Inspection and maintenance robotics: Status and trends

Aksel A. Transeth, SINTEF
Mariann Merz, Richard Moore, Ahmed K. Mohammed,
Magnus Bjerkeng, Martin A. Brandt, Esten I. Grøtli, SINTEF

2 April 2025, Maintech-konferansen

RINVE

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RIMA
ROBOTICS FOR INSPECTION AND MAINTENANCE

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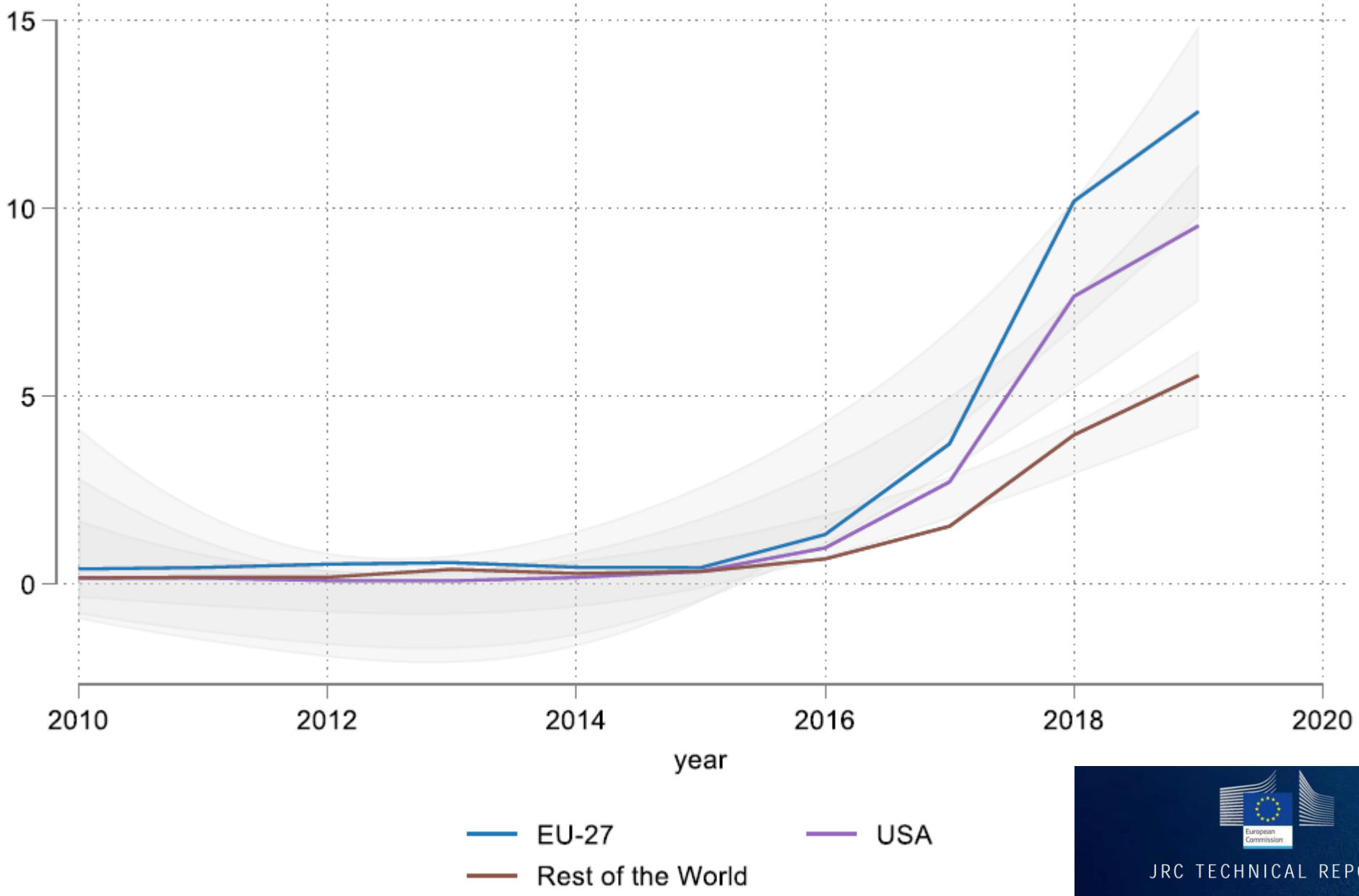
The AI Data Robotics Association

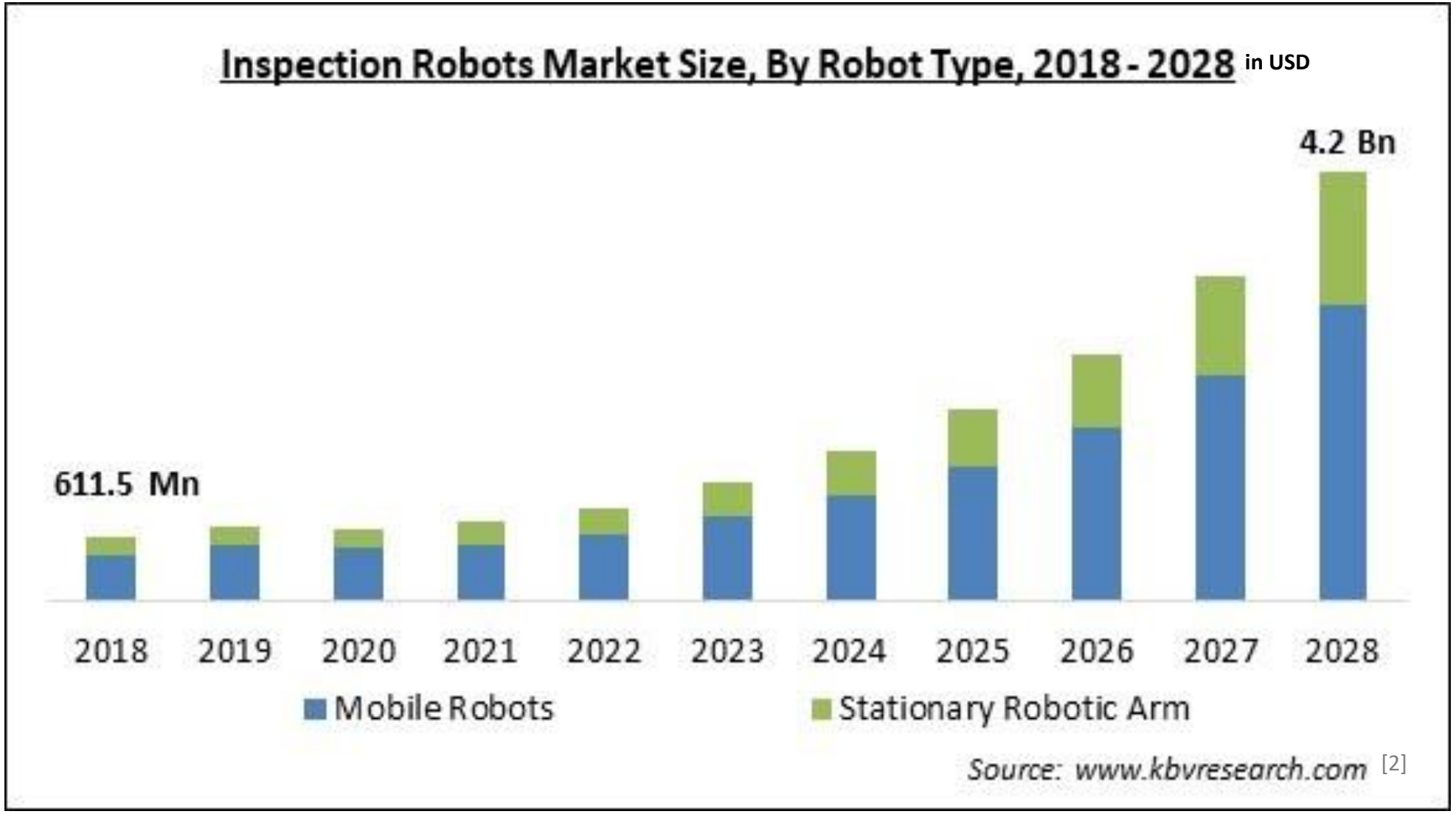
eu ROBOTICS
TOPIC GROUPS

NEMO NOOR

Teknologi for et bedre samfunn



Evolution of the global volumes of cleaning, inspection and maintenance, construction and demolition robots sales, 2010-2019



