ASV unmanned marine systems

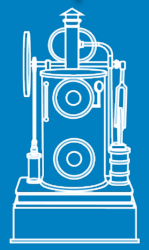
Digitization & Maritime Autonomy

GREEN BOATS AND PORTS IV PORTLAND, OR AUGUST 29-30, 2018

UNOLS
UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

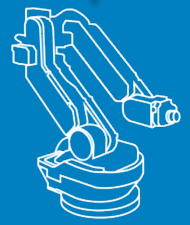
The Fourth Industrial Revolution is Here

1750 1800 1850 1900 1950 2000

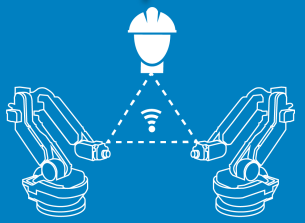


First (1784)
Mechanical production, railway, and steam power

Second (1870)
Mass production, electrical power, and the advent of the assembly line



Third (1969)
Automated production, electronics, and computers



Fourth (NOW)
Artificial intelligence, big data, robotics and more to come

Lightning speed, large scale and unprecedented impact

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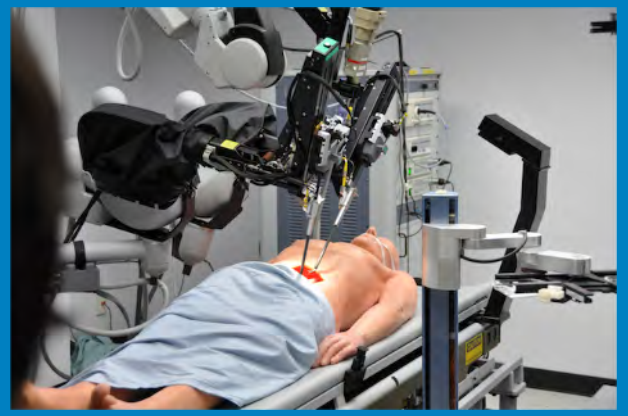
Unmanned systems / robots / drones are changing the way we live and work.



Medical

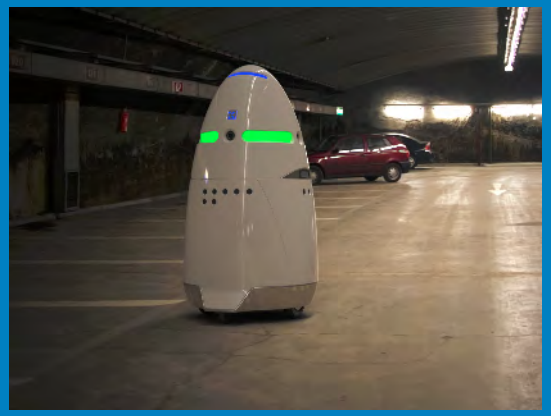
Transport

Agriculture

Mining

Warfighting

Manufacturing



Security

Build, Inspect and Repair

ASV unmanned marine systems

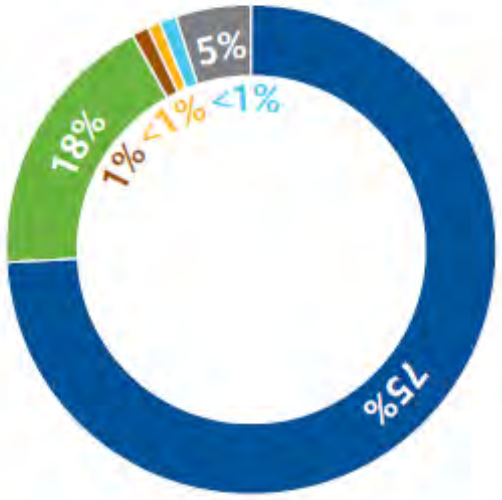
Robotics

- Improving safety
- Saving money / making money
- Being more effective
- Allowing activity on a bigger scale with more efficiency
- Filling gaps where there aren’t enough people
- Opening up new business models

ASV unmanned marine systems

Safety - Maritime Accidents

Top causes of liability loss: Marine (by value of claims)

