MOSES

REDUCED TRANSPORTATION COST AND LOWER ENVIRONMENTAL IMPACT BY AUTONOMY IN SHIPS AND PORTS

Adaptation of port call process for autonomous ship in a big port

Jorge Miguel Lara López

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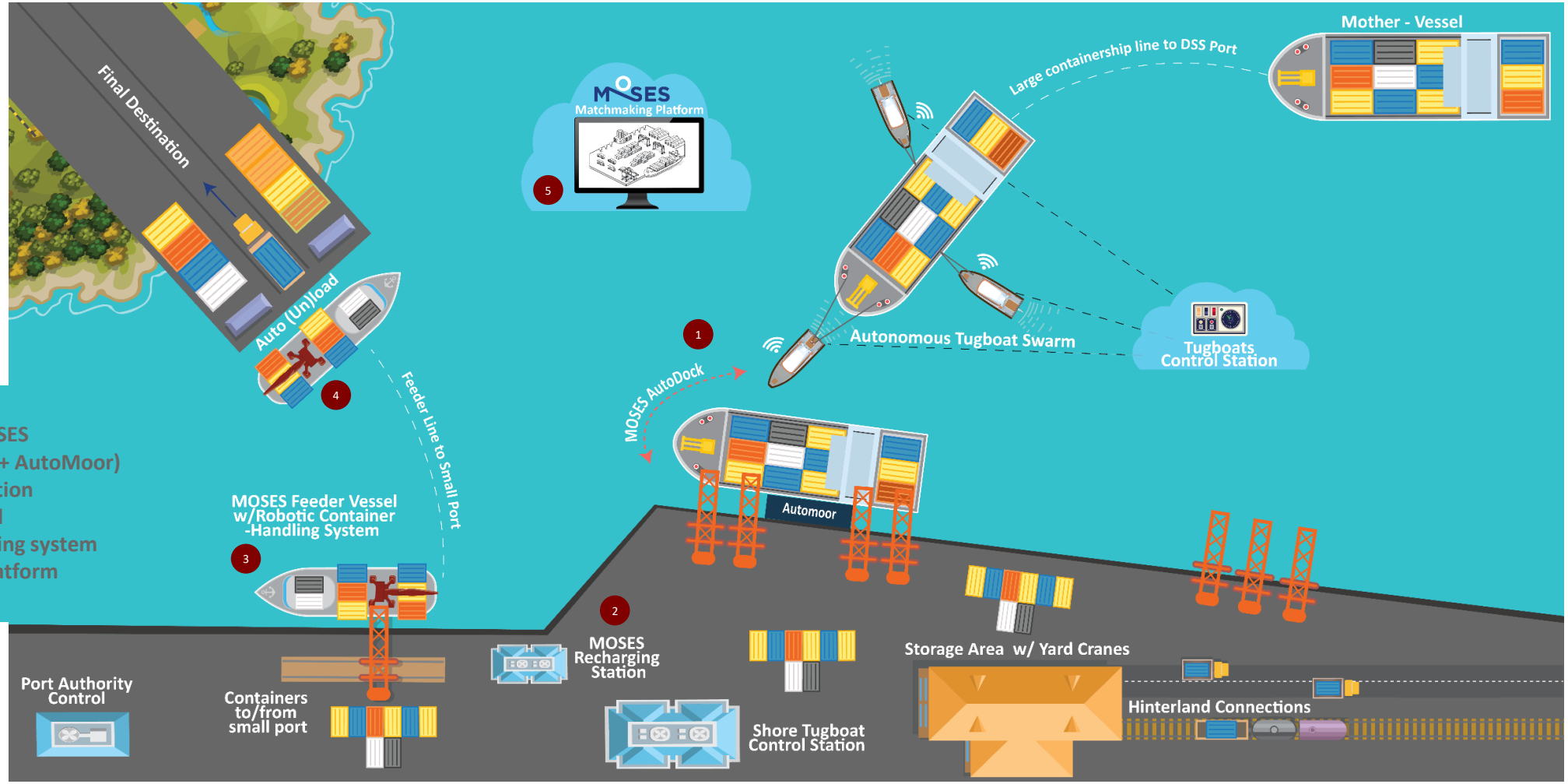
MOSES – Automated Vessels and Supply Chain Optimisation for Sustainable Short Sea Shipping

The aim of MOSES project is to **enhance the Short Sea Shipping (SSS) component** of the European supply chain by **addressing the vulnerabilities** and **strains** related to the operation of large containerships.



MOSES Innovations:

1. MOSES AutoDock (MOSES Autonomous tugboats + AutoMoor)
2. MOSES Recharging Station
3. Innovative Feeder Vessel
4. Robotic container-handling system
5. MOSES matchmaking platform

This project has received funding from the European Union's horizon 2020 research and innovation programme under grant agreement No. 861678.

MOSES Pilot Demonstrations

Pilot 1:AutoDock

SCOPE: Intelligent cooperation of autonomous tugboat swarm to manoeuvre a large containership and dock it by collaborating with an automated mooring system.

Faaborg harbour, Denmark (TUCO's facilities)

METHOD: 2x TUCO's Pro:Zero workboats will be equipped with MOSES autonomy package. The workboats will cooperate to maneuver a floating vessel to the dock. TRELLEBORG will fabricate and install on the dock a 1-off small-scale automated mooring unit prototype, outfitted with MOSES intelligence to collaborate with the workboats.

