

# M<sup>o</sup>SES



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

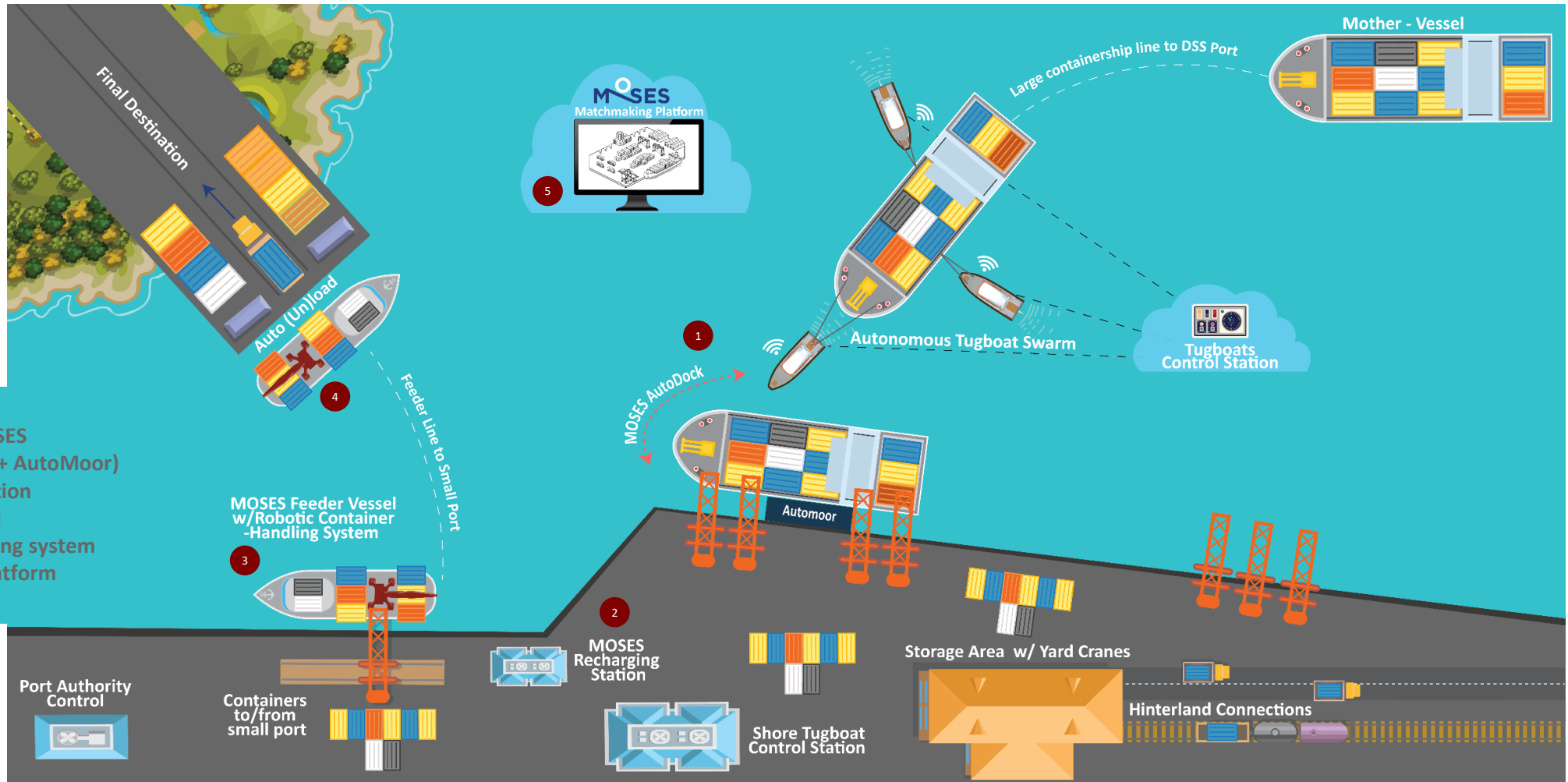
Adaptation of port call process for  
autonomous ship in a big port

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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