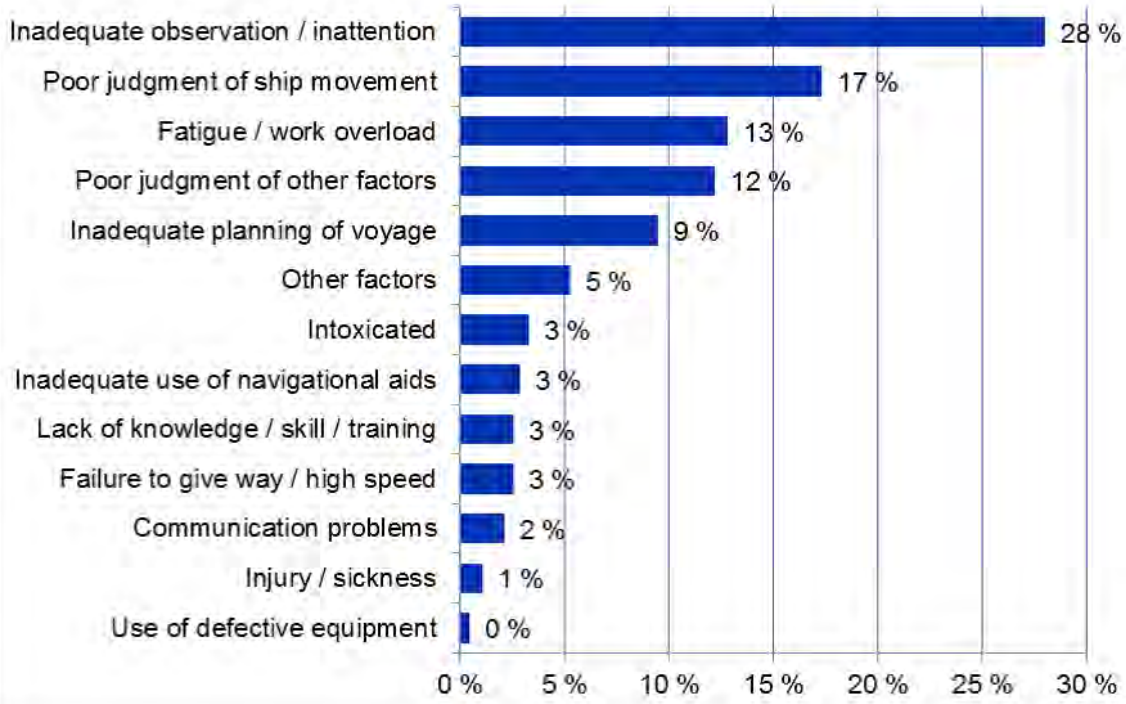


Human error	75%
Accidental nature/damage	18%
Natural hazards	1%
Negligence/poor maintenance	<1%
Failure to provide service	<1%
Other	5%

14,828 liability insurance claims analyzed between 2011 and 2016 (September 13)

Source: Global Claims Review: Liability In Focus, Allianz Global Corporate & Specialty

Human error causes of navigational accidents



Source: International Maritime Organization, International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, International Maritime Organization, London, 2011, p. 30.

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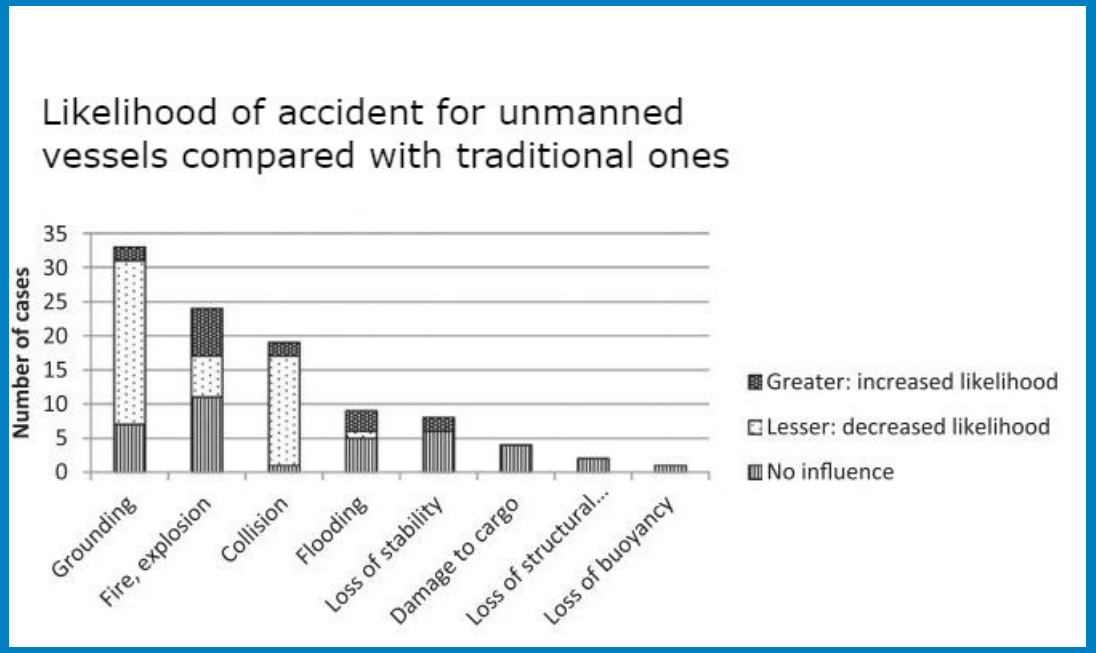
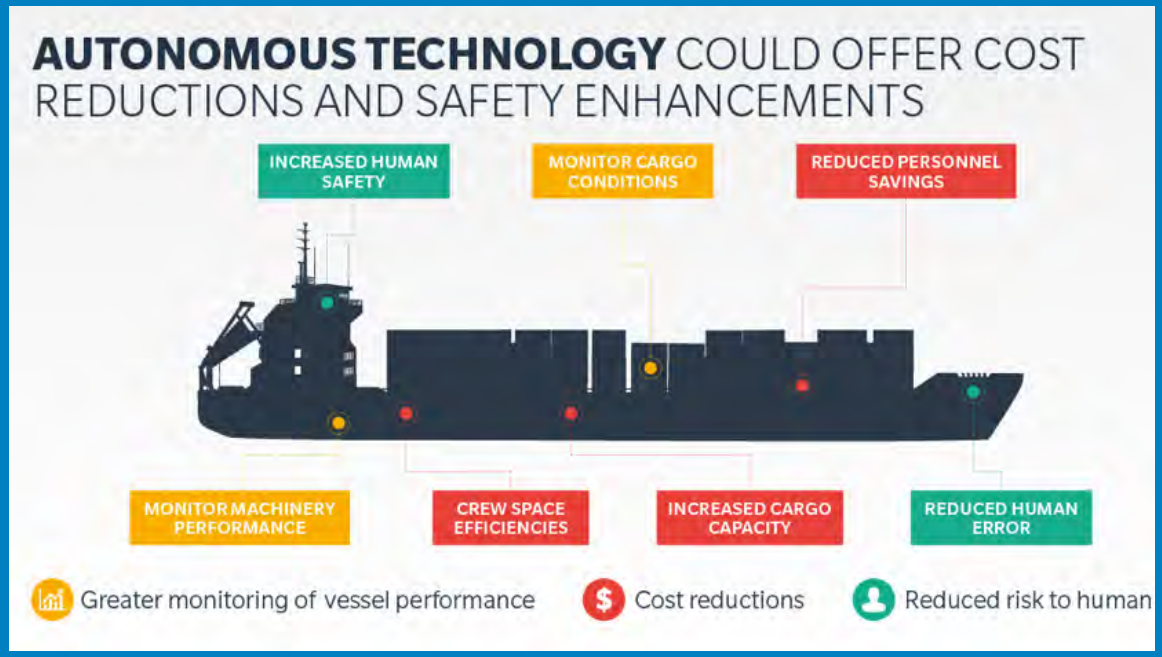
Safety at Sea in an Autonomous Era