Pilot 2:Feeder

SCOPE: Seakeeping and energy performance. Capability to be used for automated mooring.

MARIN's Seakeeping and Manoeuvring Basin (SMB), Netherlands

METHOD: A scaled ship model will be fabricated for 1 vessel design (out of the 3 evaluated in MOSES) and tested in seakeeping and manoeuvring basins.

Pilot 3:Robotic CHS

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

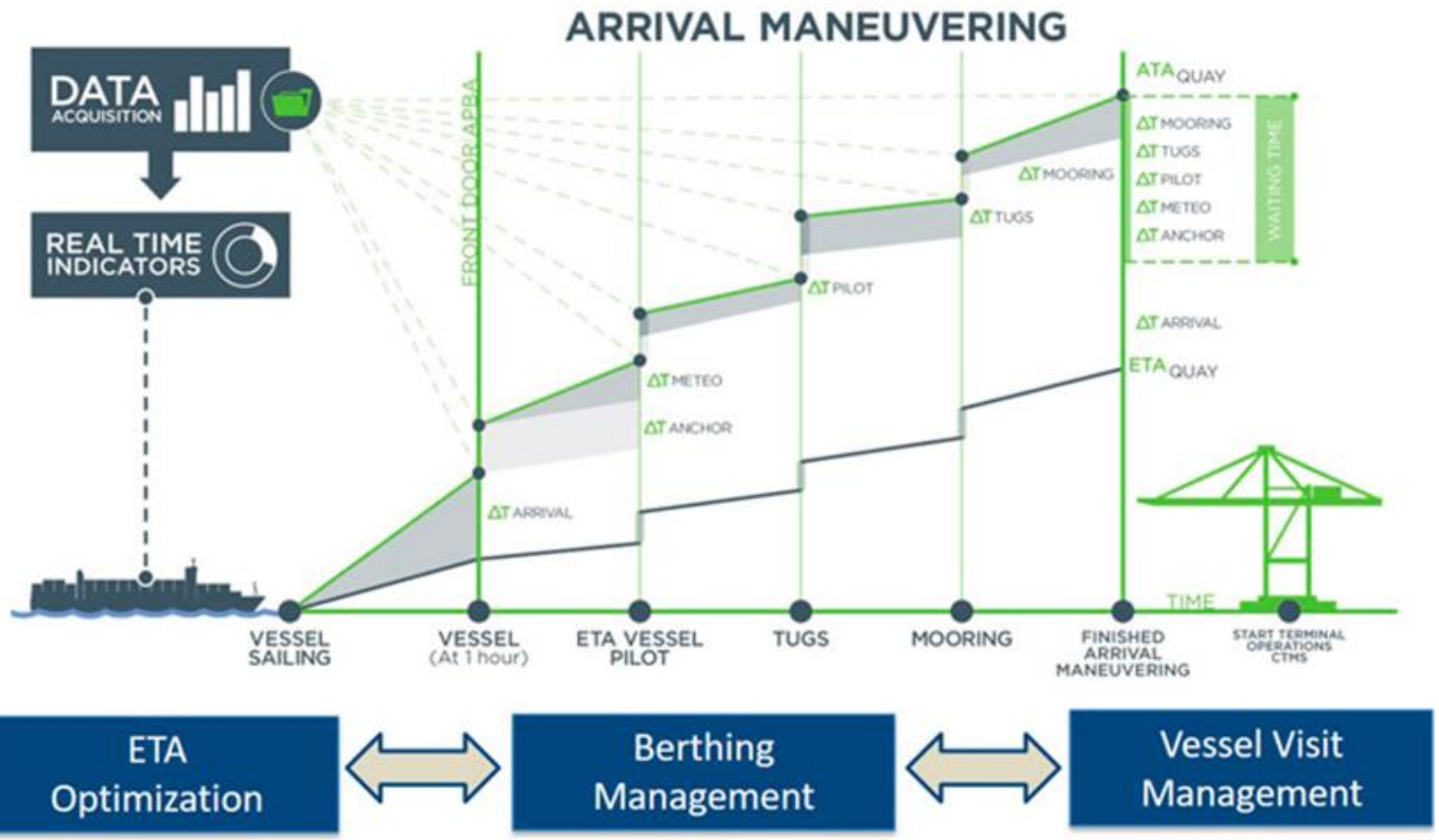
MacGregor test facility, Örnsköldsvik, Sweden

METHOD: A full-scale, operational MacGregor GLE Crane, outfitted with sensor package, will be controlled by an operator at the MOSES Shore Control Station (SCS) to handle a container. The demo will be implemented with the SCS onsite and at a remote location.

WHY A PORT COULD BE INTERESTED IN AUTONOMOUS SHIP OPERATIONS?

