NTNU

Norwegian University of Science and Technology

R&D Projects in Korea and Norway



01.06.2024

Associate Professor Hyungju Kim (NTNU)

NTNU

NTNU operates in three cities. Today, the campuses in Trondheim have about 33 000 students and 7 200 employees. Gjøvik has almost 3 500 students and 390 employees, while Ålesund has over 2 300 students and 275 employees.



NTNU



TRONDHEIM



GJØVIK



ÅLESUND







43 422	8051	398	NOK 10,5 bill
Students	Employees	Study programmes	Annual budget

Studies

- Norway's biggest university with headquarters in Trondheim
- 398 study programmes and with 43 422 students, of which 4062 are international students
- Three cities – Trondheim, Gjøvik and Ålesund

Research

- Host or parter in 46 national research centres
- Participates i 263 Horizon 2020 projects and awarded 28 ERC grants
- More than 100 laboratories / research infrastructure, of which several are national resources

Innovation

- Host or partner in 26 centres for research-based innovation
- Host or partner i 10 research centres for environment-friendly energy research
- 15 innovation managers and innovation scholarship scheme for PhD candidates

Photo: Carl-Erik Eriksson

Photo: Fotostilo/Gjøvik Region Tourist Office

Photo: Destinasjon Ålesund og Sunnmøre

NTNU - Department of Mechanical and Industrial Engineering (MTP)

Seven Research Groups at MTP

Manufacturing



Design, analysis and manufacturing of technical products and product systems.

Reliability, availability, maintenance and safety



Risk analyses, maintenance analyses, technical management and target-oriented management.

Robotics and automation



Automatic manufacturing systems, CNC, additive manufacturing, robotics, offshore automation, mechatronics and measuring technology.

Materials



Composites, polymers, corrosion characteristics, fracture mechanics and fatigue, nanomechanical modelling and testing, tribology and surface technology.

Project and quality management



Initiation, planning, implementation, project management.

Production management



Management, planning and management of manufacturing and logistics processes.

Design and engineering



Designing analyzing and production of technical products and systems.

https://www.ntnu.edu/mtp

https://www.ntnu.edu/mtp/research

https://www.ntnu.edu/mtp/laboratories

NTNU RAMS



Offshore



Wind



Hydrogen



Transportation



Healthcare



Production

- Reliability engineering
- Maintenance
- Risk assessment
- Social security & sustainability

Lectures

- Reliability and Maintenance Engineering
- Risk Management in Project
- Major Accident Analysis and Prevention
- Risk Analysis and Safety Management in Marine Systems (Marine Technology)
- Advanced Methods in Risk Analysis (Marine Technology)

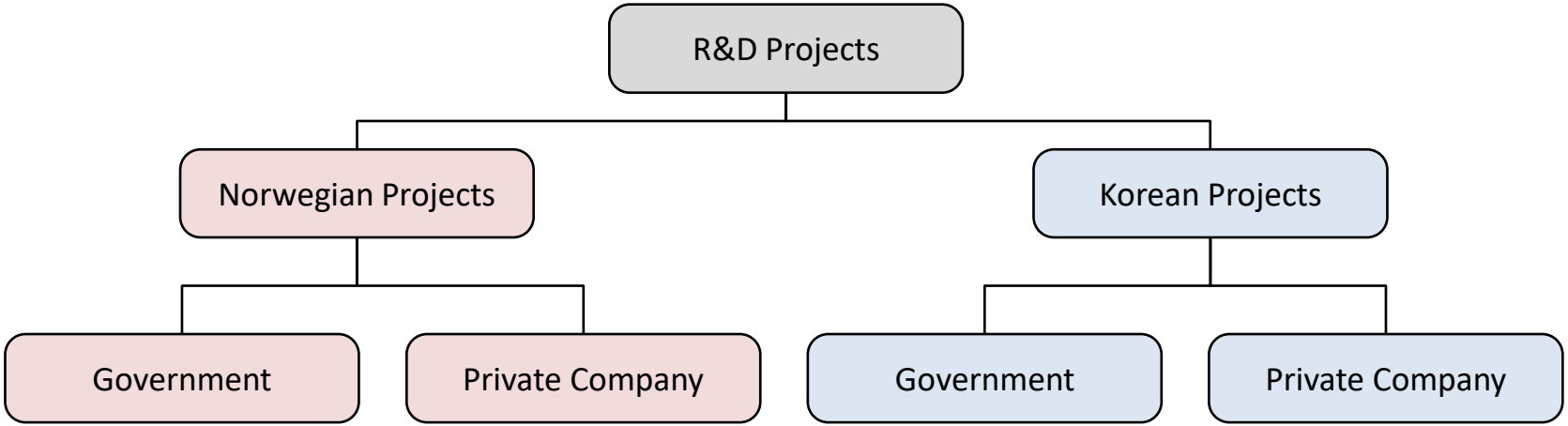
Contents

1. Hyungju's R&D Projects from both Korea and Norway
2. Characteristics of Norwegian Projects
3. Two New R&D Projects with Norwegian Funding
4. Q&A