…and the inspection and maintenance market is expected to reach **US$ 8.3 billion by 2030** [1]

[1] SNS Insider, https://www.snsinsider.com/reports/inspection-and-maintenance-robot-market-1364
[2] kbv research, https://www.kbvresearch.com/inspection-robots-market/

Many applications, diverse requirements

Assets and equipment

Pressure vessels, ship hulls, hydro turbines, flare stacks, aquaculture net cages, generators, pipe bends, storage tanks, wind turbines, …

Plants and areas

Electrical substations, solar parks, offshore/onshore O&G platforms, harbors, dams, nuclear facilities, power stations, buildings, airports, quay walls, …

Long-distance / linear

Rail infrastructures, tunnels, bridges, waterways, drinking water networks and installations, power lines, …


Credit: Stellaire.ai

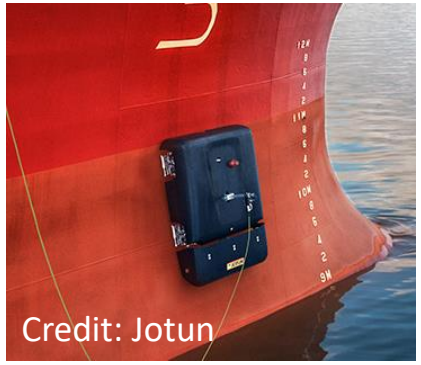

Credit: Quantum Systems


Credit: ScoutDI

Credit: IKM


Credit: Eelume

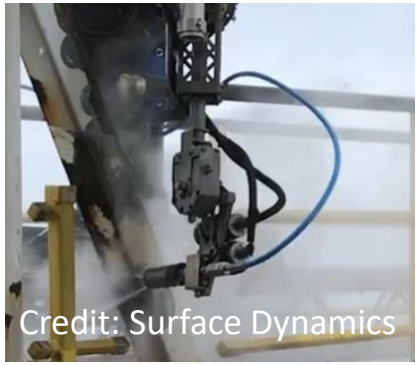
Credit: Waygate Technologies

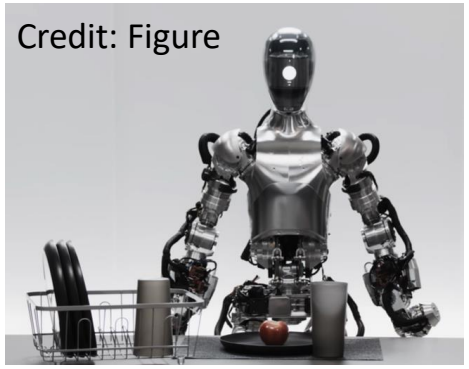

Credit: Jotun


Credit: Eddify


Credit: Railway Robotics


Credit: Infraspect


Credit: Surface Dynamics


Credit: Figure


Credit: ANYbotics


Credit: Taurob

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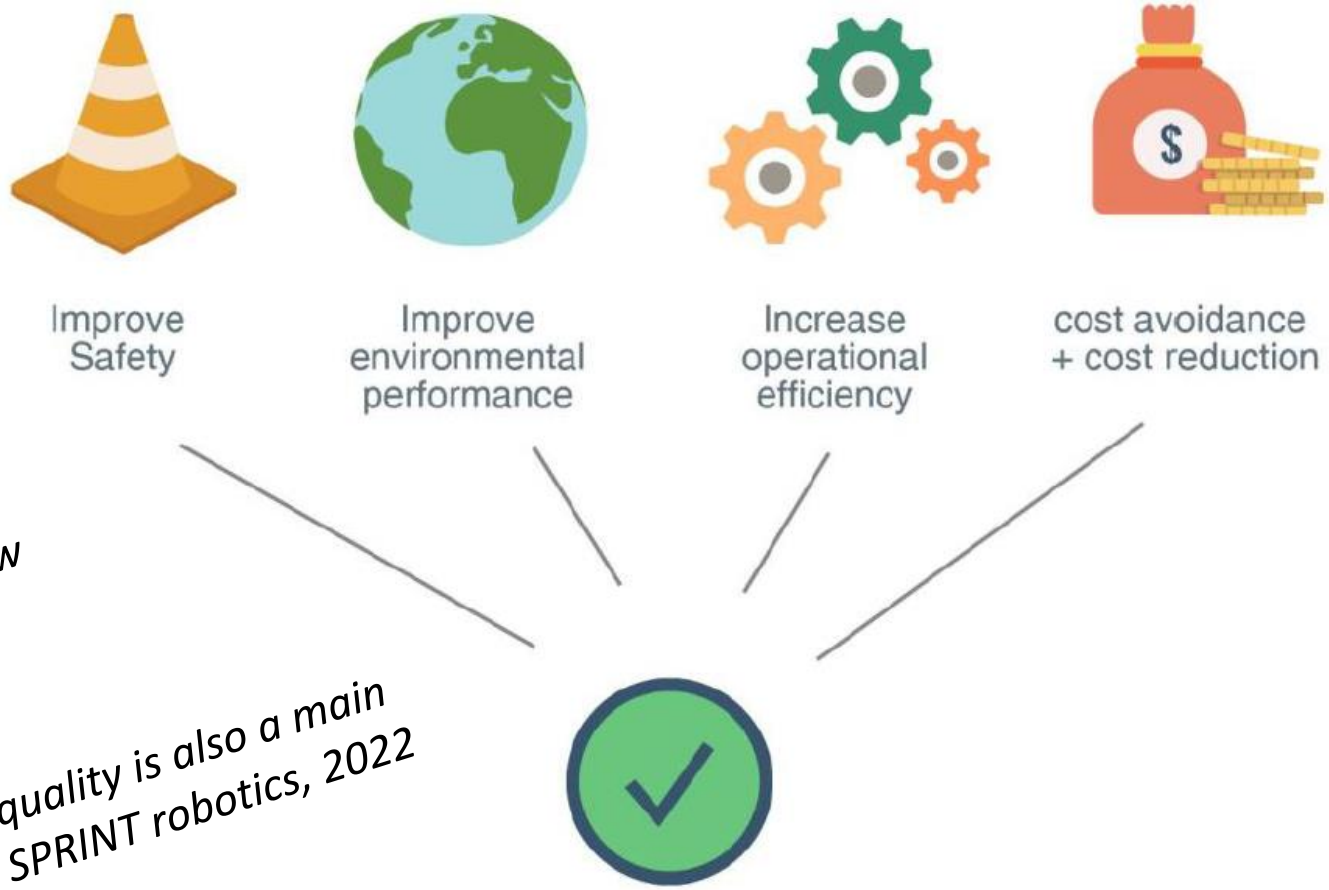
The most important common drivers for decision making in the petroleum and (petro)chemical industry