Unmanned vessels will lead to a drop in the number of collisions and groundings



Towards the assessment of potential impact of unmanned vessels on maritime transportation safety, March 2017 Reliability Engineering



https://www.brinknews.com/drone-ships-will-bring-new-risks-and-rewards/

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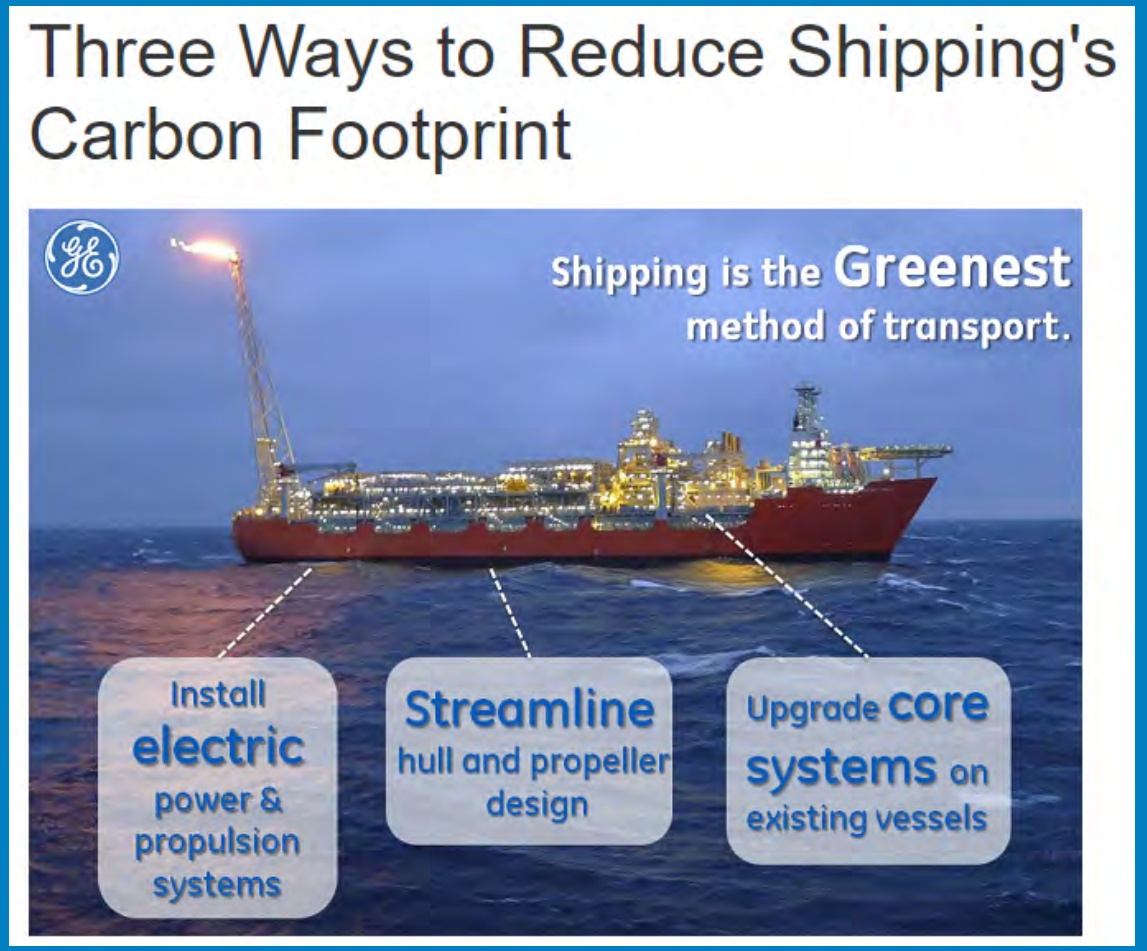
Greening Through Autonomy

USCG: Autonomous ships and regulation

On the sidelines of CMA's Shipping 2018 earlier in March, Ms. Mayte Medina, chief of USCG Office of Merchant Mariner Credentialing, discussed the critical role of integrating new technology within the regulatory approval process. Increasing efficiency and reducing cost, specialized operations, increasing environmental concerns and safety are all drivers in the industry's advancement towards autonomous shipping, she said. As such, IMO must ensure the future regulatory regime is fair and consistent.

