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# Kongsberg Maritime

*Introducing K-MATE*

*For Maritime Autonomous Surface Ships (MASS)*

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# K-MATE

## Kongsberg Maritime Autonomy Engine

- Joint project between KM and FFI
- Designed to offer new autonomous capabilities for MASS (Maritime Autonomous Surface Ships)
- Offering different operational modes:
  - Autonomous
  - Supervised
  - Direct control
- Includes modules for:
  - Control and guidance
  - Navigation and positioning
  - Scene analysis
  - Payload control
- Current capabilities
  - Autonomous Waypoint Following
  - Collision avoidance using Radar & Lidar
  - Virtual anchor, AUV following



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# K-MATE

## Kongsberg Maritime Autonomy Engine

- Adaptable autonomy kit for almost any hull
- Scalable capability from waypoint following to collision avoidance and more
- Common architecture with HUGIN and MUNIN vehicles



MASS for  
Mapping/Survey

MASS for AUV  
Supervision

MASS for AUV launch  
and recovery

MASS for Towing  
Application

MASS for integrated  
MMCM



# K-MATE



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## OEM Autonomy

- Basic autonomy engine
- Electrical integration with hull systems
- Available as a “MASS Autonomy Kit”
- Can be integrated with KM payload



## Small: 2-7m

- For science or very shallow survey
- Opportunity for payload options:
  - GeoSwath 4
  - $\mu$ PAP



## Medium/Coastal: 7-9m

- For commercial, science and defence applications
- Integrated collision avoidance
- Ability to supervise AUVs
- Full KM payload suite:
  - EM2040P or C
  - HiPAP
  - MBR

