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of the Aegean

5TH Annual
digital ship Athens
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“Bridge systems usability”

By

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Contents

- Introduction to bridge ergonomics
- Usability – implementation on bridge systems
- Marine accidents related to system usability
- Case study “docking system usability”

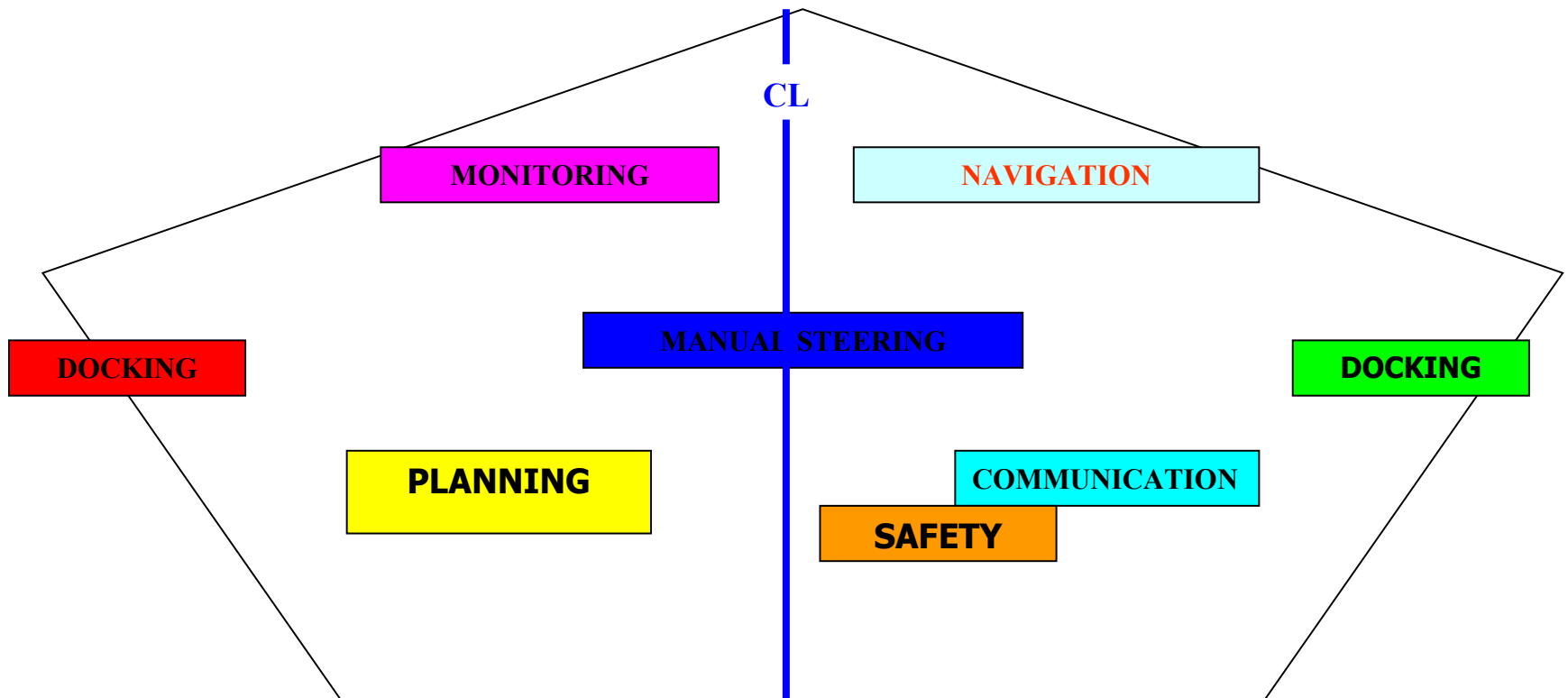


Bridge ergonomic design – the International framework

- **IMO MSC CIRC 982-** Guidelines on ergonomics criteria for Bridge Equipment and layout
- **ISO/8468** Ship's bridge layout and associated equipment – Requirements and guidelines



