



# A CAPIAS Case Study: Developing Resilient Seabed Infrastructures through Strategic Offshore and Underwater asset Protection in order to assist Decision-Making

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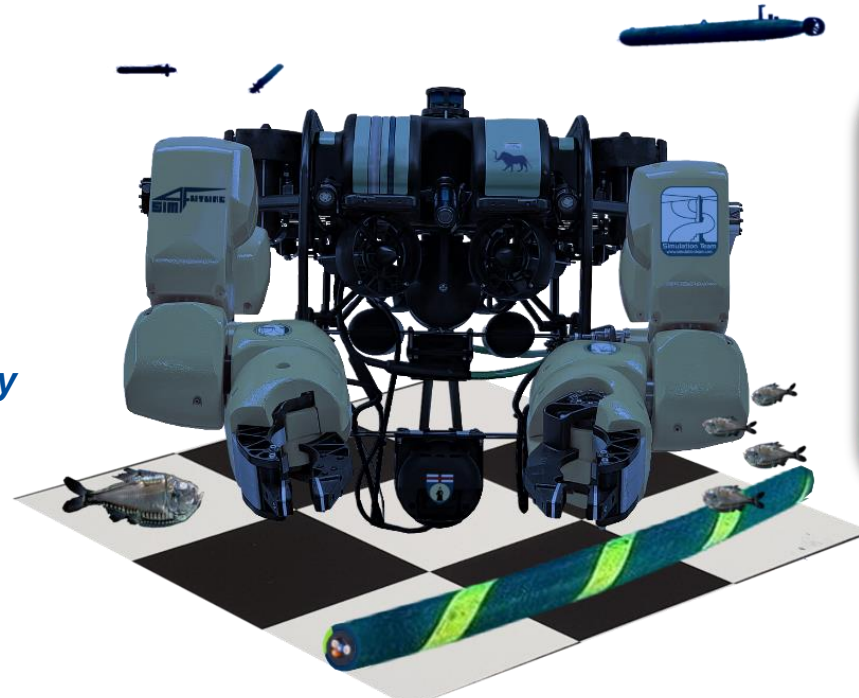
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# Fighting under Water for Strategic Assets: CAPIAS

*CAPIAS CAbles, Pipelines, marine Infrastructures & Autonomous system: protection & Simulation*

**CAPIAS** is a Solution using M&S, AI and XR for Protection of Critical Infrastructures such as UW Fields, UW Cables and Pipelines, Off-Shore Platforms, Wind Farms) respect Different Assets (e.g. Autonomous, Cyber and Conventional Assets) both as Threats and Defenders operating over Multiple Domains



**CAPIAS<sup>®</sup> uses extensively XR, AI, M&S and 3D Printing**



UW Underwater AI Artificial Intelligence

M&S Modeling & Simulation XR Extended Reality

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# CAPIAS & *Strategic Engineering* for Marine Infrastructure Protection

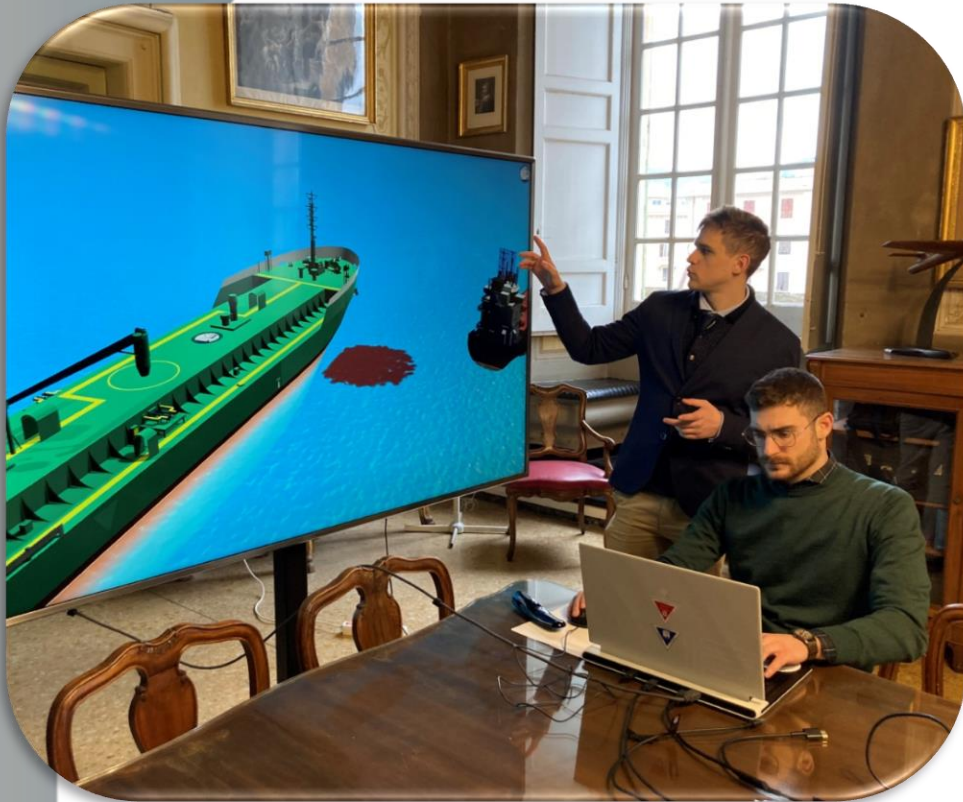


CAPIAS adopts *Strategic Engineering*: the new discipline supporting Decision Makers by combining the use of M&S, AI, Data Analytics in closed loop with Big Data from the field over Complex Systems

*Strategic Engineering* Solutions, such as CAPIAS, allow to Develop & Test: Ideas, Concepts, Tactics & Strategies, new Systems and even Decision Mindsets

**STRATEGOS** is the new International Initiative in this sector by Simulation Team, Genoa University in synergy with SIM4Future and many others Entities

M&S Modeling & Simulation AI Artificial Intelligence OSINT Open Source Intelligence



# Strategies & Strategic Engineering

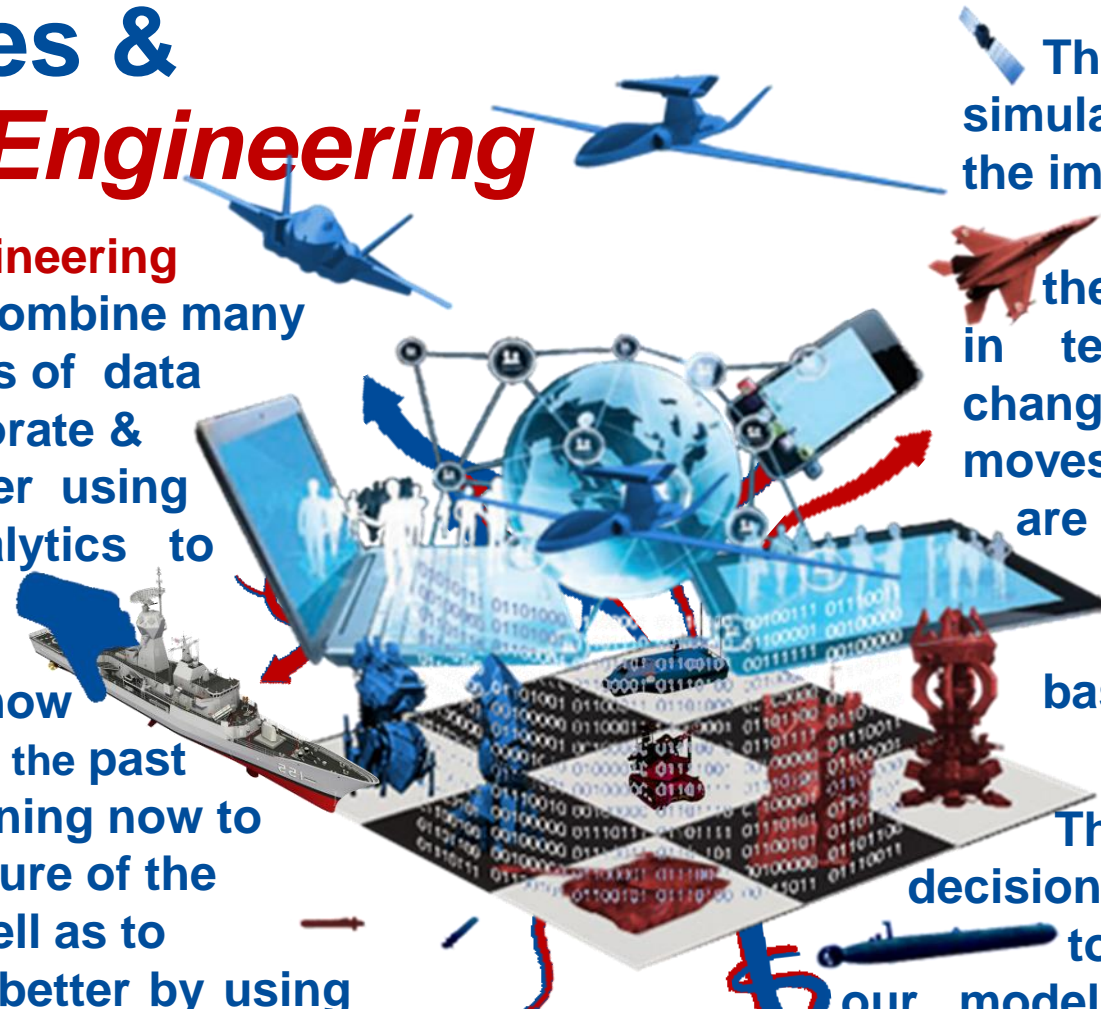
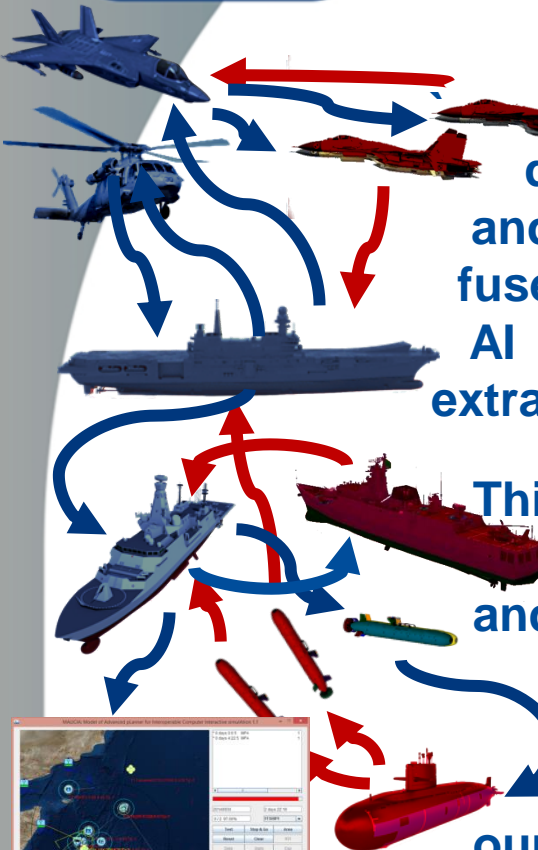
**Strategic Engineering** allows to combine many different sources of data and to clean, elaborate & fuse them together using AI and Data Analytics to extract information