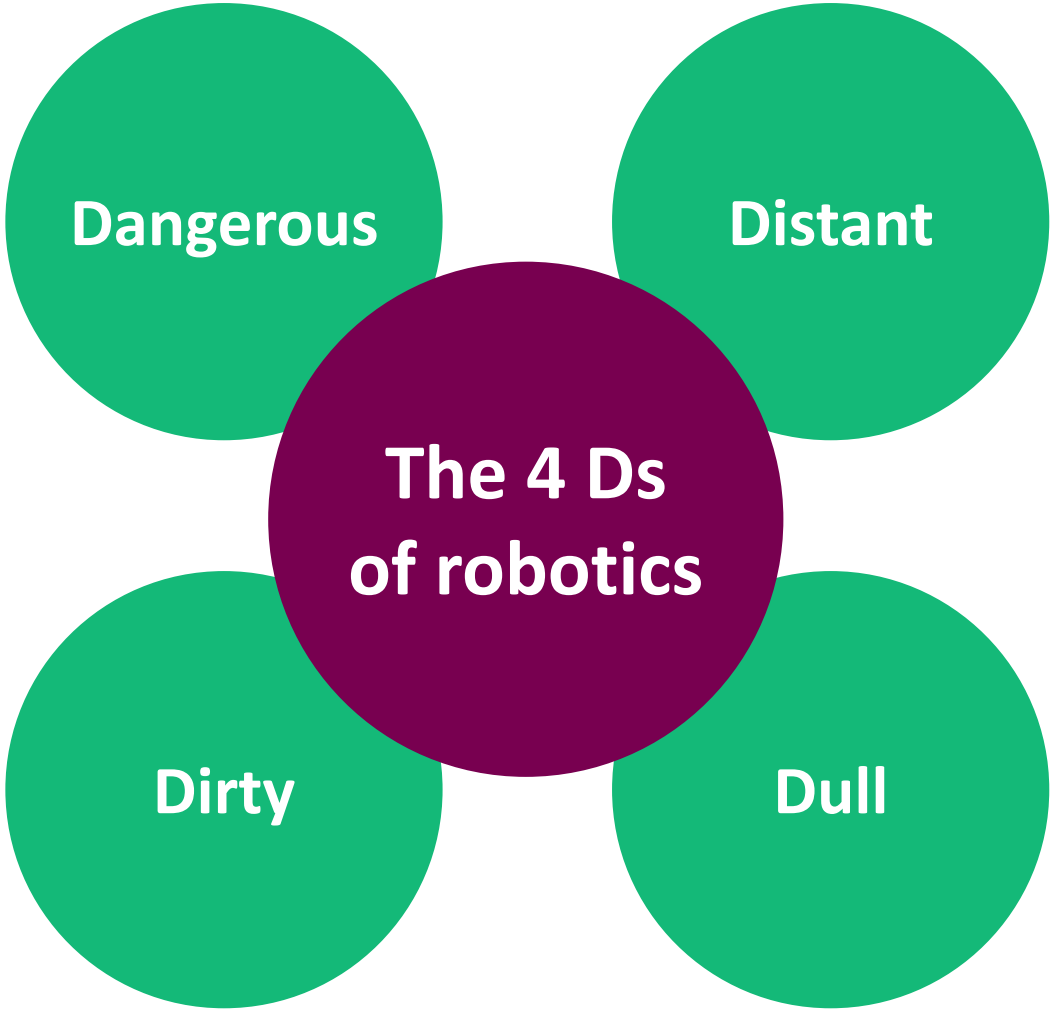
"There has to be a cost reduction to introduce new tech" Chevron, 2022

"Better quality is also a main driver" SPRINT robotics, 2022

SPRINT ROBOTICS

SPRINT Robotics Roadmap 2021

Version 4.0 | December 2021



Do more – and do it better

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Data collection

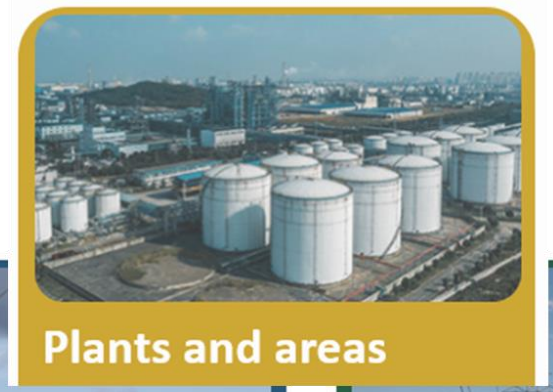
Intervention

Logistics

Collaboration

SINTEF

AI



Plants and areas

Assets and equipment

Long-distance / linear

ROBOTICS

DATA

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Business / industry acceptance

Change management, new business models, business readiness level, understand the risk of ADR, cost of robot ownership, …

Automatic data analysis

Interpretability and explainability, data quality and availability, model training automation, ownership of data, …

Standard-ization

verification and validation, testing procedures to prove capabilities and set requirements to suppliers, …

Robustness and reliability

Robust long-term autonomy, bad weather, ATEX, GNSS-denied, …

Sustainable deployments

Manage transition from one-off tests to ADR as standard tools in day-2-day operations

Integration

Integration into systems and operations, e.g., digital twins, plant management systems, work procedures, cyber security,…

Overall challenges for AI, Data and Robotics (ADR) technologies in I&M

Sources: [1] euRobotics Roadmapping process 2020-2023,
[2] SPRINT Robotics, Robotic field worker solution: Operational deployment best practices and processes.

Use cases and technologies

https://www.youtube.com/watch?v=RwtNgUHU6mI

SINTEF & ScoutDI: GNSS-denied localization

https://www.sintef.no/prosjekter/2020/adriane/

https://www.youtube.com/watch?v=RWtNgUHU6mI

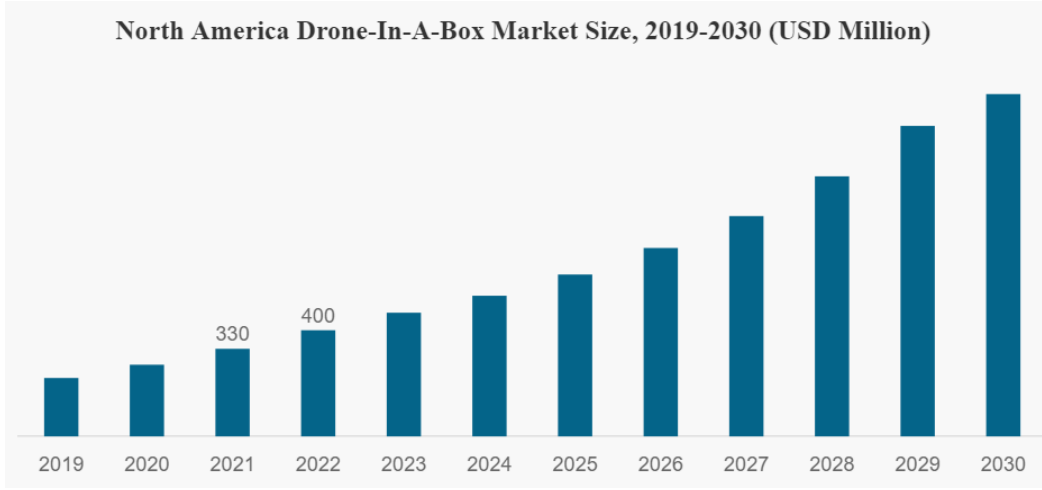
https://youtu.be/YMo3QNEov7U?si=aYlDVv5y2vxwDySz&t=11

https://www.youtube.com/watch?v=ix_ZVsBJnXs

SINTEF's "Airspector": Automatic coverage planning

https://www.sintef.no/en/projects/2024/airspector-coverage-path-planning-for-3d-aerial-inspection/

https://www.youtube.com/watch?v=ix_ZVsBJnXs



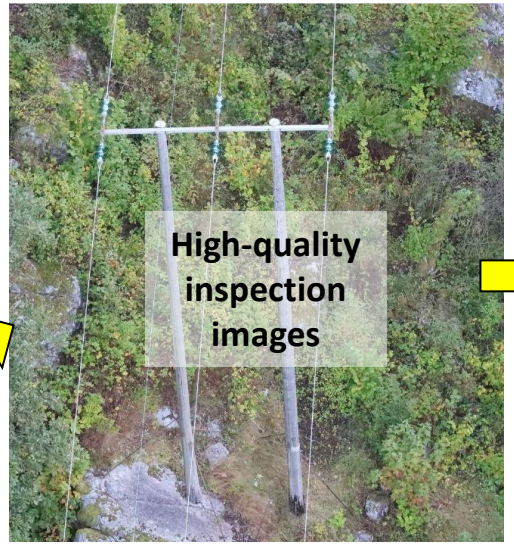
https://www.fortunebusinessinsights.com/drone-in-a-box-market-108470