The IMO has engaged in conversations about how autonomous boats will fit into the rules of the sea, repetitive tasks are more efficient and safer when automated, and autonomous boat operations are inexpensive compared to the costs of maintaining manned vessels for many of the dull, dirty or dangerous tasks.



https://www.maritime-executive.com/article/Three-Ways-to-Reduce-Shippings-Carbon-Footprint-2014-09-27#gs.r1XKW_Y

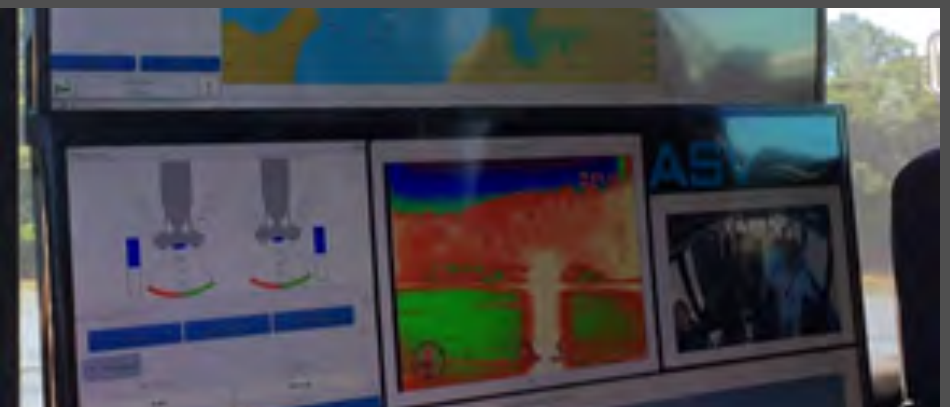
ASVs can dramatically reduce carbon emissions in offshore operations

The Force Multiplier Effect: Using Autonomous Surface Vehicles for Hydrographic Survey

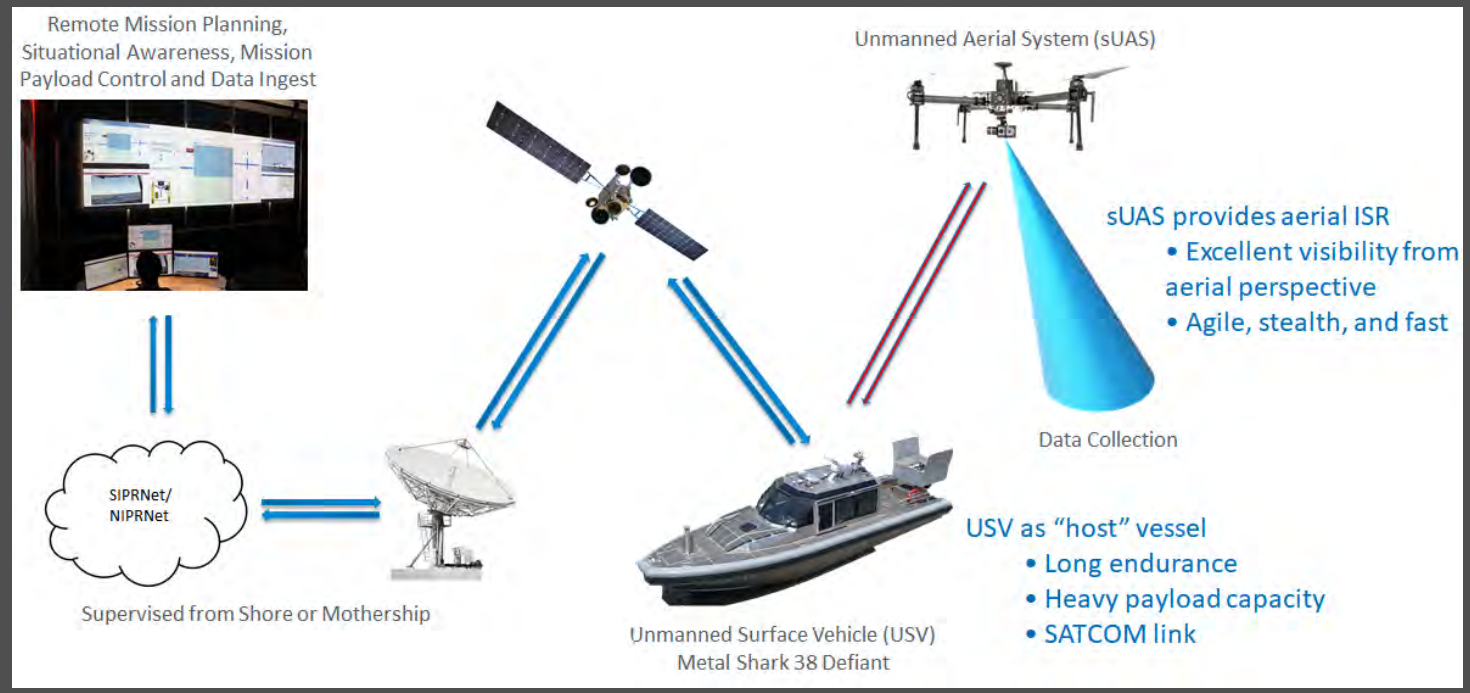
The 10,649km survey was carried out by an ASV Global C-Worker 5 unmanned vessel alongside the Q105 survey ship acting as the mother vessel. The C-Worker 5 carried out 53% of the survey