This allow us to know what happen in the past and what is happening now to get a good picture of the present as well as to understand it better by using our up-to-date Models & AI

The Models are used to simulate the situation and the impact of our decisions but also to consider the possible alternatives in terms of situation changes and other players moves. So the Decisions are made with benefits of Results of Simulation & Smart Systems based on AI

The real impacts of our decisions on the field allows to dynamically refine our models & hypotheses by using advanced Machine Learning Techniques

AI Artificial Intelligence



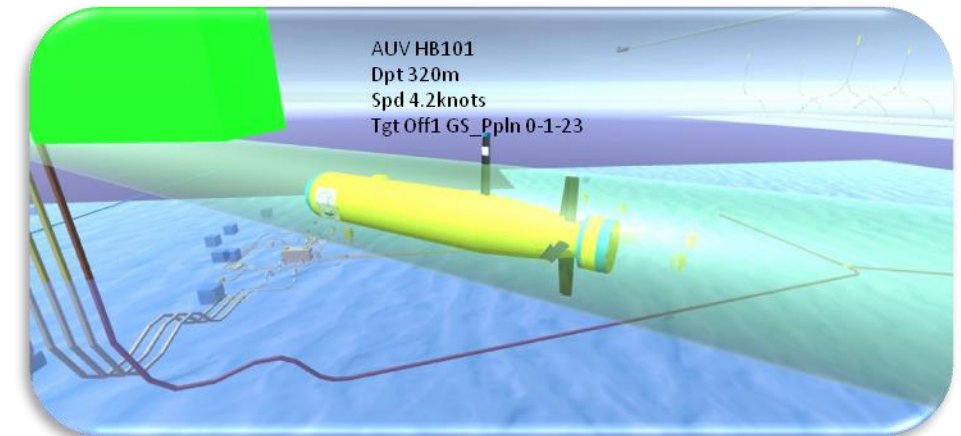




# Turning Depth Darkness into Clear View: from Data to Information



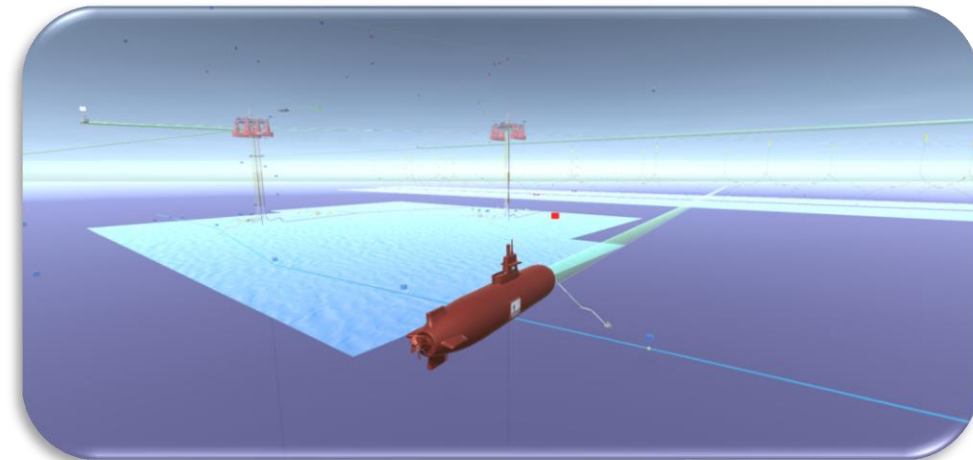
XR, combining AR & VR, makes intuitive the elaborations provided by Data Analytics & Fusion, AI and Models. In CAPIAS, it is possible to move from Data, originated from Heterogeneous Networks, Sensor Grids & Digital Systems, with all their *Inconsistencies & Problems*, up to extract Valuable Information and create a *Clear View*





# ...from *Fog of War* to *Battlefield Awareness*

Potential Threats, from Antagonists to Anchor Strikes, from Storms to Seismic Activities, are pretty hard to be identified and assessed. CAPIAS analyses, evaluates and proposes most effective Protective Solutions and Actions comparing them by using Modeling, Simulation, IA and AI

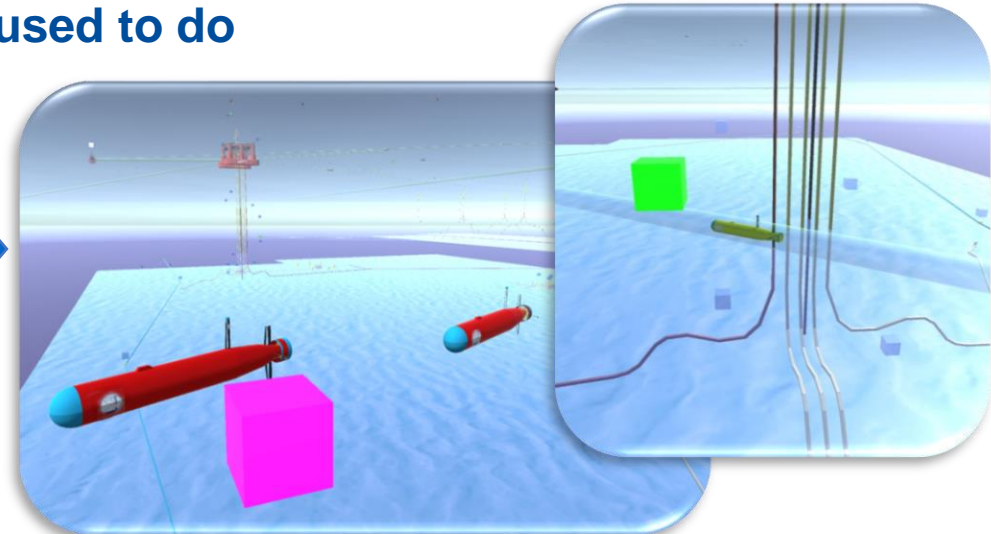
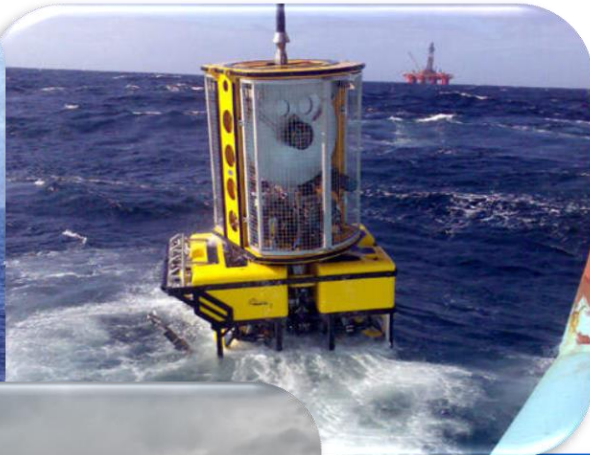