# 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

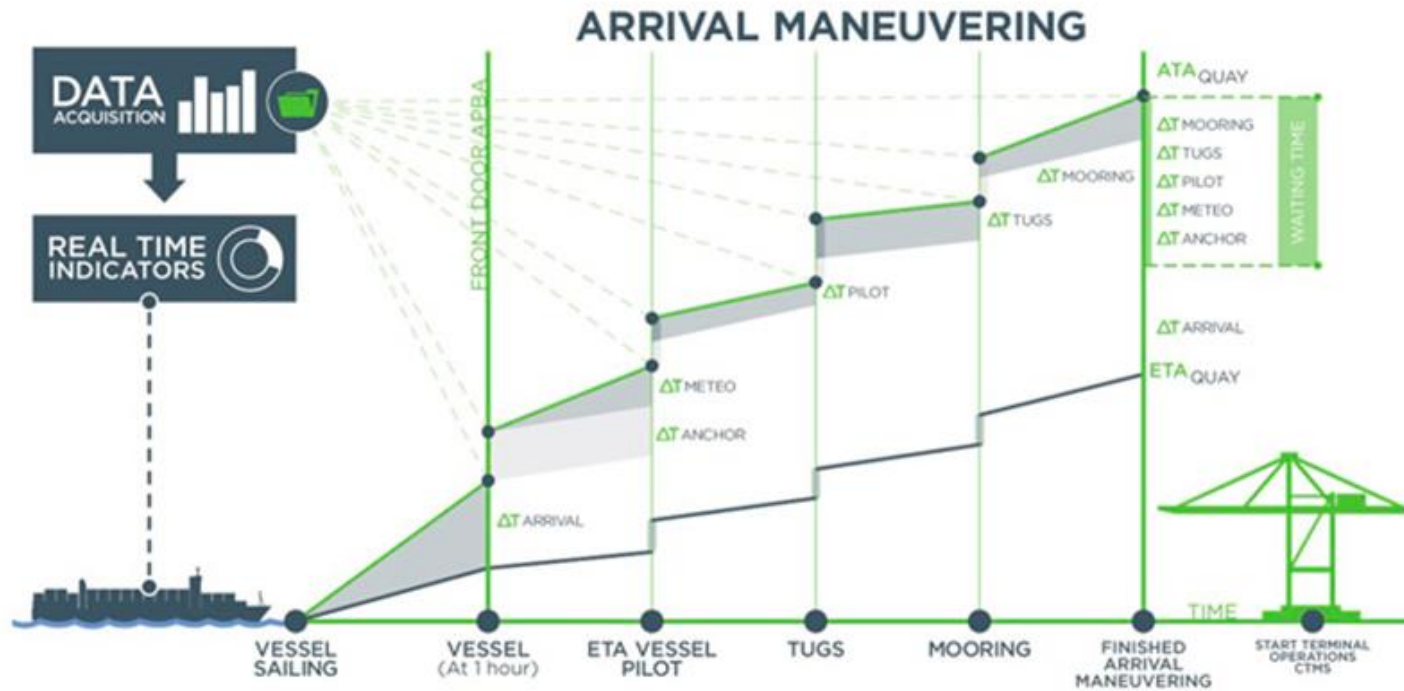
**METHOD:** A full-scale, operational MacGregor GLE Crane, outfitted with sensor package, will be controlled by an operator at the MOSES Shore Control Station (SCS) to handle a container. The demo will be implemented with the SCS onsite and at a remote location.



An aerial photograph of a port area, showing a city skyline in the upper left, a large body of water in the center, and a port terminal with several ships docked. A large blue text box is overlaid on the image, containing a title and a list of reasons why a port might be interested in autonomous ship operations.

## WHY A PORT COULD BE INTERESTED IN AUTONOMOUS SHIP OPERATIONS?

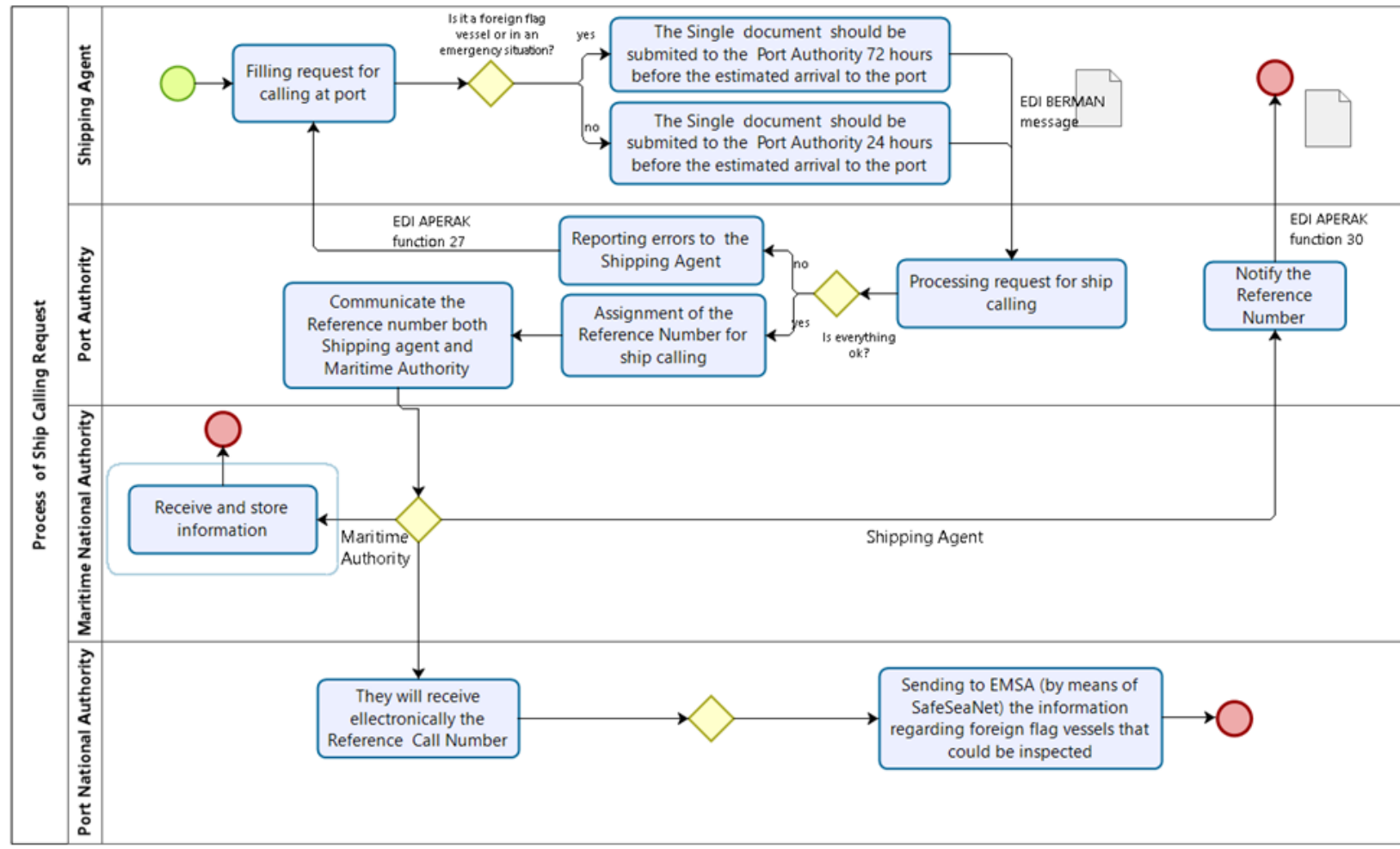
1. Reduction of congestion related to hinterland connections
2. Move cargo to close smaller ports improving the connectivity and fostering real shift of cargo from road to maritime traffic and complement rail capacity.
3. Decrease times of a port call process from the operational point of view
4. Foster 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