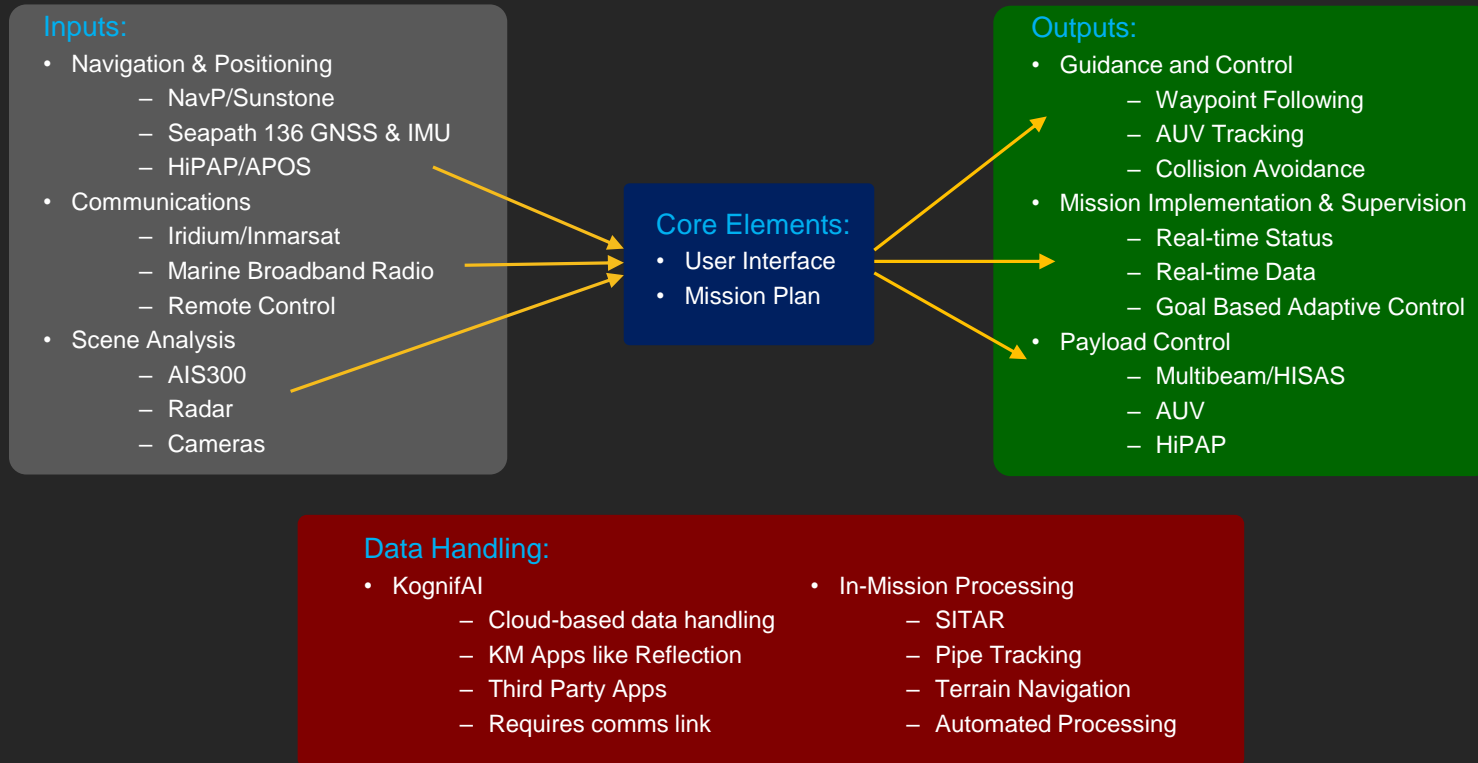


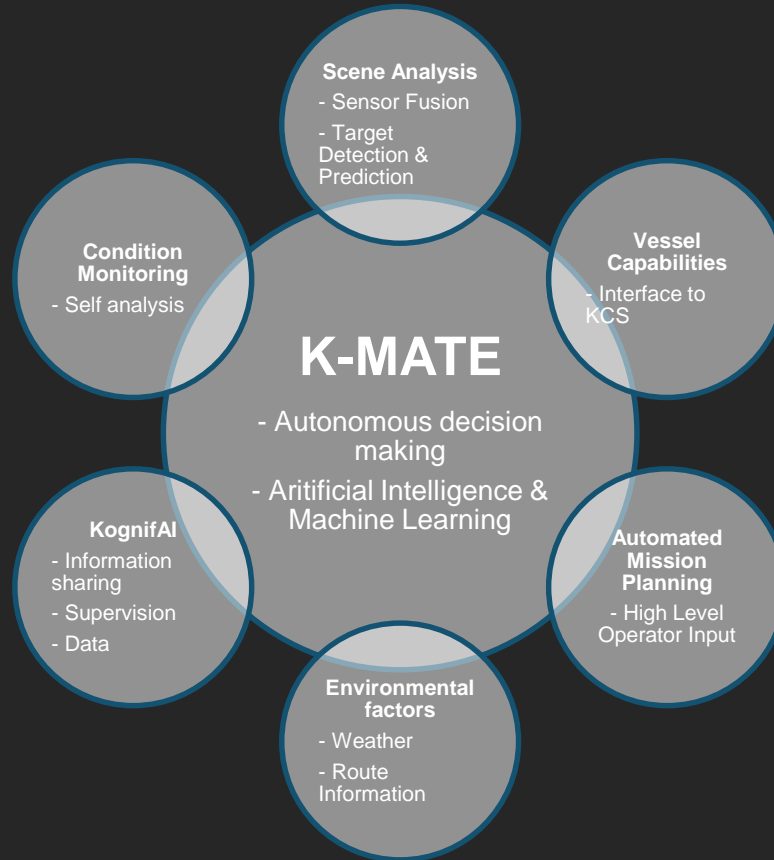
## Large/Trans-Ocean: 10-15m

- For commercial, science and defence applications
- Integrated collision avoidance
- Ability to supervise AUVs
- Full KM payload suite including:
  - EM302, 2040 or 712
  - HiPAP
  - MBR



# K-MATE Components







# K-MATE Goal Based Performance

## Pre-Mission Goal Based Mission Planning

- Enable K-MATE to determine the best survey pattern
- Track spacing determined by simulated performance of multibeam echosounder
- Ability to determine a stand-off range from AUV or mothership

## In-Mission Adaptive Control

- Modify survey pattern based on environment and sensor performance
  - Wind, waves and sea state
  - Track spacing adjustment based on real-time sonar performance monitoring
  - Adjust heading and speed to adapt to AUV or mothership
- In-mission processing algorithms e.g. target recognition
- Adaptive in-mission replanning