Hyungju’s R&D Projects

from Korea and Norway

Research Project Overview



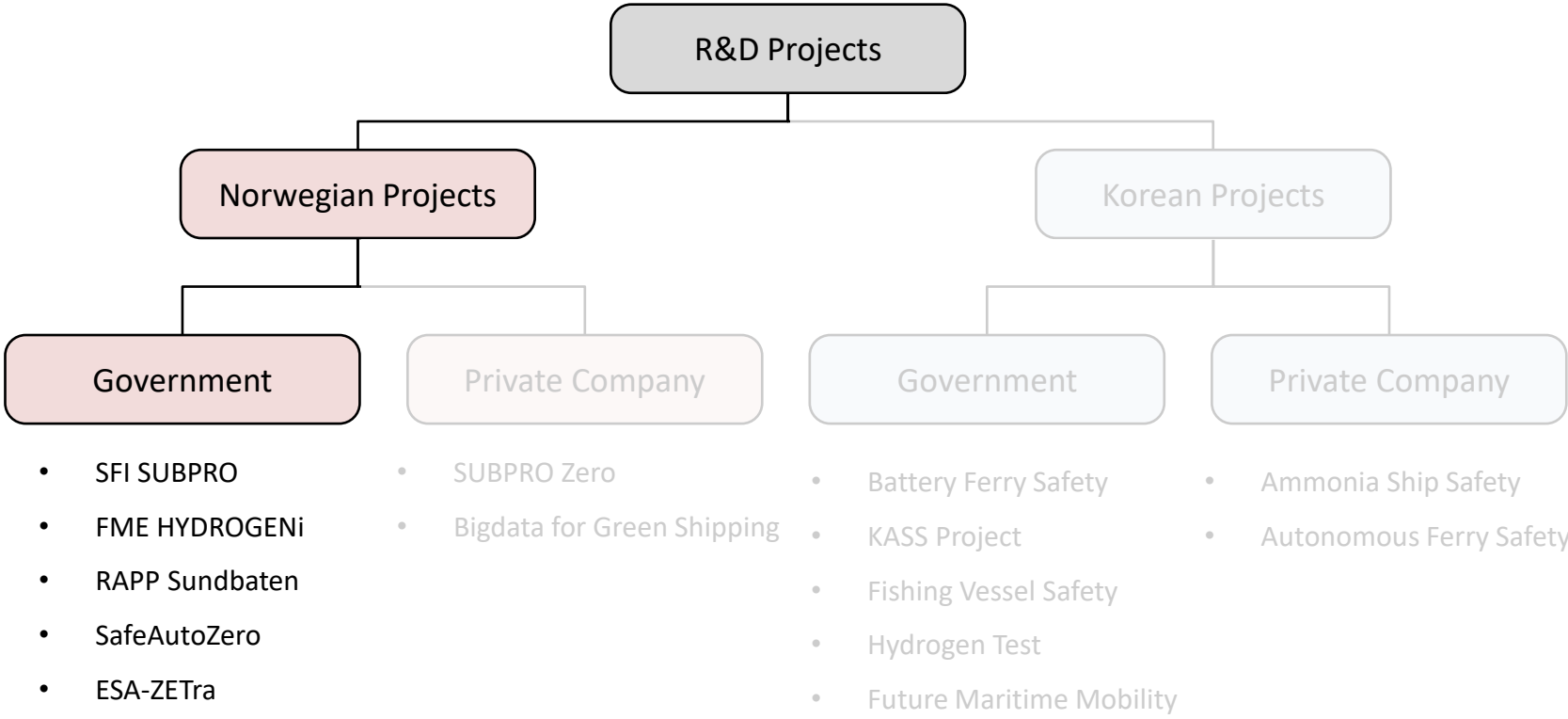
- SFI SUBPRO
- FME HYDROGENi
- RAPP Sundbaten
- SafeAutoZero
- ESA-ZETra

- SUBPRO Zero
- Bigdata for Green Shipping

- Battery Ferry Safety
- KASS Project
- Fishing Vessel Safety
- Hydrogen Test
- Future Maritime Mobility

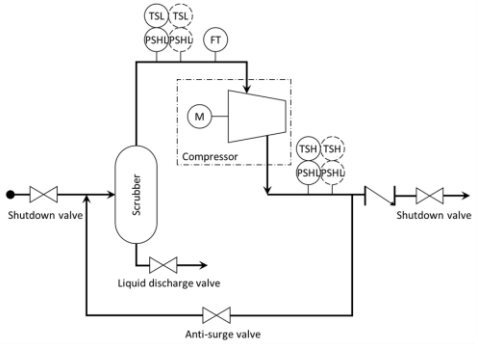
- Ammonia Ship Safety
- Autonomous Ferry Safety

Research Project Overview



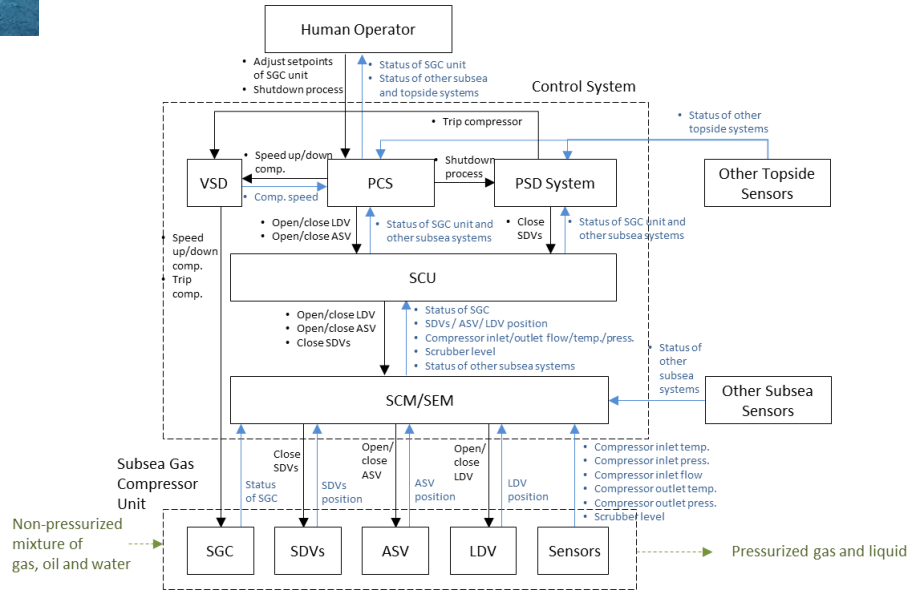
SFI SUBPRO (2015 – 2023)



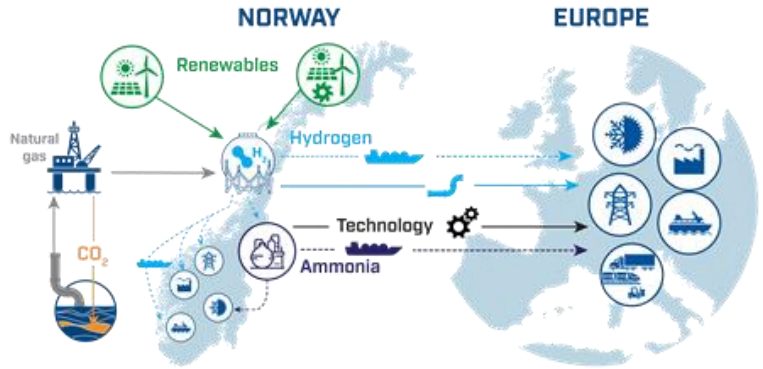


Partners and Collaborations at SUBPRO





FME HYDROGENi (2022 – 2030)