- 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)



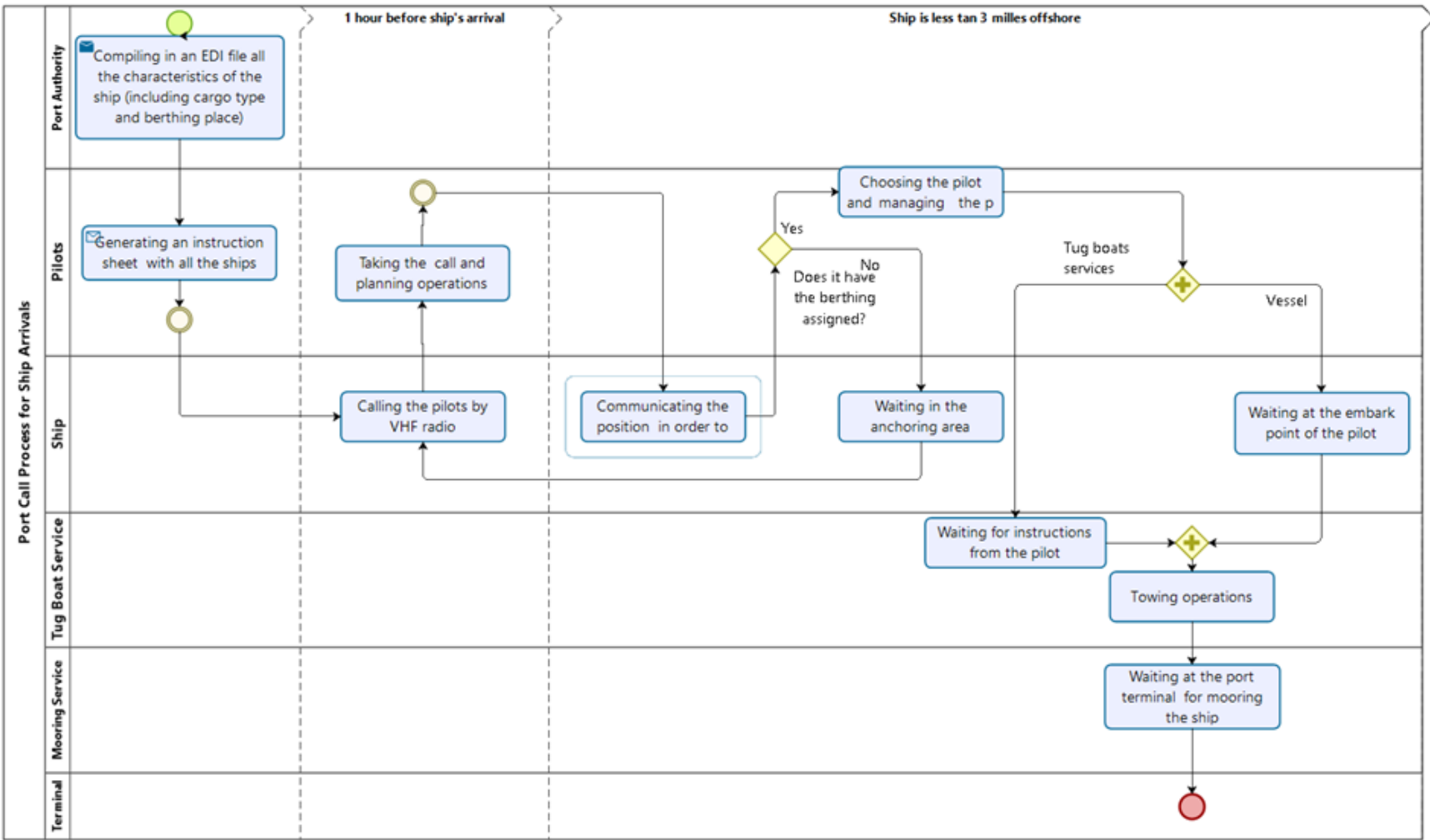
Regulation (EU) 2019/1239 establishing a European Maritime Single Window environment