1. Reduction of congestion related to hinterland connections
2. Move cargo to close smaller ports improving the connectivity and fostering real shift of cargo from road to maritime traffic and complement rail capacity.
3. Decrease times of a port call process from the operational point of view
4. Foster 24/7 cargo movements even though adverse conditions
5. Reduce accidents during manoeuvring
6. Provide modern and qualitative services to their demanding customers (shipping companies, terminals, etc.)
7. New dedicated traffics
8. Solutions to SSS and cabotage services
9. Be more competitive while keeping the safety

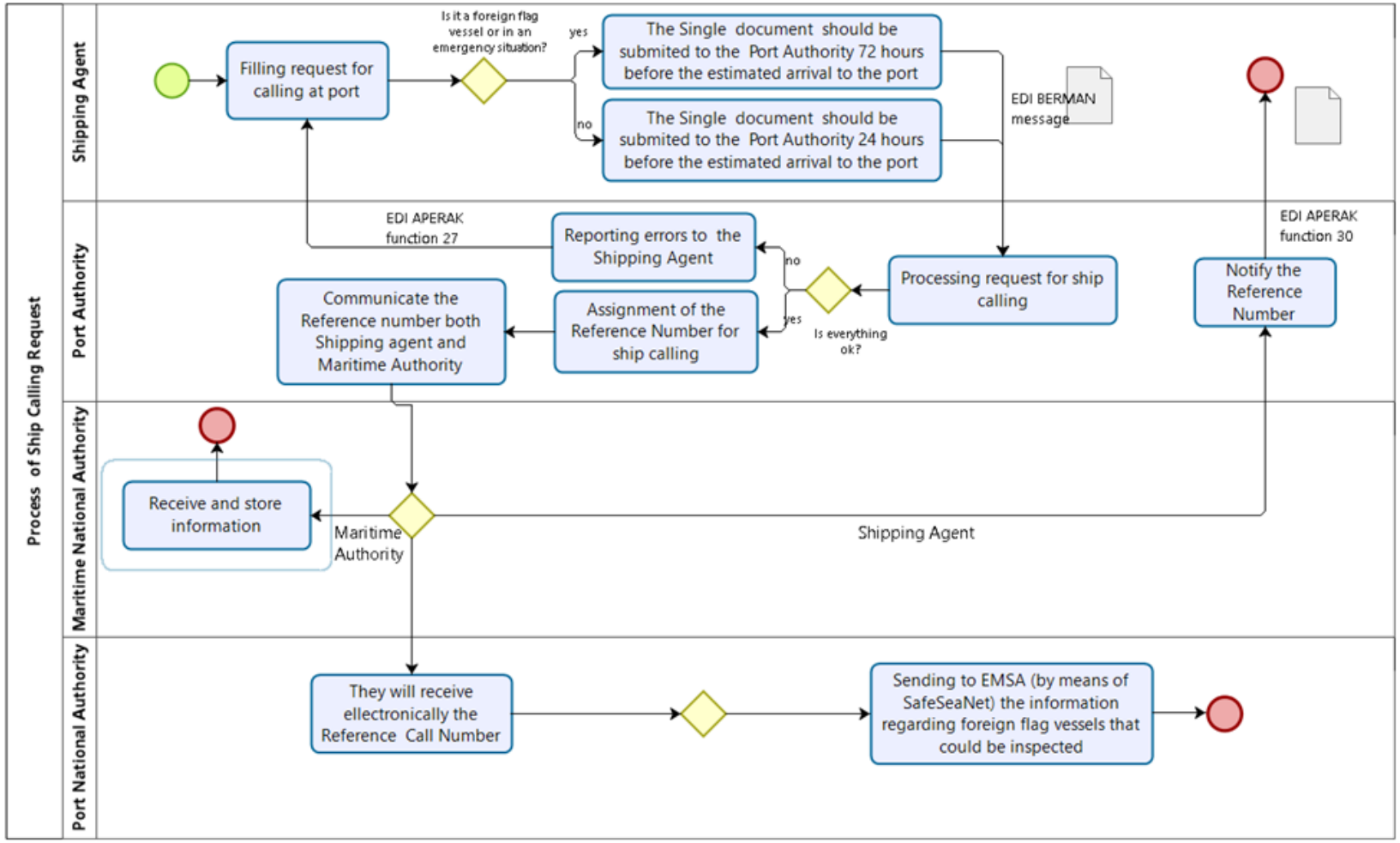
Port call process



- Information about the crew (Captain on board?) Where? Coordination with VTS and Nautical port services
- Typology of nautical ports services (Pilotage and Towage)
- Other services (bunkering, Marpol…)
- Typology of port terminal (automatic, multi-brand, private/public)