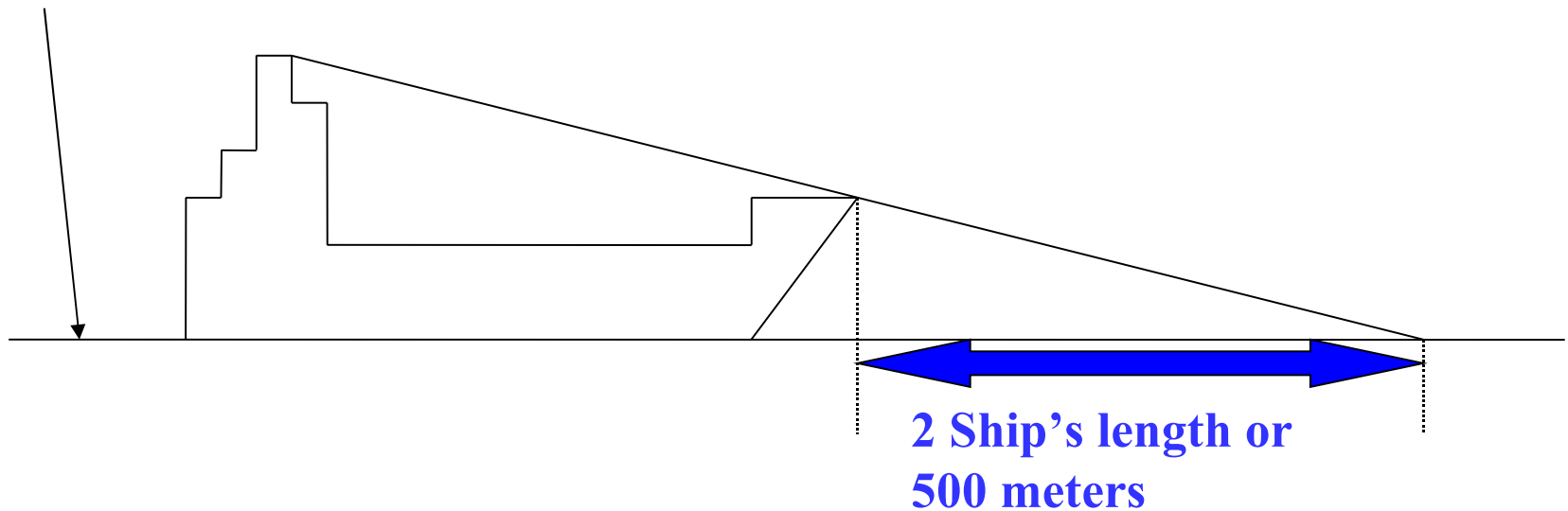
IMO/ISO Requirements working stations





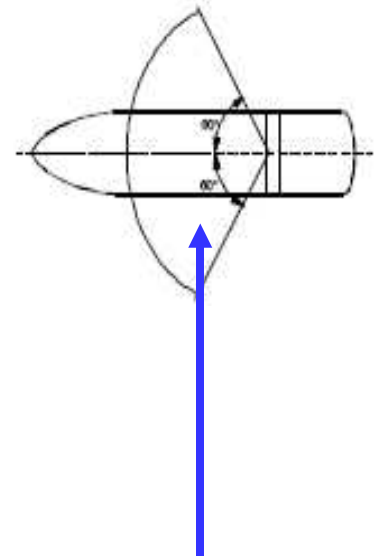
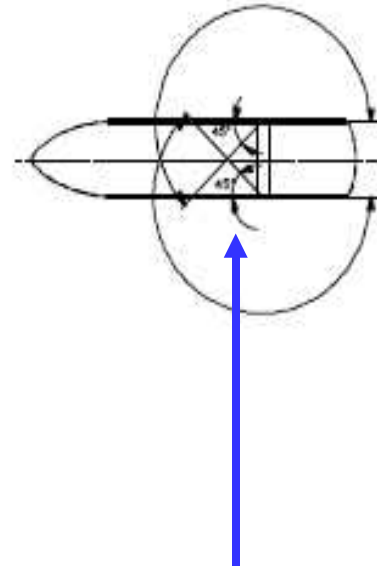
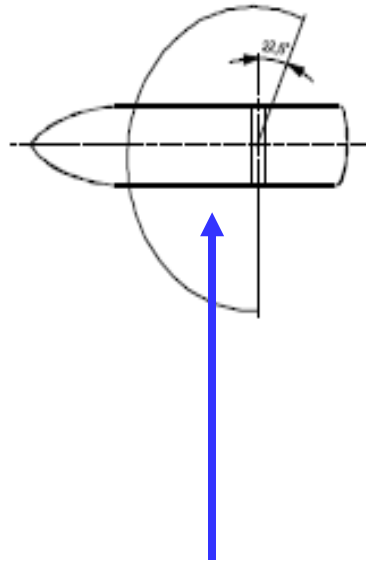
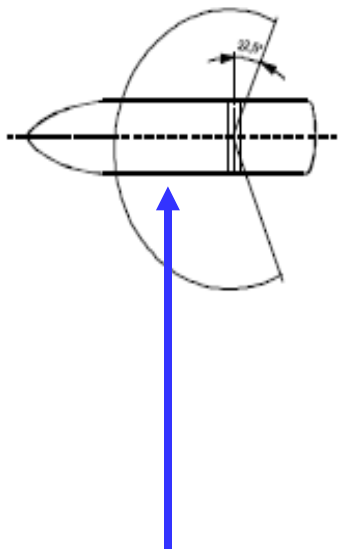
IMO/ISO Requirements Blind sectors