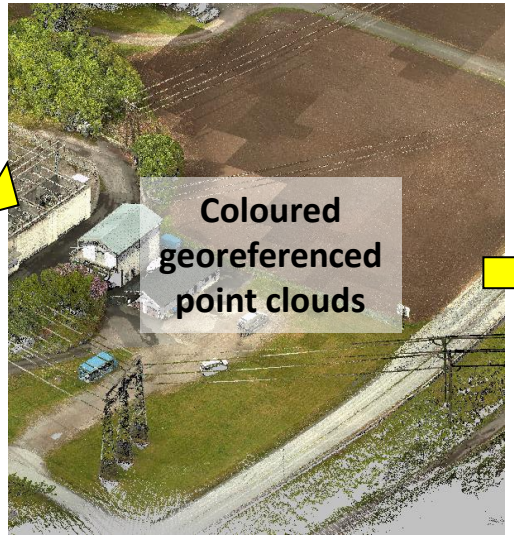
2017

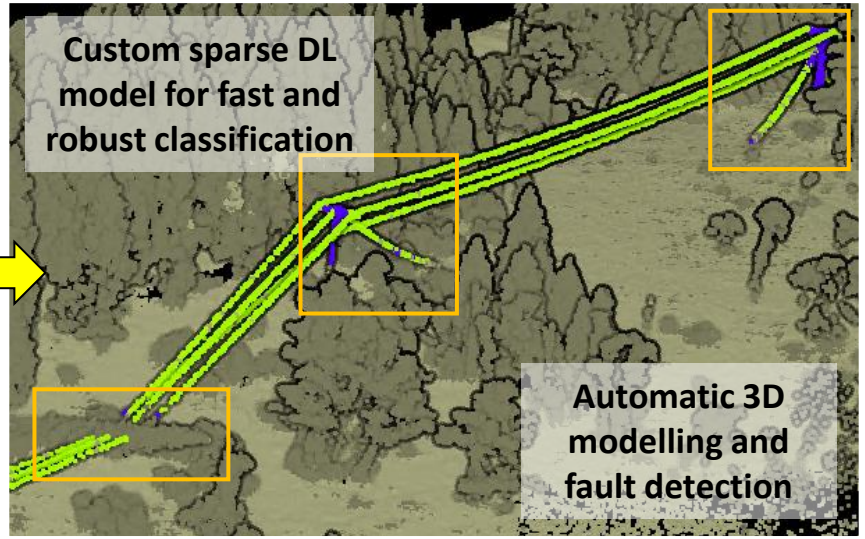
2023

Teknologi for et bedre samfunn

Visual/lidar fault detection of the electrical grid







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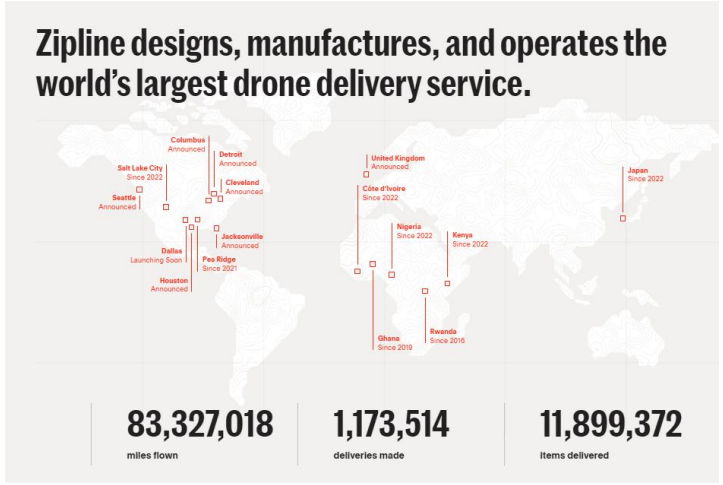
Drone logistics



2024

https://www.flyzipline.com/

Airbus tests first shore-to-ship drone deliveries

By BEN SAMPSON — 27th March 2019 — 2 Mins Read

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https://www.aerospacetestinginternational.com/videos/airbus-tests-first-shore-to-ship-drone-deliveries.html

2019

nrk Logg på

Vestland

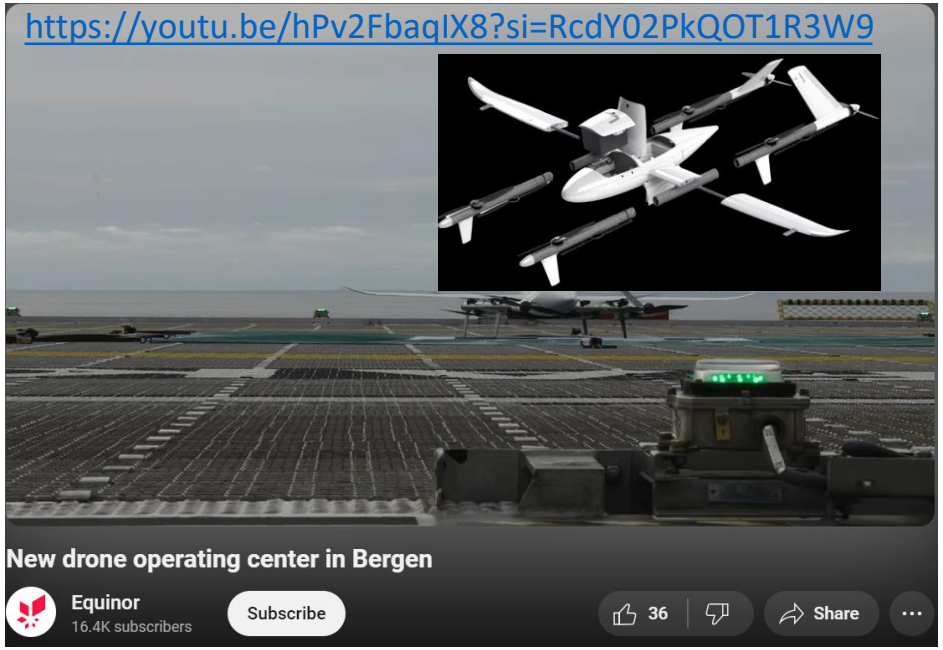
Snakk med oss Vestlandsrevyen P1 SF P1 H Vestland i dag

Her flyr dei for første gong utstyr med drone til Nordsjøen

MONGSTAD (NRK): Minihelikopter skal i 150 km/t frakte kritisk utstyr til Nordsjøen – heilt utan mannskap.

2020

https://youtu.be/hPv2FbaqIX8?si=RcdY02PkQOT1R3W9



2023

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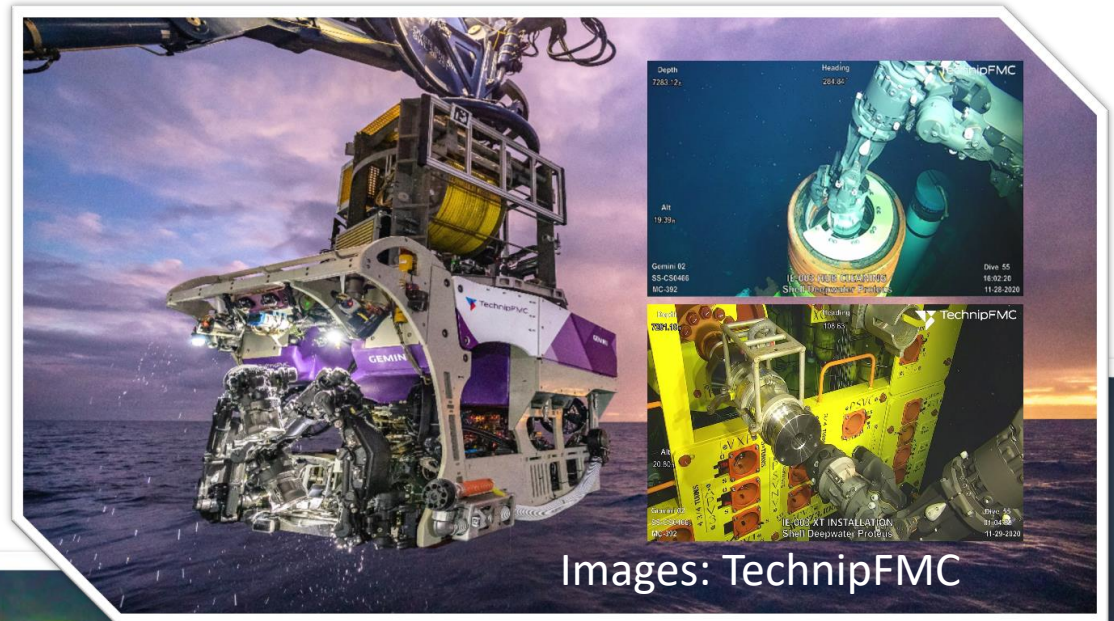
Subsea I&M



OFFSHORE ENERGY

Saipem's underwater drone hits milestone with six-month-long uninterrupted operations

INNOVATION

May 6, 2024, by Nadja Skopljak

2017 Resident. Tethered Remote controlled

2020 Up to 30-day diving. Semi-autonomous.

2023/2024 Resident. AUV+ROV. Semi-autonomous.

