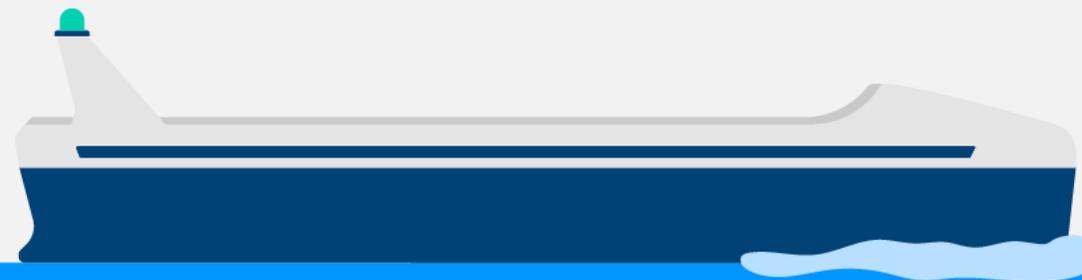


Ongoing MASS projects in Norway

Sailing together: Striving for a future-proof IMO MASS Code

Sifis Papageorgiou – Principal surveyor / Technical coordinator for international work

Department for vessels and seafarers



Autonomous ship projects in Norway today

- Flagship projects: Yara Birkeland and Asko seadrones
 - Commercially active, testing phase
- Smaller, automatic passenger transport
 - MilliAmpere
 - Several cities are showing interest (Torghatten and Zeabuz paradigm)
- Ongoing USV projects
 - Reach Subsea
 - Deepocean
- Extensive R&D activity in academia and industry clusters (AUTOSHIP, AEGIS, SEAMLESS, SFI Autoship, AUTOFLEX)

