



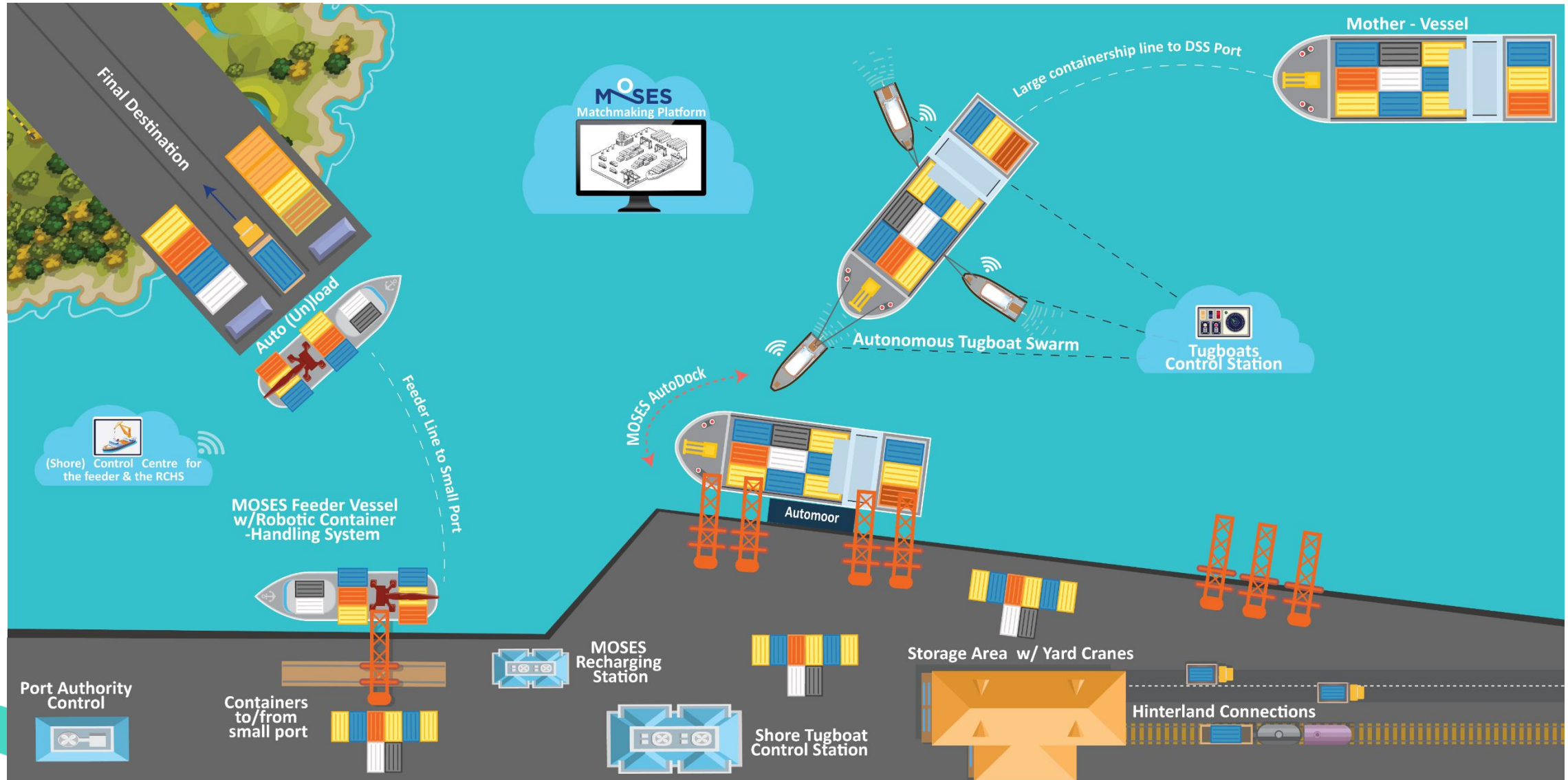
MARIN Pilot Demonstration

Robotic Container Handling System

TNO innovation
for life

Hans van den Broek

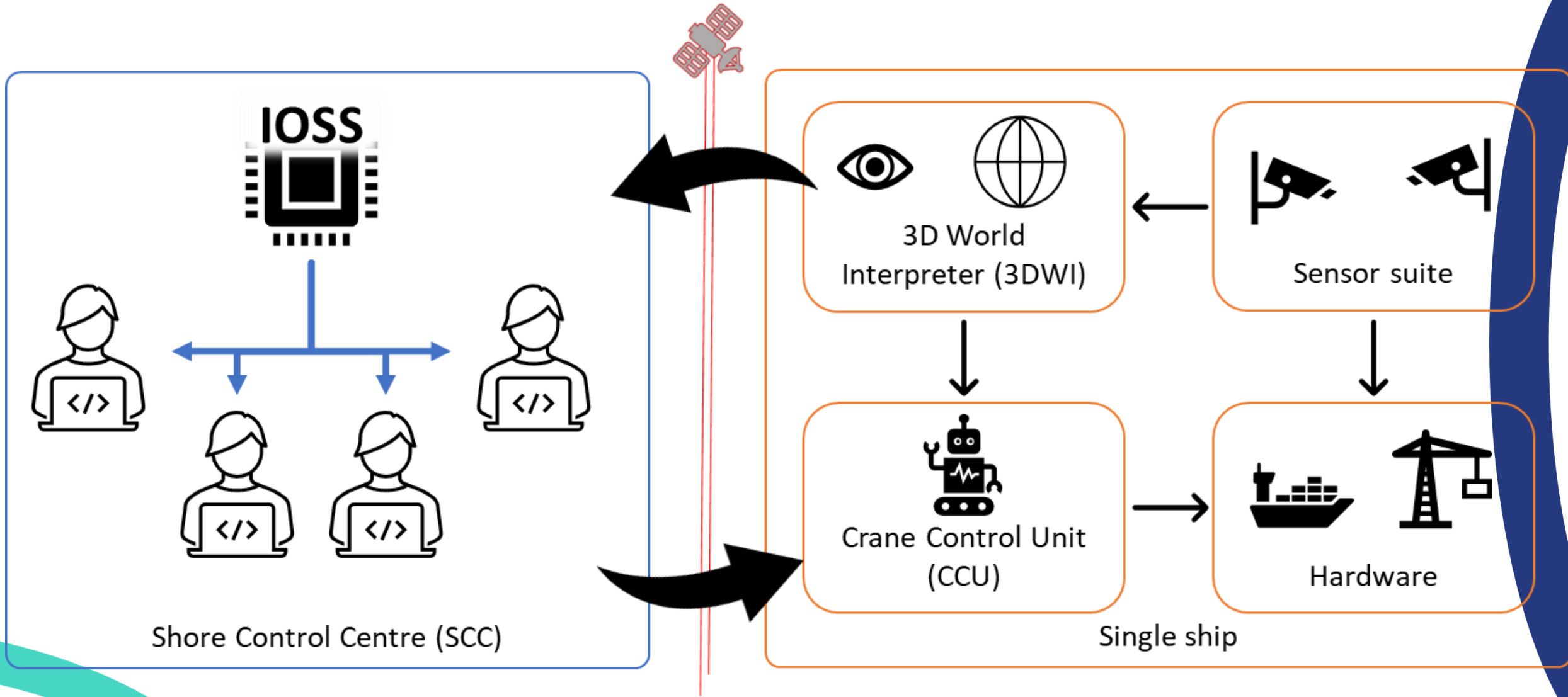
Frank ter Haar



Port of Rotterdam, NL



Port of Mykonos, Greece





MARIN Pilot Demonstration

3D world interpreter

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Frank ter Haar

How to saveguard the persons and objects from the crane and vice versa?
How to locate the container in the order list?