OFFSHORE ENERGY

Saipem's underwater

SAFESUB: Safe and autonomous subsea intervention through utilizing understanding of uncertainty

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imenco SMART SOLUTIONS

NTNU

The Research Council of Norway

I·K·M IKM Subsea AS

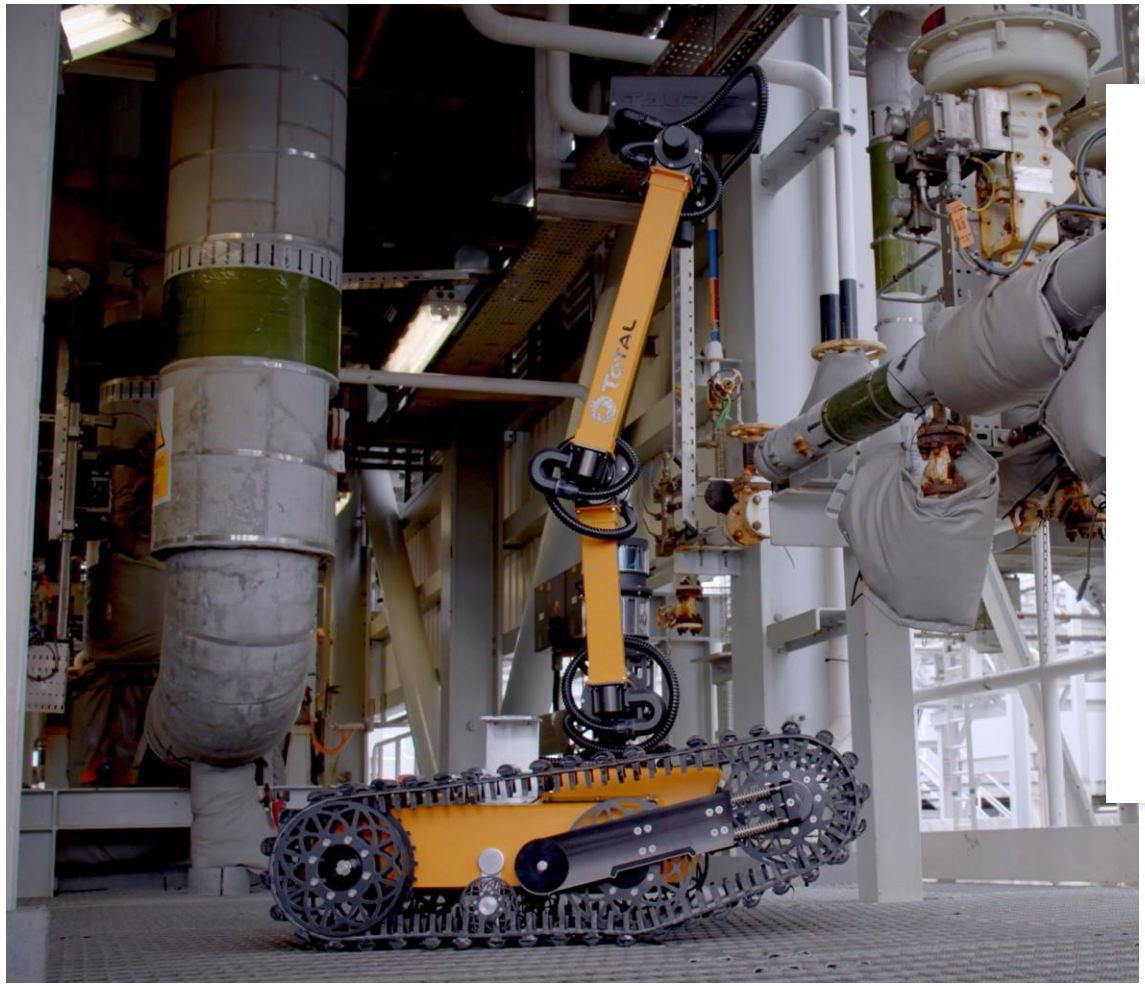
https://www.sintef.no/en/projects/2023/safesub_en/

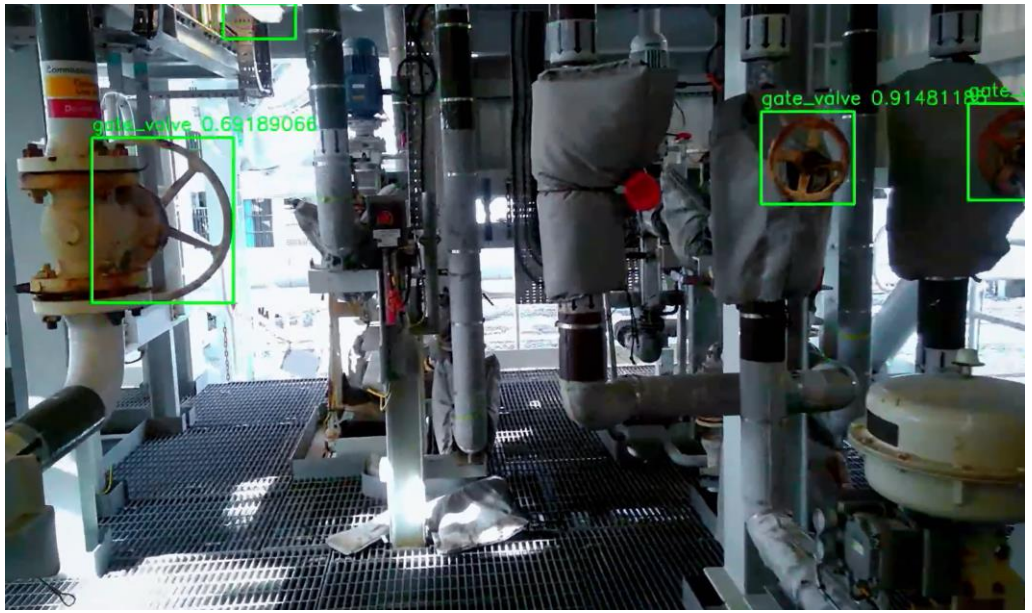
Image

2017 Resident. Tethered Remote controlled

2020 Up to 30-day diving. Semi-autonomous.

2023/2024 Resident. AUV+ROV. Semi-autonomous.