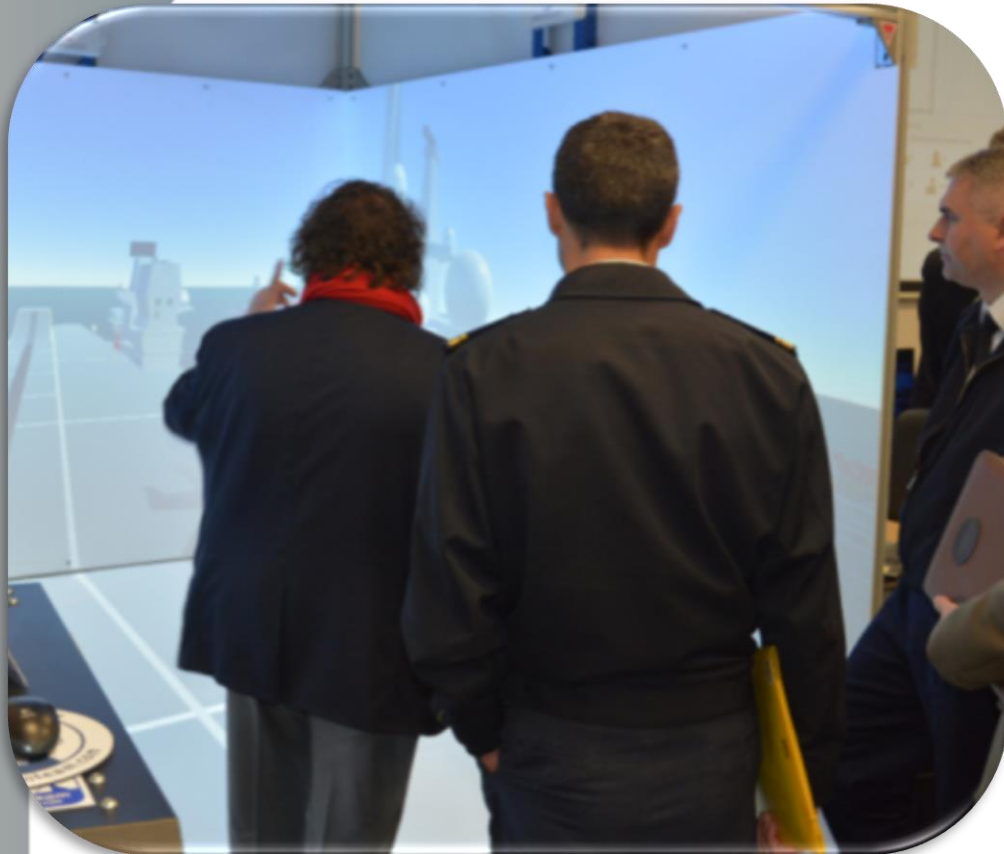
# ...from Information about what is ongoing to Models & Simulations to Know what to do

The key to Win on Strategic Issues is the ability to understand what happen and what is on going, but even more the ability to enrich this Information by developing Knowledge on best Decisions evaluated by Models & Simulation in terms of Impacts & Risks considering also Actions, Reactions & Interactions as CAPIAS is used to do

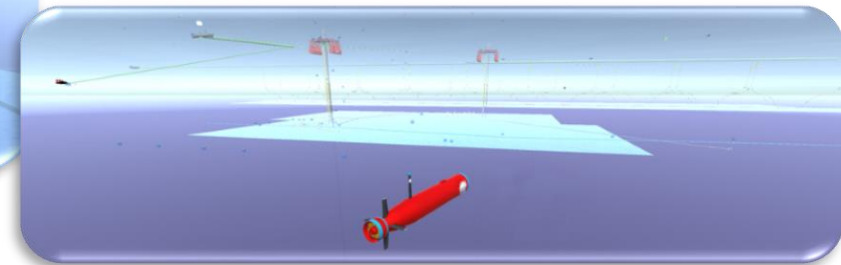
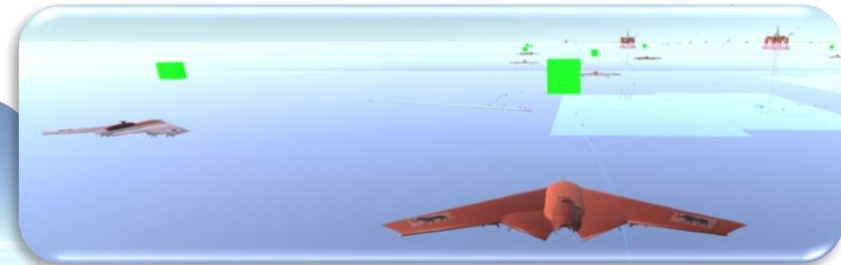
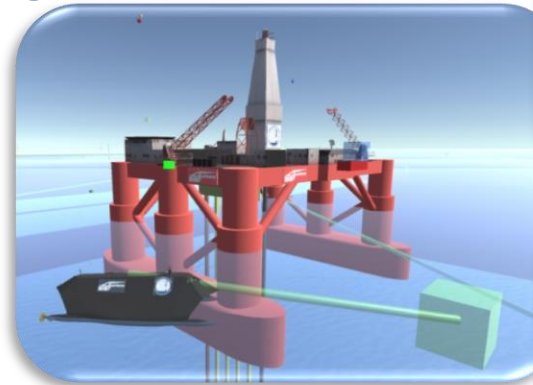




# Information and Knowledge allow to develop Wisdom through the Human & AI Synergies



CAPIAS adopts **Strategic Engineering** Approach, so it allows to close the loop by developing Synergies with Decision Makers, Commanders, Executives and Engineers. AI and M&S create a Knowledge that, by interacting with Humans, lead to Wisdom necessary for achieving Strategic Victory, real Resilience and supporting Prevention & Mitigation of new Threats



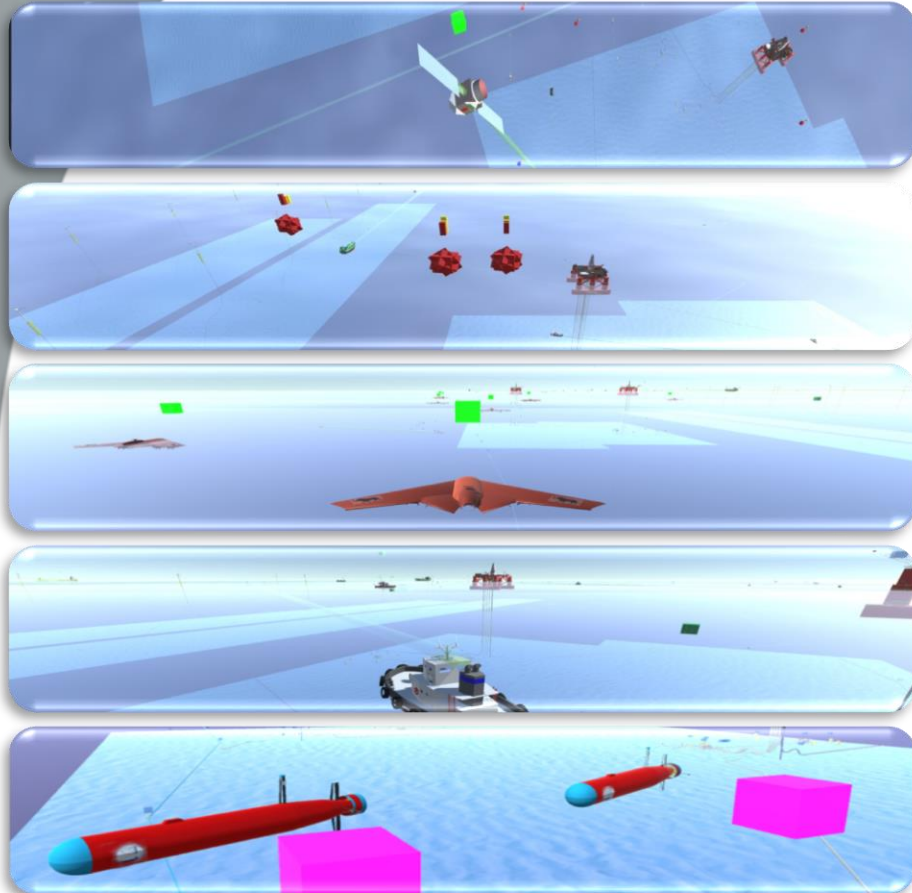




# CAPIAS: multiple Domains & Threats

**CAPIAS** is able to operate over multiple Domains including Sea Surface, Underwater World, Air, Coastal Areas, Space & Cyber Space. The Entities and Networks are correlated and the alternative choices & actions, such as Hybrid Threats, could be evaluated in terms on impacts on different layers such as:

- downgrading Acoustic Modem Communications could lead to avoid Awareness on Underwater Detections
- Compromising ICT System Integrity could lead to inability to react or GPS spoofing could transform a Cargo Ship into a *torpedo* against a Wind Farm
- Swarms of UAVs and AUVs could coordinate an attack to Oil & Gas Infrastructures in synchrony with a Cyber Attack
- Contamination of the Food Chain for Off-Shore Platforms
- Menaces to data cables generated by ROV or Divers as well as by simple medium size boats towering Seabed Threats

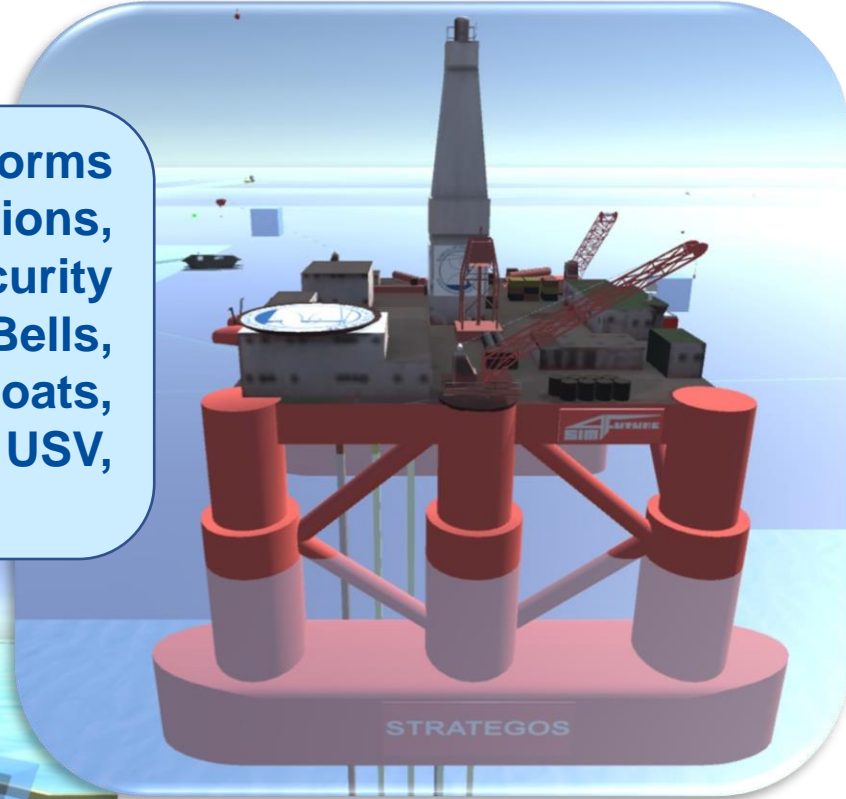




# CAPIAS: Off-Shore Platforms & Fields



The Simulated Platforms include communications, Cyber Layer, Security Resources, Diving Bells, Divers, Support Boats, ROV, AUV, UUV, USV, UAV, Helicopters, etc.