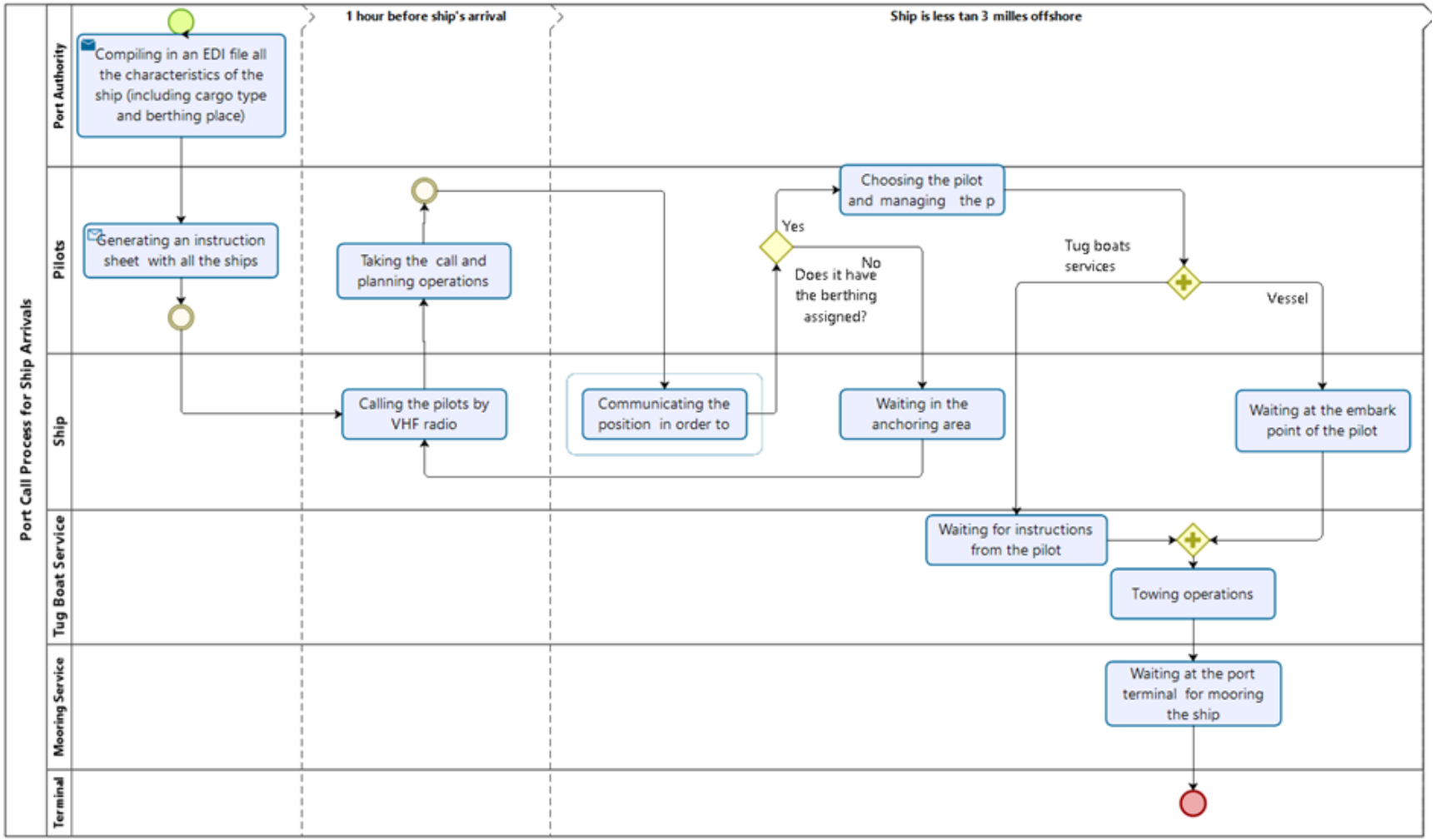
Port call process

Regulation (EU) 2019/1239 establishing a European Maritime Single Window environment



Key aspects about detailed and accurate information of the autonomous ship – specificities compared with the info provided by a current vessel. Clear standards about the information and protocols. Role of the Shipping Agent

Port call process



VHF Radio communications – Who and how?
Pilot onboard? – Exemption of pilotage for autonomous ships? Situational awareness
Crew to facilitate towage
How to assure mooring interaction when berthing

Communication flow between PCS and SCS

1.-Information provided by Port Authority

- Edi file
  - Port call reference number
  - the vessel particulars
  - Type of cargo
  - Berthing place
  - Estimated Time of Arrival (ETA)
  - Weather forecast
  - Position of cranes
  - Traffic constrains
  - Emergency instructions

72 hours for foreign vessels and vessels in emergency

24 hours for national vessels

- Accurate information according to the level of autonomy
- Interaction with real traffic manned
- Same protocols during incidents or emergency situations? Defining clear responsibilities for the SCTC, Pilot, VTS, etc.
- Assure safe interaction with port nautical and other services

2.-Shore control station process

- Generating file including the planning for all vessels
  - Berth availability time
  - Assign Tugs according to vessel characteristics
  - Assign Pilot
  - Assign specific AutoMoor units

24 hours for all vessels

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3.- Information provided by Shipping Agent to the Port Authority/SCS