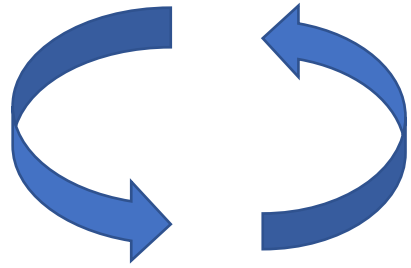
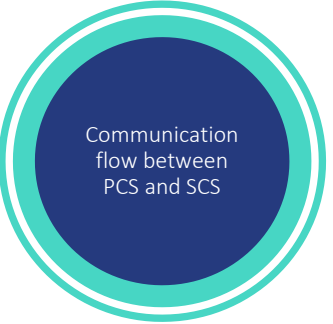
Key aspects about detailed and accurate information of the autonomous ship – specificities compared with the info provided by a current vessel. Clear standards about the information and protocols. Role of the Shipping Agent



Port call process

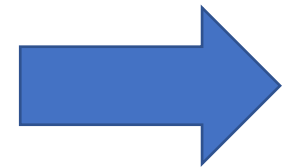


VHF Radio communications – Who and how?  
 Pilot onboard? – Exemption of pilotage for autonomous ships? Situational awareness  
 Crew to facilitate towage  
 How to assure mooring interaction when berthing



## 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



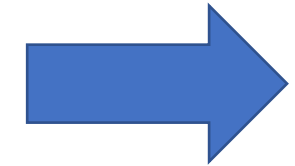
72 hours for foreign vessels and vessels in emergency  
24 hours for national vessels