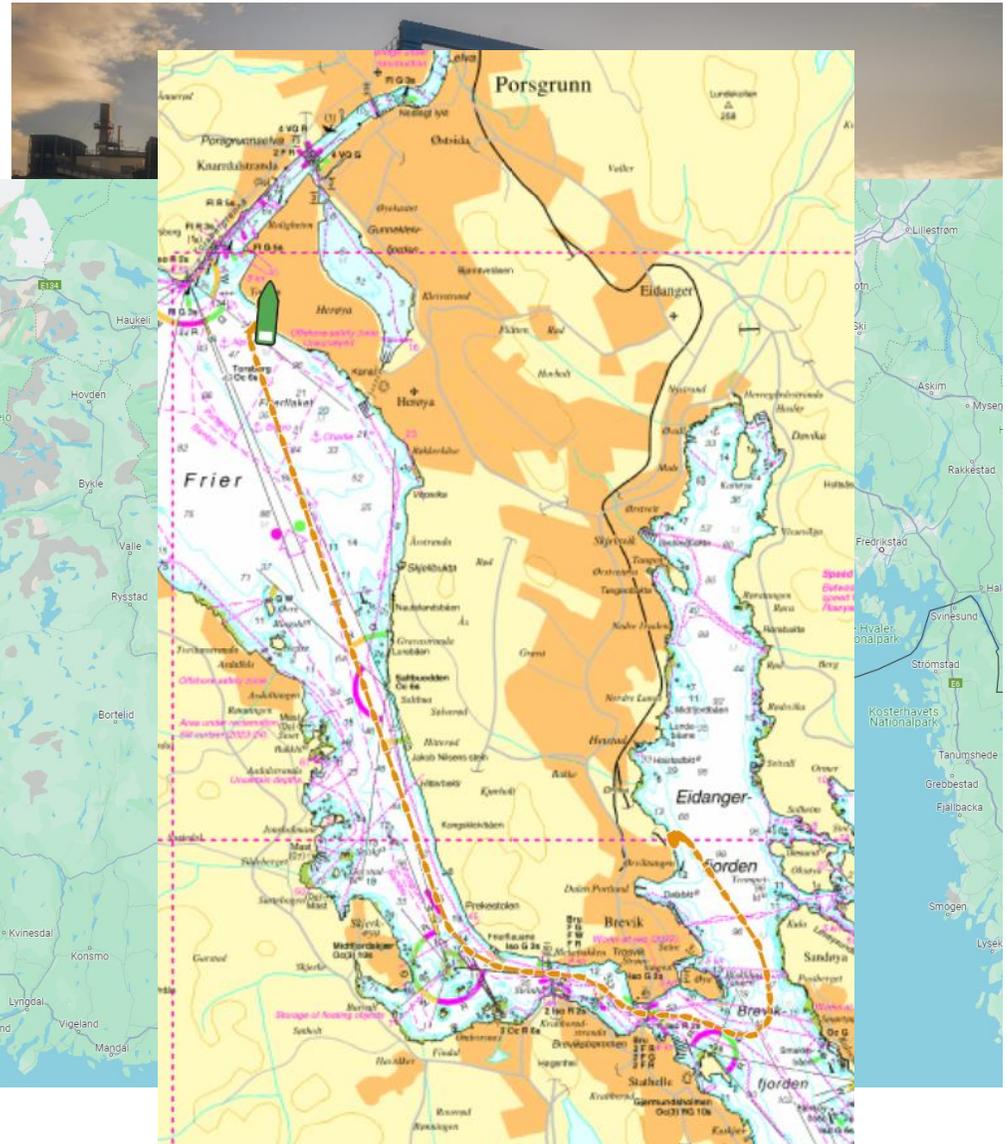


Ship characteristics

Name	Ship type	Length (m)	Beam (m)	Capacity	Status
Yara Birkeland	Container feeder	80	15	120 TEU	In operation/ testing
ASKO seadrones	Ro-ro cargo	67	15	16 trailers	In operation/ testing
Deeptunean – Ocean Challenger	ROV support vessel	24	7.5		Final design approval phase/ under construction
Reach Remote	ROV support vessel	23.9	8		Final design approval phase/ under construction

