# Multi-robot interactive teams for large infrastructure inspection: The H2020 BugWright2 project

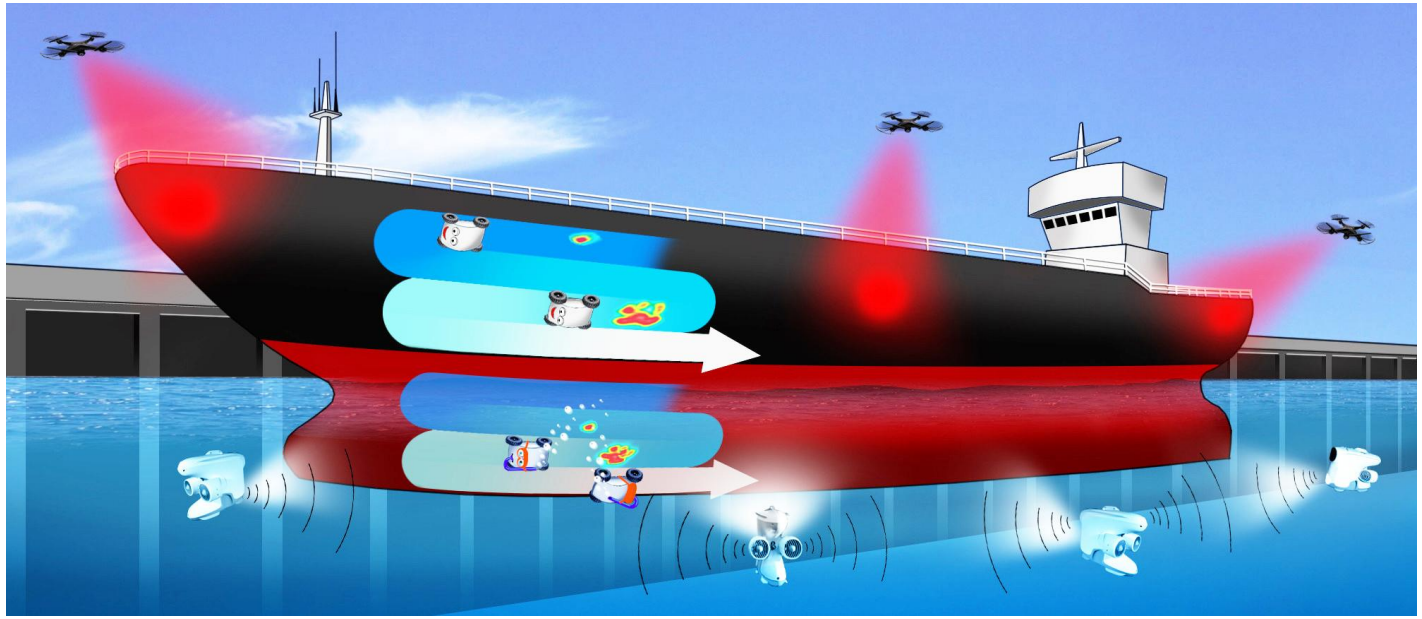
AFIA: Robotique et IA 2020

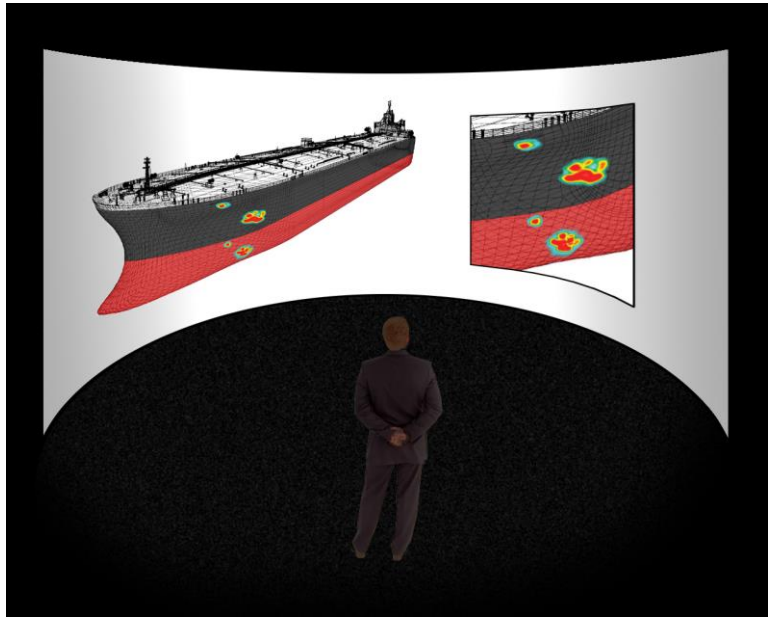
Cédric Pradalier – UMI 2958 GT-CNRS

# BugWright2: Overview

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 871260

# BugWright2: Autonomous Robotic Inspection and Maintenance on Ship Hulls and Storage Tanks





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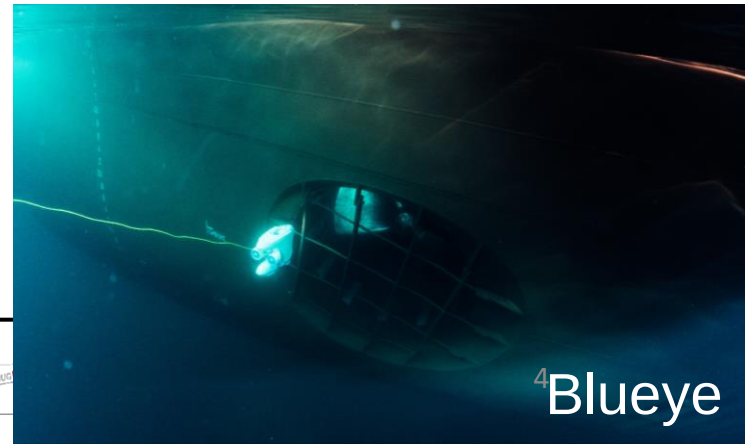
# Objectives

- Autonomous multi-robot operations on and around metallic structures: ship hulls and storage tanks
  - Inspection (visual and acoustics): impact on regulations
  - Cleaning: economic and environment impact
- Immersive interfaces and decision support for maintenance
- Pilot in harbors, shipyards and service provider to build a viable business model



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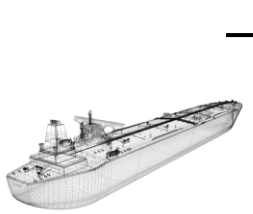
# Approach



Initialisation:

Laser Acquistion
Previous Model
Main Dimensions
CAD Model

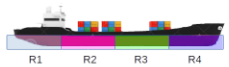
3D Data Sources

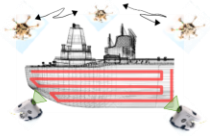
Step 1

Multi-Robot Task Allocation

Step 2

Mission Planning



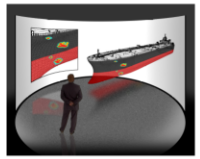