- **3D World Interpreter functionalities**

- **F1 Sensor Suite Design**

- **F2 Object recognition and 3D reconstruction algorithms**

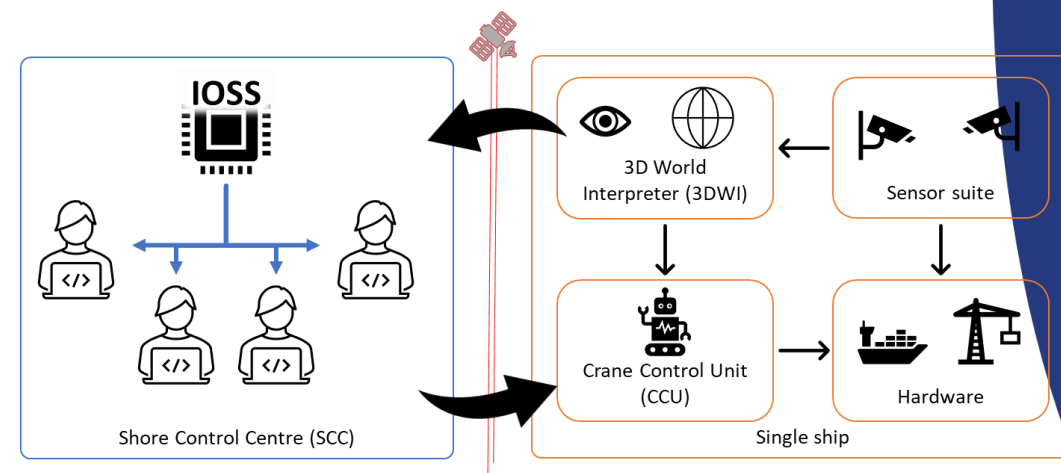
- initial 3D world to CCU

- initial 3D world to IOSS

- **F3 Safeguarding crane and humans**

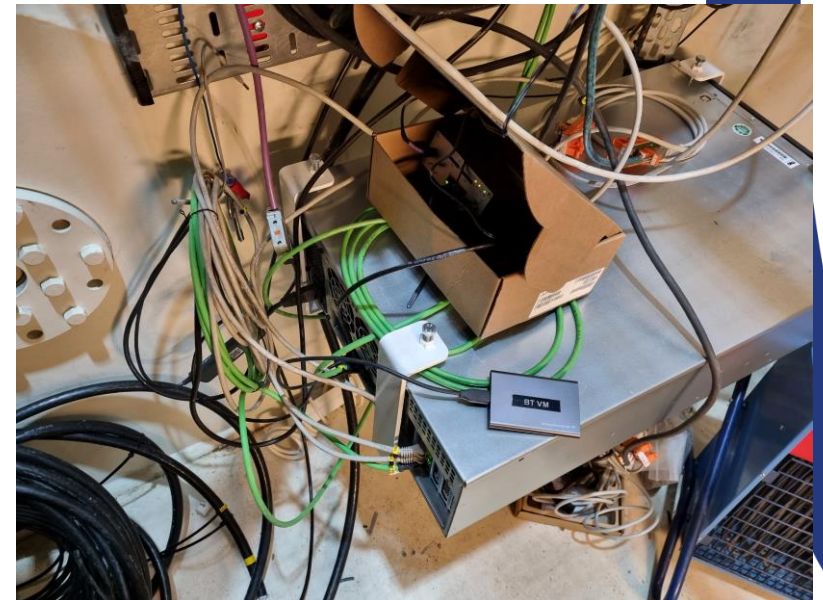
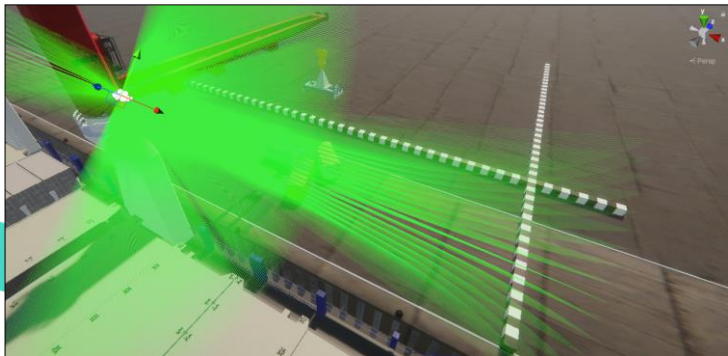
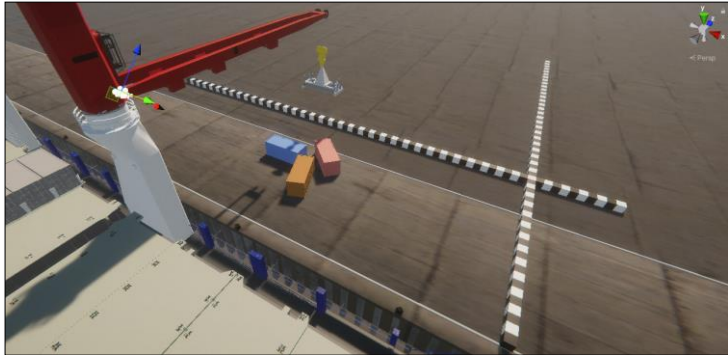
- live red-alert to CCU emergency stop