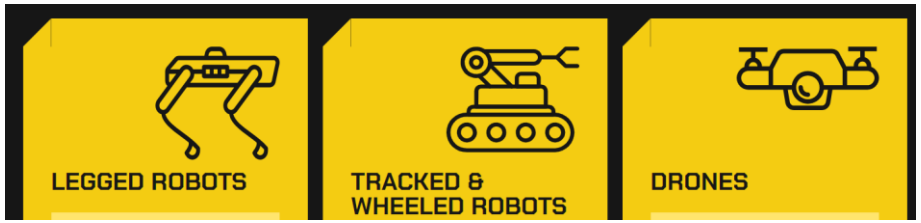
TAUROB

TOTAL

https://www.youtube.com/watch?v=E7svE6ITN-g

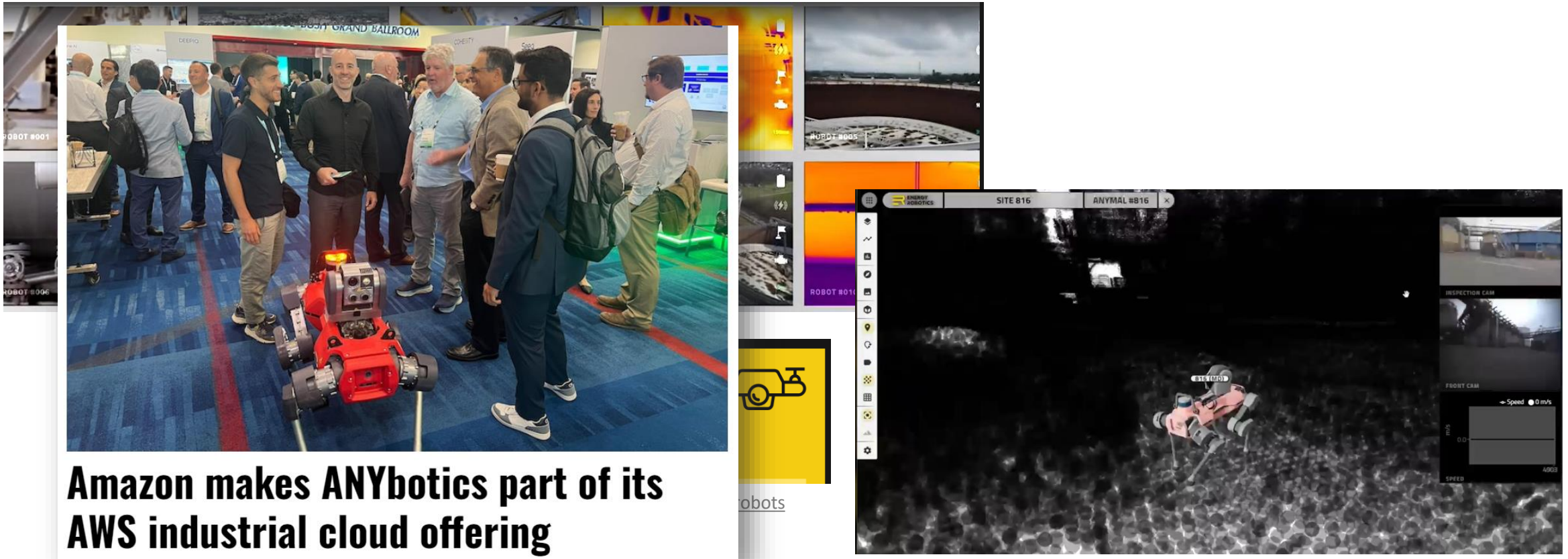
Technology for a better society

Robot fleet management



Screenshots from https://www.energy-robotics.com/inspection-robots

Robot fleet management



Amazon makes ANYbotics part of its AWS industrial cloud offering

https://roboticsandautomationnews.com/2024/09/11/amazon-makes-anybotics-part-of-its-aws-industrial-cloud-offering/85530/

Autono-mous Robot fleet management

Amazon makes ANYbotics part of its AWS industrial cloud offering

https://roboticsandautomationnews.com/2024/09/11/amazon-makes-anybotics-part-of-its-aws-industrial-cloud-offering/85530/