- 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

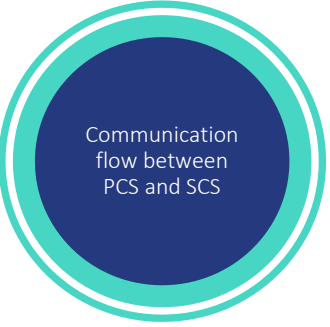
## 2.-Shore control station process

- 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





### 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.





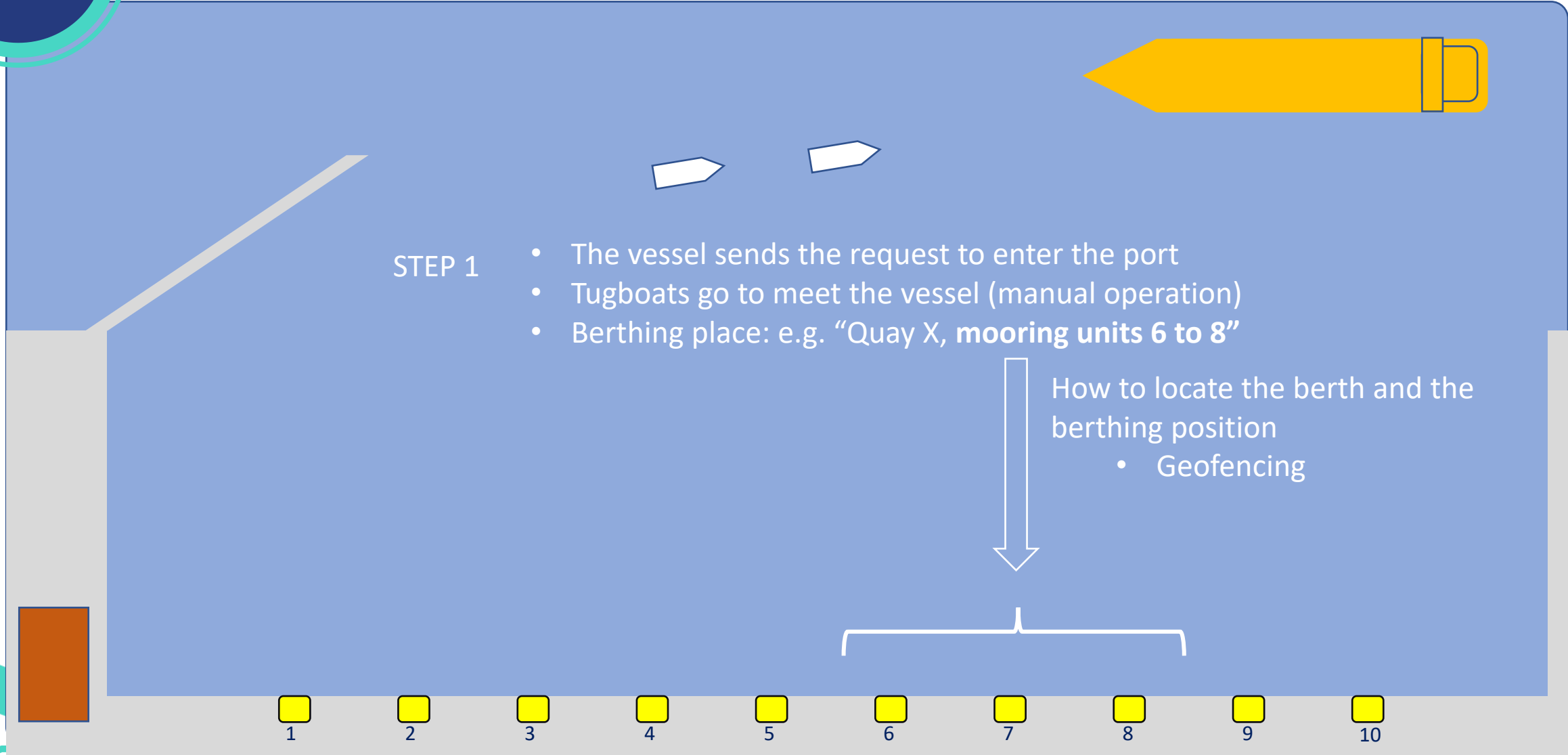
# MOSES Berthing step by step

## STEP 1

- The vessel sends the request to enter the port
- Tugboats go to meet the vessel (manual operation)
- Berthing place: e.g. "Quay X, mooring units 6 to 8"