Half the Cost / Twice the Production”

- ✓ Less people offshore
- ✓ Lower cost (second vessel)
- ✓ Reduced CO2 emissions



Conversions, Security, Inspection, and Surveillance Applications



Optionally Manned Metal Shark Defiant 38 Patrol Boat with VTOL UAS and Over the Horizon Communications (11.5m / 40+ knots)

The benefits of ASV technology can be realised in a very wide range of applications.

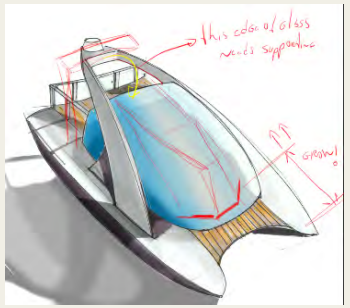
Sectors	Large number of needs / tasks within each sector	Large number of customers / users for each application
Energy		
Food		
Transport	City transportation – People Coastal transportation – People Canal container network Coastal freighters Ocean going containerships Micro-Freight (local delivery) Tugs Fuelling Inspection	
Security		
Exploration		

Delivering the benefits of robotics and autonomy on the water

Construction / Inspection

Warfighting

Exploration



Transport

Over 100 systems delivered to date. More powered systems than anyone else in the world.

ASV OVERVIEW

- ASV Global Designs, Builds, Supplies, & Supports ASV Technology Worldwide
- Unmanned & Optionally Manned New Builds, Conversions
- USV Control Systems for Defense and Commercial Markets
- Autonomous COLREG Cognizant Navigation Systems
- Founded in 2010, 140 Employees, US Owned
- Delivered approximately 100 systems from 6’ to 42’ in length
- Powered by Diesel, Solar, Wind, Battery; Endurance up to 30 days
- Integrated 40+ Different Payloads / 100+ Real World Missions
- Supervised Autonomous Operations w/ Radio Telemetry or Satellite