## Conditions

- Safety is overriding factor
- Collision avoidance takes priority over mission plan or adaptive control

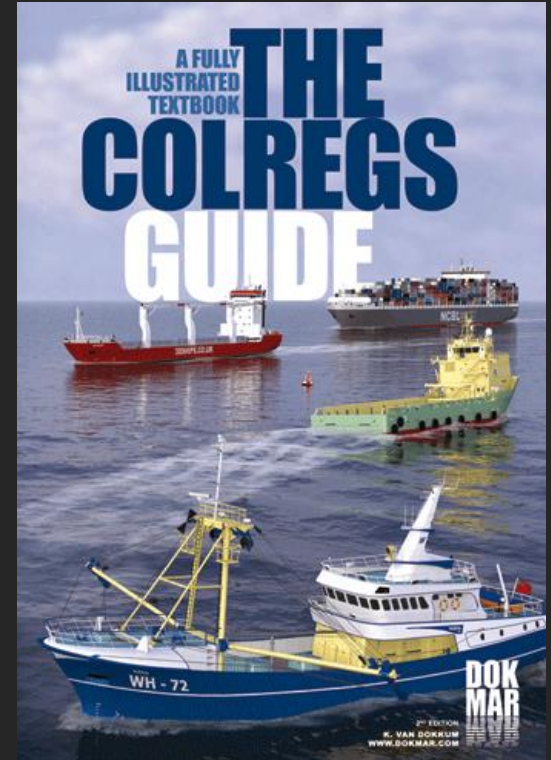
# K-MATE Collision Avoidance

## Scene Analysis

- Sensors:
  - Radar
  - AIS
  - Cameras (Infrared, day TV)
- Processes:
  - Data is fused on-board in K-MATE and potential collisions are identified
  - Traffic is always transmitted to control centre

## Collision Avoidance

- Phase 1:
  - Alert operator
  - Sound horn, flash lights
  - Come to a stop
- Phase 2:
  - Open communications link to nearby traffic
  - Automated response in accordance with the rules of the road
  - mission plan or adaptive control

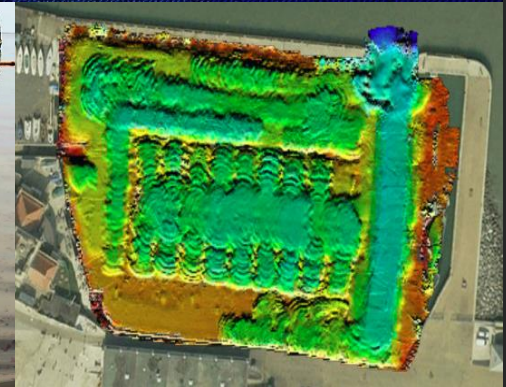
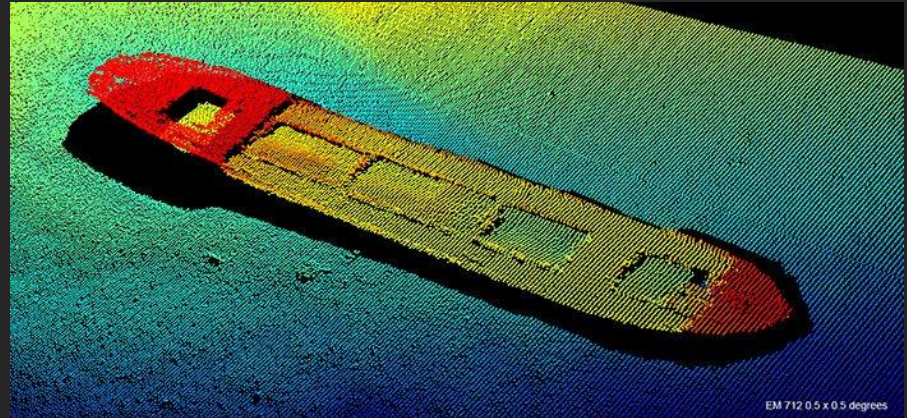