Step 3

Inspection Data Collection

3D Model Update

Autonomous Robot Navigation

Mission Monitoring and Data Review



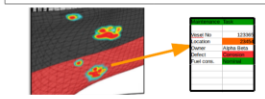
Autonomous Inspection

Hull Cleaning
Augmented Reality
Defect Marking

Maintenance

Step 5

Data Post Processing:
Secure Data Storage
& Actionable Data Generation



Step 4

LONG TERM PILOT

Teleoperated Surveys

Teleoperated Surveys
With Localization
With Localization Monitoring

Autonomous Surveys

Single Robot
Multiple Identical Robots
Multiple Different Robots
Full System Evaluated

M6
M12
M18
M24
M30
M36
M48

Localization WP4
Visualization WP7
Autonomous Navigation WP5
Multi-Robot Inspection WP6
Multi-Robot Inspection WP6

Homogeneous
Heterogeneous

R&D ACTIONS

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# Impacts

- On technology: demonstration of technologies for multi-robot deployment in a large-scale industrial problem
- On economy:
  - Autonomous cleaning leads to large scale fuel saving, lower service cost, no immobilization costs
- On (world-wide) regulations and safety:
  - Autonomous inspections regulated by certification agencies and World Maritime Organisation (UN)
- On environment:
  - Safer ships and storage tanks
  - Lower fuel consumption
  - Less need for antifouling