How to locate the berth and the berthing position

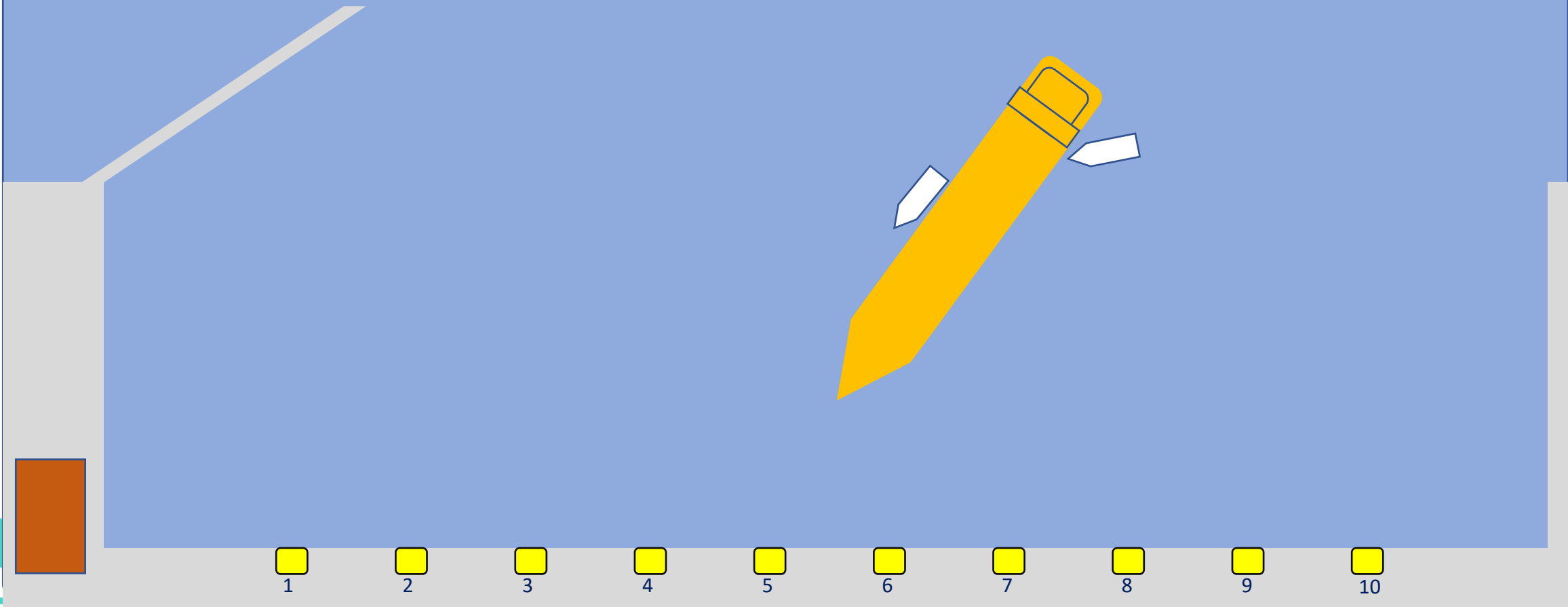
- Geofencing





# MOSES Berthing step by step

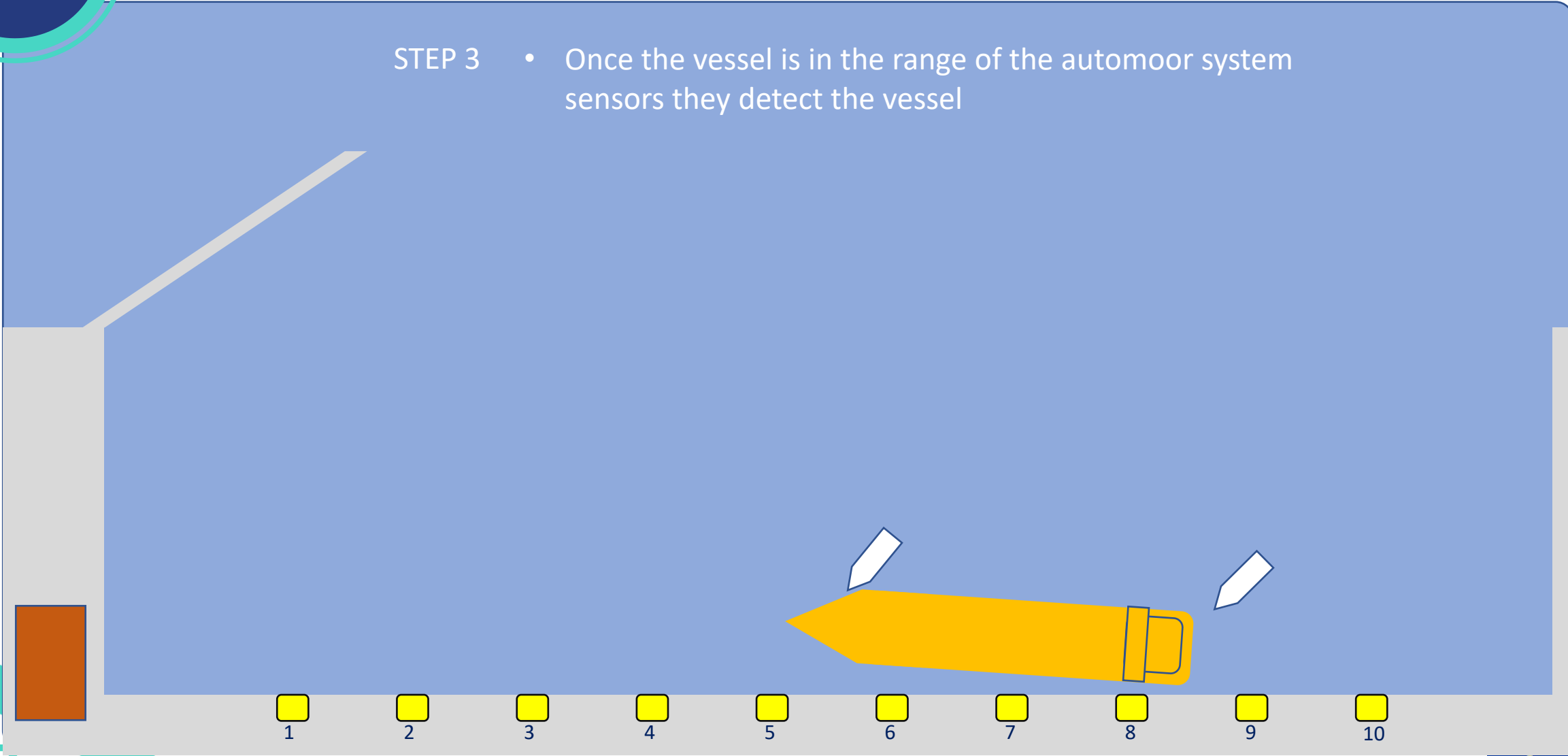
- STEP 2 • Once the vessel is inside port, tugboats swarm berth the vessel (autonomous operation)





# MOSES Berthing step by step

STEP 3 • Once the vessel is in the range of the automoor system sensors they detect the vessel