# K-MATE: Applications

- Commercial
  - Hydrography
  - AUV Support
  - Oil spill monitoring and clean-up
- Defence
  - MCM
  - REA
  - ASW
- Scientific & Research
  - Oceanography
  - Hydrography
  - Environmental monitoring
- Miscellaneous
  - Search & Rescue
  - Marine salvage





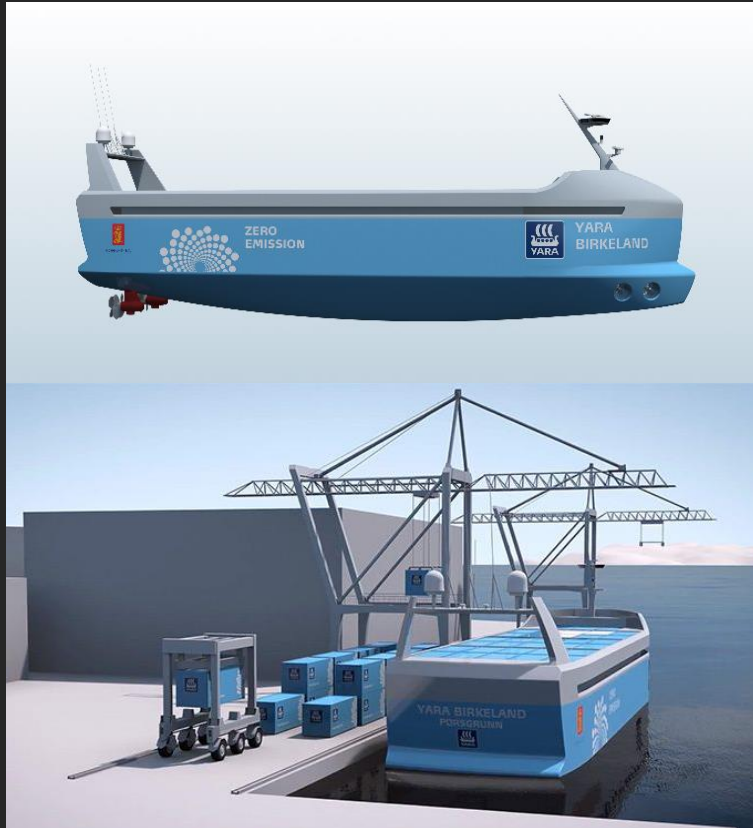
# K-MATE and KognifAI

## Connecting the Ocean Trough Data

- Real-time access to system performance and data globally
- Secure cloud-based data storage
- Apps for visualization and processing
  - KM Apps like Reflection
  - Third party Apps
- Sharing access and adding value
  - Transmitting meaningful data to minimize bandwidth
  - Accessing the full data set when possible
  - Requires smart processing on-platform



# K-MATE: Yara Birkeland



## Key Facts:

- Fully battery powered ship
- Prepare for remote control and fully autonomous operations
- Dimensions & Performance
  - LOA: >70 m
  - Beam: 15 m
  - Depth: 12 m
  - Draft: (full) 5m
  - Service speed: 6 Knots

## Purpose and Performance:

- To replace road journeys
  - Herøya to Brevik: 7 nm
  - Herøya to Larvik 30 nm
- Controlled by:
  - YARA at Porsgrunn
  - Kongsberg Maritime

## Schedule:

- 2017: design finalized
- 2018 Delivery & testing with small crew
- 2019: Remote operation
- 2020: Fully autonomous operation



# K-MATE: Hrönn

## Key Facts:

- Light duty, offshore utility ship servicing:
  - Offshore energy
  - Hydrography
  - Scientific
  - Offshore fish-farming
  - ROV or AUV support
- Capabilities and equipment:
  - DP
  - Navigation & positioning
  - Communications
- K-Chief automated bridge and K-Bridge ECDIS will be replicated in control centre

## Activities:

- Design completed in 2017
- Testing e in Norway's dedicated autonomous trials area
- To be classed an flagged by DNV GL and Norwegian Maritime Authority