- live alerts and CCU info to IOSS



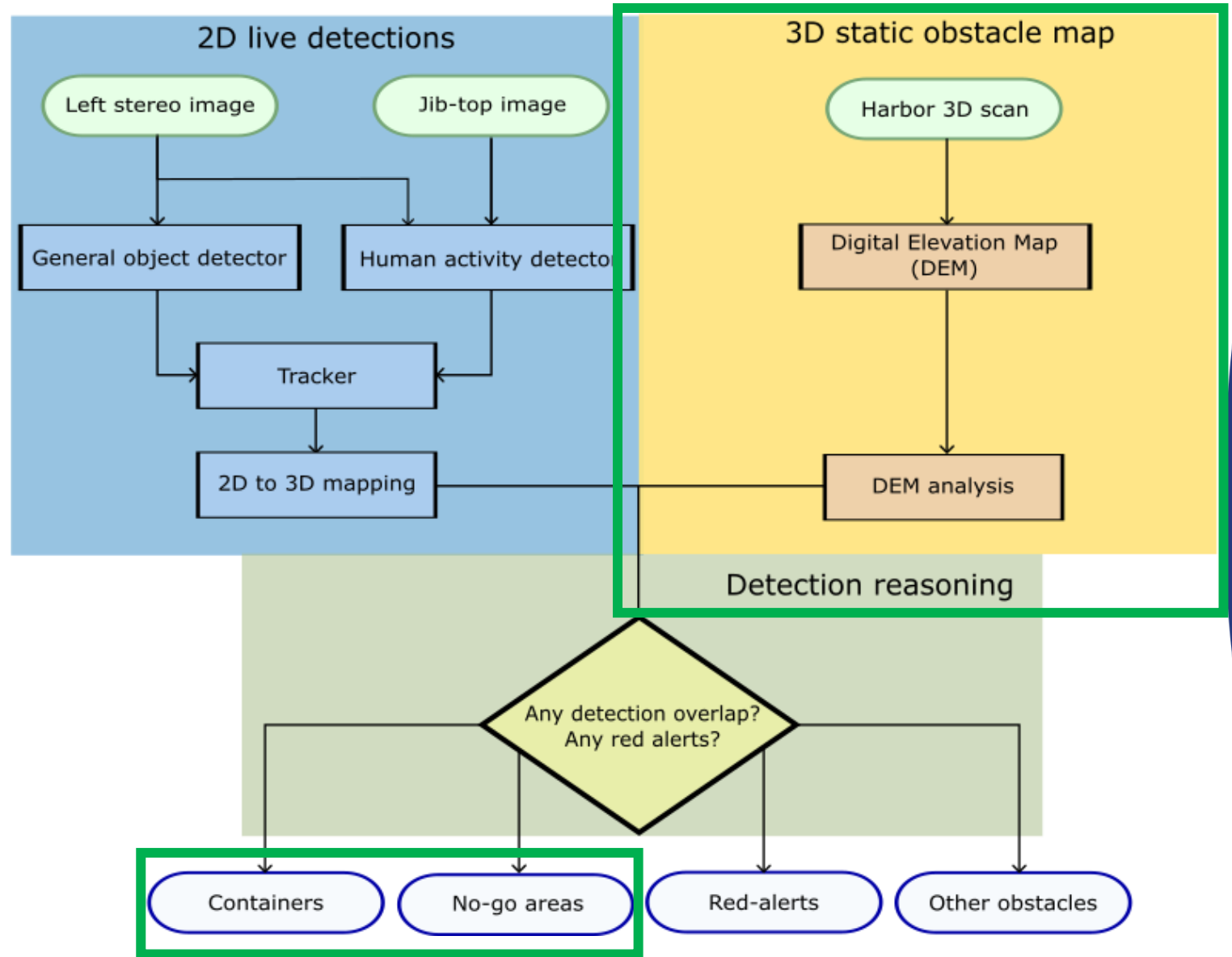
- **F1 Sensor Suite Design**

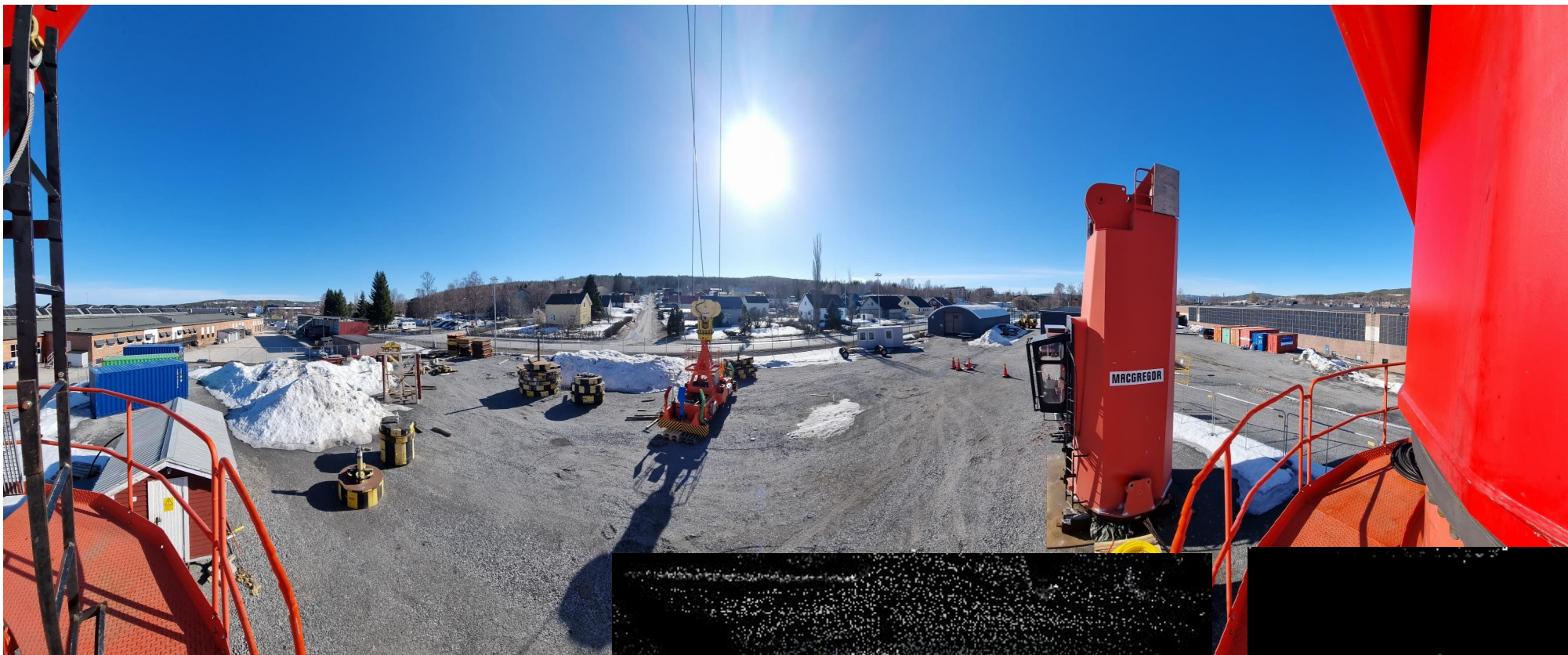
A sensor suite and data acquisition pipeline



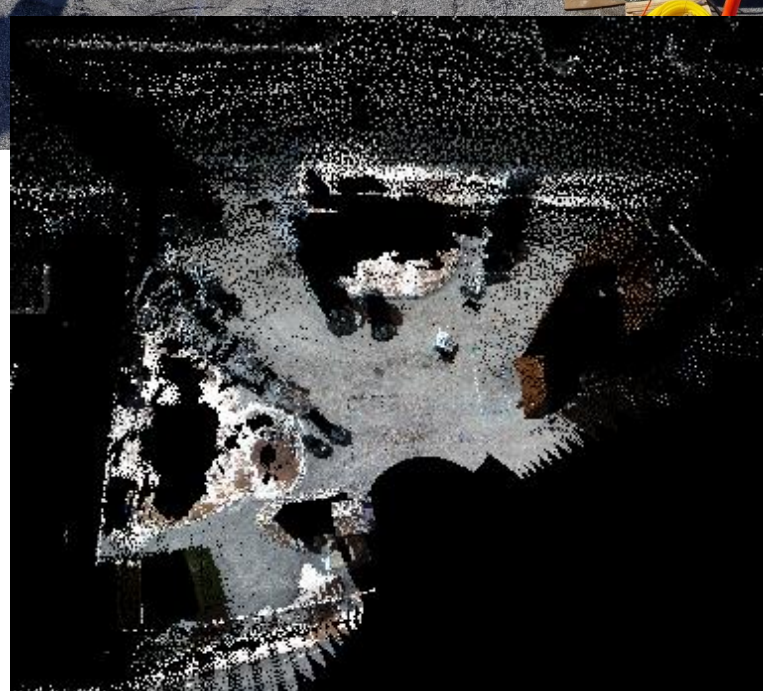
- **F2 Object recognition and 3D reconstruction algorithms**

Image fusion of an existing 3d model, live stereo camera, live LIDARs, and live crane states to build a 3d reconstruction around the crane and object interpretation for remote SA



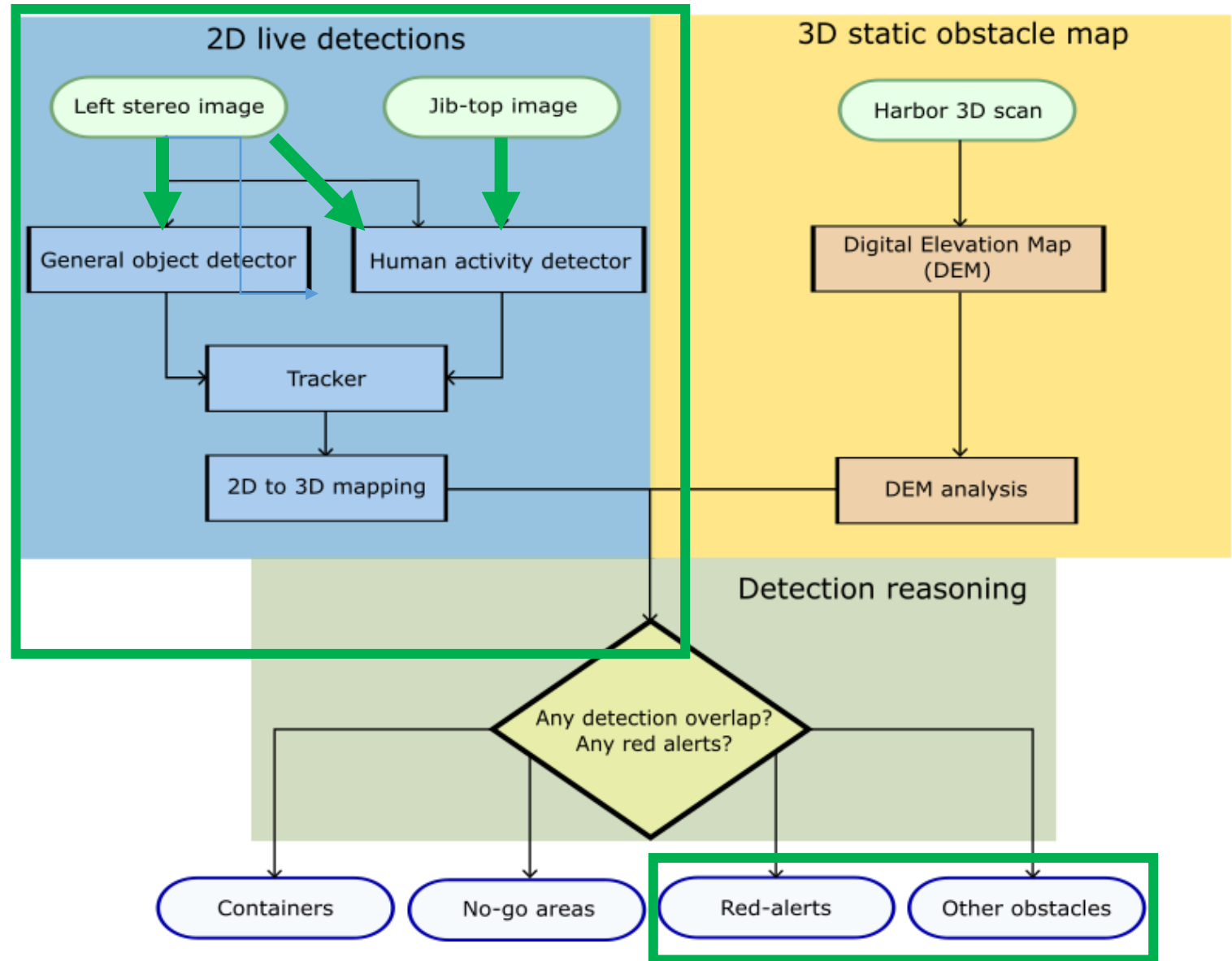


- F2 Object recognition and 3D reconstruction algorithms



- **F3 Safeguarding crane and humans**

Construct static and dynamic and red-alert layers to safeguard the crane (obstacles to avoid) and human activity (e.g. persons, bicycles, cars) near the crane