Sea surface





IMO/ISO Requirements Field of vision



Navigation station

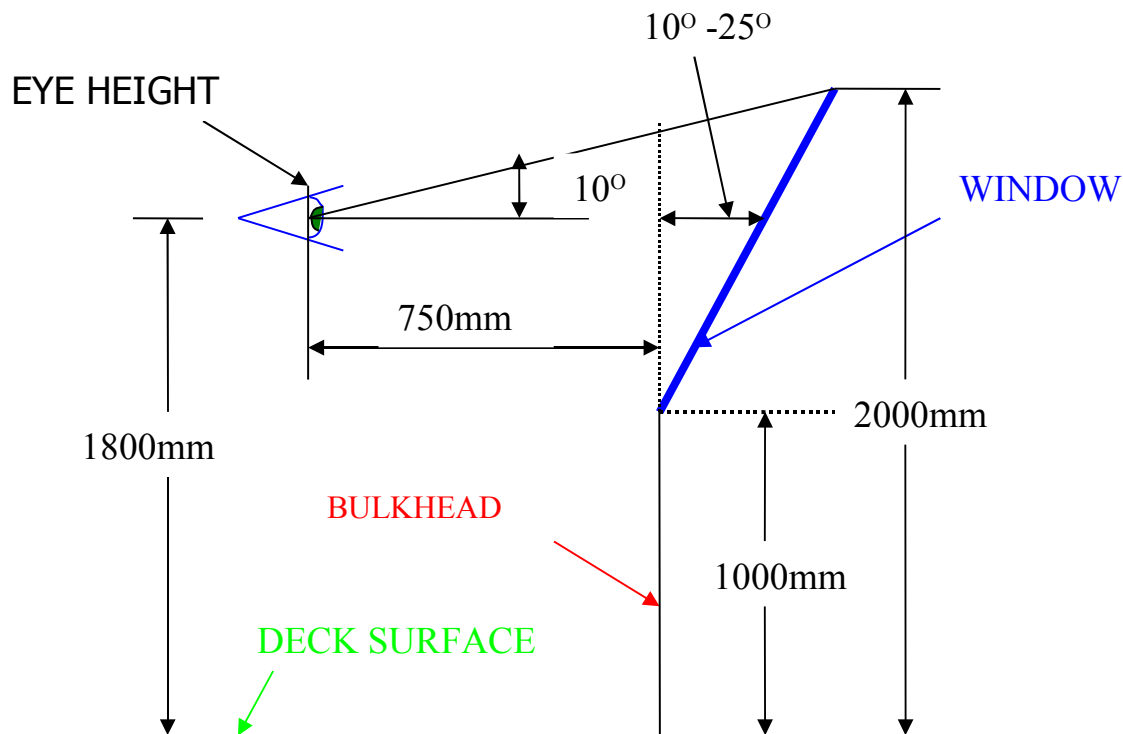
Monitoring station

Docking station

Manual steering
station

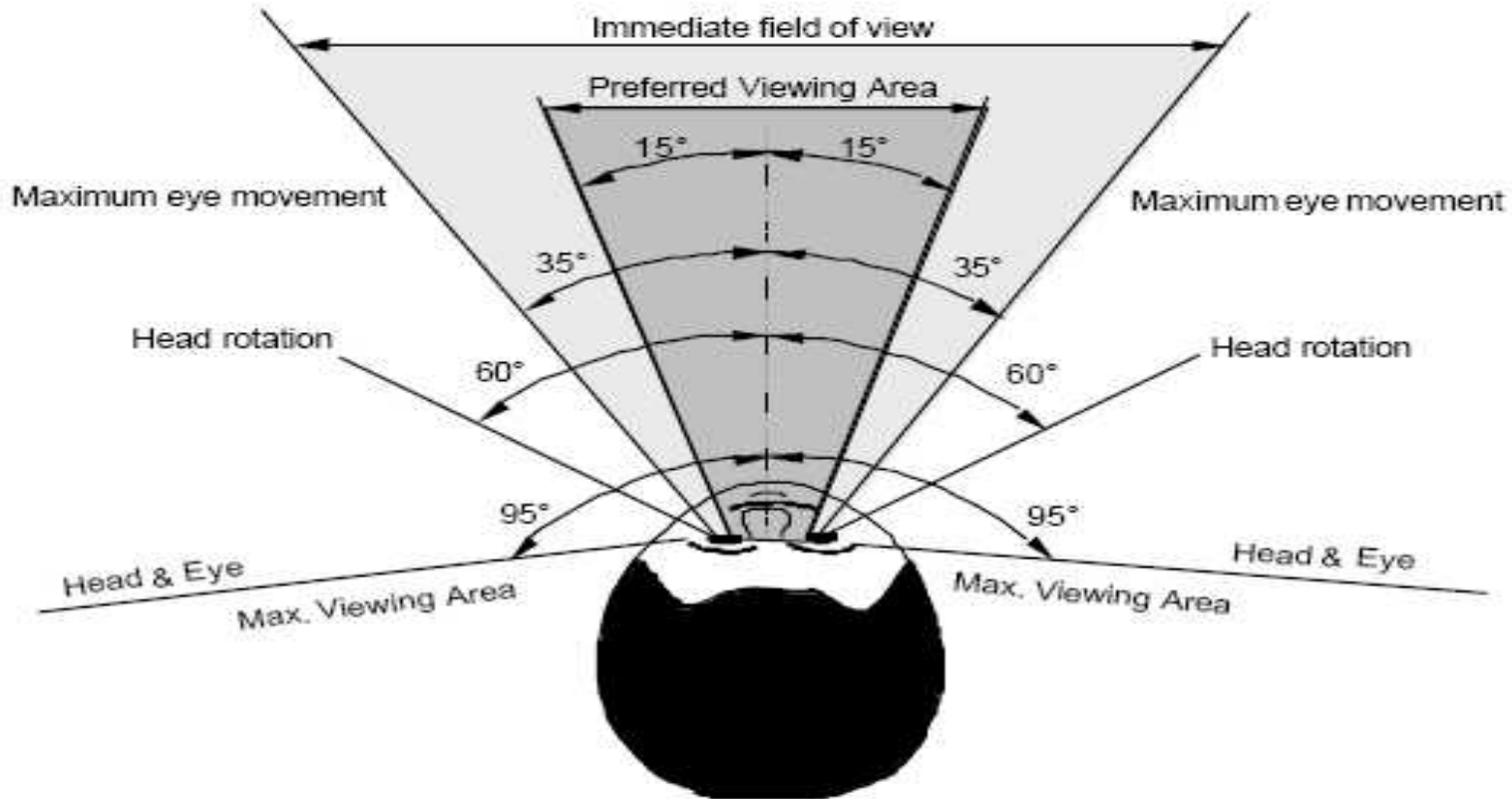


IMO/ISO Requirements Bridge windows





IMO/ISO Requirements display arrangement





Bridge system usability

- usability – definition- components
- Bridge system usability
- Bridge systems usability measures
- Examples