R&D PARTNERS

Centre host

SINTEF | IFE | NTNU | UNIVERSITY OF OSLO | ISN University of Southeastern Norway | UiT The Arctic University of Norway

ENERGY COMPANIES

equinor | GASSCO | vår energi

POWER COMPANIES

ANEO | NORDKRAFT | Statkraft | Troms Kraft

PROCESS INDUSTRIES

Air Liquide | CASALE | eramet | Hydro | YARA

MARITIME VENDORS/OPERATORS

ABB | Bergen Tankers as | Corvus Energy | HAVhydrogen | HYON | KONGSBERG | TECO 2030 | Wilhelmsen

CLUSTERS

ENERGI I NORD | HERRYA INDUSTRIPARK | maritime cleantech | Mo Industripark as | RENERGY

INTEREST GROUPS

Energi Norge | Norwegian Fertiliser Producers Research Association

SAFETY SPECIALISTS

HYEX SAFETY | PETROLEUMSTILSYNET | KYSTVERKET | safetec

VENDORS

AKER CARBON CAPTURE | AKER HORIZONS | AkerSolutions | altera | CoorsTek | GASNOR | HYDROGEN MEM-TECH | hystar | JOTUN | nel | Norwegian Hydrogen | Panametrics | PERMASCAND | RENERTEN | SICK | TechnipFMC | vallourec | Z·E·G

Sundbåten (2019 – 2022)



MARITIME ROBOTICS

ULSTEIN

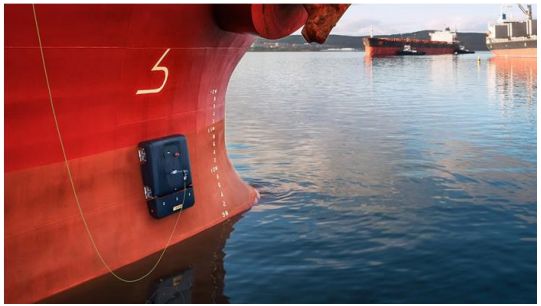
NTNU

USN

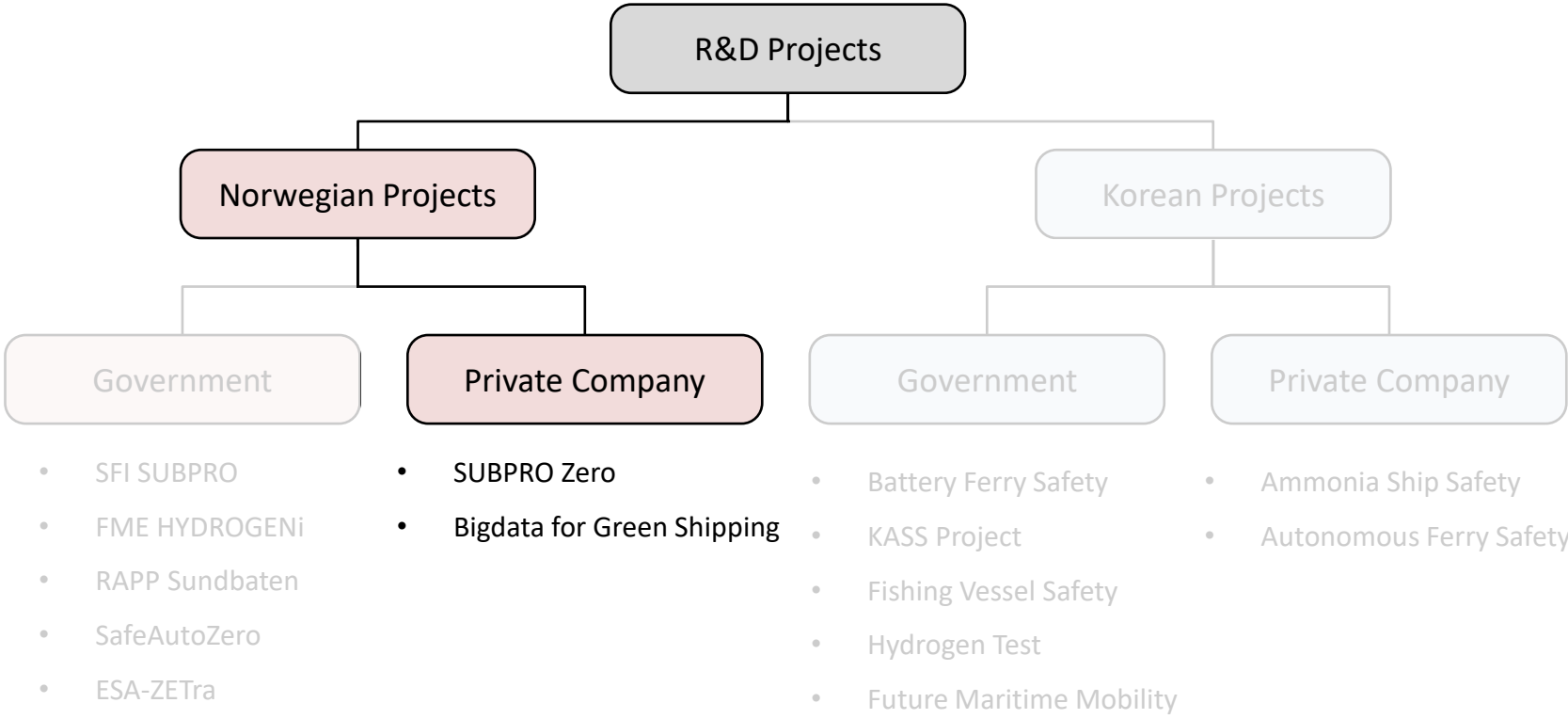
Hullskater (2019 – 2021)