**CAPIAS** reproduces Off-Shore Platforms, FPSO and UW Fields with their Service Requests, Failures as well as support Assets and could be affected by Natural & Human Hazards

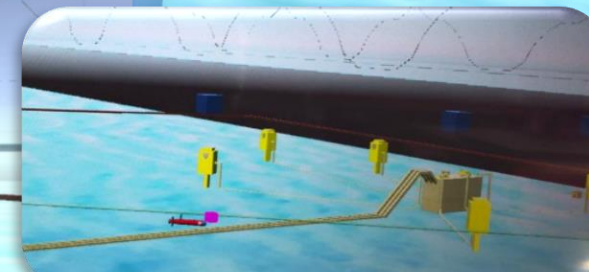
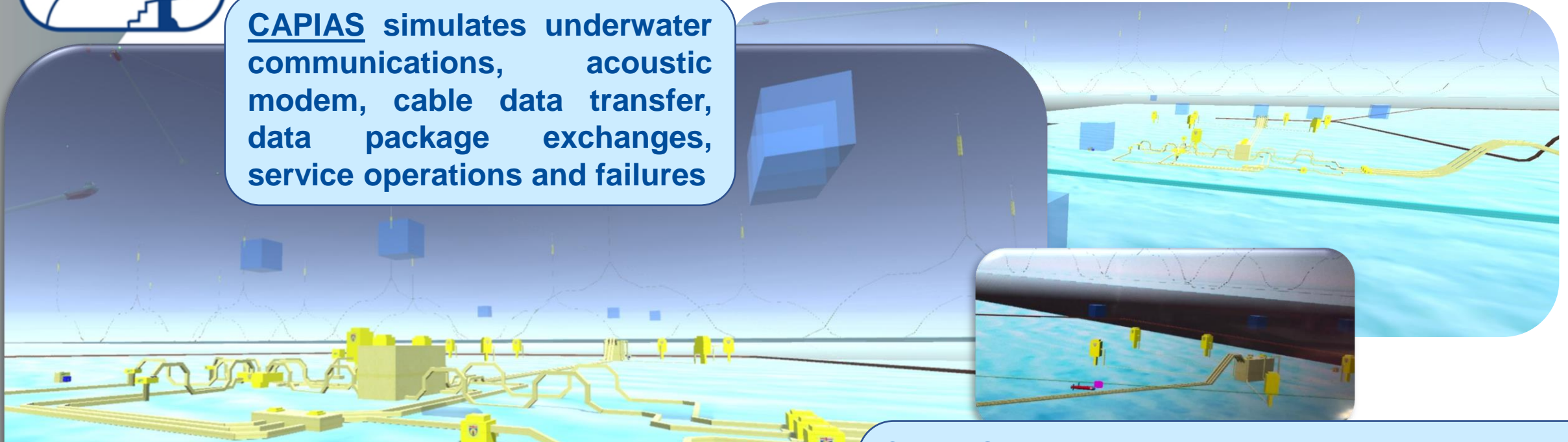
- AUV Autonomous Underwater Vehicle
- ROV Remotely Operated Vehicle
- UAV Unmanned Aerial Vehicle
- USV Unmanned Surface Vehicle
- UUV Unmanned Underwater Vehicle



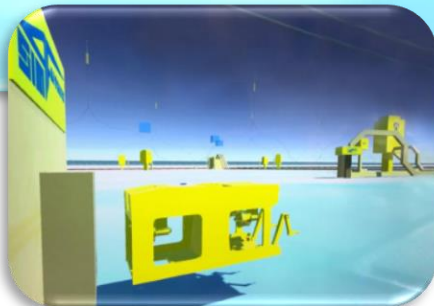


# CAPIAS: Underwater Fields & Pipelines

**CAPIAS** simulates underwater communications, acoustic modem, cable data transfer, data package exchanges, service operations and failures

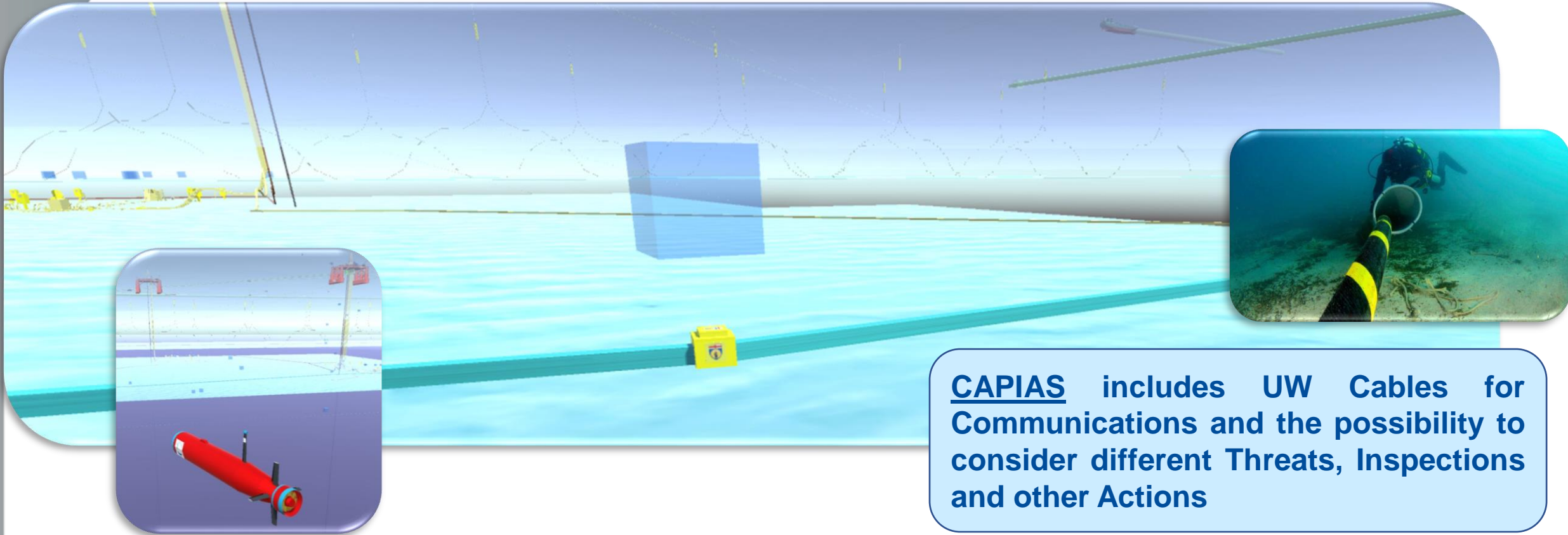


**CAPIAS** includes among Underwater Assets such as Oil & Gas Pipelines, UW Fields with their requests to carry out Inspections, Service and Maintenance Plans as well as to simulate impact of Accidents and Antagonist Actions