Blueye


Roboplanet

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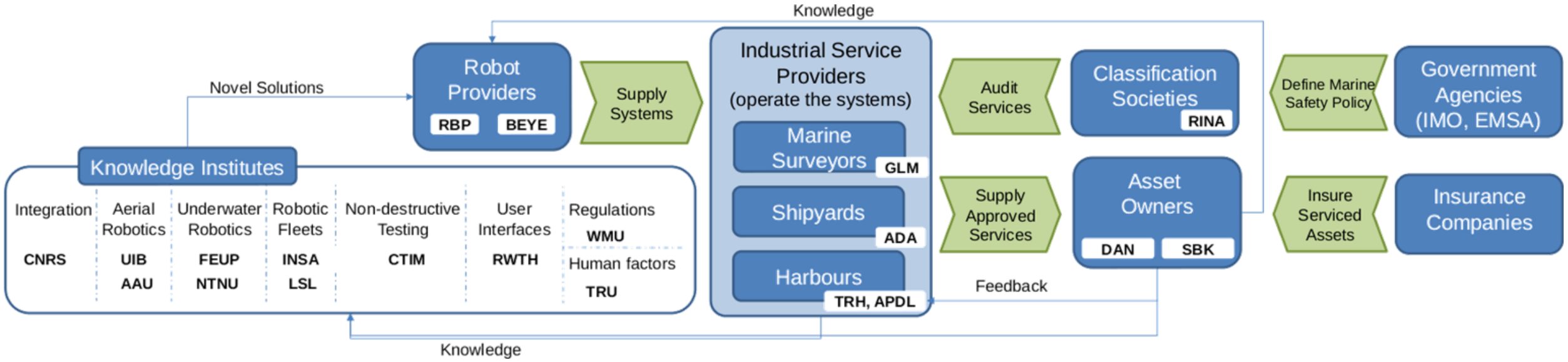
# BugWright2: Autonomous Robotic Inspection and Maintenance on Ship Hulls and Storage Tanks

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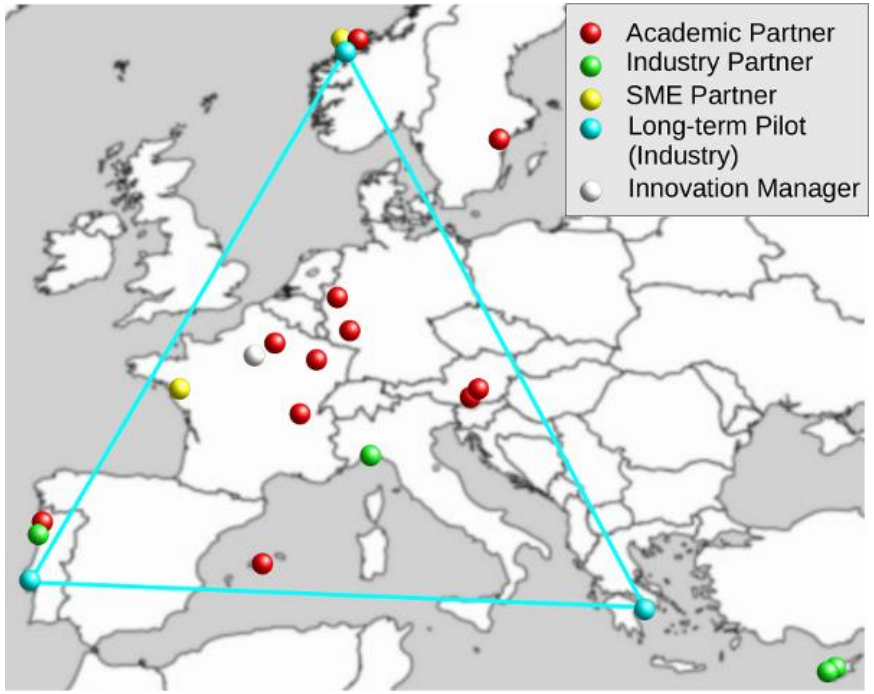
# BugWright2: Partners