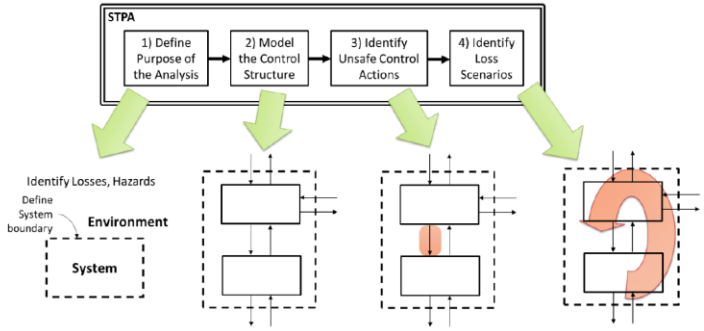


Research Project Overview



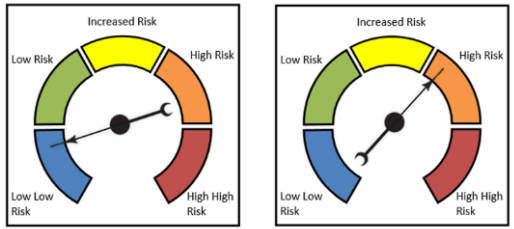
SUBPRO Zero





+

AkerBP
NTNU
Norwegian University of Science and Technology
equinor
vår energi
SIEMENS energy
AkerSolutions
KONGSBERG
TotalEnergies
PETROBRAS

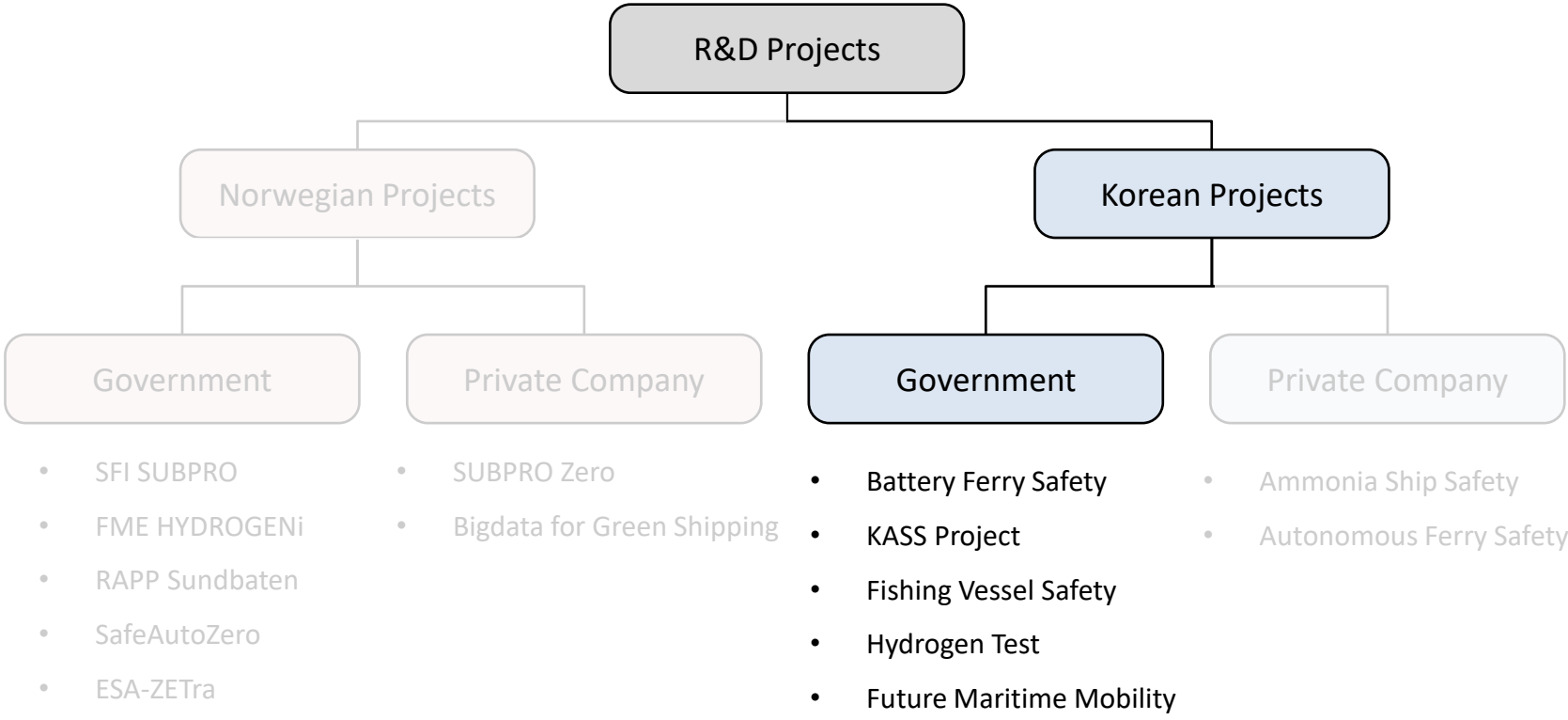


Bigdata for Green Shipping



A.WILHELMSEN FOUNDATION

Research Project Overview

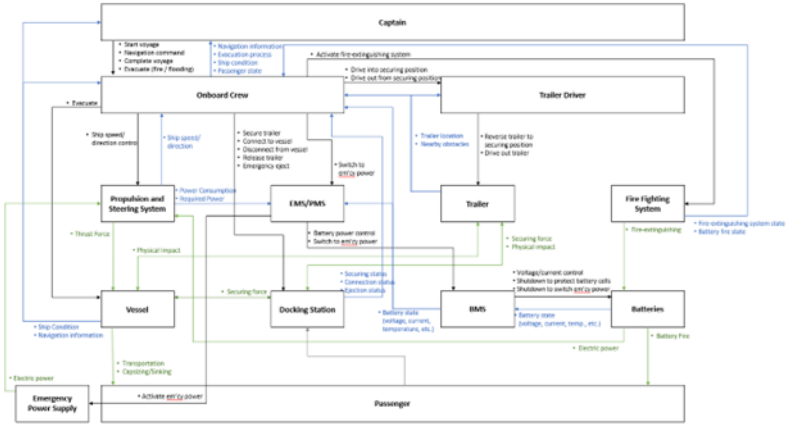


Battery Ferry Safety (2020 – 2022)