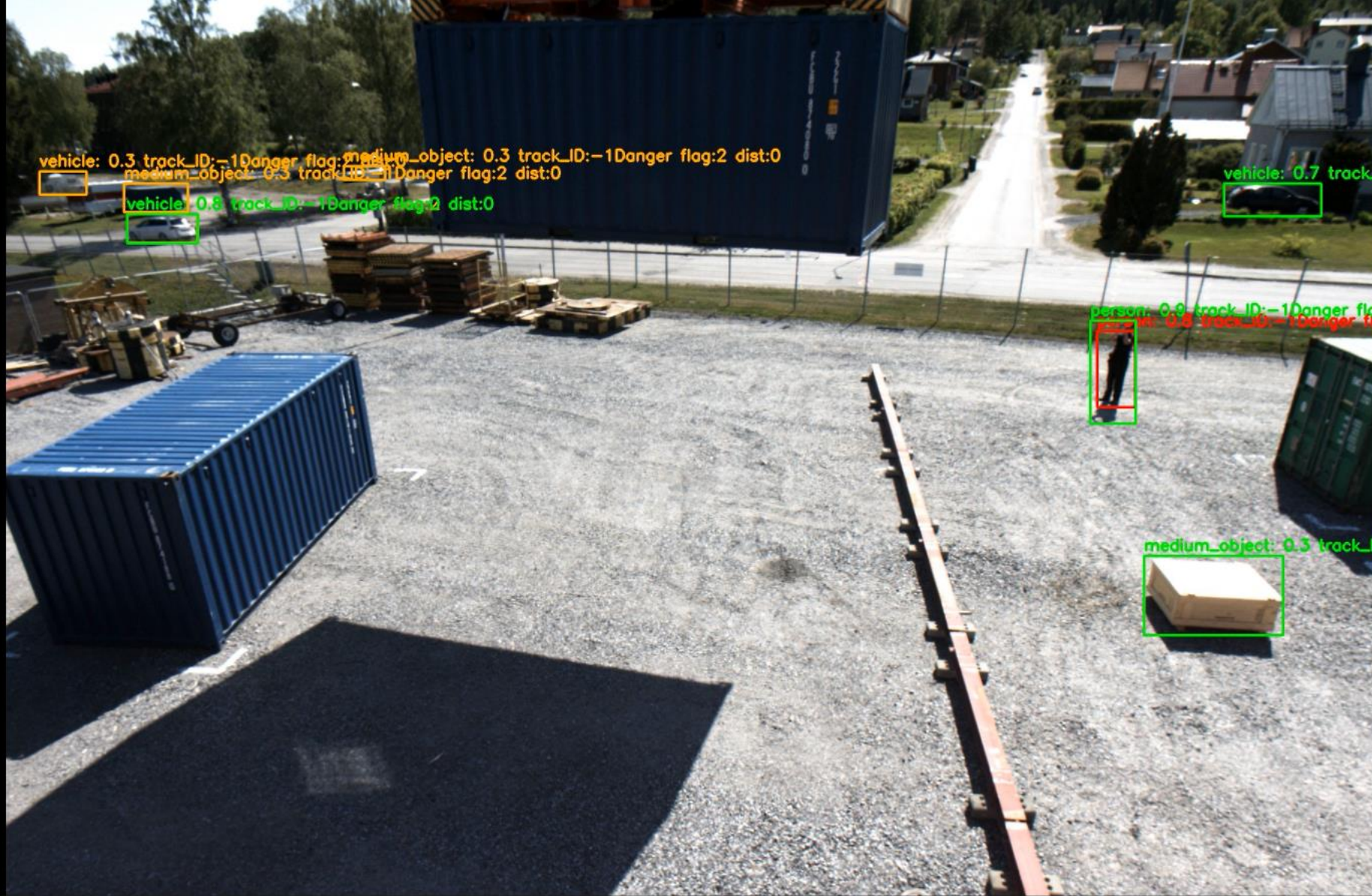


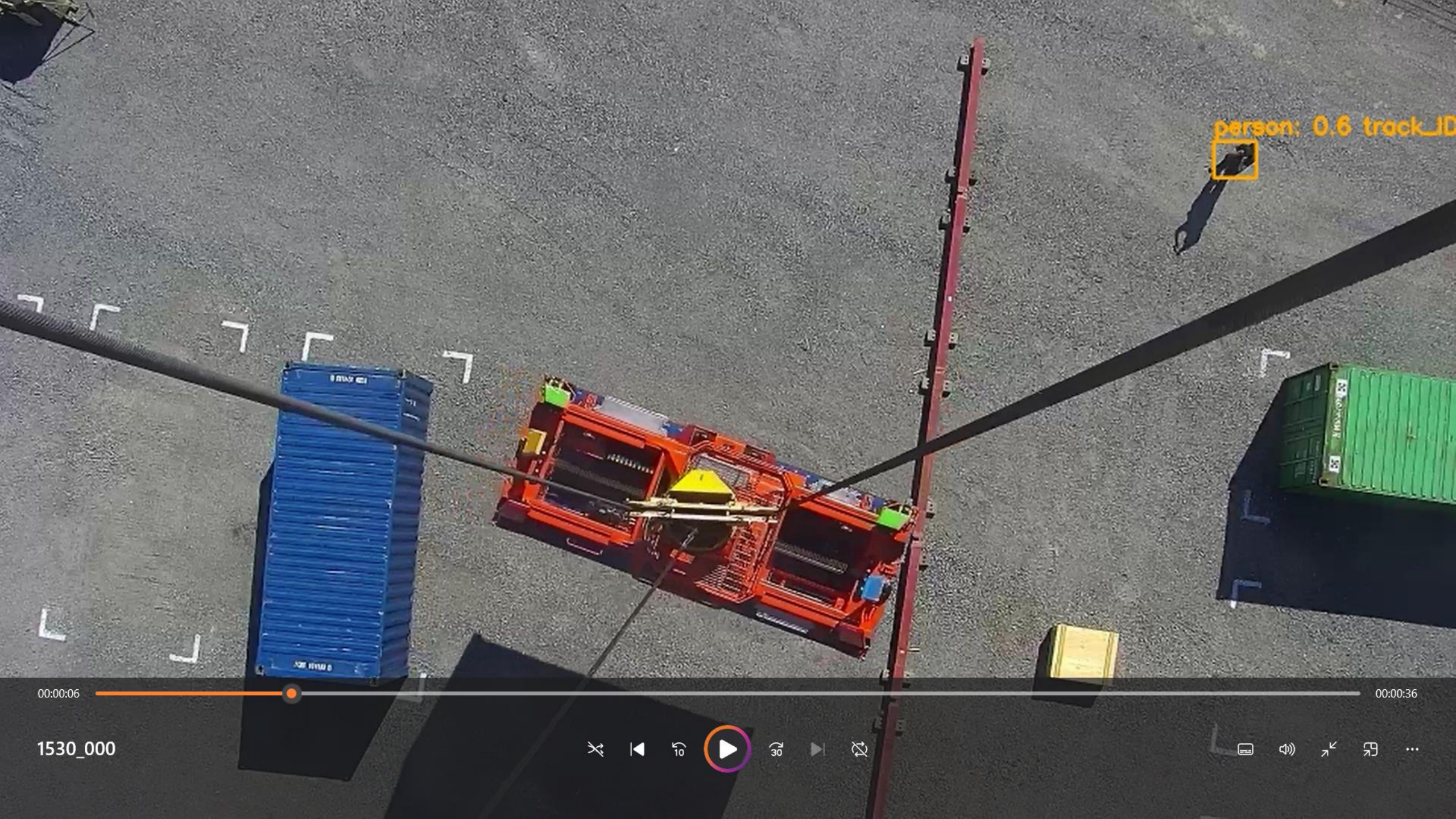
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person: 0.6 track_ID