Early Adopter Partners and Customers

Military Product Group: Marine Targets | Mine Countermeasures | Conversions

Commercial Product Group: Catamarans| Workboats | Conversions

Existing ASV Global Product Examples

Field-Proven Defense Platforms


ASView® Conversion
BAE Pac24


ASView® Conversion
BAE Pac950


MAST Conversion
ASV/RN Test Bed


C-Sweep (12m)
Thales MMCM Variant


C-Sweep (11m)
Thales Halcyon Variant


X-LARS/MAST Swarm
ASV/RN Test Bed


C-Target 13 (13m)
High Speed Target


C-Target 3 (3m)
High Speed Target


USS – (5m) Diesel
Semi-Submersible


C-Worker 12 (12m)
Twin Diesel Z-Drive


ASView® Conversion
Metal Shark Defiant 38


MAST II (13m)
Phase II Patrol

Commercially Deployed Surface Vehicles


C-Cat 3 (3m)
Electric Survey Class


C-Worker 4 (4m)
Diesel Jet Drive


C-Enduro (4m)
Hybrid Persistent Class


C-Worker 5 (5m)
Diesel Direct Drive


C-Worker 6 (6m)
Twin Diesel / Electric


C-Worker 7 (7m)
Twin Diesel / Electric


C-Worker 8 (8m)
Twin Diesel Direct Drive


C-Worker 12 (12m)
Twin Diesel Z-Drive

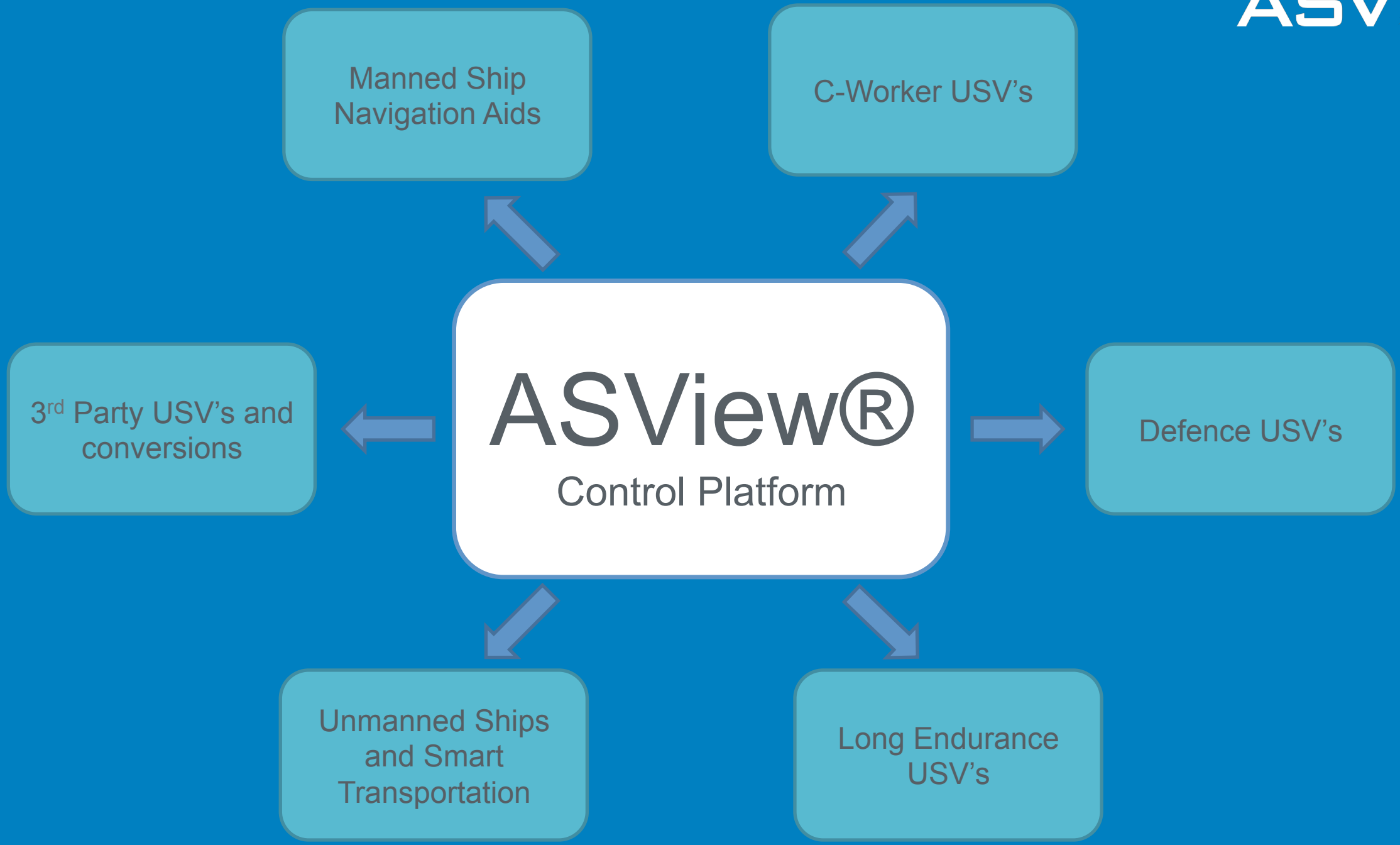

ASView® Conversion
CHS Launch


Offshore Crew Boat (55m)
Quad Jet Drives


C-Enduro IV (4m)
Persistent Class


C-Stat 2 (2m)
Station Keeping Buoy

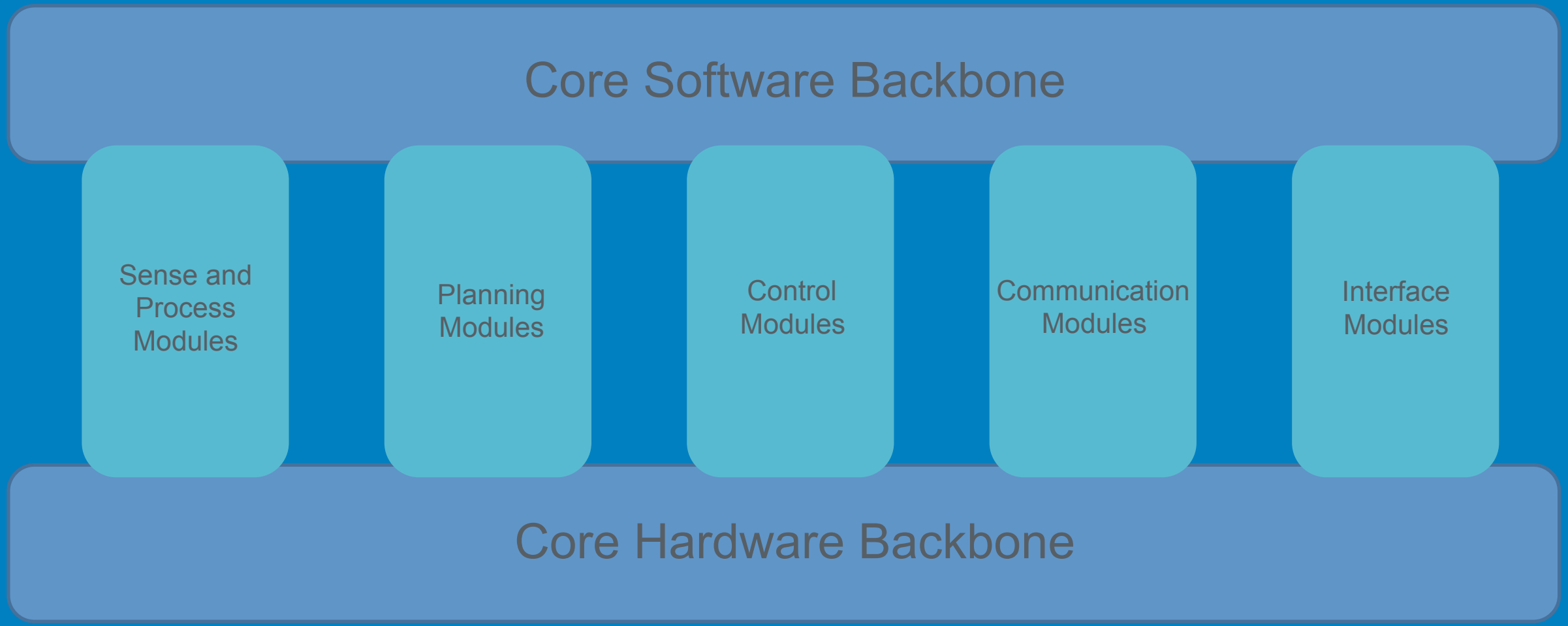
ASV Global's market is 60 percent defense and 40 percent commercial