# CAPIAS: UW Data Cables as Strategic Asset



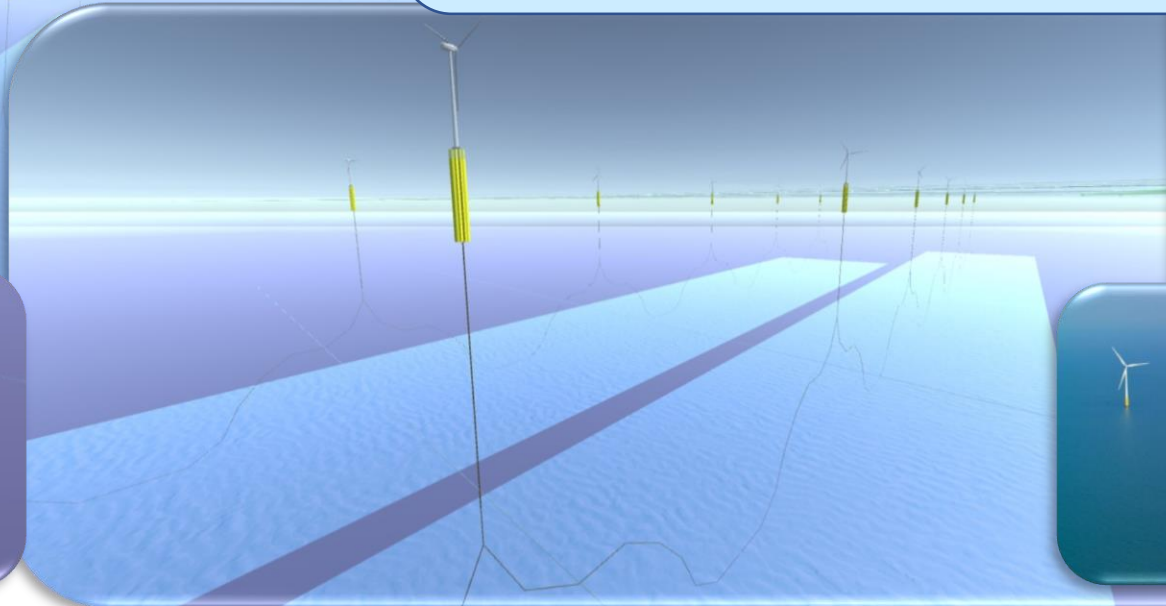
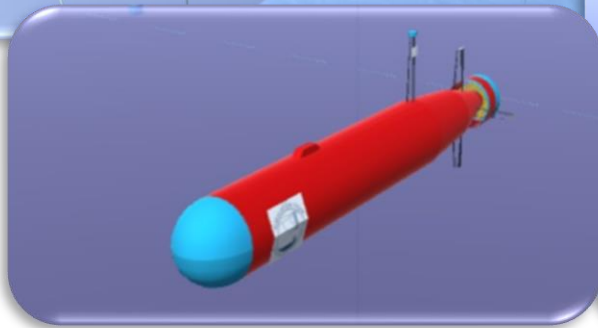
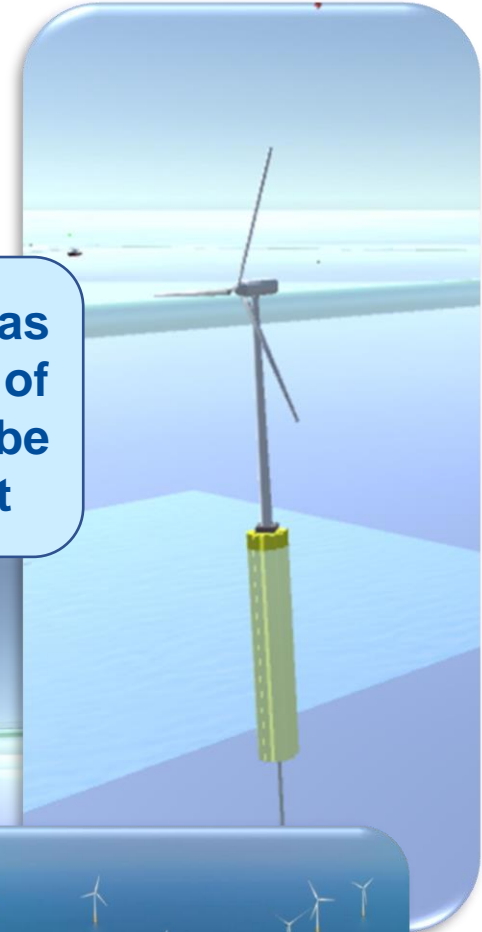
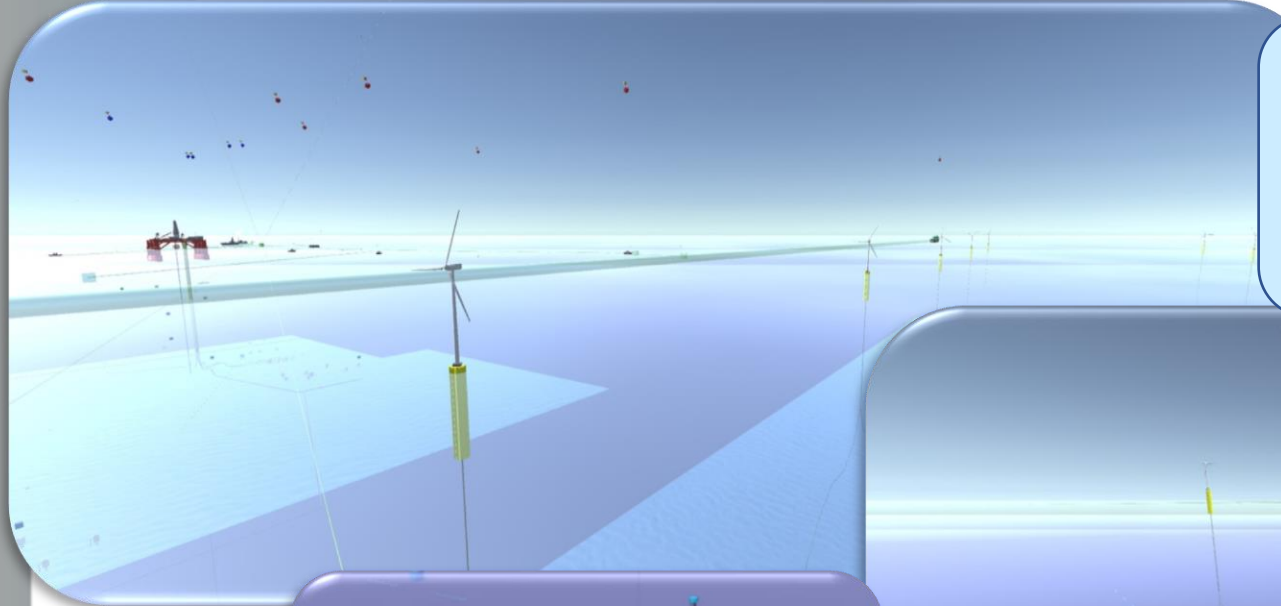
**CAPIAS** includes UW Cables for Communications and the possibility to consider different Threats, Inspections and other Actions





# CAPIAS: Marine Energy Assets

Marine Energy Sources such as Off-Shore Wind Farms are part of CAPIAS Scenario to be considered as Assets to Protect





# CAPIAS: Boats



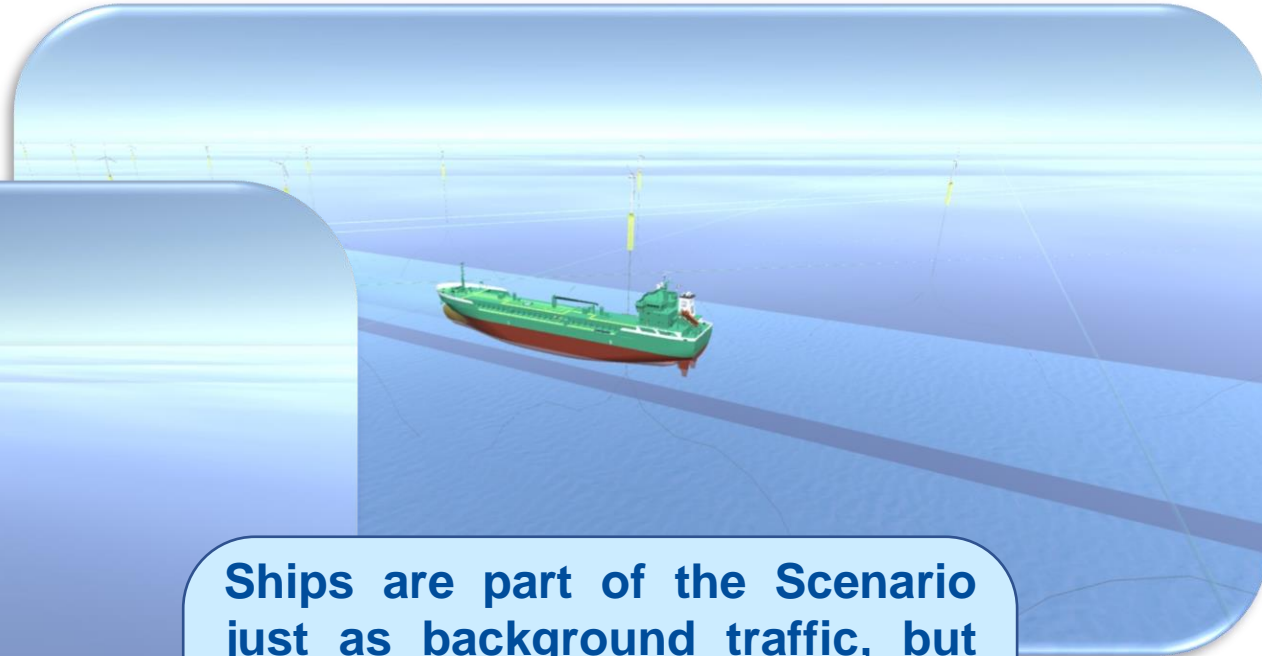
Different Support Boats and Vessels including carriers for Diving Bell, ROV and other supports are part of the scenario as well as other surface entities external to Off-Shore Operations, but crossing the area







# CAPIAS: Ships



**Ships are part of the Scenario just as background traffic, but even as potential threats due to cyber actions such as GPS spoofing, hijacking or simple accidents due to failures or improper anchoring**





# CAPIAS: Persistent Protection by UxV

Innovative Solutions and Proposals for guarantee persistent surveillance and proactive readiness are part of the CAPIAS simulation. For instance it is reproduced a collaborative use of Autonomous Systems: an USV SWATH with a revolver carrying 3 AUV and a Catcher to recover them in critical conditions and hold on his belly