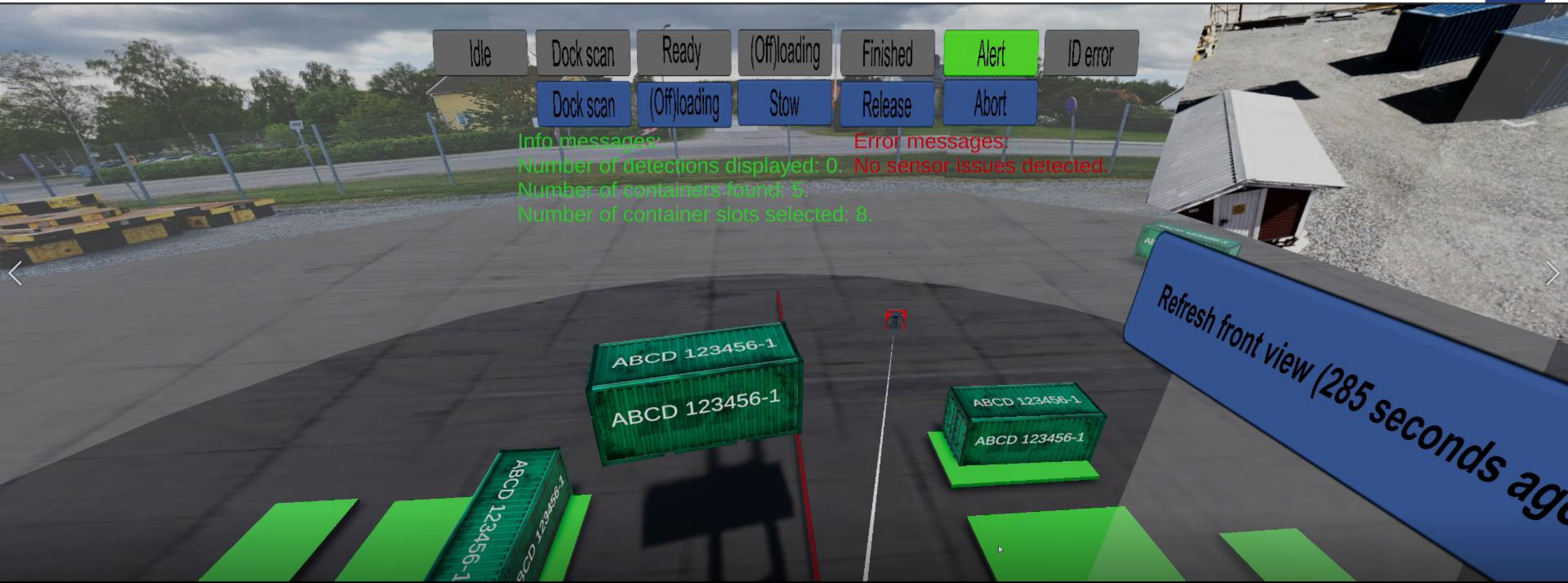
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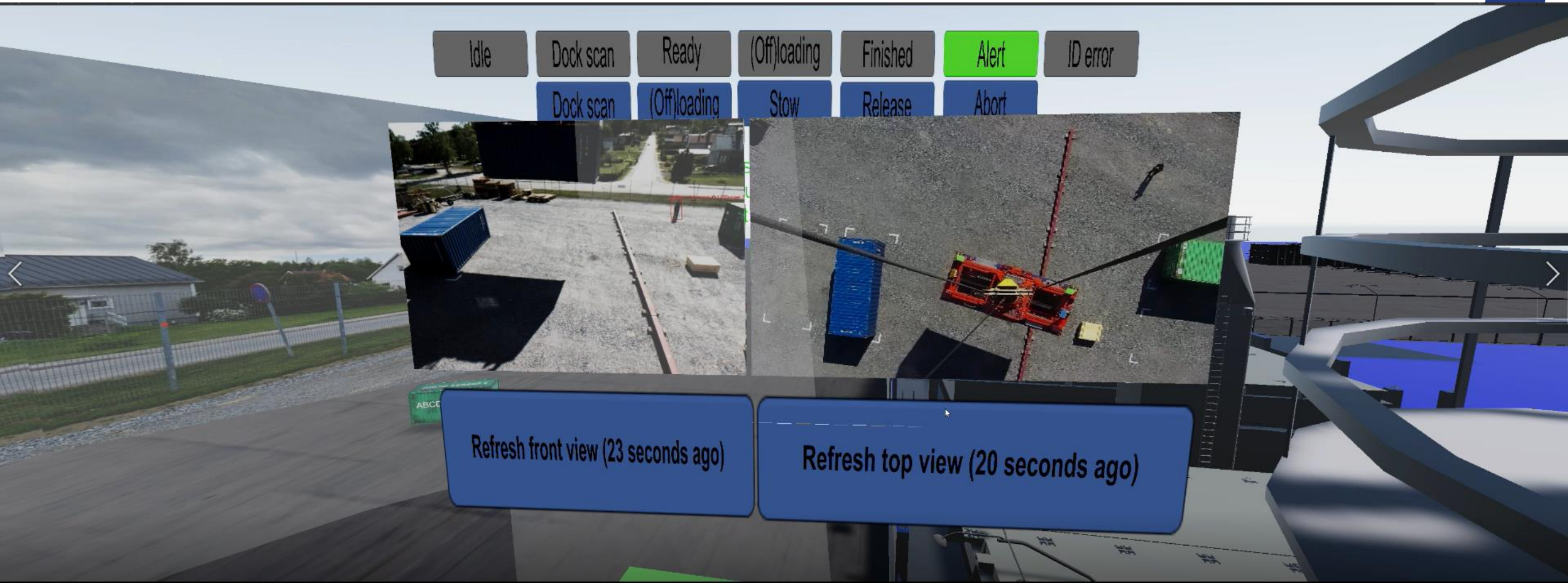
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3D-Twin with the interpreted objects for remote SA







MARIN Pilot Demonstration

Intelligent Operator Support for Shore Control Centers

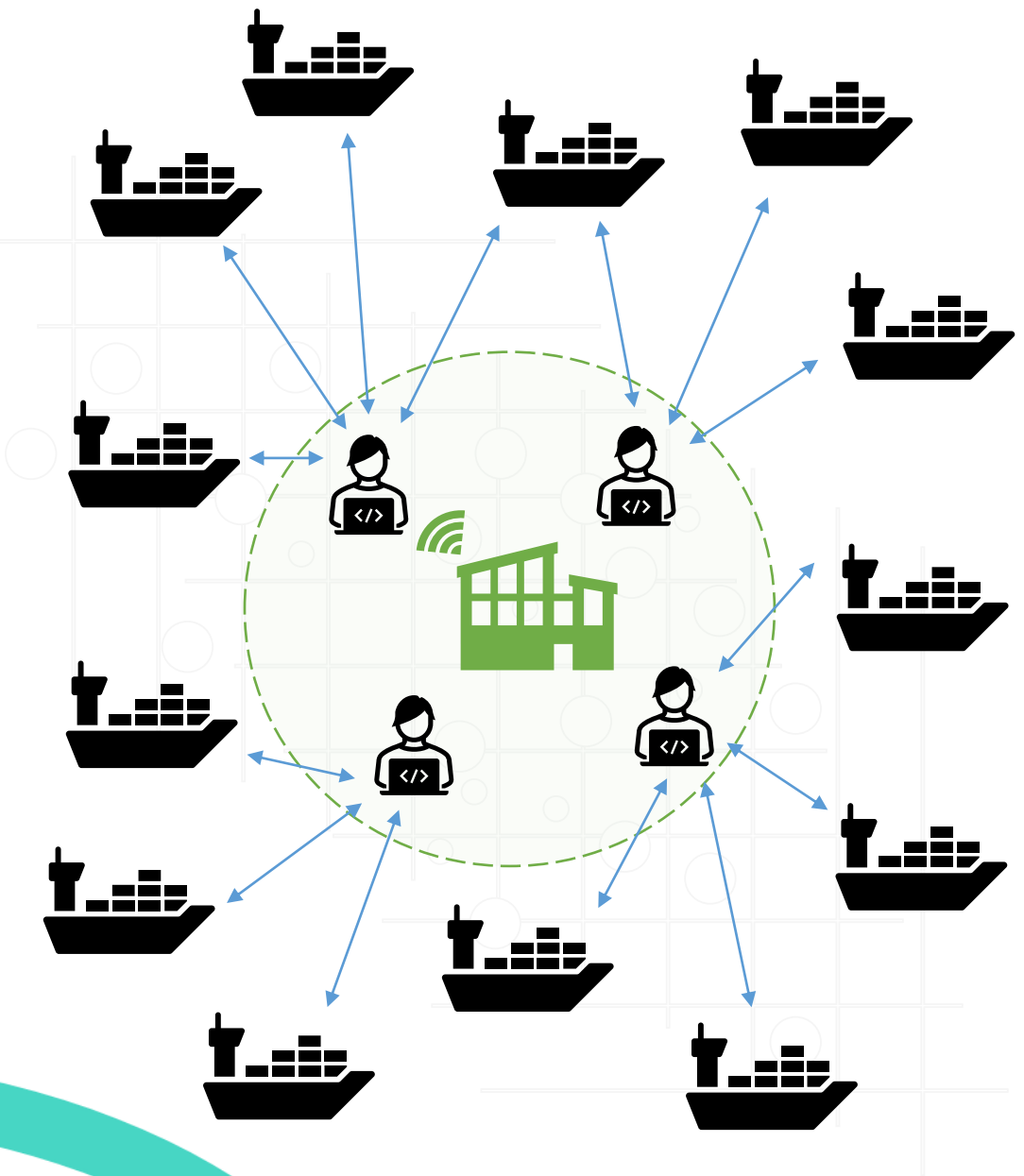
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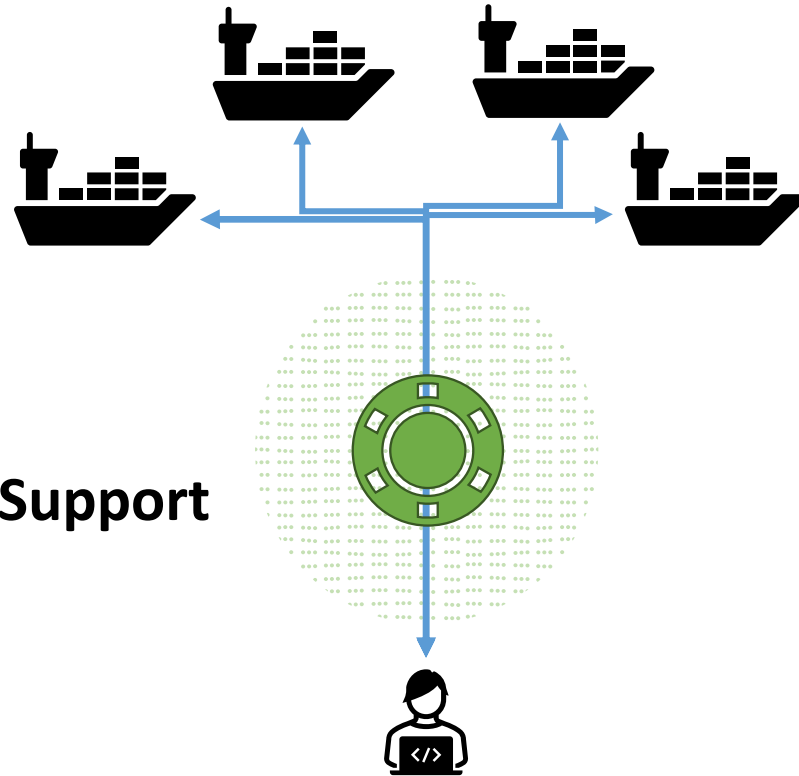