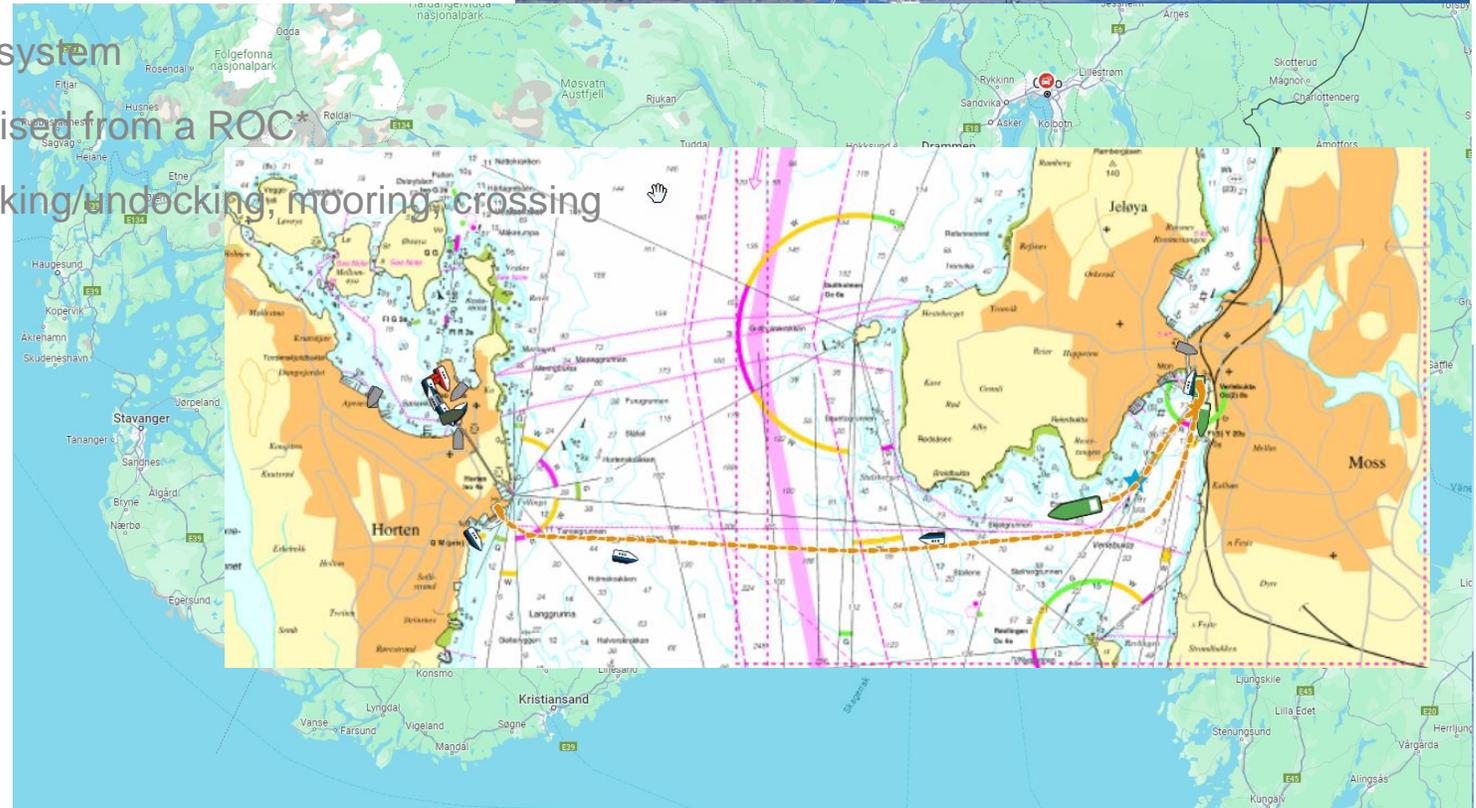
Yara Birkeland

- Fully electric
- Fallback states per mission phase and system
- After final approval: uncrewed – supervised from a ROC*
- Operational area



ASKO seadrones (x2)

- Fully electric
- Fallback states per mission phase and system
- After final approval: uncrewed – supervised from a ROC
- Currently automated: DC charging, docking/undocking, mooring, crossing
- Operational area



Reach Remote (x2)

- Hybrid diesel-electric propulsion system and battery package
- Fallback states
 1. Limp home with degraded system functionality
 2. Abort current operation and standby
 - a. When sailing: stop and standby
 - b. When in ROV operation: Recover ROV and standby
 3. Move to a set safe location [e.g. move out of safety zone]
 4. Controlled drifting
 5. Anchoring
- Uncrewed, with support vessel during testing, operated from ROC*
- Operational area: Haugesund area (testing mainly in Horten)



Ocean Challenger

- Hybrid diesel-electric propulsion system and battery package
- Fallback states
 1. Station keeping
 2. Towing
 3. Anchoring
- Possibility to be uncrewed, remotely monitored 1:1
- Operational area: not defined (Norwegian Continental Shelf)