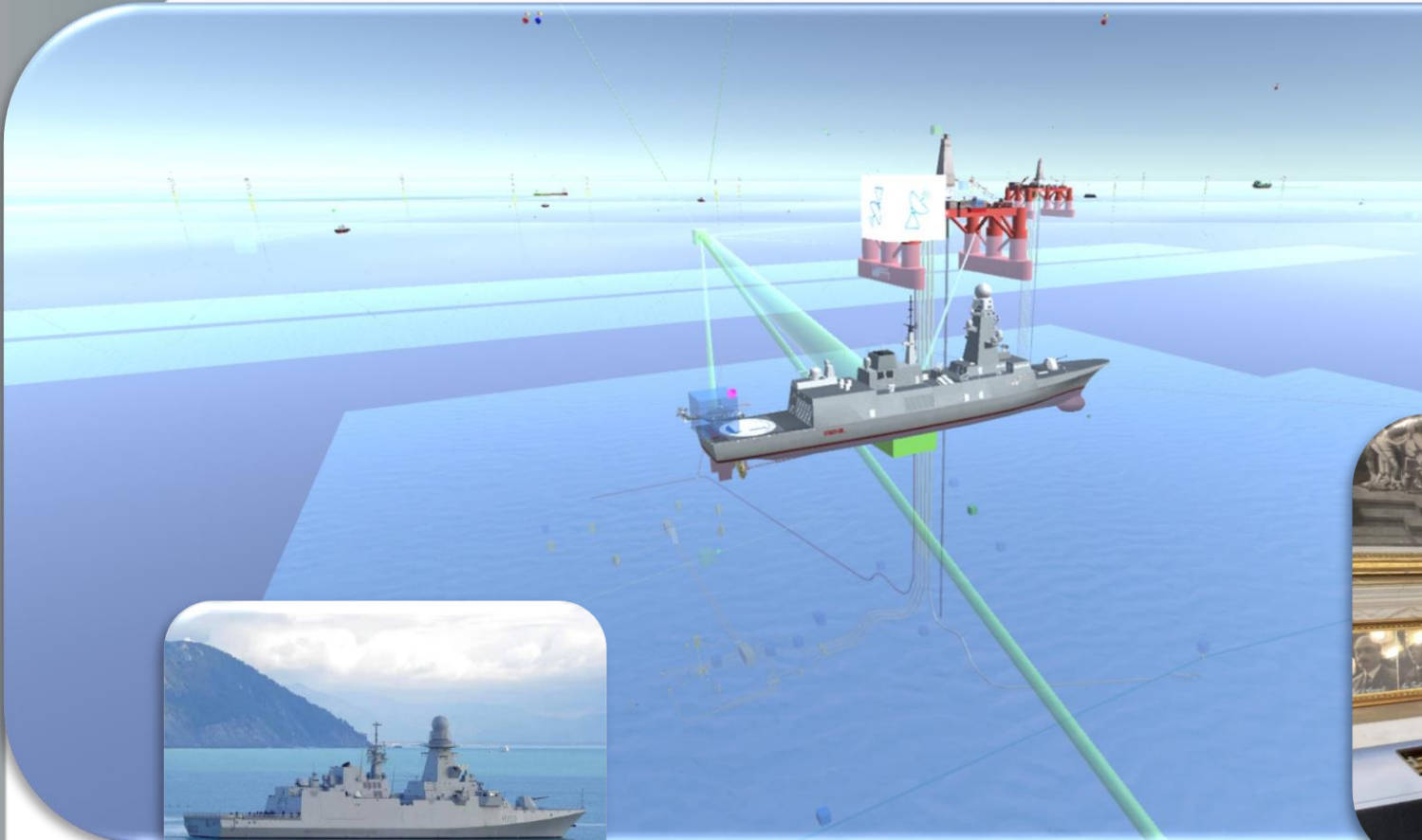




# CAPIAS: Vessels

Navy Vessels are part of CAPIAS Scenario with their capability to defend the Marine Strategic Assets directly as well as in cooperation with other entities.

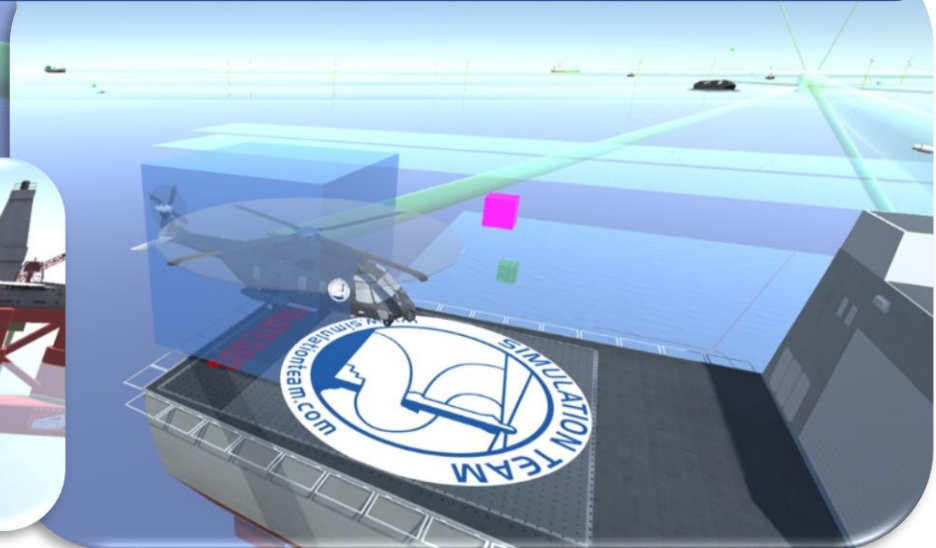
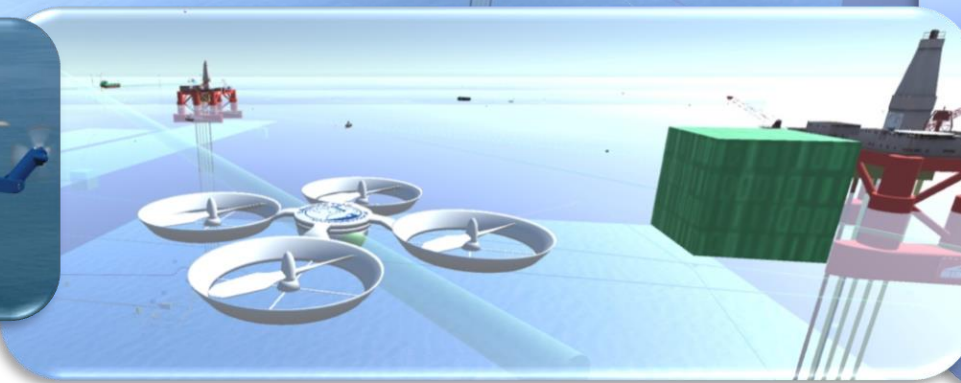
Users can assign orders also interacting with 3D Printed Models by XR and AR Goggles





# CAPIAS: Helicopters & Drones

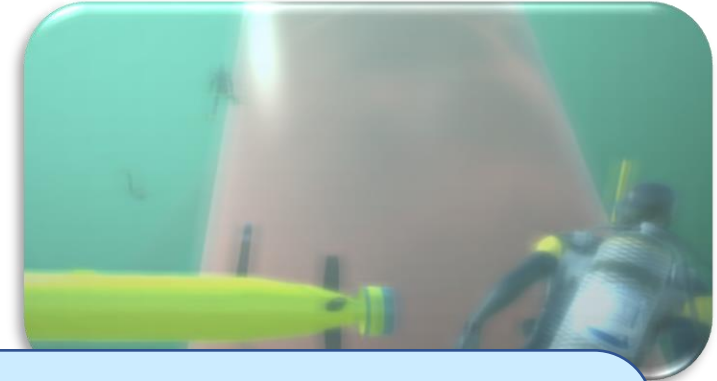
CAPIAS includes simulation models of Helicopters and Drones for Off-Shore Operations as well as Naval Force Assets such as Rotary Wing Aircrafts and fixed wing UAV



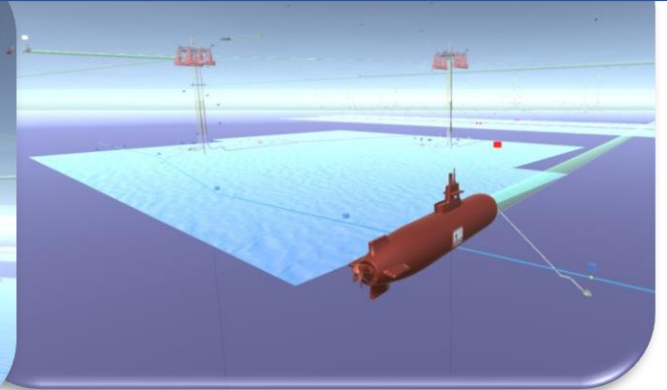
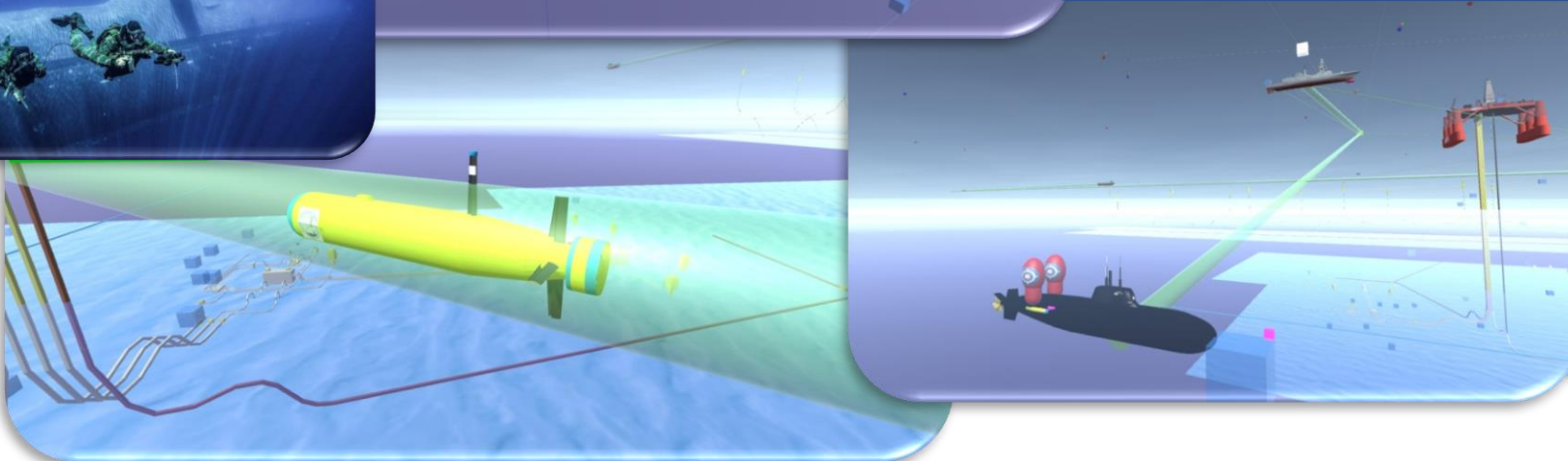
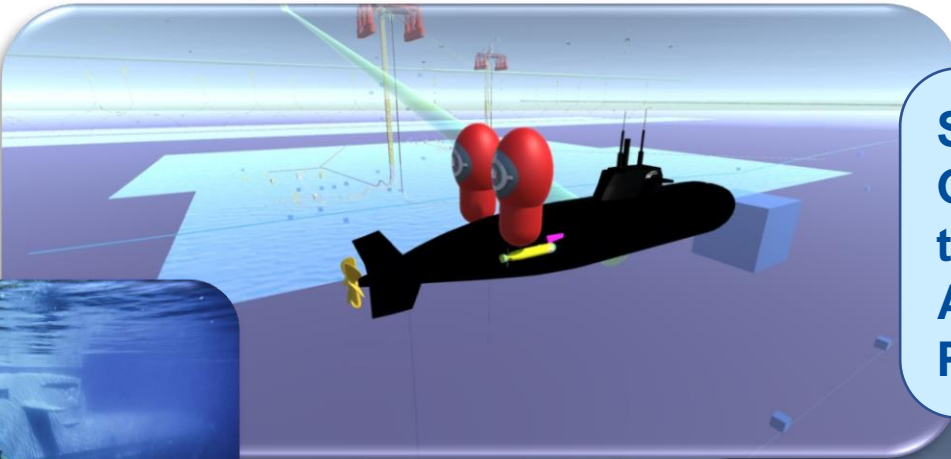