How to support remote operators in their supervision of dozens of autonomous operations in the maritime industry.



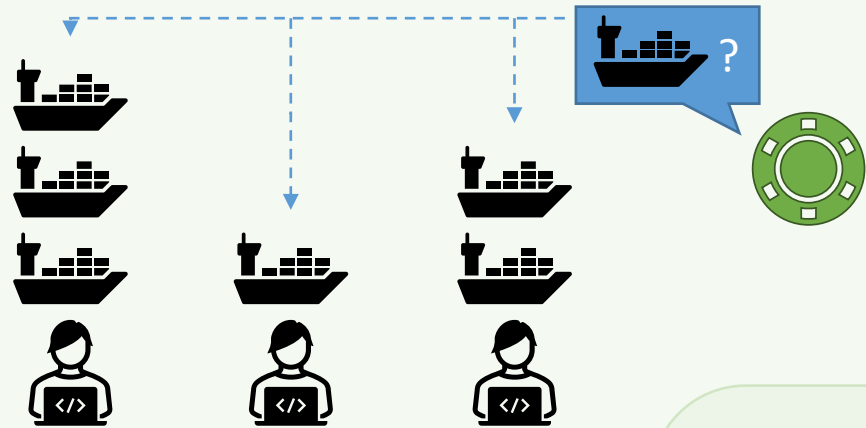


Intelligent Operator Support

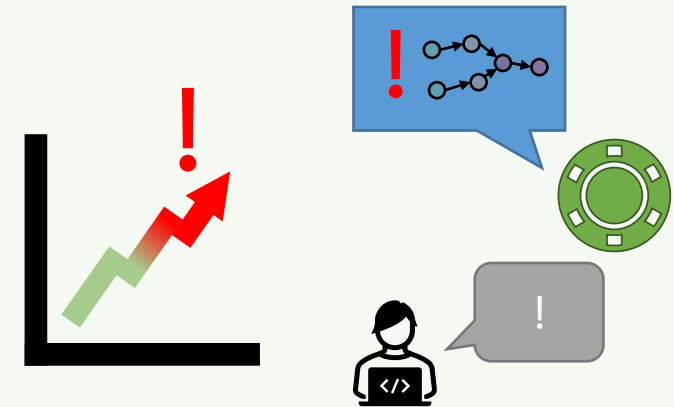


Support functions

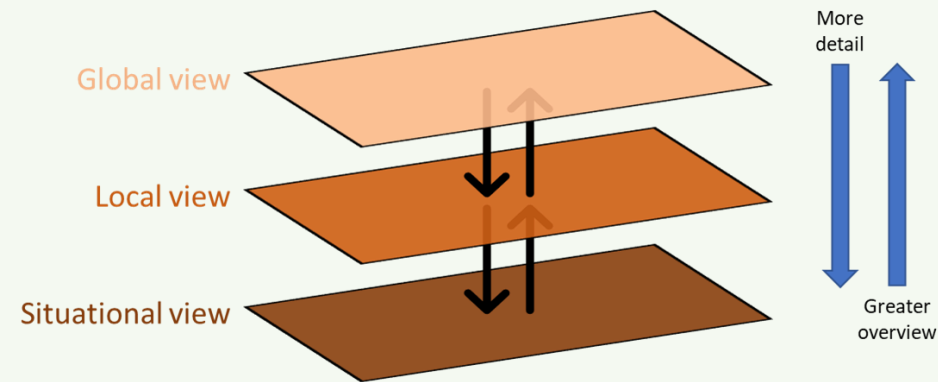
Dynamic Allocation of Operations to Operators