Controller: Onboard crew

ID	Control Action	Condition		Unsafe Control Actions?					
		Battery trailer is properly secured	Vessel is ready to be connected	Not provided	Provided	Too early	Too late	Too short	Too long
CA.OC.003	Connect battery trailer to vessel	Yes	Yes	Unsafe [H3.2]	Safe	Unsafe [H3.1]	Unsafe [H3.2]	N/A	N/A
		Yes	No	Safe	Unsafe [H3.1]	N/A	N/A	N/A	N/A
		No	Yes	Safe	Unsafe [H3.1]	N/A	N/A	N/A	N/A
		No	No	Safe	Unsafe [H3.1]	N/A	N/A	N/A	N/A

Controller	No.	UCA	SV	ATR	SKU	RPN
Onboard Crew	UCA.OC.001	Onboard Crew does not provide Guide Battery Trailer to Securing Position command when the securing position is clear [H3.2]	1	2	3	6
	UCA.OC.002	Onboard Crew provides Guide Battery Trailer to Securing Position command too early before the securing position is clear [H3.1]	4	4	3	11
	UCA.OC.003	Onboard Crew provides Guide Battery Trailer to Securing Position command too late after the securing position is clear [H3.2]	1	2	3	6
	UCA.OC.004	Onboard Crew provides Guide Battery Trailer to Securing Position command when the securing position is not clear [H3.1]	4	4	3	11
	UCA.OC.005	Onboard Crew does not provide Secure Battery Trailer command when the battery trailer is parked on correct securing position [H3.2]	1	1	4	7
	UCA.OC.006	Onboard Crew provides Secure Battery Trailer command too early before the battery trailer is parked on correct securing position [H3.1]	2	4	4	10
	UCA.OC.007	Onboard Crew provide Secure Battery Trailer command too late after the battery trailer is parked on correct securing position [H3.2]	1	2	4	7
	UCA.OC.008	Onboard Crew provide Secure Battery Trailer command when the battery trailer is not parked on correct securing position [H3.1]	2	4	4	10
	UCA.OC.009	Onboard Crew does not provide Connect Battery Trailer to Vessel command when the battery trailer is properly secured and the vessel is ready to be connected [H3.1]	1	1	4	7
	UCA.OC.010	Onboard Crew provides Connect Battery Trailer to Vessel command too early when the battery trailer is properly secured but the vessel is not ready to be connected [H3.1]	3	4	4	11

KASS Project (2020 – 2025)



Shipping sector

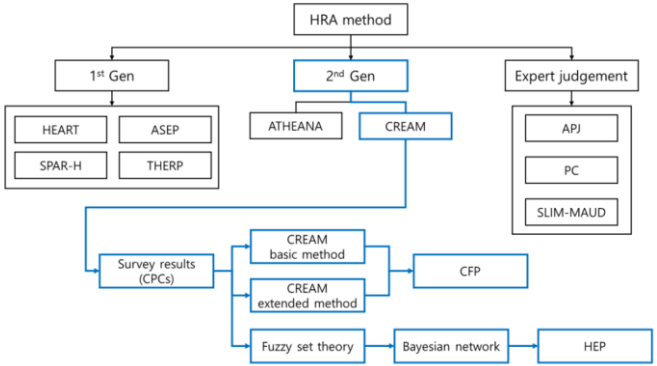
Shipbuilding sector

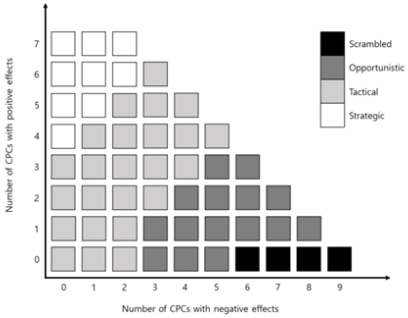




Fishing Vessel Safety (2022 – 2026)







$$\beta = X - Y = \sum_{reduced} CPC - \sum_{improved} CPC \quad (1)$$

$$\log(CFP/CFP_0) = k\beta \quad (2)$$

$$\log(CFP_{max}/CFP_0) = k\beta_{max} \quad (3)$$

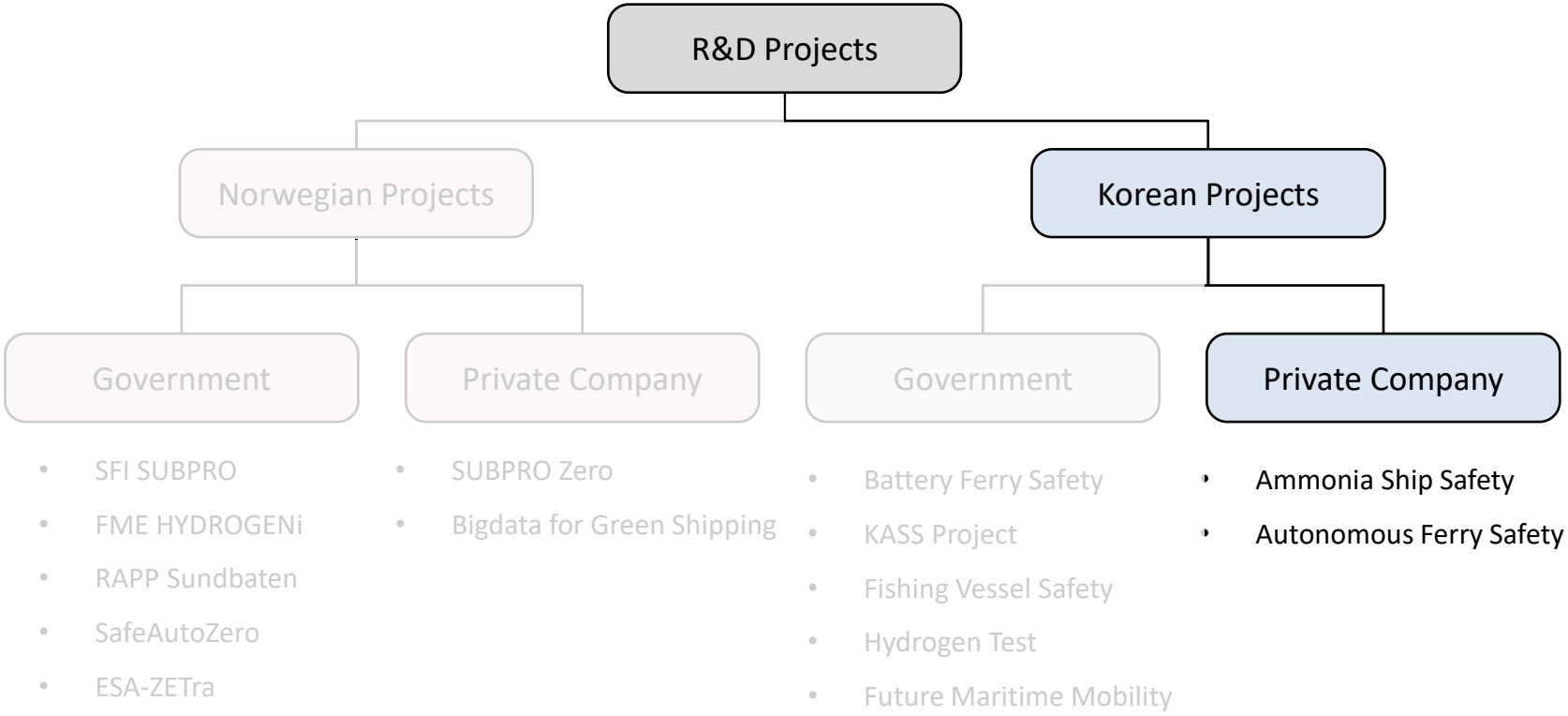
$$\log(CFP_{min}/CFP_0) = k\beta_{min} \quad (4)$$