ROBPLAN: Autonomous I&M robotics with AI-planning

SINTEF

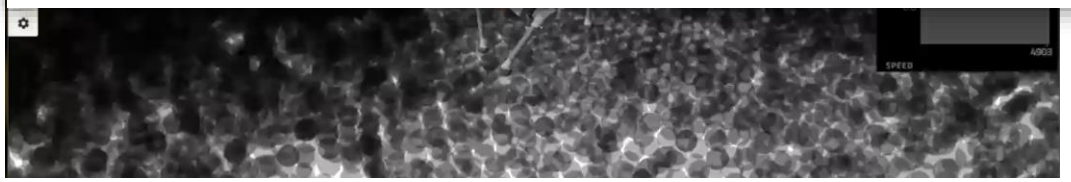
NTNU

equinor

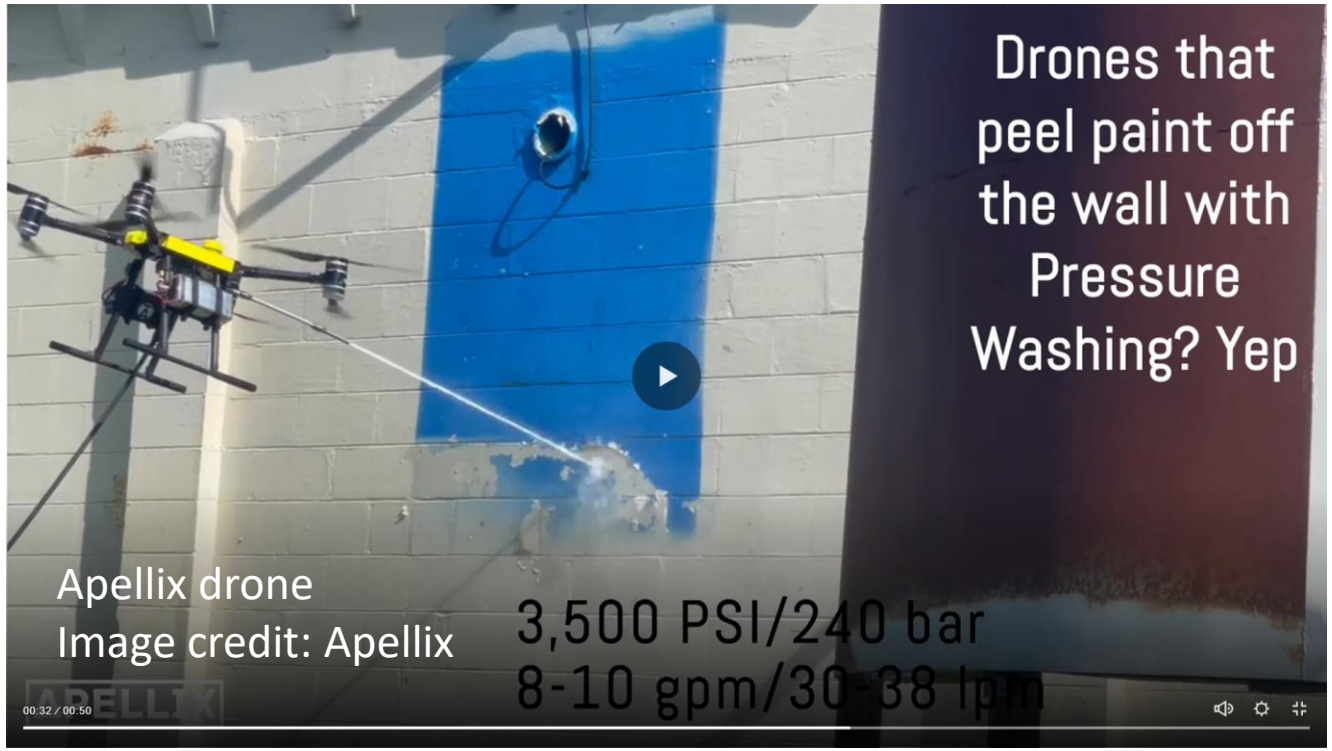
ScoutDI

The Research Council of Norway

https://www.sintef.no/en/projects/2021/robplan/



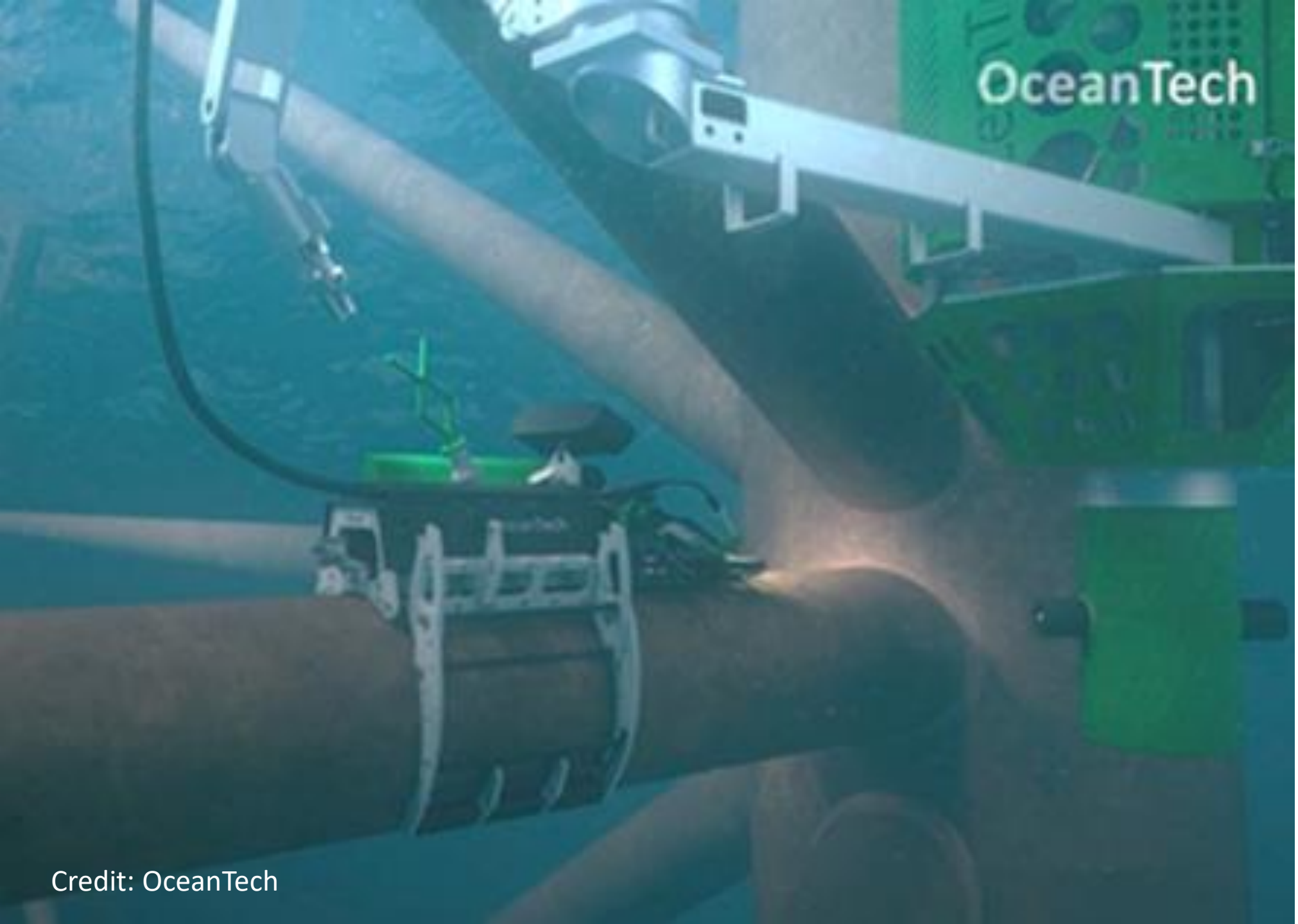
High pressure drone cleaning/spraying



System T

Home > Products > System T

SURFACE DYNAMICS



Credit: OceanTech

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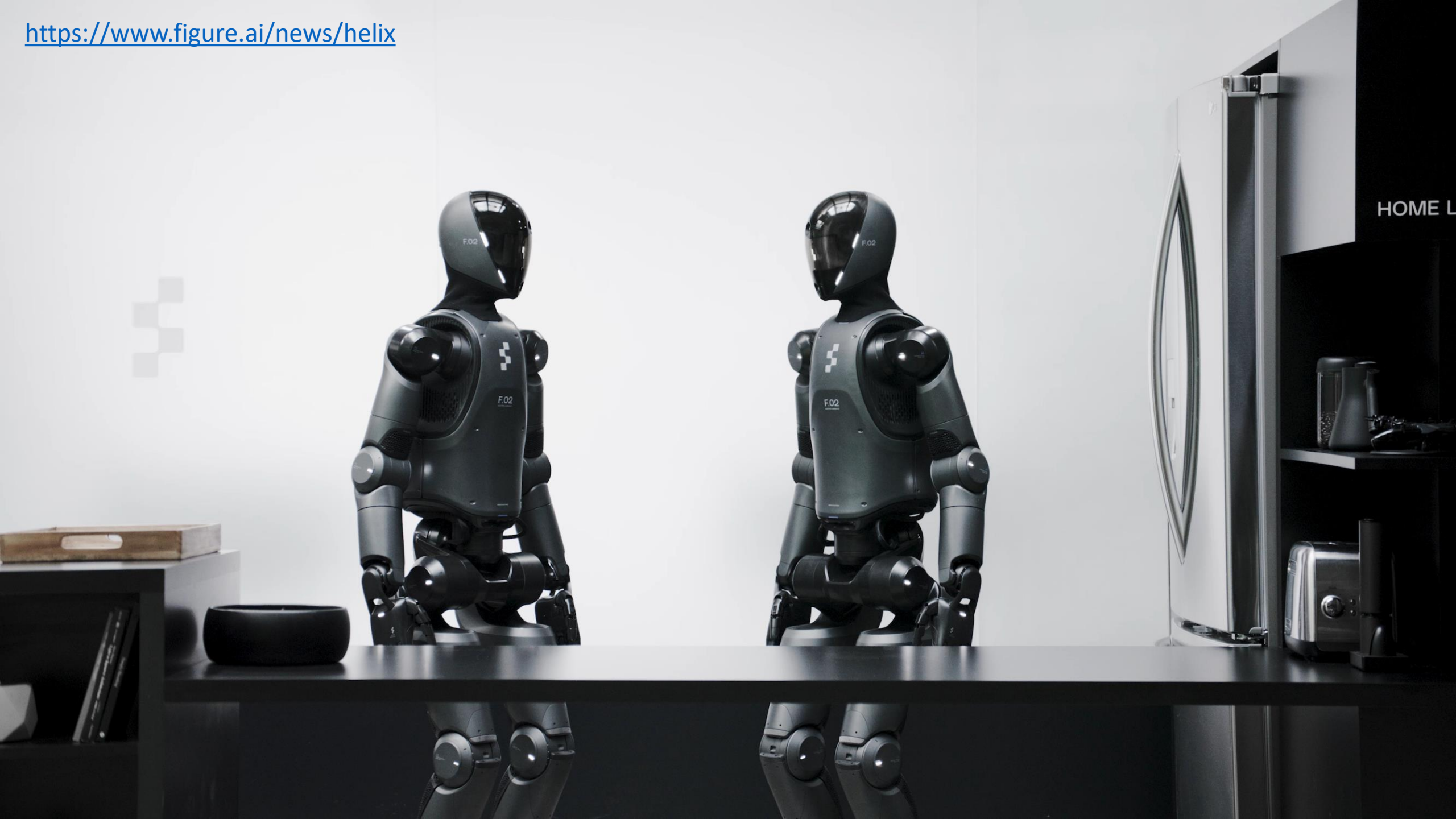
OCEANTECH INNOVATION

The Research Council of Norway

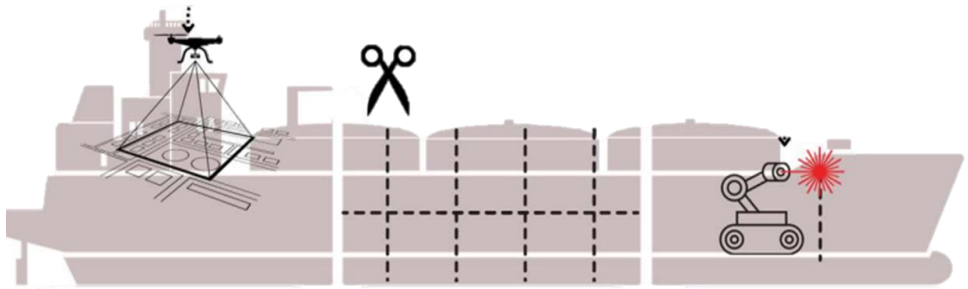
https://www.figure.ai/news/helix



The FLAIT project: https://airsideinnovation.com/mission/

AIRSIDE INNOVATION · opscom systems · AVINOR · widerøe GROUND HANDLING · NORCE · SINTEF