"STATIC" INFORMATION

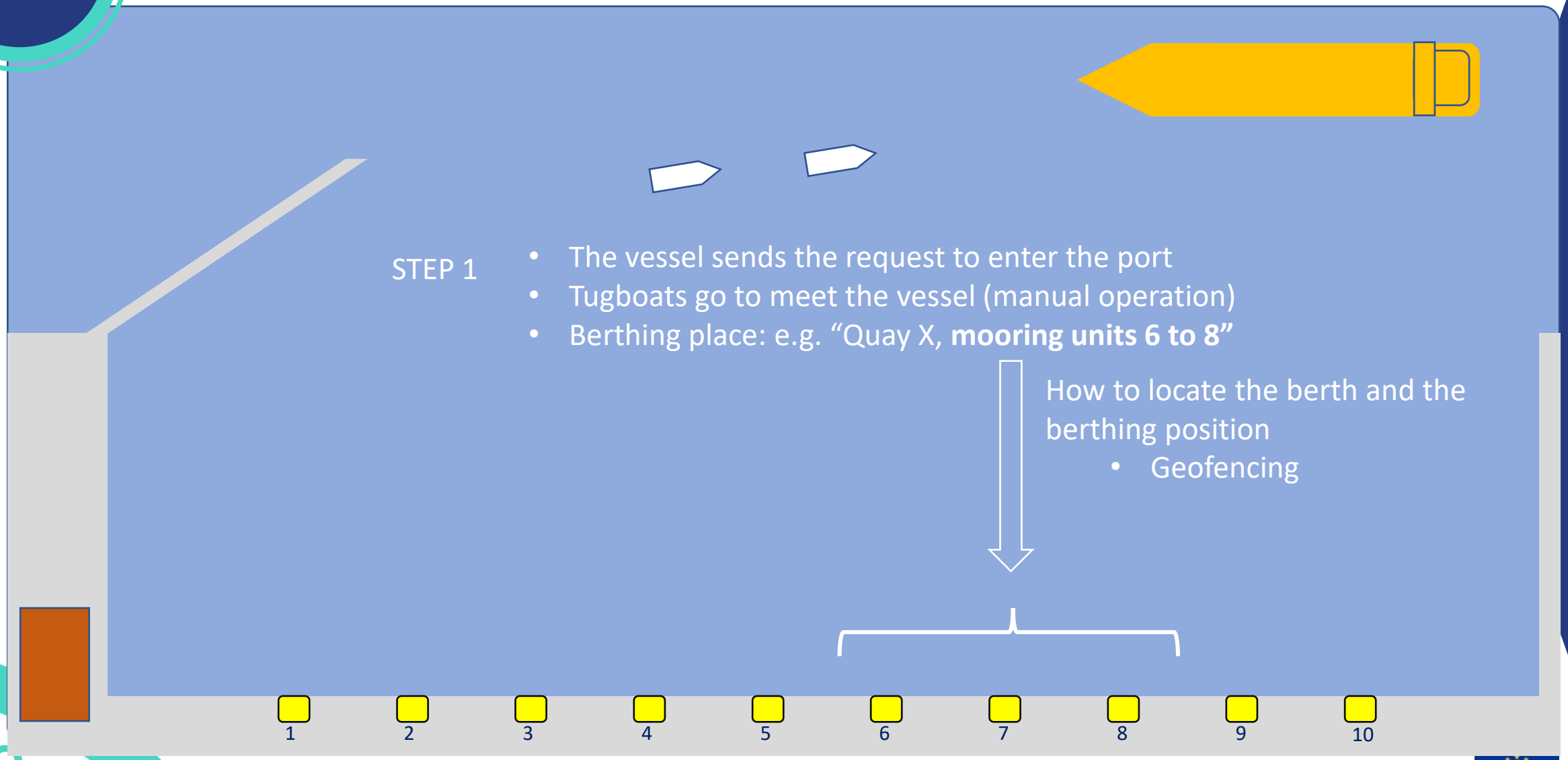
- Ship particulars
  - Current draught
  - Trim
  - Displacement
  - Overall length including bulbous
  - Beam
  - Freeboard
  - Number of anchors
  - Number and characteristics of engines

DYNAMIC INFORMATION

- Manoeuvring conditions
  - Number of propeller
  - Are CPP?
  - Direction of rotation
  - Type and maximum allowable angle of rudders
  - Turning circle and stopping distance at the current conditions
  - Number, position and power of the thrusters
  - Minimum steerage speed
  - Any propulsion constrain

- Role of the Shipping Agent
- The information about the ship particulars should be extremely precise and useful.
- Share the ship characteristics file with VTS for regular services. Occasional calls?
- Interaction with real traffic manned
- Comply with the regulation sometimes requires some changes in the protocols in comparison with the current procedures.

