Trondheimfjorden, Storfjorden and Horten are established
- Grenland to be announced 2018
- Tromsø possible next



Supported by research council

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Norwegian Forum for Autonomous Ships

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- 45 Institutional Members
  - Including Industry, authorities, class, insurance research, universities, ports …
  - 2 other institutions as personal members

NFAS Norsk Forum for Autonome Skip

http://nfas.autonomous-ship.org

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Internasjonal posisjon

MUNIN: A concept study for a fully unmanned handymax dry bulk carrier on intercontinental voyage.

- Duration: 01.09-2012 – 31.08.2015
- Funding: 2.9 million EUR of budget 3.8 million EUR
- Activity code: SST.2012.5.2-5: E-guided vessels - the 'autonomous' ship

http://www.unmanned-ship.org/munin/

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NTNU AMOS

NTNU AMOS
Centre for Autonomous Marine Operations and Systems

- Supported by Norwegian Research Council
- Norwegian "Centre of Excellence"
- Established 2013
- Planned for 10 years
- Total budget approx. EUR 80 million

https://www.ntnu.edu/amos

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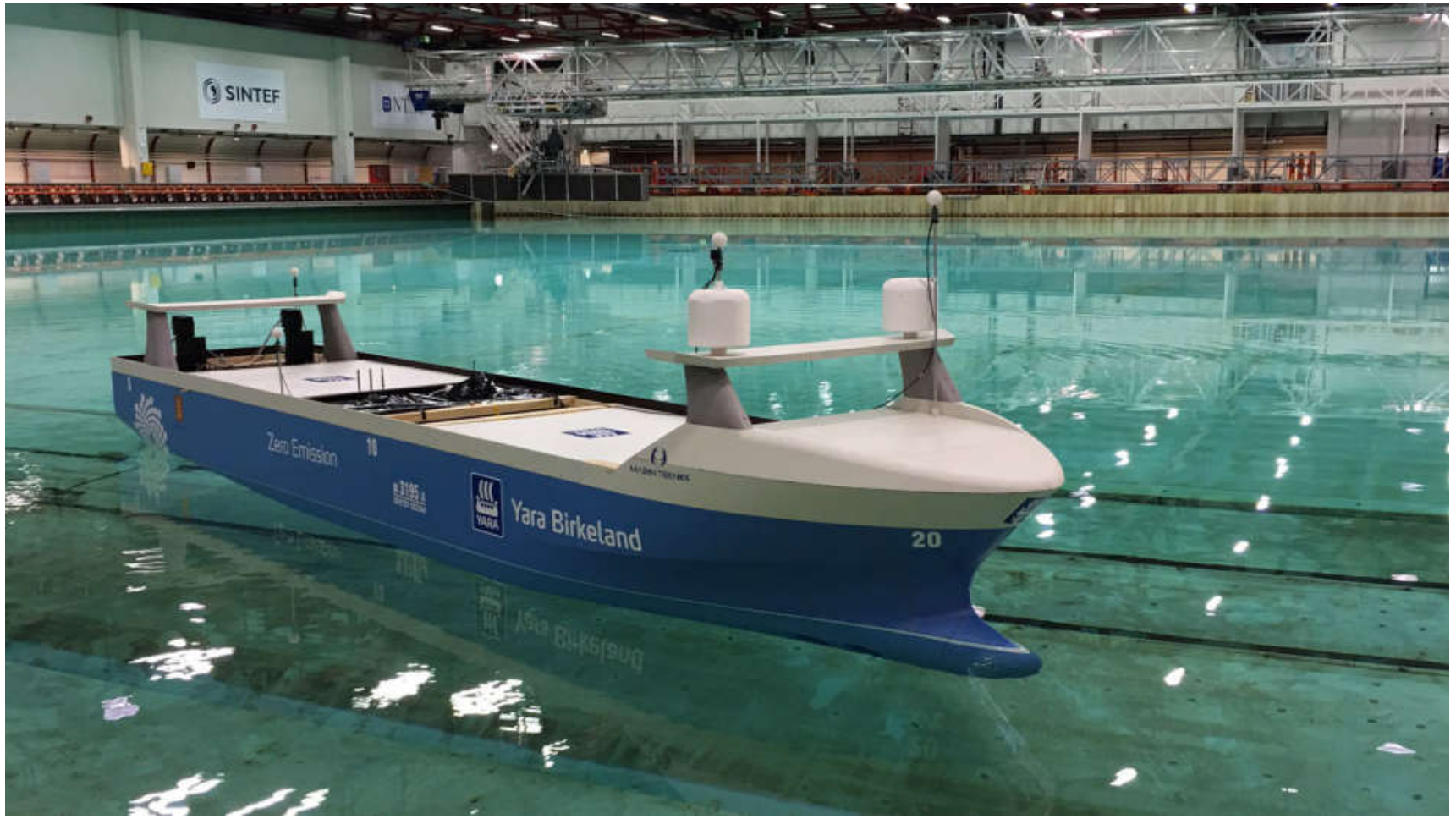
SINTEF