Manned Ship Navigation Aids
C-Worker USV's
3rd Party USV's and conversions
ASView®
Control Platform
Defence USV's
Unmanned Ships and Smart Transportation
Long Endurance USV's

ASView® Capabilities

- Safely navigates and executes line-of-sight and beyond-line-of-sight missions
  - Man-in-the-loop approach
  - Increasing autonomy delivers safe and efficient operations over-the-horizon
- Manages lost comms and deals with failure safely within a robust safety case
  - Manages data across multiple redundant links
  - Integrated emergency stop, collision avoidance and last response systems
- Controls and monitors the vessel's onboard systems
  - Modular interfaces supports the majority of marine systems
  - Provides graphical and intuitive feedback, warning and alarms to the remote supervisor
- Integrates with customers payloads and delivers their effect
  - Integrates with almost any payload subsystem
  - Interfaces with the customer's chosen mission management systems

Details of ASView®



Autonomy - Architecture

Mission Input

High Risk

Low Risk

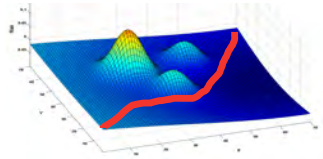
Horizon:
Hours/Kms

Horizon:
Minutes/1-3nm

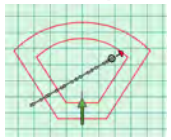
Horizon:
<1 min/<~100 m

Route Planner

Path Planner



Trajectory Planner/
Last Response



Vessel Control

Radar

Cameras

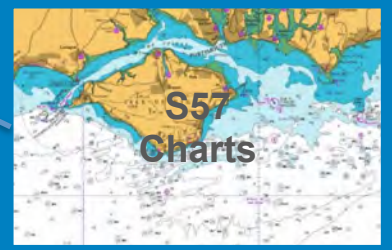
AIS

Track Fusion Engine

World model

Future world models

Geo Fencing



Waypoint plans

ASV unmanned marine systems

Improving Situational Awareness

The intelligent analysis augments standard situational awareness displays to provide an advanced operator aid. Situational awareness is improved by presenting:

- Standard navigational chart data
- Standard contact data such as position, course, speed, etc.
- Standard features such as CPA (closest point of approach) range and time
- Highlighting of important contacts based on intelligent situational analysis
- Current COLREGS situation (Head On, Crossing Stand On, Overtaking Give Way, etc.)
- Expected COLREG behavior (stand-on / give way) for own-ship where relevant
- Expected COLREG behavior (stand-on / give way) for each contact where relevant
- Alerts when own-ship must give way and CPA range/time fall below configurable thresholds
- Alerts when a give way contact and CPA range/time fall below configurable thresholds
- Alerts when approaching charted obstructions including shoals

When paired with video sensors the system improves awareness by overlaying on the video:

- Highlighting of important contacts based on intelligent situational analysis
- Relevant subset of data known about important contacts
- Operator cues for locating detected contacts visually

In addition to intelligent analysis the system can provide the operator with intelligent guidance to resolve potential issues:

- Suggest paths to avoid contacts in accordance with COLREGS
- Suggest paths to avoid grounding

When interfaced with an autopilot the system can execute a suggested path selected by the operator.

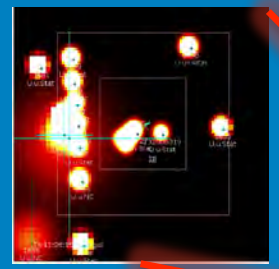
a. Overview of tasks and methods planned to achieve each objective – an iterative approach, to include simulations and sea trials on civilian assets will be included in the formal proposal.

Navigation Aid Display:

- Color coded risk display
- Interactive touch screen functions
- Risk level set/lock
- CPAs, ETAs, Alarms
- “Best Safe Course” Function
- Simulator for Training/Briefing