SHEREC: Robotics and AI for ship recycling



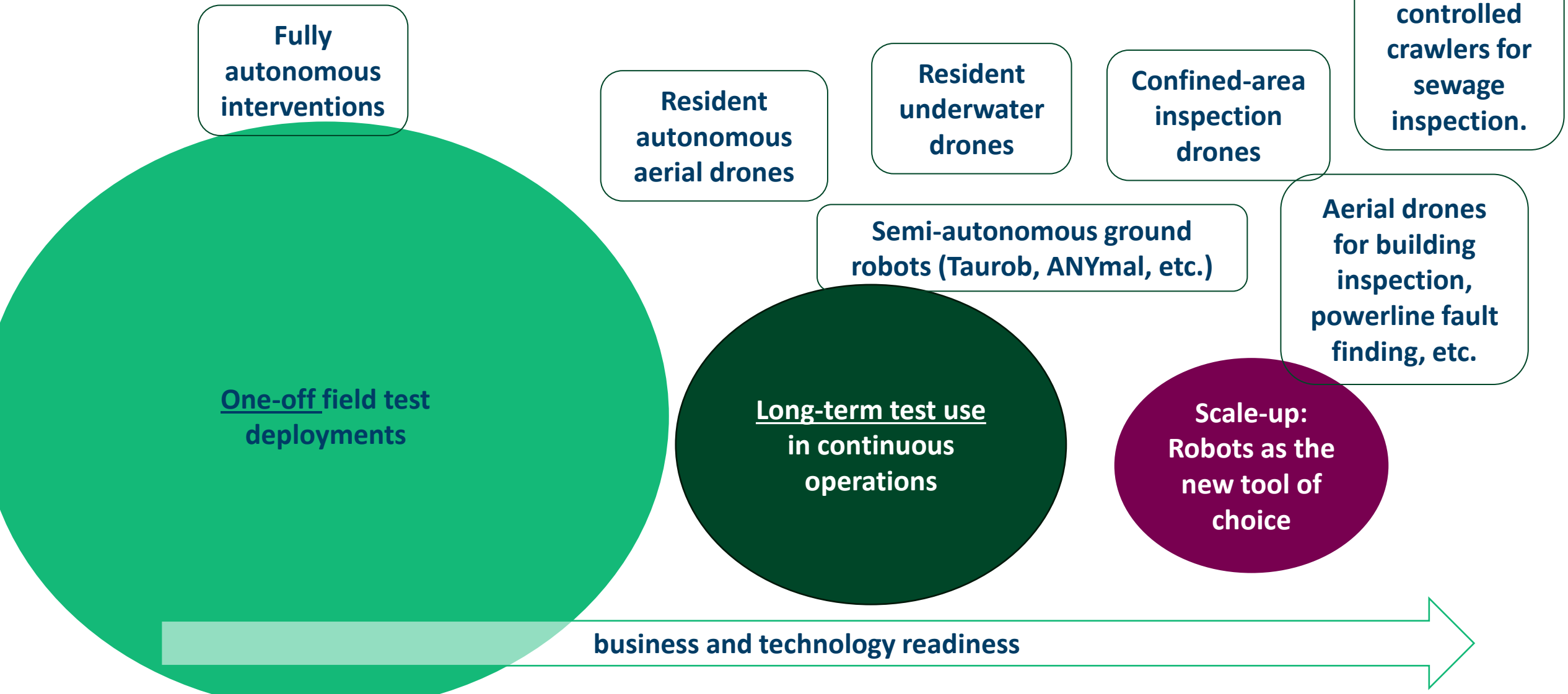
UNIVERSIDAD POLITÉCNICA DE MADRID · UNIVERSITÄT PADERBORN · NTNU · SINTEF

hktm İyi Mühendislik 444 4580 · AVSAR SHIP RECYCLING · Funded by the European Union

contact: ahmed.mohammed@sintef.no

Ecosystem systems and business development

Commercial adoption of I&M robotics depends heavily on the application



SINTEF coordinates research and industry clusters on I&M robotics in Europe and Norway

I&M topic group

The AI Data Robotics Association

https://adr-association.eu/

I&M topic group

EUROPEAN ROBOTICS FORUM

ERF2022 ROTTERDAM 28-30 JUNE

EVENT

ERF2022 workshop: From one-off deployments to I&M robotics in continuous operation

In this workshop at the European Robotics Forum 2022, suppliers, end-users, and R&D personnel will present and discuss key factors to enable transitioning from "one-off" test deployments to inspection and maintenance (I&M)

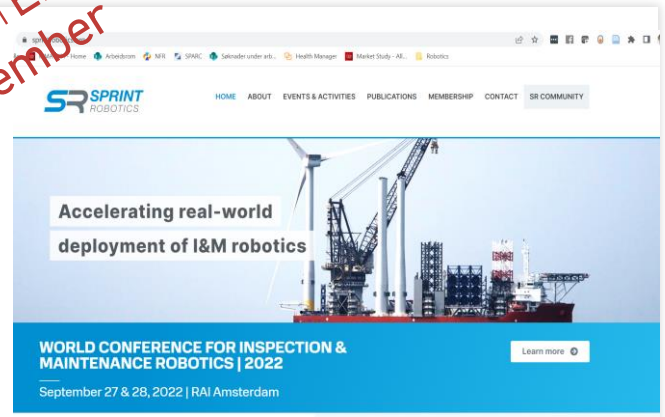
RINVE

www.sintef.no/RINVE

https://www.sintef.no/RINVE

Norwegian network

SINTEF is member



sprintrobotics.org

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I&M topic group

https://adr-asso

I&M topic group

EVENT

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deployments to I&
continuous op

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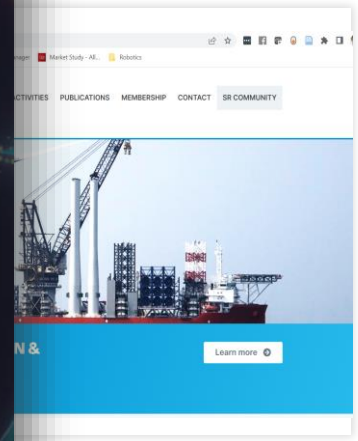
AI, Data, Robotics Forum #ADRF25

VENUE CALL FOR WORKSHOPS

AI, Data, Robotics Forum

23-24 September 2025 Stavanger, Norway



sprintrobotics.org

Want more I&M robotics info?

Use of UAS for Overhead Powerline Inspection in Norway - Status and Challenges*

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Trondheim, Norway
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SINTEF Energy Research
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3rd Sture Holmstrøm
SINTEF Digital
Trondheim, Norway
sture.holmstrom@sintef.no

***Abstract*—Over the past decade, Unmanned Aerial Systems (UAS) have emerged as pivotal tools in fault localization inspections and scheduled assessments of overhead power lines. Driven by technology advancements and the promise of safer and more efficient inspections, the adoption of UAS among electrical grid operators has witnessed significant growth. This paper examines**

[8], and large-scale infrastructure inspection and maintenance [1], [3] - [6]. These industries rely on aerial data collection, with early adopters seeing drones as a cost-effective, flexible, safe, and environmentally friendly alternative to manned aircraft or helicopters. However, as for most disruptive technolo-

Research Article

INTERNATIONAL JOURNAL OF ADVANCED ROBOTIC SYSTEMS

International Journal of Advanced Robotic Systems
March-April 2021: 1–15

DOI: 10.1177/17298814211002973
journals.sagepub.com/home/arx
SAGE

An autonomous drone-based system for inspection of electrical substations

Helge-André Langåker[1], Håkon Kjerkreit[1], Christoffer L Syversen[1], Richard JD Moore[2], Øystein H Holhjem[3], Irene Jensen[4], Aiden Morrison[4], Aksel A Transeth[3], Oddgeir Kvien[5], Gunnar Berg[5], Thomas A Olsen[6], Alexander Hatlestad[6], Thomas Negård[7], Rolf Broch[7] and Jørn E Johnsen[7]

Report

Photo: ScoutDI

Market Study on Inspection and Maintenance Robotics in Norway

Suppliers, Market Needs and Challenges

Author(s):
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Report No:
2023:00938 - Unrestricted

Contact: Aksel.A.Transeth@sintef.no

Teknologi for et bedre samfunn

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Technology for a better society

SINTEF

Data collection

"Geo-reference" sensor data

Increase quality

Increase consistency

Sensors "on demand"

Intervention

Improve data management

Continuous monitoring

Data trending

Logistics

Multitasking

Collaboration

Durability

New work processes

SINTEF

Data collection

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Robots4humans

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