$$k = \log(CFP_{max}/CFP_{min})/(\beta_{max} - \beta_{min}) \quad (5)$$

$$CFP_0 = CFP_{max}/10^{k\beta_{max}} \quad (6)$$

$$CFP = CFP_0 \times 10^{k\beta} = 0.00562 \times 10^{0.25\beta} \quad (7)$$

Research Project Overview



Ammonia Ship Safety (2024)





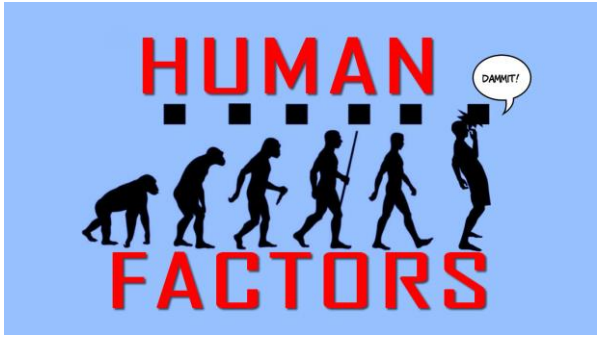


HD YARA

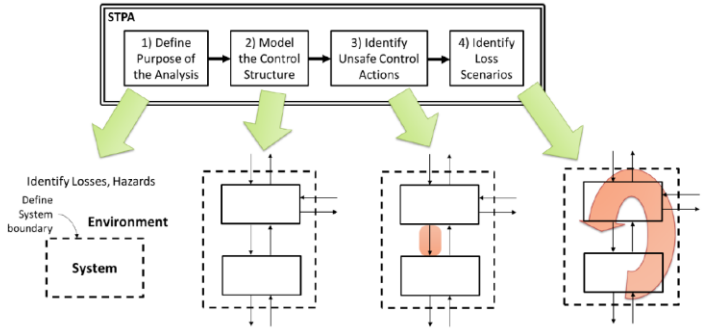
USN NTNU

Autonomous Ferry Safety (2024 – 2025)





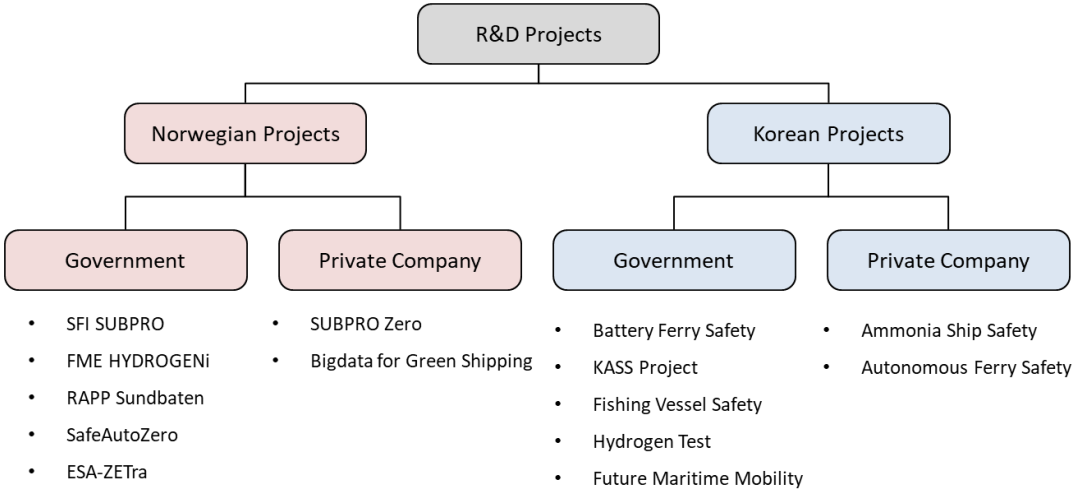
SAMSUNG

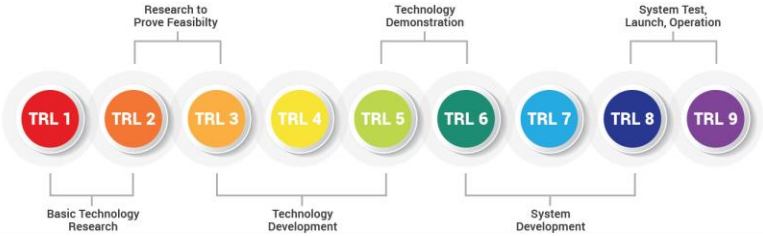


Characteristics of Norwegian Projects

High Degree of Freedom









Easy to Apply



- Project Period: 4 years
- Budget: 3.7M NOK (approx. 450M KRW)

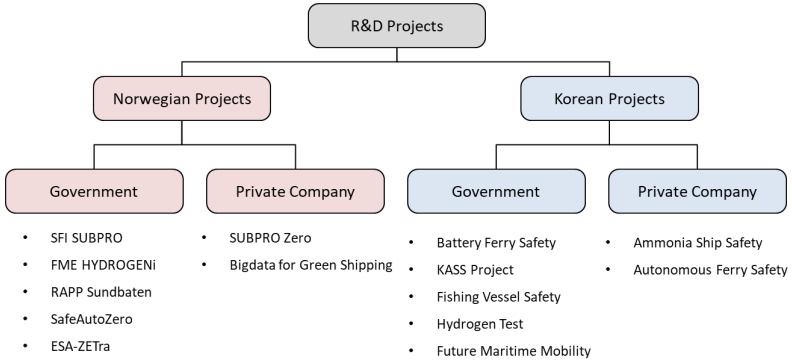
Norwegian Directorate for Higher Education and Skills

- Web application (no figure, limited attachment)
- Application Document: 19 pages in total
- Project Description: 6 pages
- Others: participant list, budget table, etc.