- French Partners
  - CNRS UMI 2958 GT-CNRS: Coordination, Robotics & Acoustics – Cédric Pradalier, Nico Declercq
  - INSA Lyon: Multi-agent systems – Olivier Simonin
  - Roboplanet: Inspection Crawlers
  - CETIM: Inspection technologies
  - In Extenso Innovation: Innovation Managemnent

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# Innovation Action

- Development of the technologies towards a clearly defined application
- Development of demonstrators
- Short path to market, strong industrial implication, less fundamental research
- Field Robotics

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# Inspection of Ships and Tanks

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# Robotic Inspection of Ships and Tanks: Magnetic Crawlers


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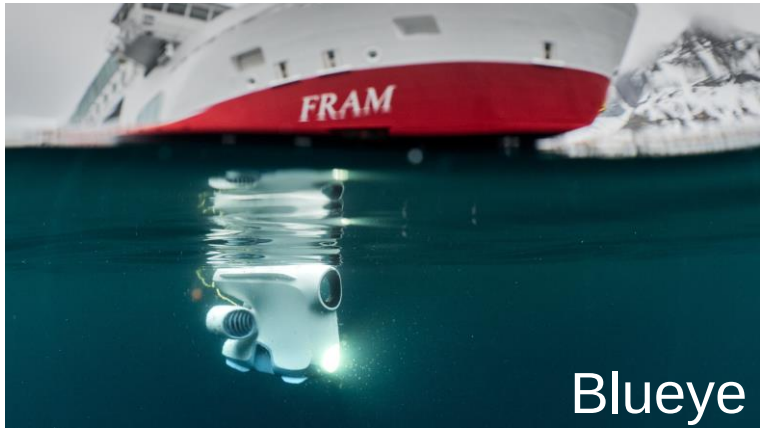
# Inspection of Ships: Submerged Hull

Blueye




Blueye

Blueye

Roboplanet

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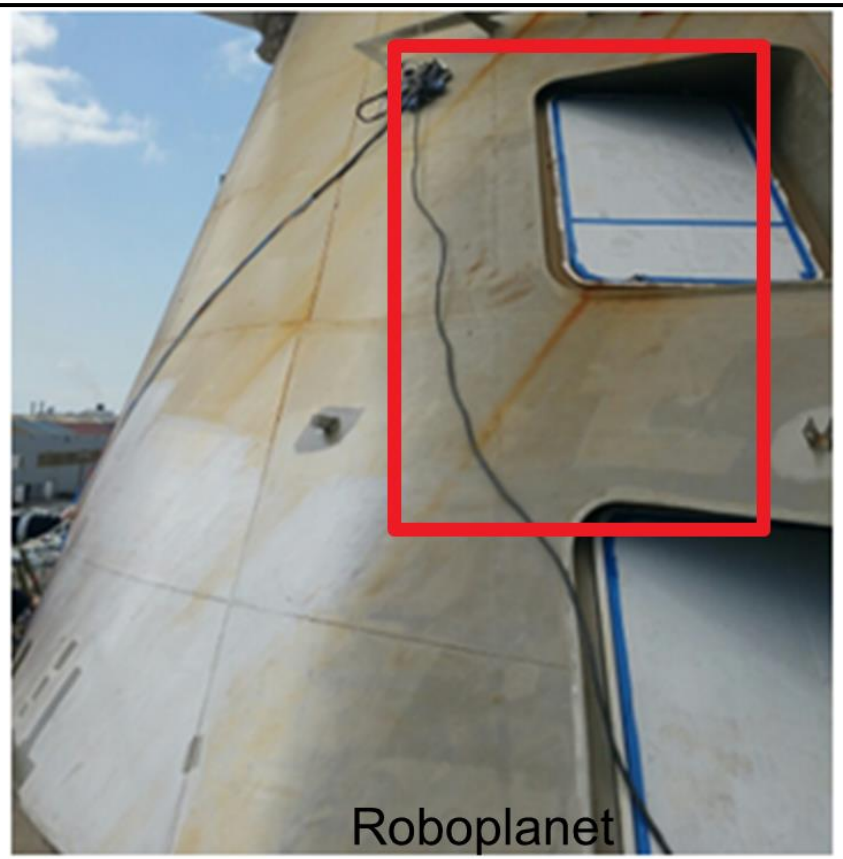
# Inspection of Ships: Cleaning




Before

After

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