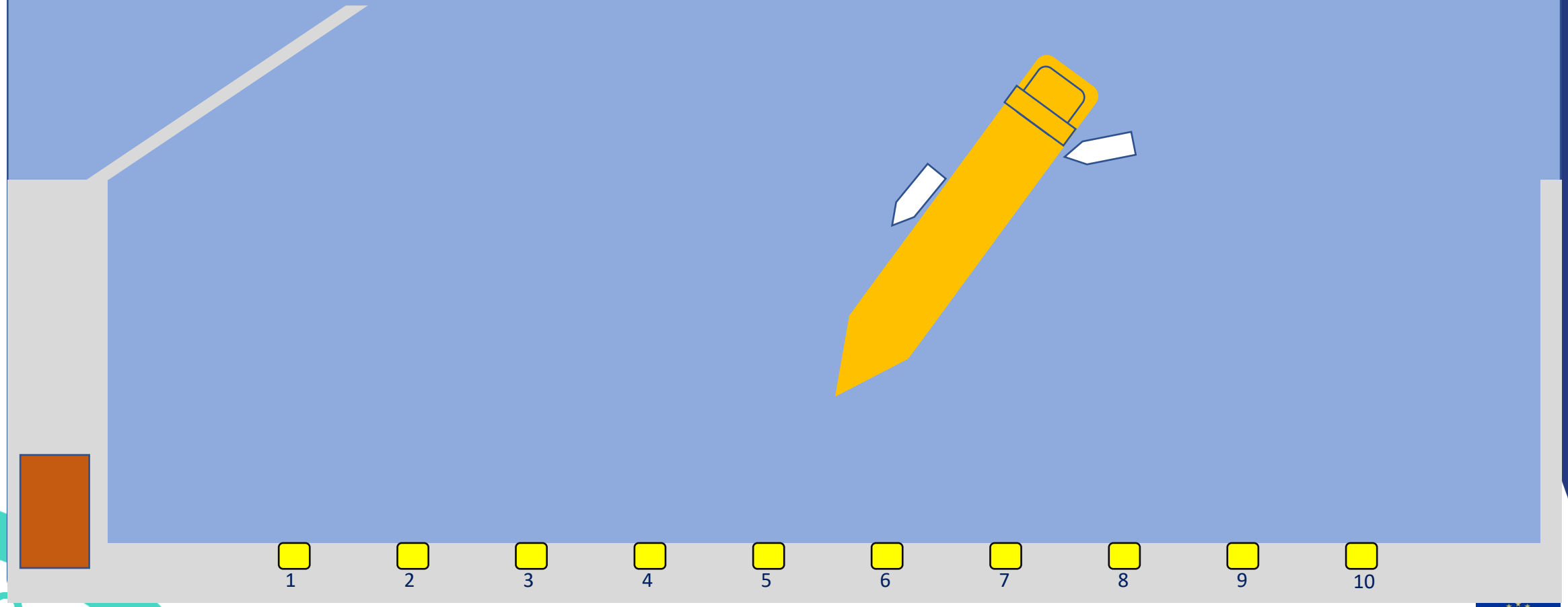
MOSES Berthing step by step



MOSES Berthing step by step

STEP 2

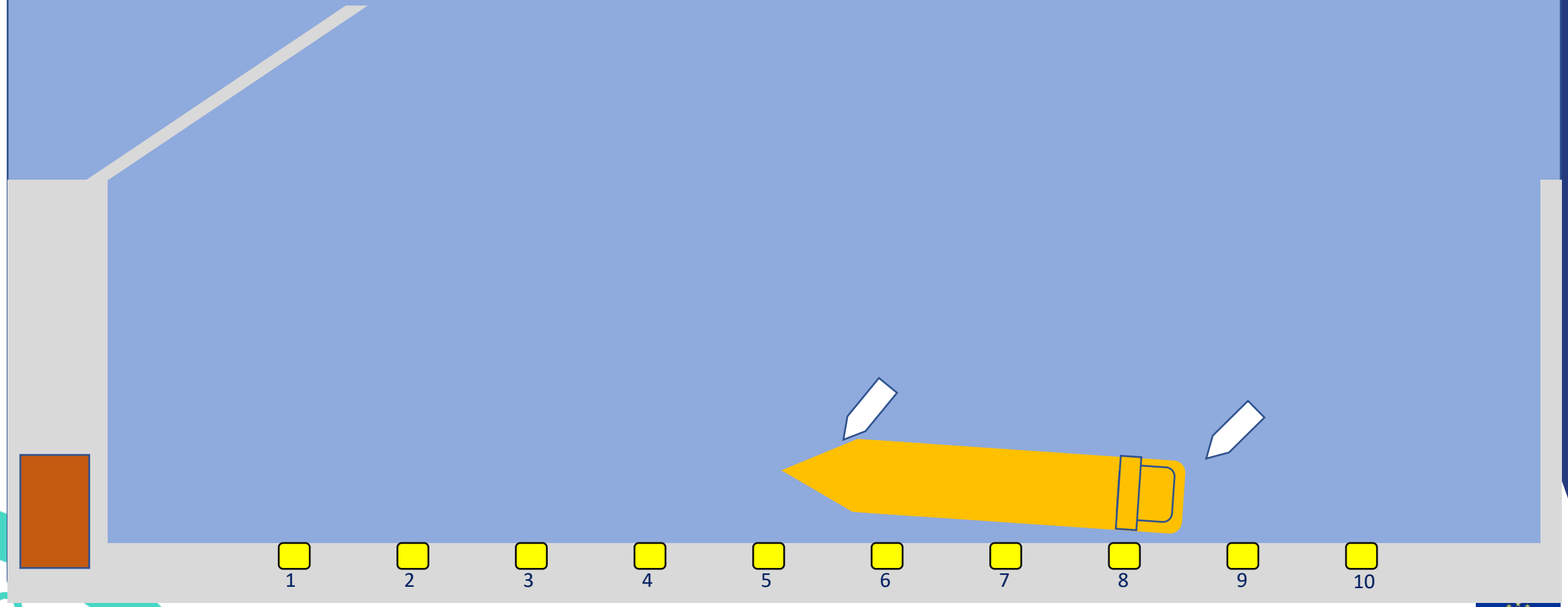
- Once the vessel is inside port, tugboats swarm berth the vessel (autonomous operation)