Yara Birkeland



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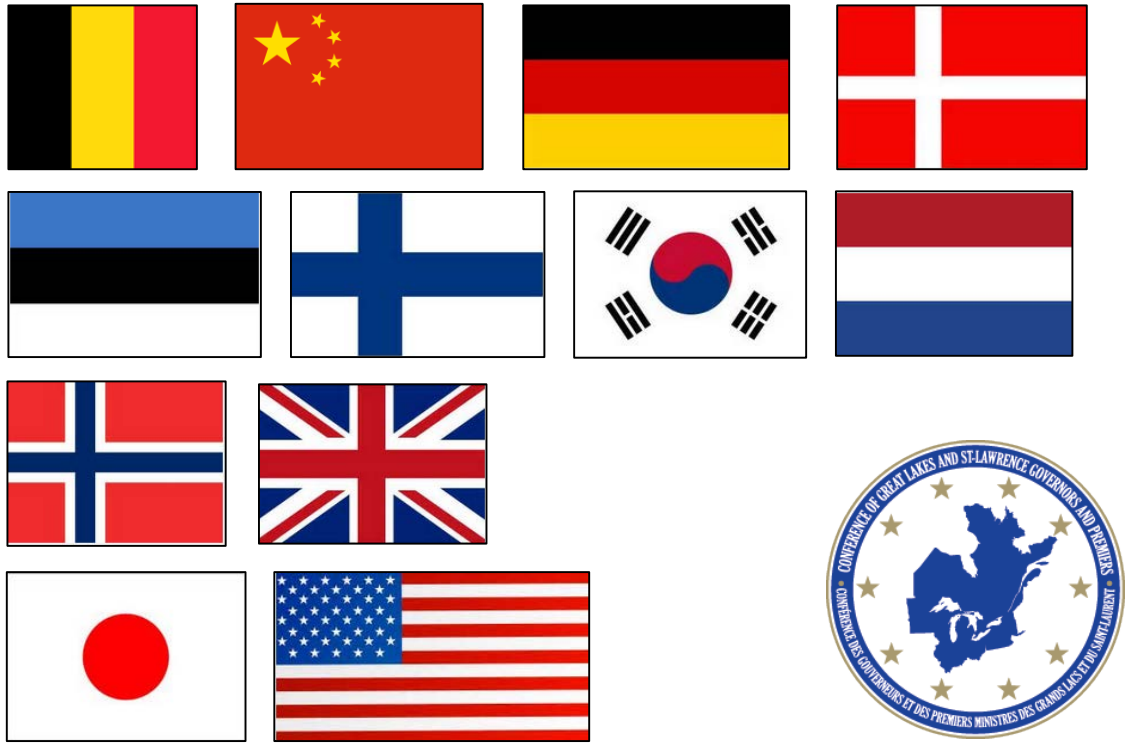
International Network for Autonomous Ships

- Agreed on at meeting in Oslo Oct. 30th 2017
- Hosted by NFAS and SINTEF Ocean
- 22 participants at meeting
- 2 correspondent countries
- First inland meeting in Trondheim November 6-7



International interest groups

UK Marine Industries Alliance

NFAS Norsk Forum for Autonome Skip

OZT Study Group Japan

IMO starts work at scoping exercise at MSC 99 in May 2018.

ONE SEA
AUTONOMOUS MARITIME ECOSYSTEM

KAUS

Systems and Components for Autonomous Ships - SCAS

Korea Autonomous and Unmanned Ship Forum

Unmanned Cargo Ship Development Alliance

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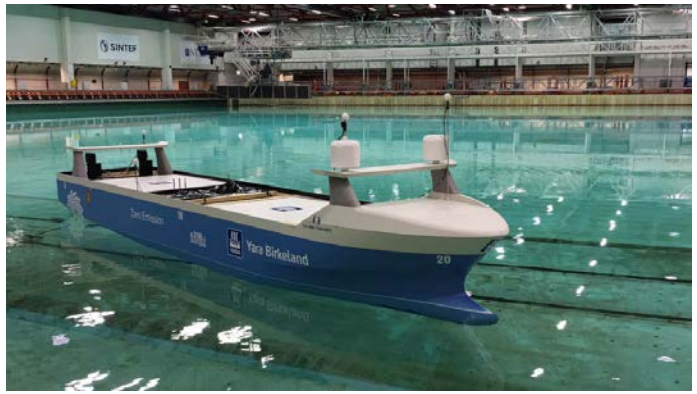
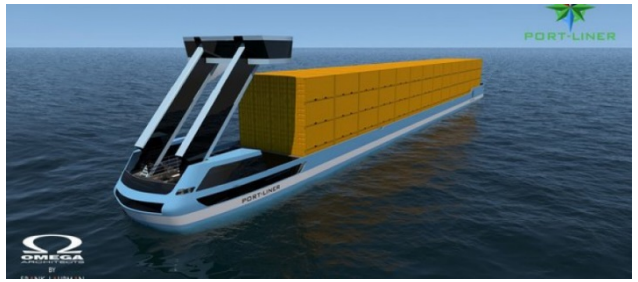
International activities



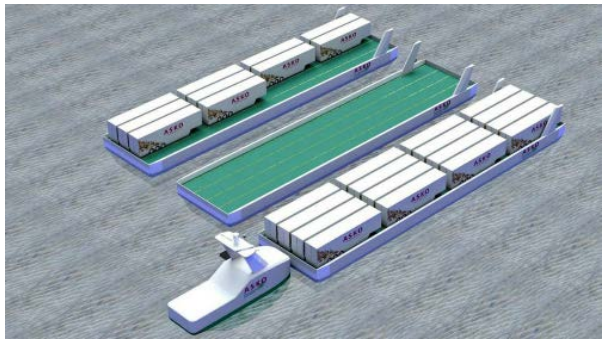
The only project: Yara Birkeland

Remote tug: Copenhagen

Remote OSV: From San Diego



R&D: Belgium, inland waterways



Concept: ASKO

Concept: Yunzhou Tech

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Konklusjoner

- Ubemannede skip er ikke "fullt autonome"!
- De er en del av et transportsystem!
- Ubemannede skip vil endre sjøtransporten!
- Dette er viktig for Norge og vi er fremdeles ledende – enn så lange?

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Technology for a better society