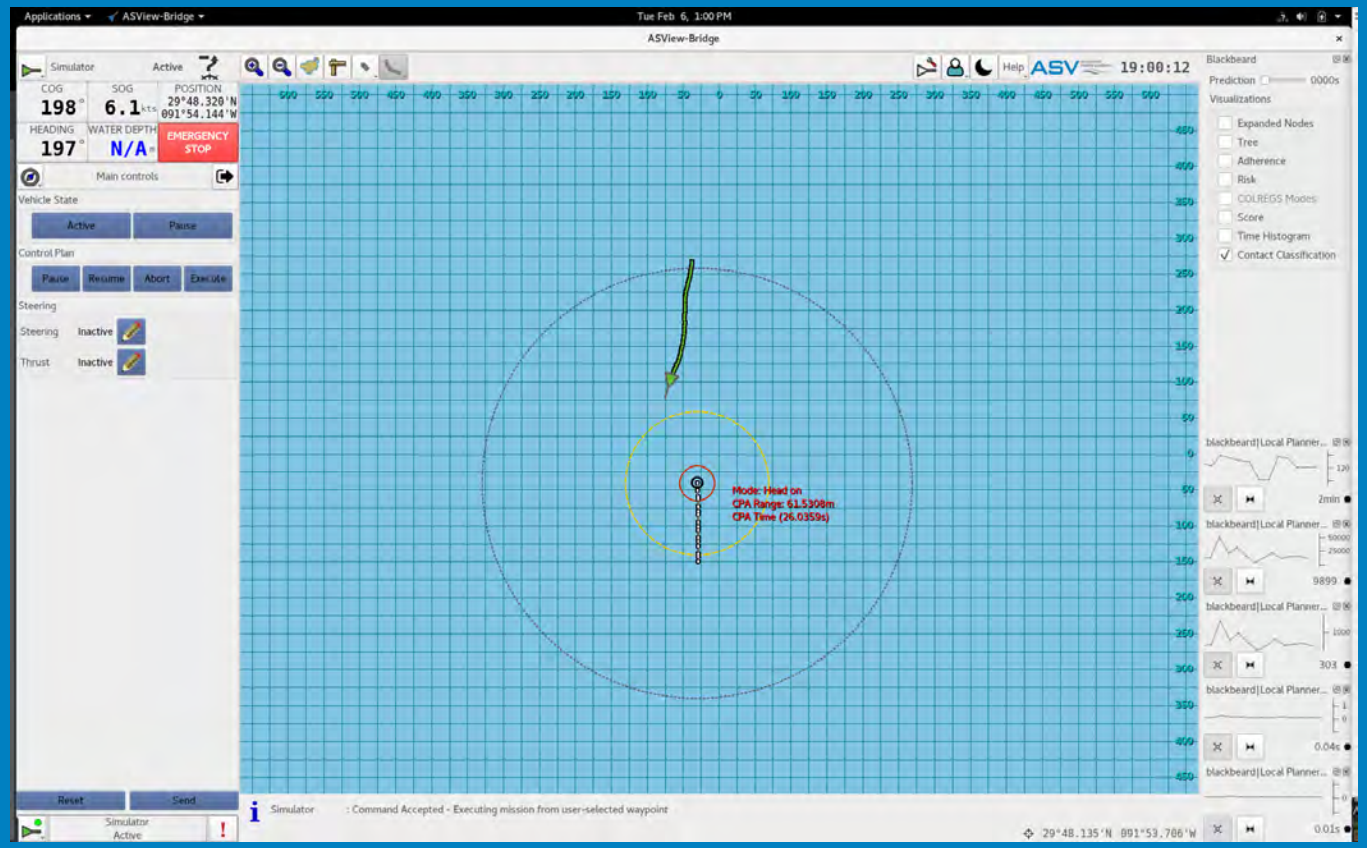
ASV unmanned marine systems

ASView™ Navigation Bridge Aid



Developments in Progress

- Graphical visualization of COLREG
- Classification and CPA information for contacts
- Audible alarms to alert the user
- Augmented reality type views of camera data



- The outer-most dashed gray circle is the "COLREGS classification radius". This is the radius within which we avoid contacts according to COLREGS.
- The yellow circle is the "risk" radius. We generally try to stay out of this region; it's "risky".
- The red circle is the collision radius. We avoid this region no matter what. All are user-configurable.

ASV unmanned marine systems

Conversions and upgrades to conventional vessels

R&D Boats ✓ | Survey Boats ✓ | Patrol Boats ✓ | Tugs | Supply Boats | Freighters | Ferries | Containers






DONE

TO DO

Scaling up to Larger Ships

- Have a tested and demonstrated COLREG compliant navigation capability broadly equivalent to a **constantly vigilant** human recreational skipper
- Have upcoming work to experiment with a proof of concept bridge aid on passenger ferries and tugs
- Fully expect that like for like scaling up is straightforward and naturally brings system performance improvements
- A modular architecture allows easy and seamless integration with other systems
- The system is available as a “driver assistance” Bridge Aid and R&D for HMI factors.
- Fully expect that like for like scaling up is straightforward
- Short term cost savings for large ships might simply come from reduced risk of operation (and insurance costs) due to improved and reliable situational awareness
- Looking to consider the what next – what regulatory issues are there? what statistical evidence is required for safety cases?

The Future for Maritime Autonomous Systems

- The future looks good, Opportunities abound
  - Maritime autonomous systems are already undertaking work offshore MCM, oil and gas, security, hydrography etc.
  - Huge potential for greater use of maritime autonomous systems across a wide spectrum of offshore industries
  - Help operators perform better (man/machine teaming).
  - Help insurance community, owners, regulators understand their exposures.
  - US can be lead in regulation / insurance / classification
  - US industry has a huge opportunity and export prospects are good

- However, there are challenges to overcome
  - Some COLREG issues, eg minimum manning
  - Marine facilities and skills are a challenge
  - Training & operator certification
  - Insurance & liability
  - Regulatory approach for MAS needs solutions
  - There are plenty of technical challenges left to resolve

- The good news is that projects are underway in all areas

The rise of unmanned systems is set to continue!








ASV
unmanned
marine systems