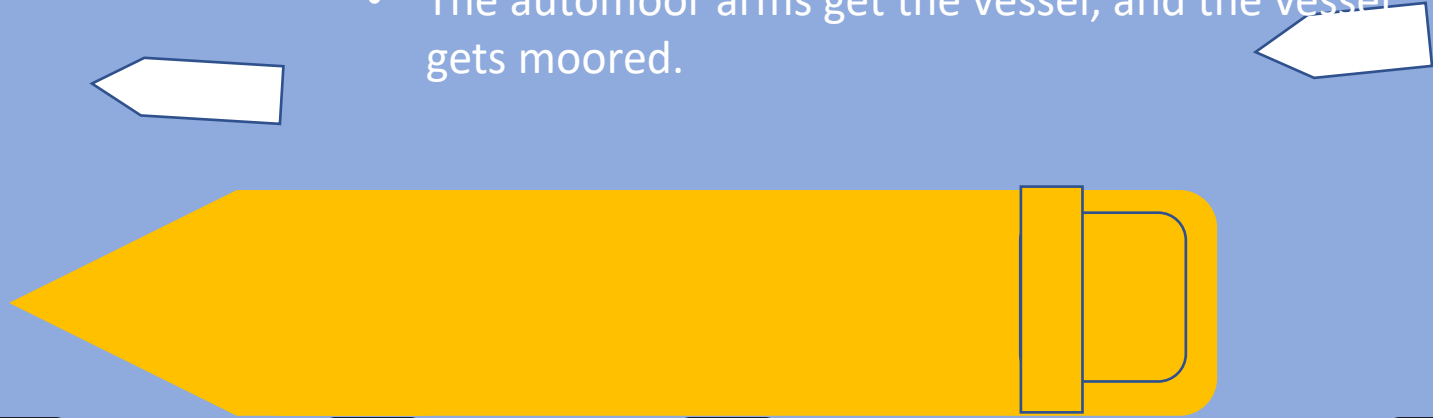




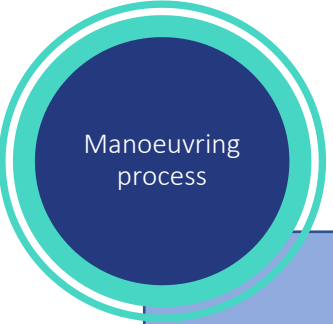


# MOSES Berthing step by step

- STEP 4
- Automoooring process: once the vessel is at <math><1\text{m}</math> distance of all the required automoor units,
    - Tugboats swarm autonomous operation ends.
    - The automoor arms get the vessel, and the vessel gets moored.