Pioneering Research



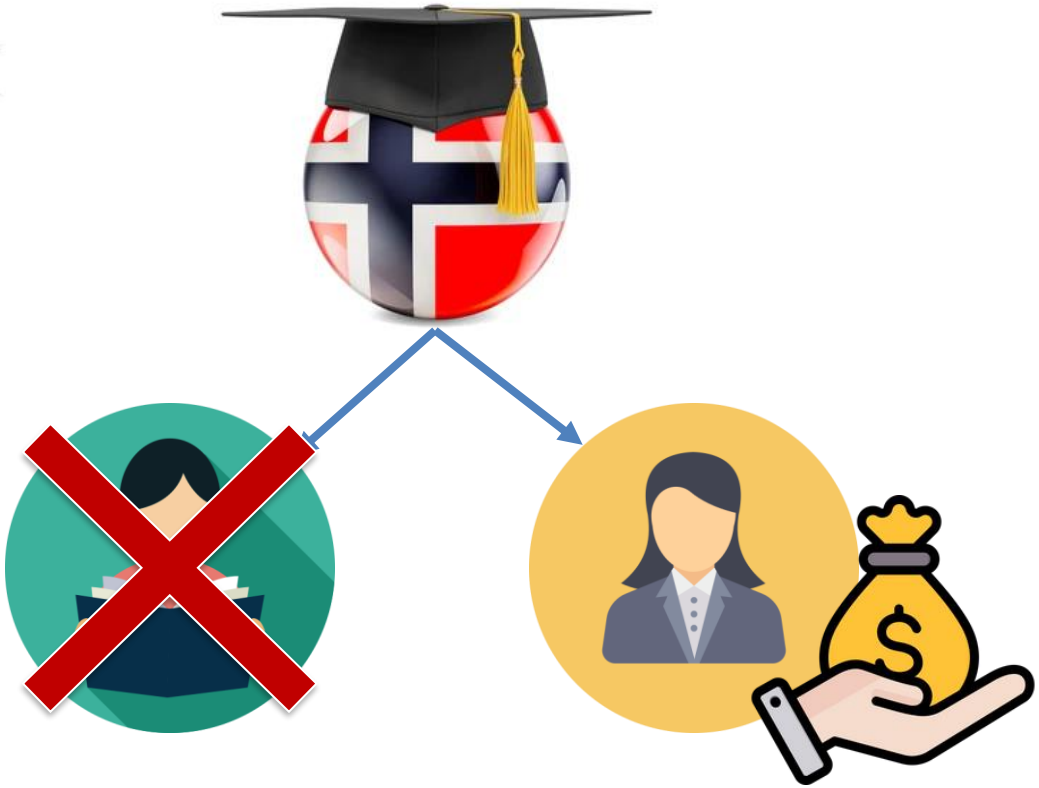






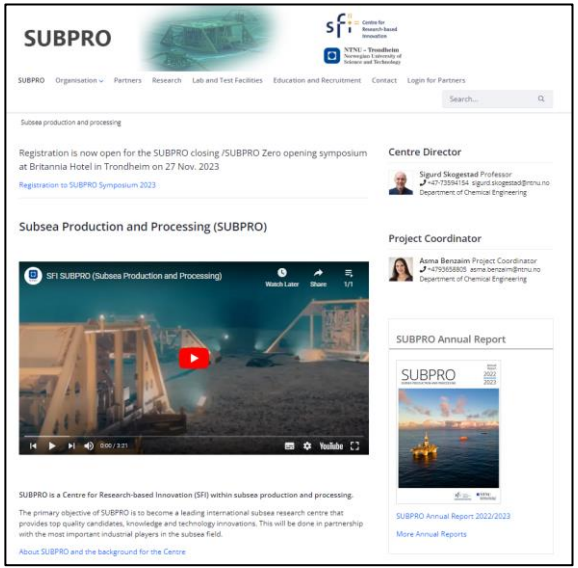
Long-term Project Period (minimum 3 years)