MOSES Berthing step by step

STEP 3

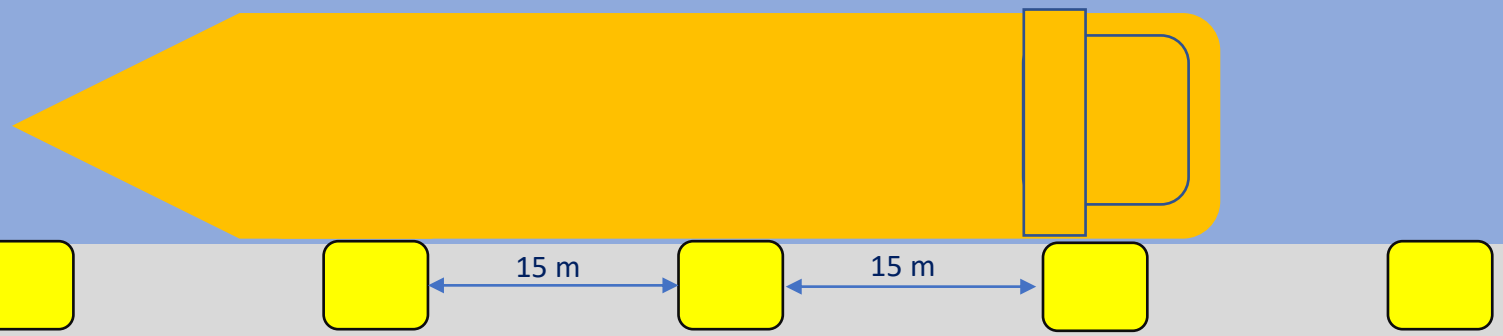
- Once the vessel is in the range of the automoor system sensors they detect the vessel



MOSES Berthing step by step

STEP 4

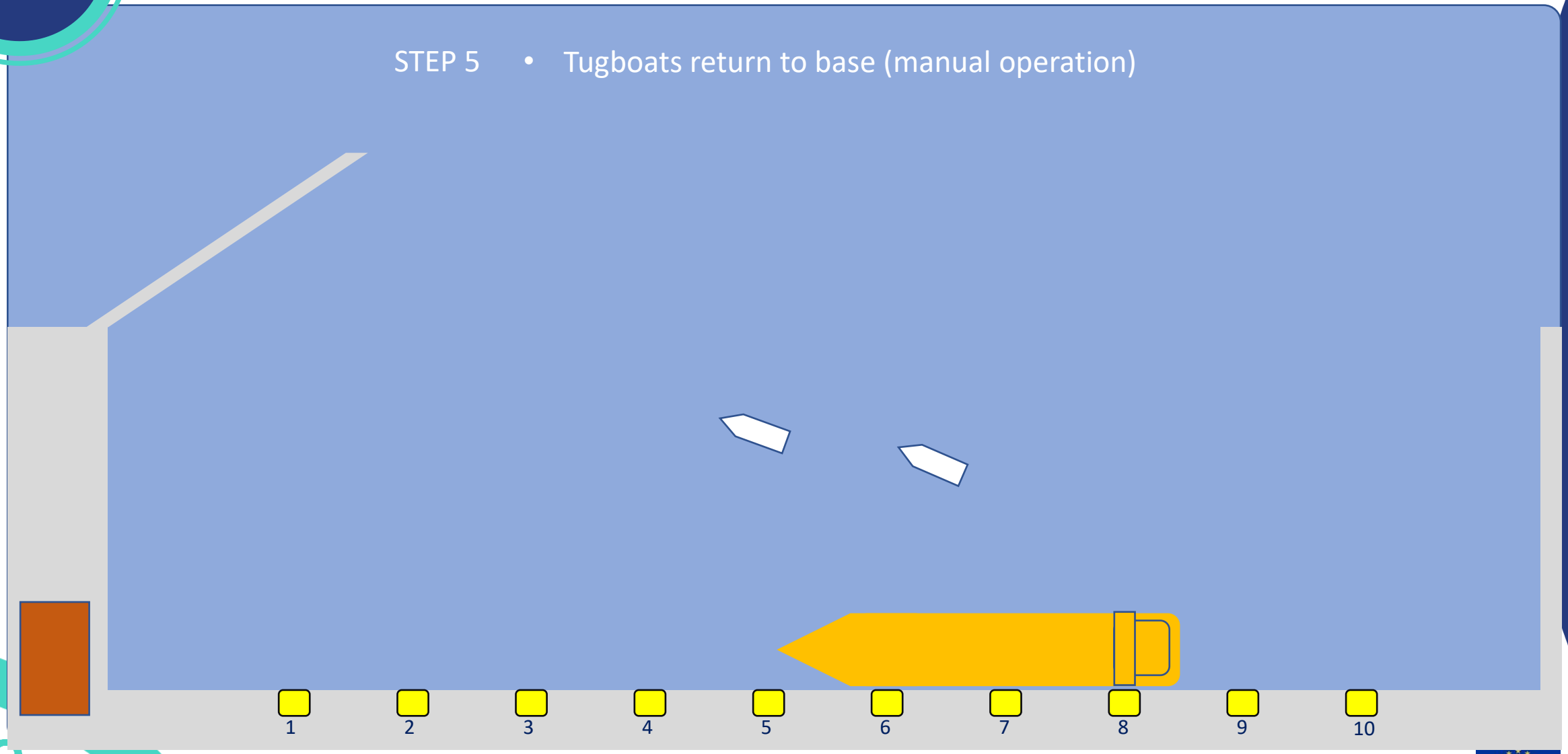
- Automooring process: once the vessel is at <1m distance of all the required automoor units,
  - Tugboats swarm autonomous operation ends.
  - The automoor arms get the vessel, and the vessel gets moored.