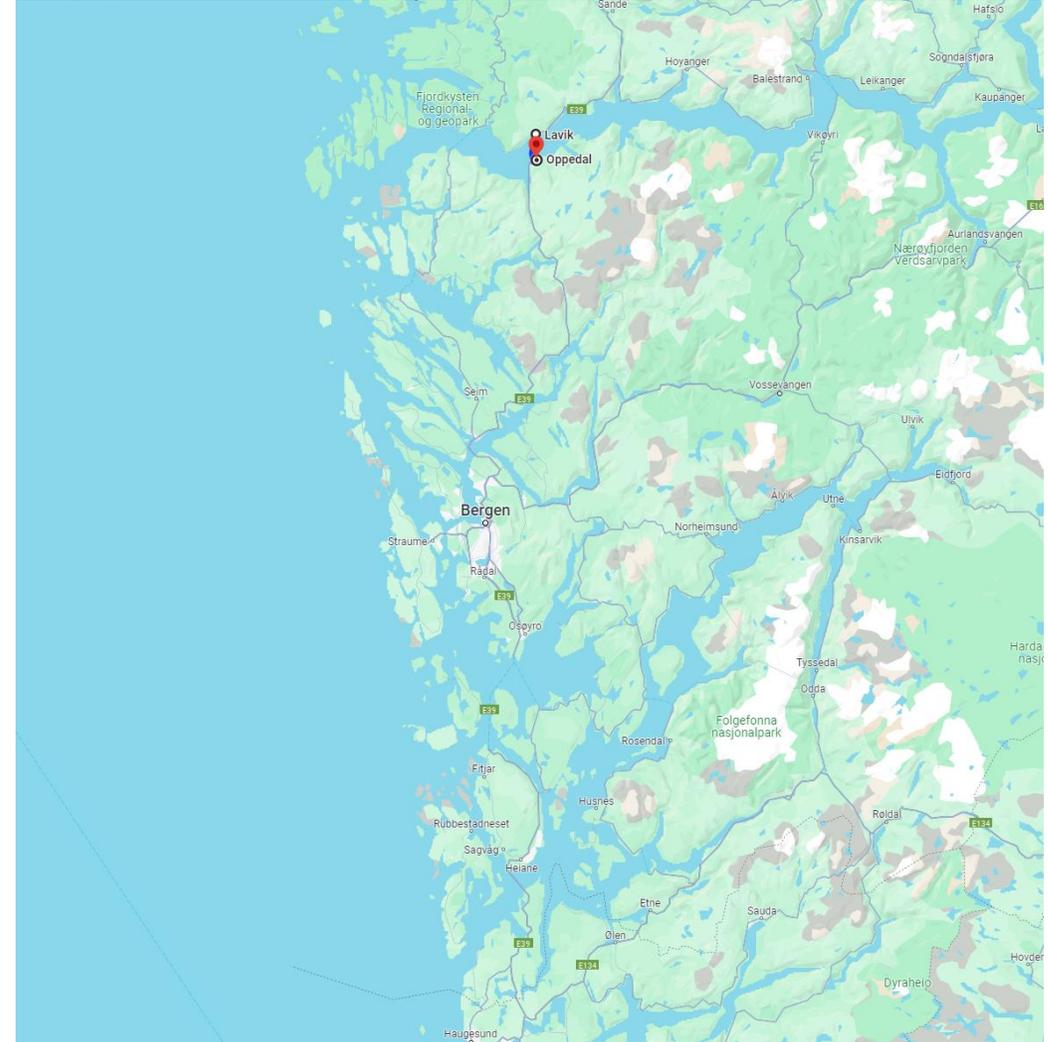
ROC*

- Masterly concept
- Several working stations while enabling to monitor and control several vessels for several owners at the same time



Fjord1 (Lavik – Oppedal ropax ferry)

- No uncrewed operation – reduced crewing
- Preliminary approval
- Four vessels to be operated



Current regulatory approach for autonomous ships

National (Norwegian territorial waters and economic zone)	National rules. All current projects will be handled by exemptions where necessary. RSV 12-2020: Guidelines related to the construction or installation of automated functionality, with the intention of performing unmanned or partially unmanned operations. (based on IMO's Circ.1455)
Between countries with bilateral agreements	No agreement up to date. Will be assessed on a case-by-case basis. (Norway just co-signed North Sea MoU)
International voyages	As per SOLAS exemptions and equivalences if possible, eventually MASS Code

Main challenges



Technology/system qualification - standards in development phase



Safety level – how to demonstrate equivalence



Testing/validation methodologies



ROC standards

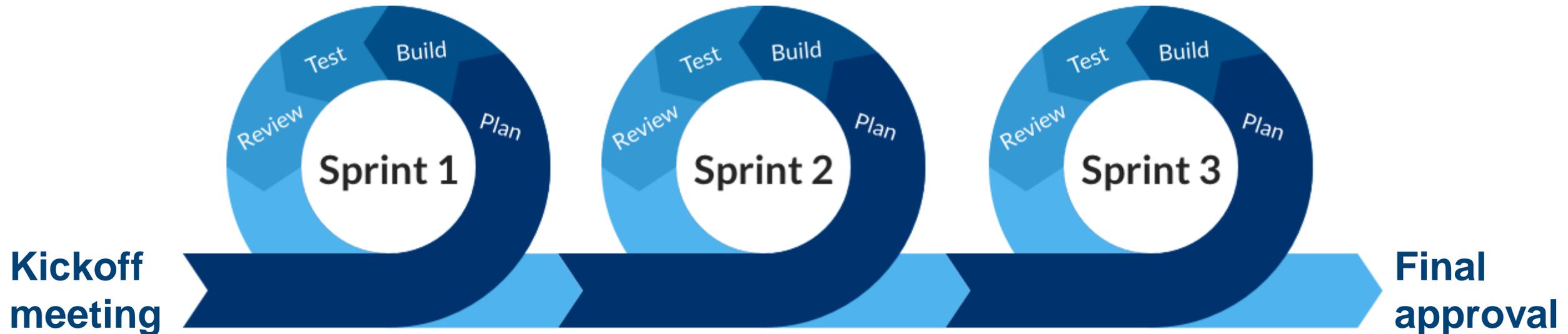


Remote operator competence standards



Wide range of concepts and systems

Iterative design and approval process



Next steps

- Non-mandatory MASS Code implementation
- RSV 12-2020 revision
- Collaboration within North Sea MoU