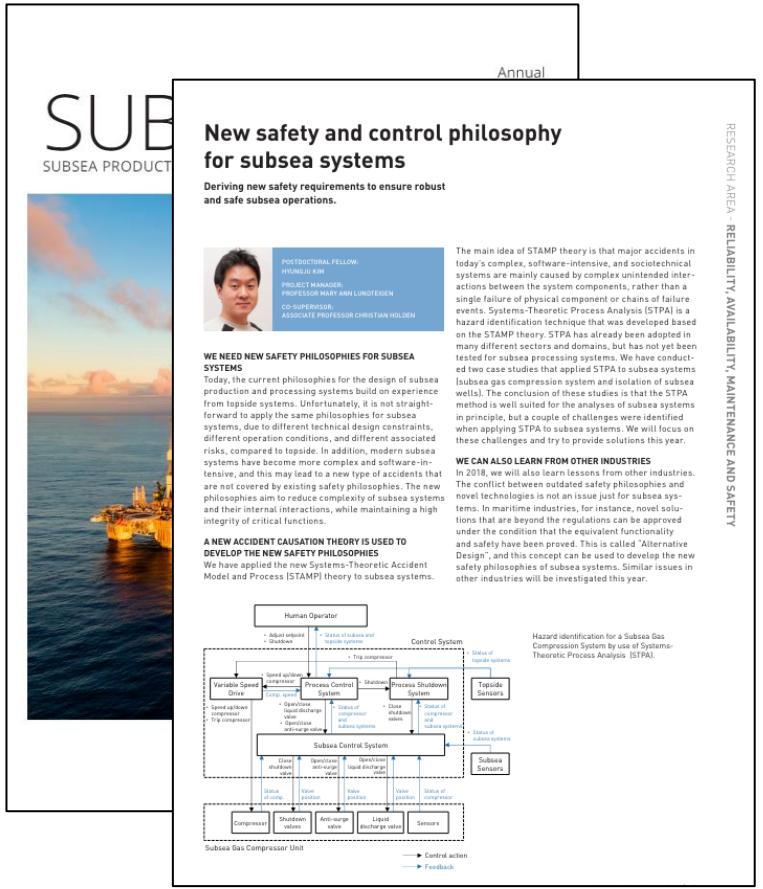




Make Research Results Public

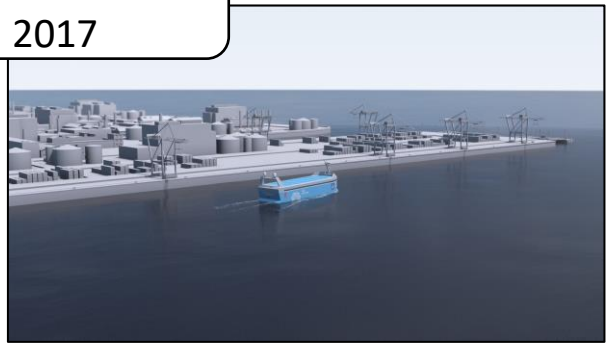






Overhype

Advertisement: 2017



Autonomous Operation (Demo): 2023 – 2026



Advertisement: 2022

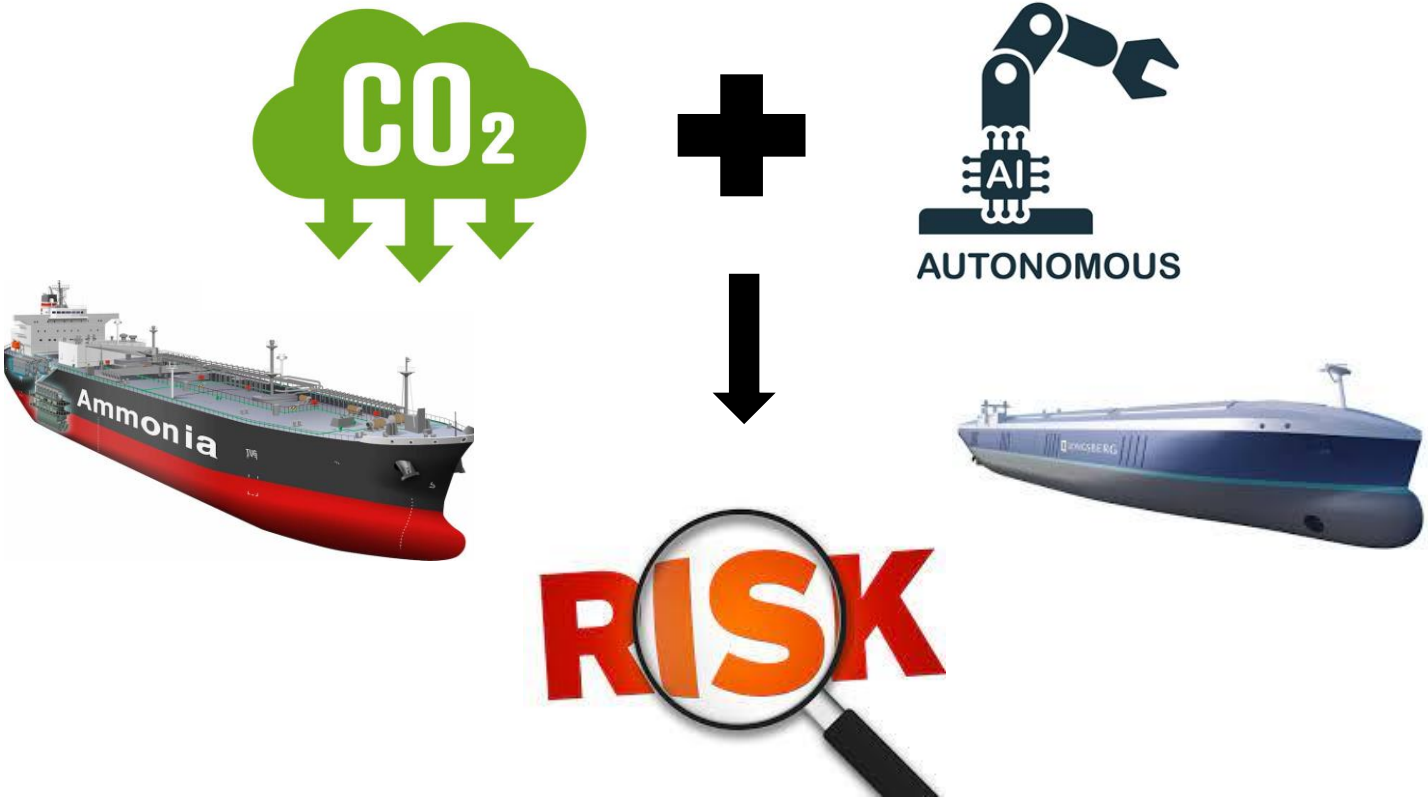


Hydrogen Fuel Cell: 2023



Two New R&D Projects with Norwegian Funding

Safety of Autonomously Operated Green Ship



Critical Interaction Among Diverse Green Solutions

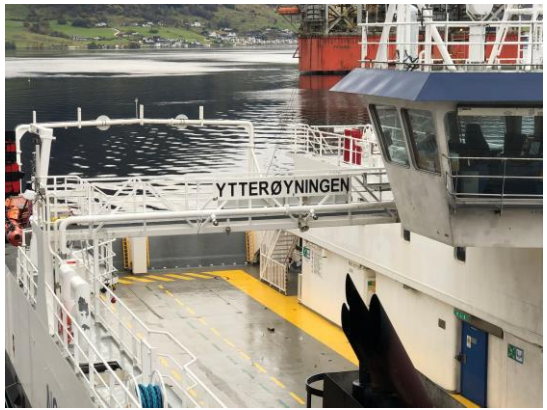






Photo 2 - Time 0 min, 3 seconds - Ignition of both fuels occur. Hydrogen flow rate 2100 SCFM. Gasoline flow rate 680 cc/min.





R&D Project in Norway










thank you
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