	4	5	6	7	8	9
Vessel detected?		NO	Yes	Yes	Yes	NO
Distance		-	0 m	0 m	0 m	-

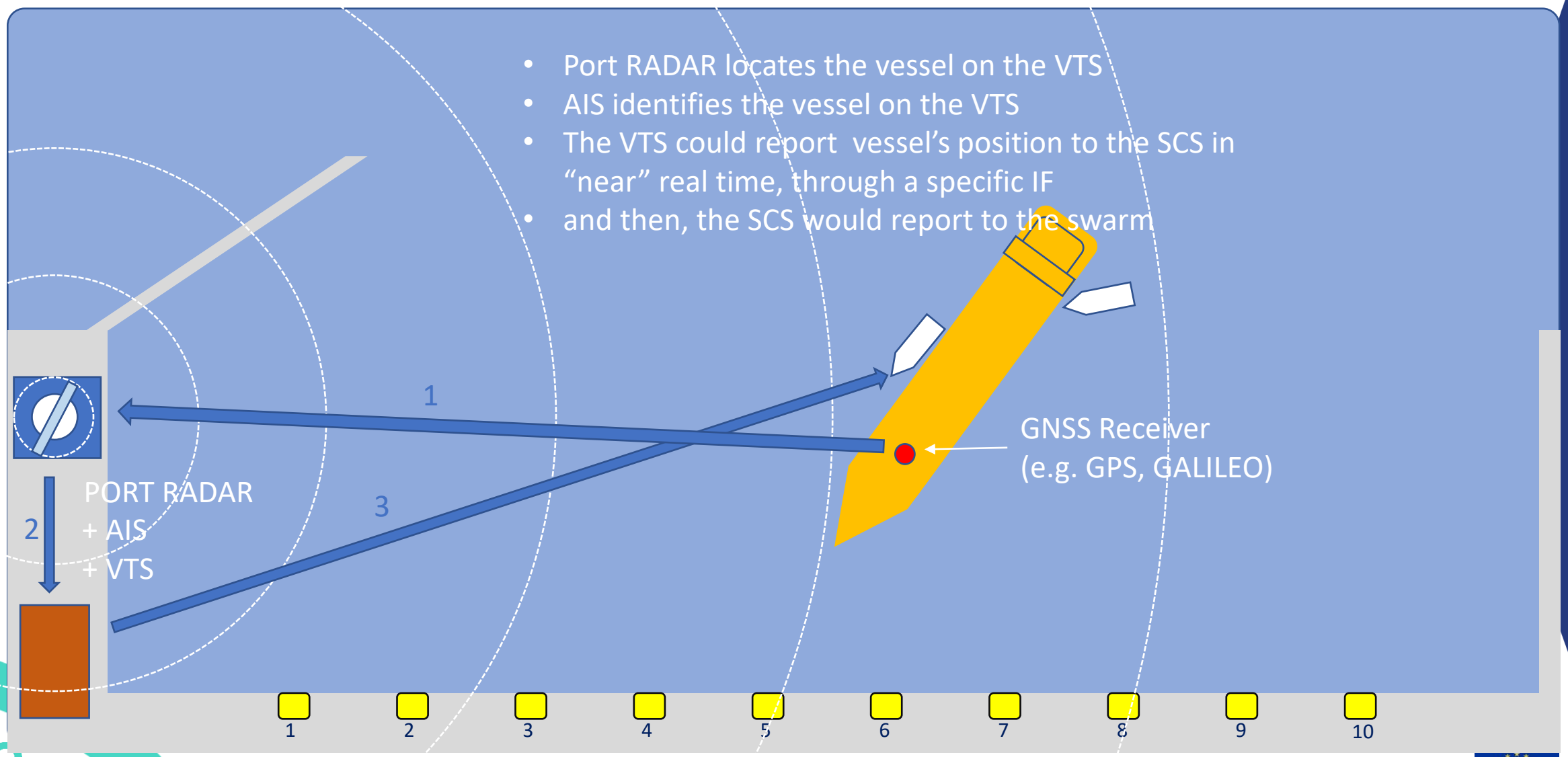
MOSES Berthing step by step

STEP 5 • Tugboats return to base (manual operation)



SCS Traffic Management functionalities

- Port RADAR locates the vessel on the VTS
- AIS identifies the vessel on the VTS
- The VTS could report vessel's position to the SCS in "near" real time, through a specific IF
- and then, the SCS would report to the swarm



CONCLUSIONS

1. The definition of protocols and ship-port-SCS is key
2. The fact that the ship is sharing the voyage plan with exact waypoints with the VTS will conduct to a better planification, performance and, as a consequence, a reduction of incidents and accidents
3. When bad weather conditions and the pilotage cannot be provided (the pilot is a safety measure), with autonomous ships, it will be possible to carry out the port call process
4. It is expected a reduction of the manoeuvring time
5. The autonomous ship will be willing to navigation even though congestion constraints.
6. A high percentage of accidents occur because communication errors. As the new communication will be standardised, the communication will be improved. The specific accident also has a great impact in terms of marine pollution. Moreover, will lead to less crew fatigue.
7. Mandatory adoption of this aspects in the current regulation is needed
8. Boosting smart navigation and hence, the reduction of emission
9. Logistics bottleneck solutions
10. New skills for the crew and a reduction of the recruitment constraints.

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Thank you for your attention!

Contact

Jorge Miguel Lara López

jlara@fundacion.valenciaport.com

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This project has received funding from the European Union's horizon 2020 research and innovation programme under grant agreement No. 861678.