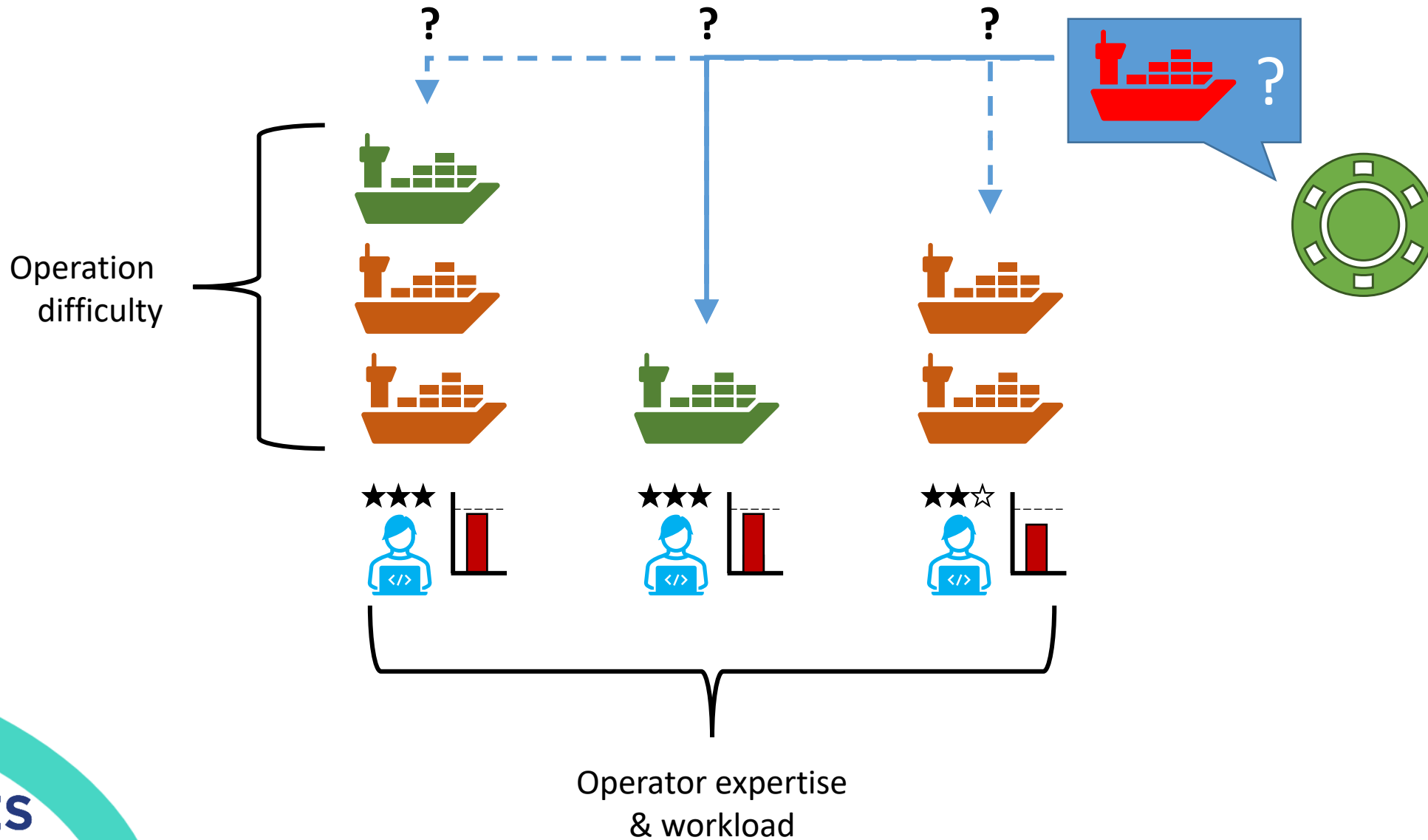
Continuous Intepretable Risk Assessment



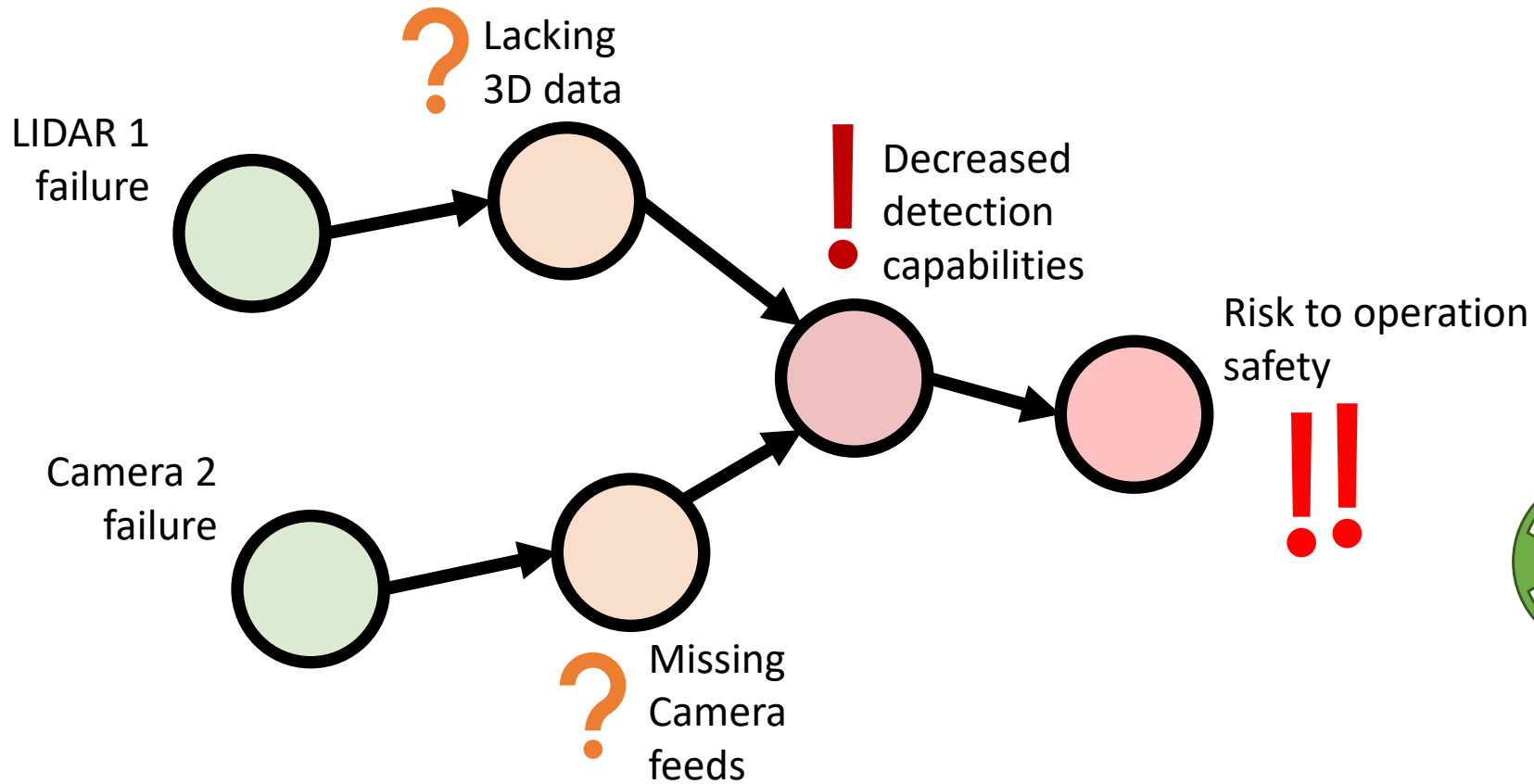
Progressive Disclosure



Dynamic Task Allocation; Who does what?

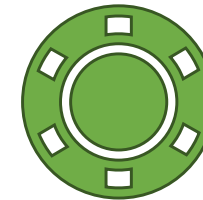


Risk Assessment: Timely and interpretable notifications

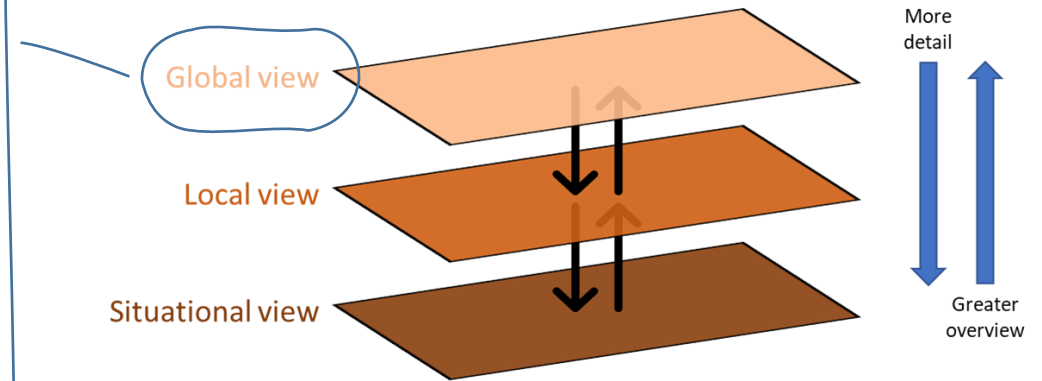


Higher risk to physical harm due to decreased detection capabilities caused by several sensors failing.

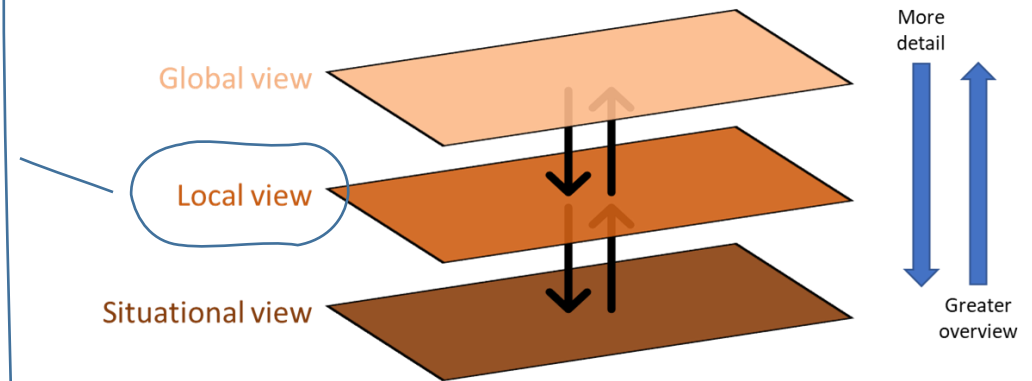
At next port, contact the local port authorities to review LIDAR 1 and Camera 2.