# CAPIAS: Submarines



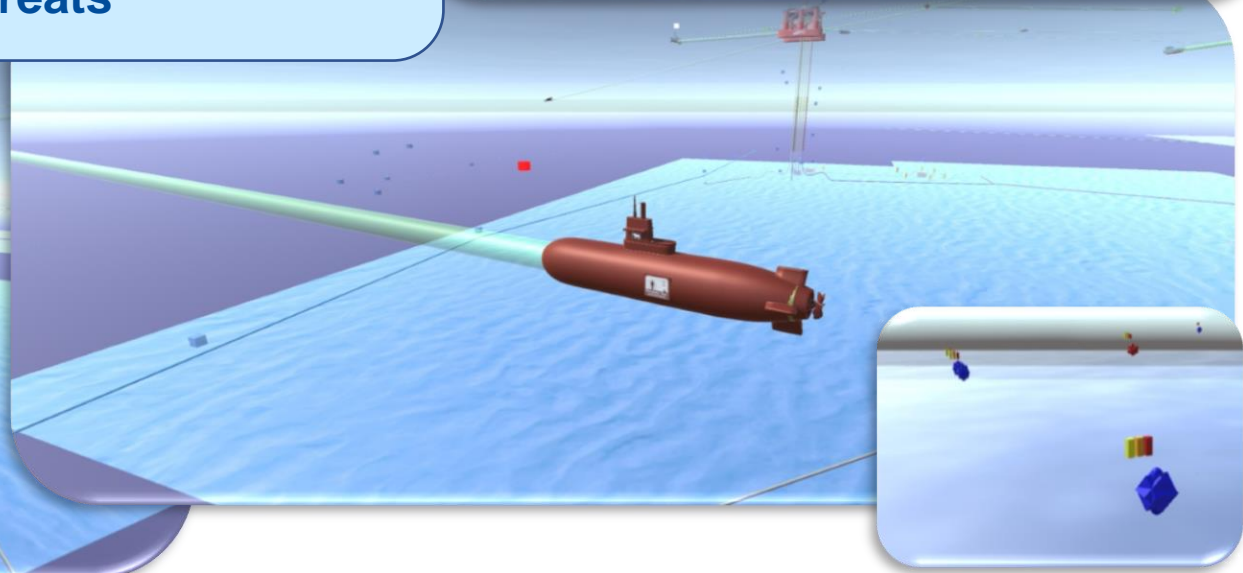
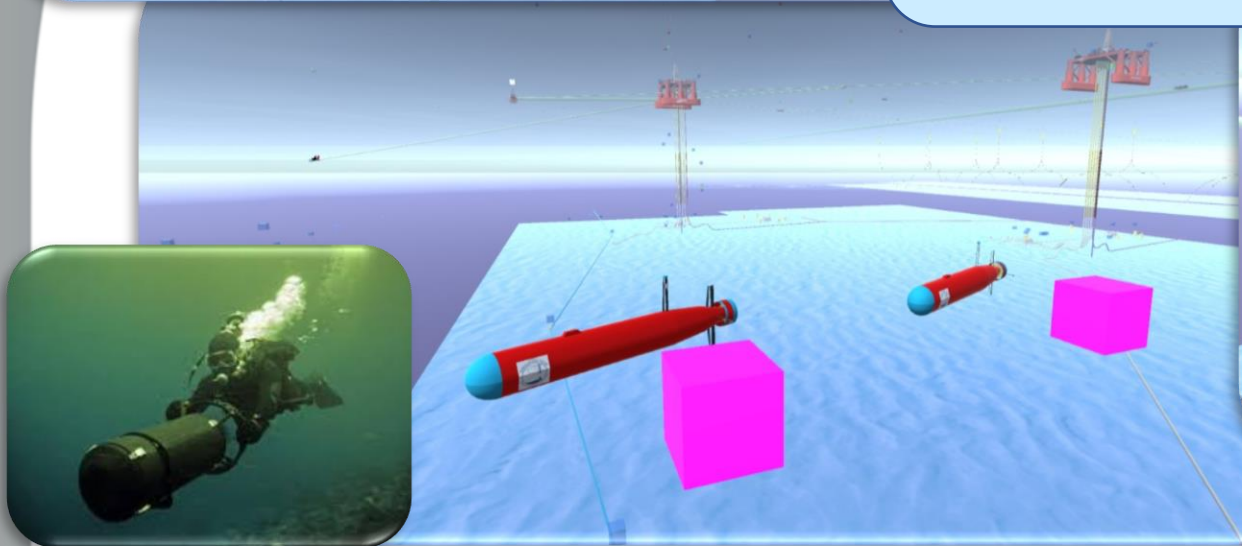
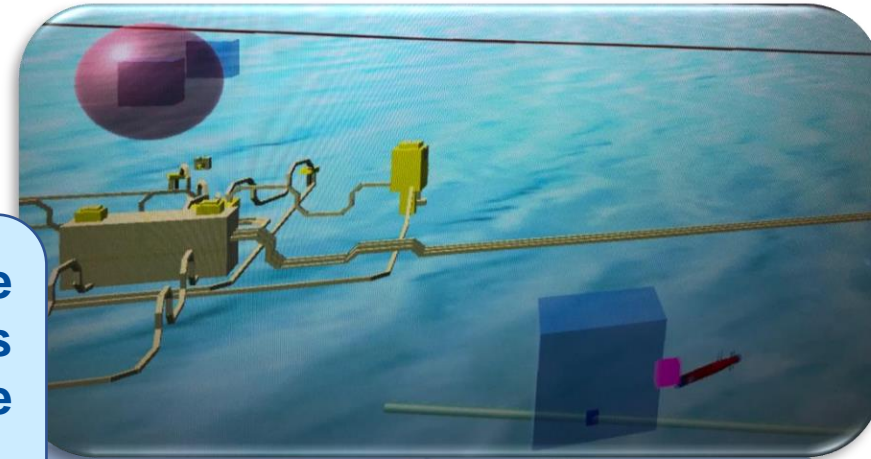
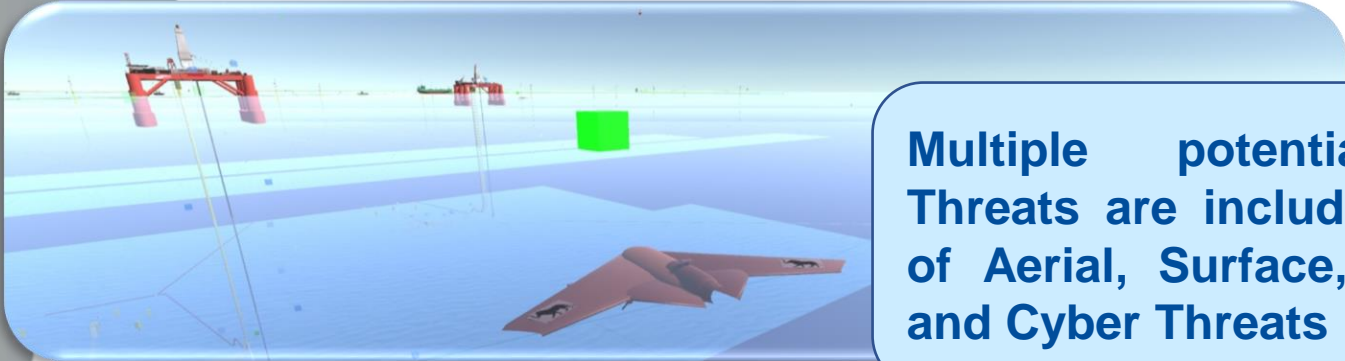
Submarines, Autonomous Systems and UW Sensor Grids are part of CAPIAS and could be operated also to investigate solutions for delivery and recovery AUV as well as to face challenges related to Protection of Strategic Marine Assets





# CAPIAS: Hostile Threats

Multiple potential Hostile Threats are included in terms of Aerial, Surface, Submarine and Cyber Threats