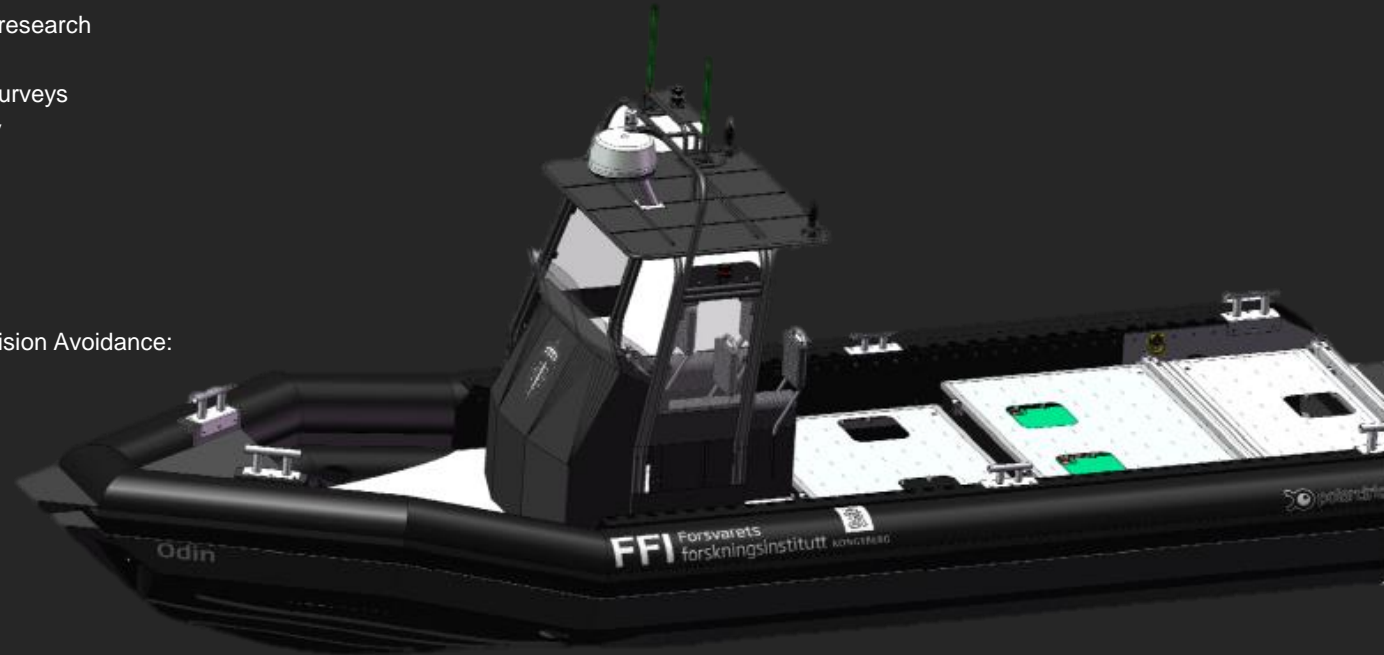
# K-MATE: Odin

## Project:

- Joint development between FFI and KM
- Can be manned or unmanned
- Multipurpose platform for defence research
  - Hydrography
  - Mine Countermeasures surveys
  - AUV launch and recovery
- Configured to carry an AUV

## Equipment:

- Systems:
  - Dual engines
  - Electronic anchor
- Navigation, Communication & Collision Avoidance:
  - Seapath 136
  - AIS 300
  - Radar, Camera & LIDAR
  - MBR
  - Iridium





# K-MATE: SEA-KIT



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## Utilizing Kongsberg Maritime Solutions:

- K-MATE
- AIS 300
- Seapath 130
- Maritime Broadband Radio
- HiPAP Positioning and Communications System
- Multibeam Echosounders



# K-MATE: SEA-KIT Trans-Ocean Survey

## Dimensions:

- Length: 11 m
- Width: 3 m
- Height: 3 m
- Designed to carry a HUGIN AUV

## Performance:

- Endurance:
  - Standard: >30 days
  - Enhanced: >300 days
- Speed: <8 Knots

## Equipment:

- Systems:
  - Dual diesel electric generators
  - Dual stern thrusters plus bow thruster
  - Electronic anchor
- Navigation, Communication & Collision Avoidance:
  - Seapath 136
  - AIS 300
  - Radar & Camera
  - MBR
  - INMARSAT & Iridium