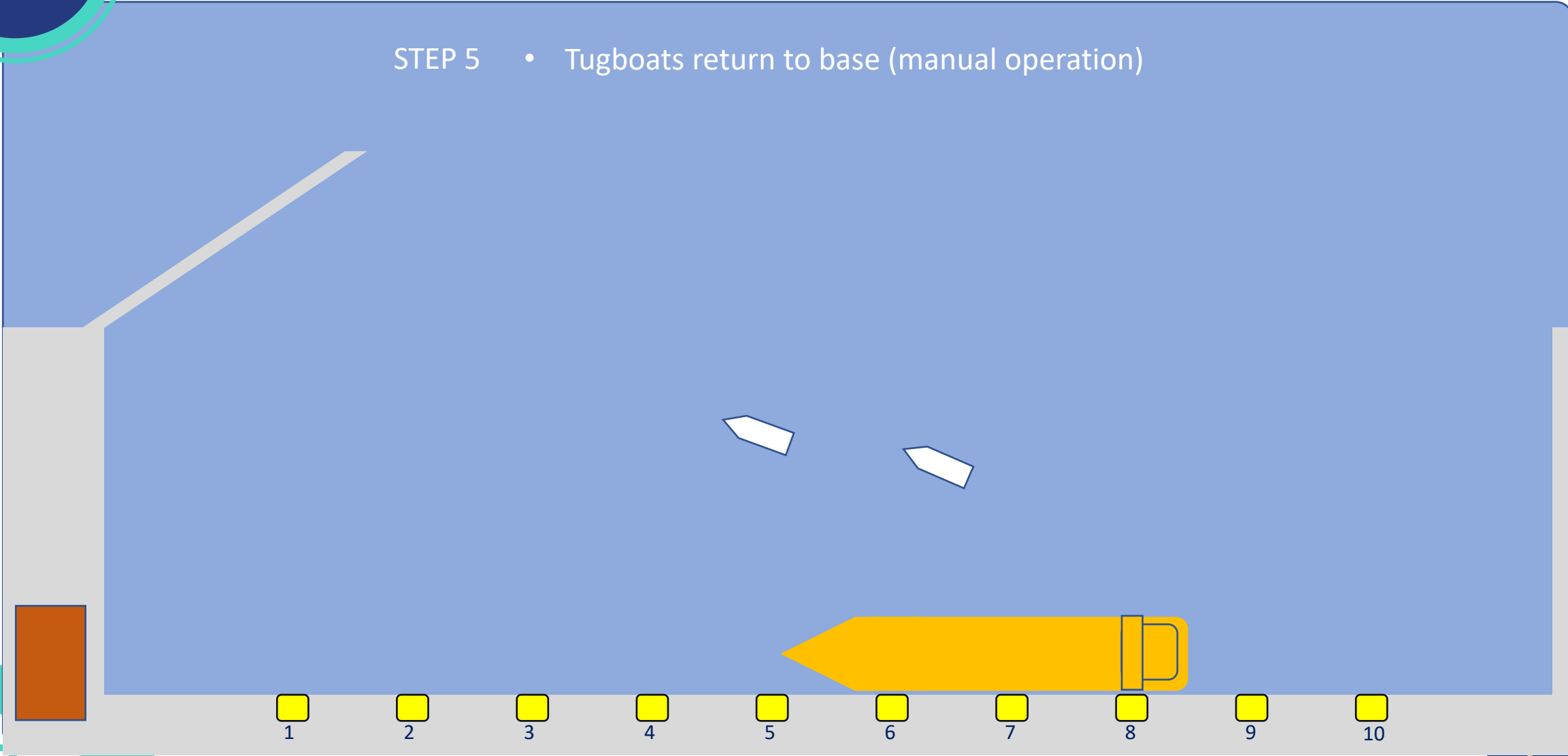


				15 m		15 m		
	4	5	6		7		8	9
Vessel detected?		NO	Yes		Yes		Yes	NO
Distance		-	0 m		0 m		0 m	-



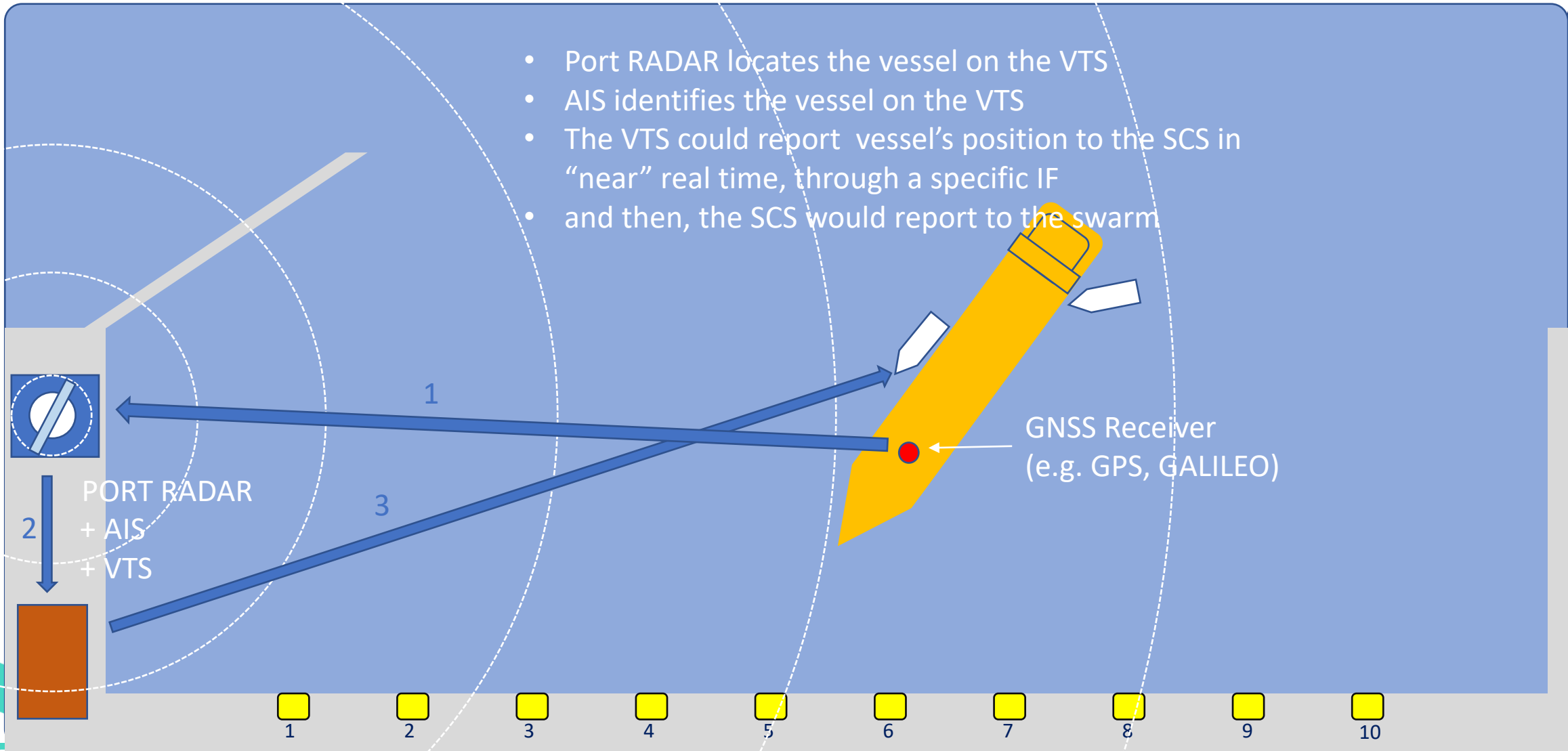
# MOSES Berthing step by step

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.





# MOSES

## Thank you for your attention!

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 MOSES project2020

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 MOSES Project



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