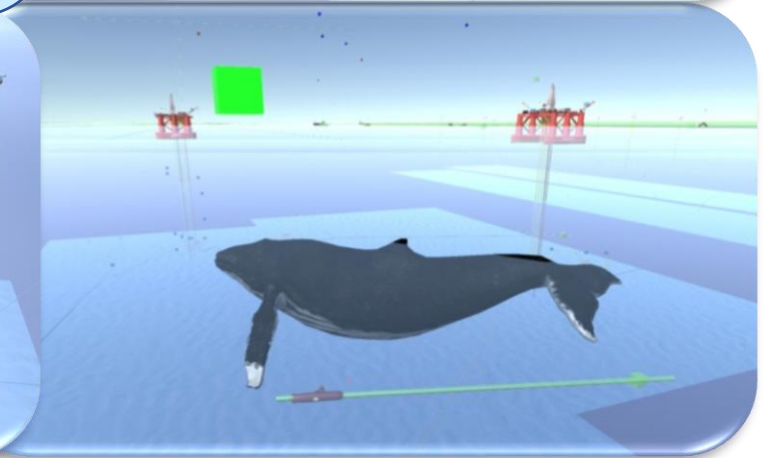
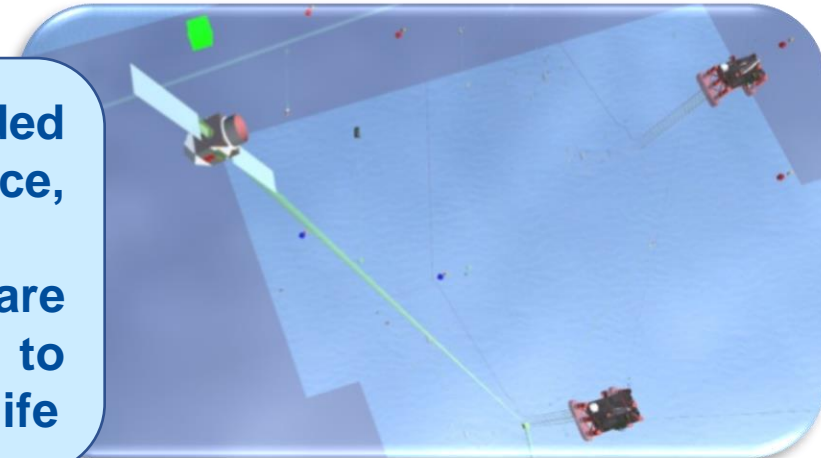




# CAPIAS: Complex Scenario on 6 Dimensions

**CAPIAS** reproduces a complex scenario considering the Extended Maritime Framework (EMF) covering dimensions: Sea Surface, Underwater, Coast, Air, Space and Cyberspace.

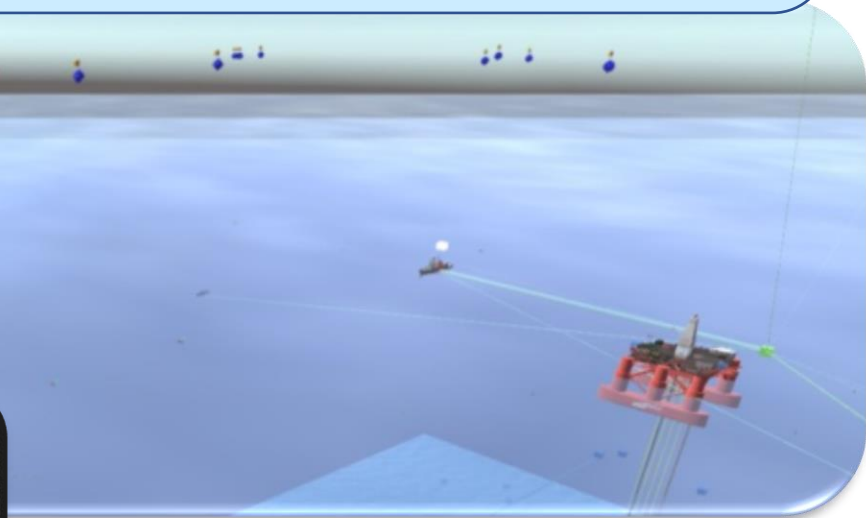
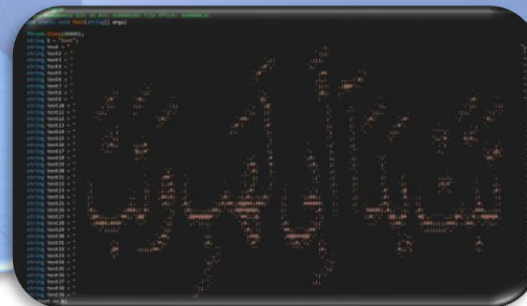
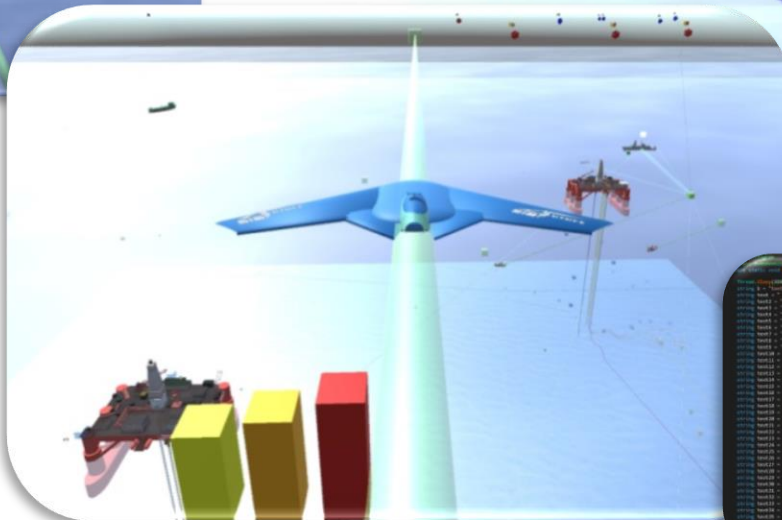
Satellite and Cyber elements are reproduced and in the Scenario are included even external elements that could create confusion or need to be protected are present (e.g. general traffic, recreational craft, marine life)





# CAPIAS: Cyber & Comms

CAPIAS Simulates the Communication over Heterogeneous Networks (e.g. Acoustic Modems, RF, Skynet, Link 16, etc.). All entities and elements have their Cyber Correspondent and are interconnected considering their Availability, Integrity and Confidentiality as well as the Cyber Ware actions to defend or compromise dynamically these characteristics

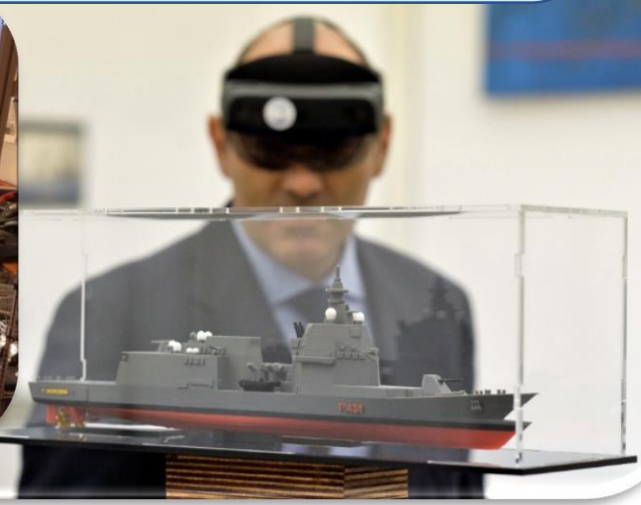
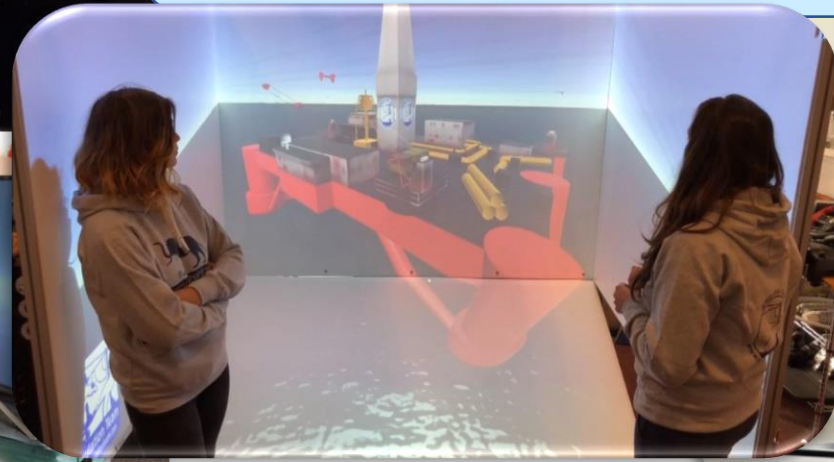






# CAPIAS: 3D Printed Interactive Assets by XR

The Simulation could be accessed on Workstations, SPIDER CAVE, as well as on Smart Phones and XR for Augmented Reality to interact even with Physical Model obtained by 3D Printing of Vessels and Oil Platform in scale, all immersed within the same Virtual Interactive World



CAVE Cave Automatic Virtual Environment  
SPIDER Simulation Practical Immersive Dynamic Environment for Reengineering  
3D Three Dimensional



## Summarizing

**CAPIAS** is a very innovative and new approach to create intuitive and interactive multi domain scenarios addressing the vulnerability and maintainability of strategic marine assets. This support tool is based on **Strategic Engineering**.

The extensive use of XR, M&S and AI/IA allows to test virtually new solutions, including new assets, concepts, procedures and strategies considering their respective feasibility, efficiency, effectiveness, reliability & robustness as well as resilience