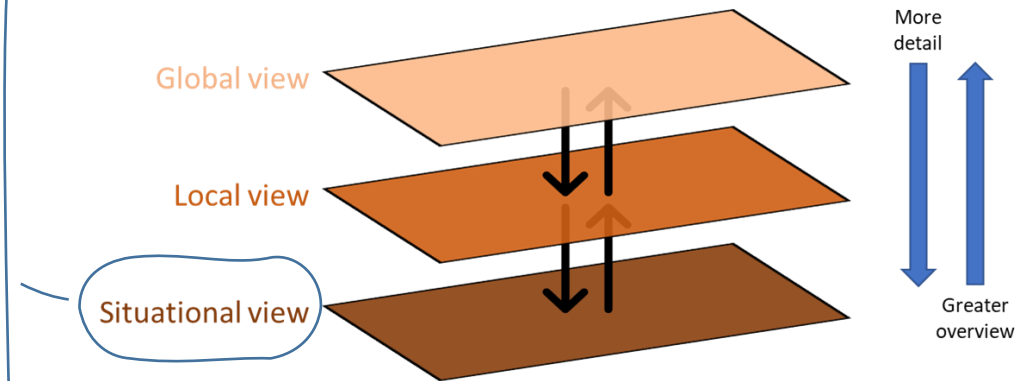
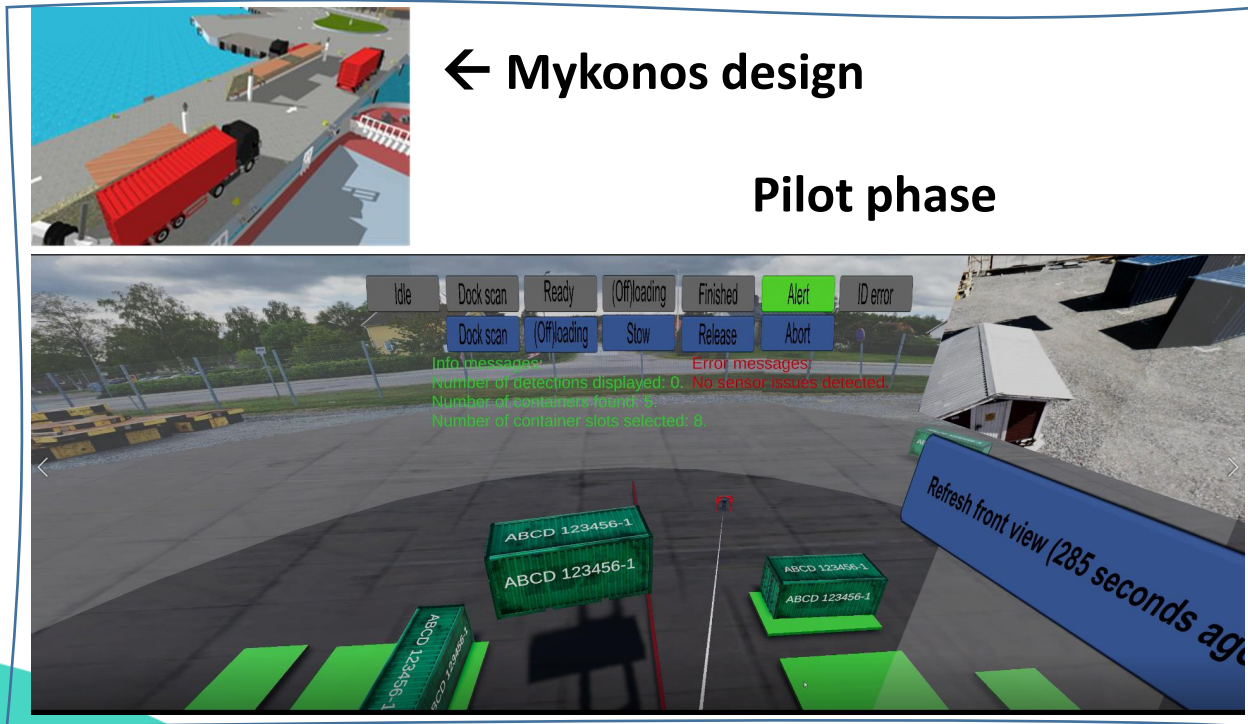
Progressive Disclosure; What to show when?

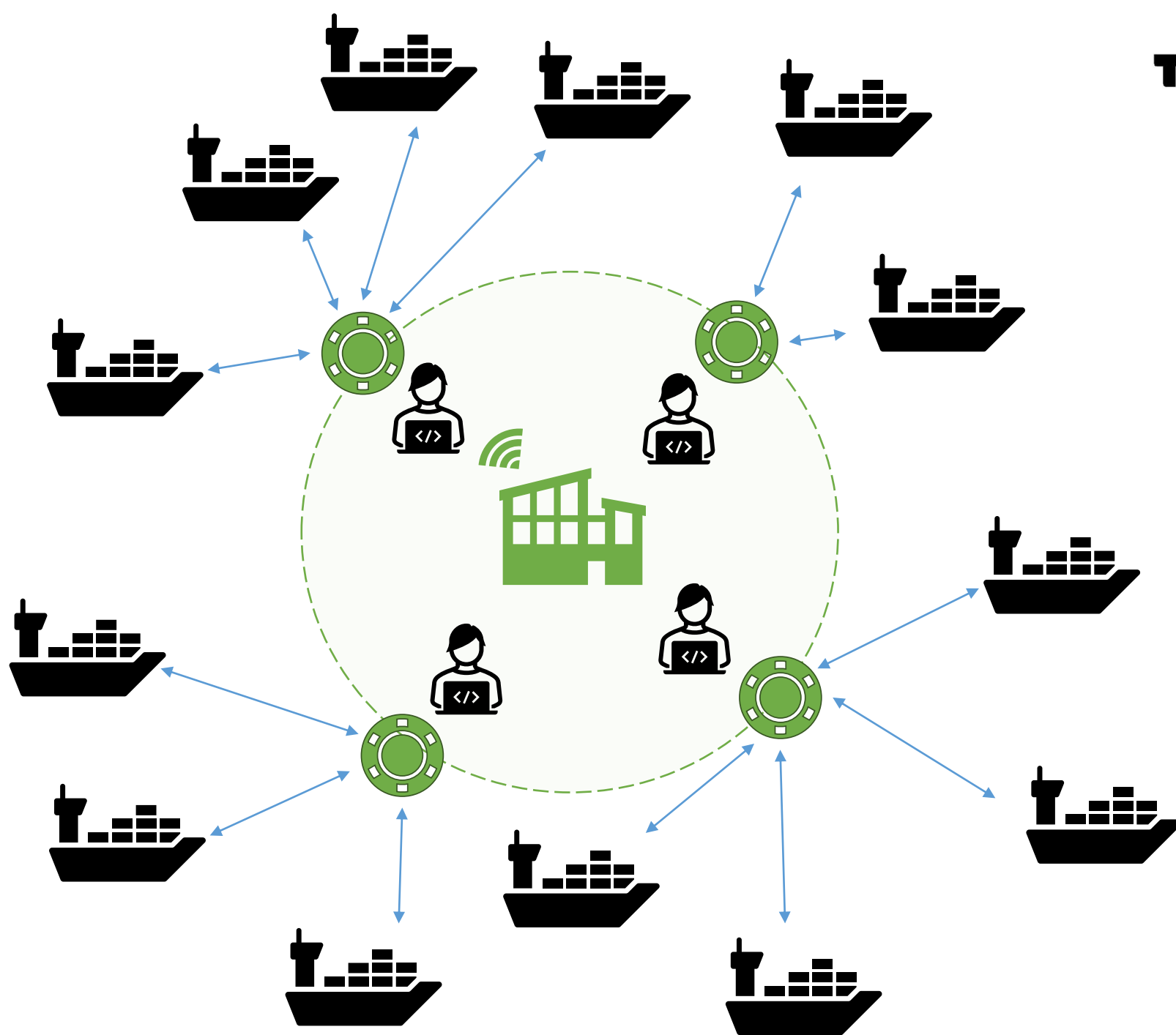


Progressively Disclosing Interactions; When to show what?



Progressively Disclosing Interactions; When to show what?







PILOTS

Pilot 1: AutoDock

Intelligent cooperation of **autonomous tugboat swarm** to **manoeuvre** a large floating vessel and **dock it** by collaborating with an **automated mooring system**.

Pilot 2: Feeder

Seakeeping and **energy performance capabilities**. Capability to be used for **automated mooring**.

Pilot 3: Robotic CHS

Autonomous container handling capability and shared control between human operator and system.



MOSES

Thank you for your attention!



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