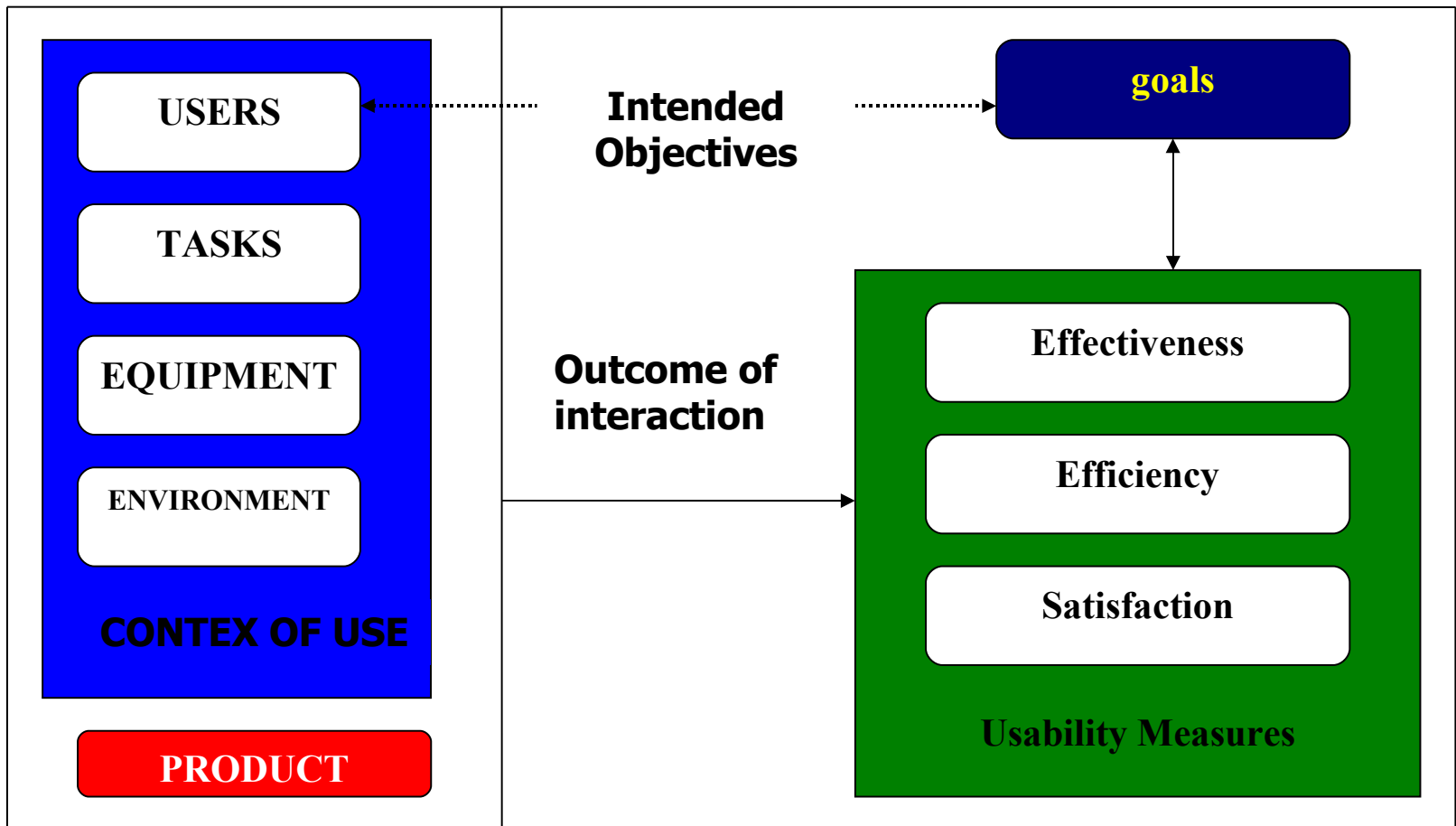


Usability - definition

Usability is defined as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. (ISO 9241-11)



Components of usability





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Usability on the Bridge - context of use-

- Users
- Tasks
- Equipment
- Environment



Usability on the Bridge - Users-

- Bridge personnel qualified and certified as per STCW 95
- Soft skills
- Experience
- Physical attributes



Usability on the Bridge - Tasks-

- Voyage planning
- Safety of navigation
- Voyage monitoring
- Pilotage
- docking - undocking
- Emergencies (management center)



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Usability on the Bridge - Equipment-

Equipment as per IMO MSC/Circ 982 Appendix 2



Usability on the Bridge - Environment-

ORGANIZATIONAL ENVIRONMENT	TECHICAL ENVIRONMENT	PHYSICAL ENVIRONMENT
Hours of work	Hardware	Atmospheric conditions
Group working	Software	Auditory environment
Job function	Reference materials	Thermal environment
Work practices		Visual environment
Assistance		Environmental instability
Management structure		Workplace design
Attitudes and culture		Workplace safety
Job design		



Usability measures -Effectiveness-

Effectiveness Measures of effectiveness relate the goals of the user to the **accuracy** and **completeness** with which these goals can be achieved.

Example: if the goal to be achieved for an ARPA radar system is the calculation of a target CPA, the ratio of the of the calculation to the final approach distance of the target, reflects the effectiveness of the ARPA system.



Usability measures -Efficiency-

Measures of **efficiency** relate the level of effectiveness achieved to the expenditure of resources. Relevant resources include mental or physical effort, time, materials or financial cost

Efficiency in the ARPA radar example can be measured by:

- Effort to get the displayed result
- time spent
- cost of useless maneuvers due to doubtful results.



Usability measures -Satisfaction-

Satisfaction measures the extent to which users are free from discomfort, and their attitudes towards the use of the product.

In the ARPA example satisfaction can be measured by :

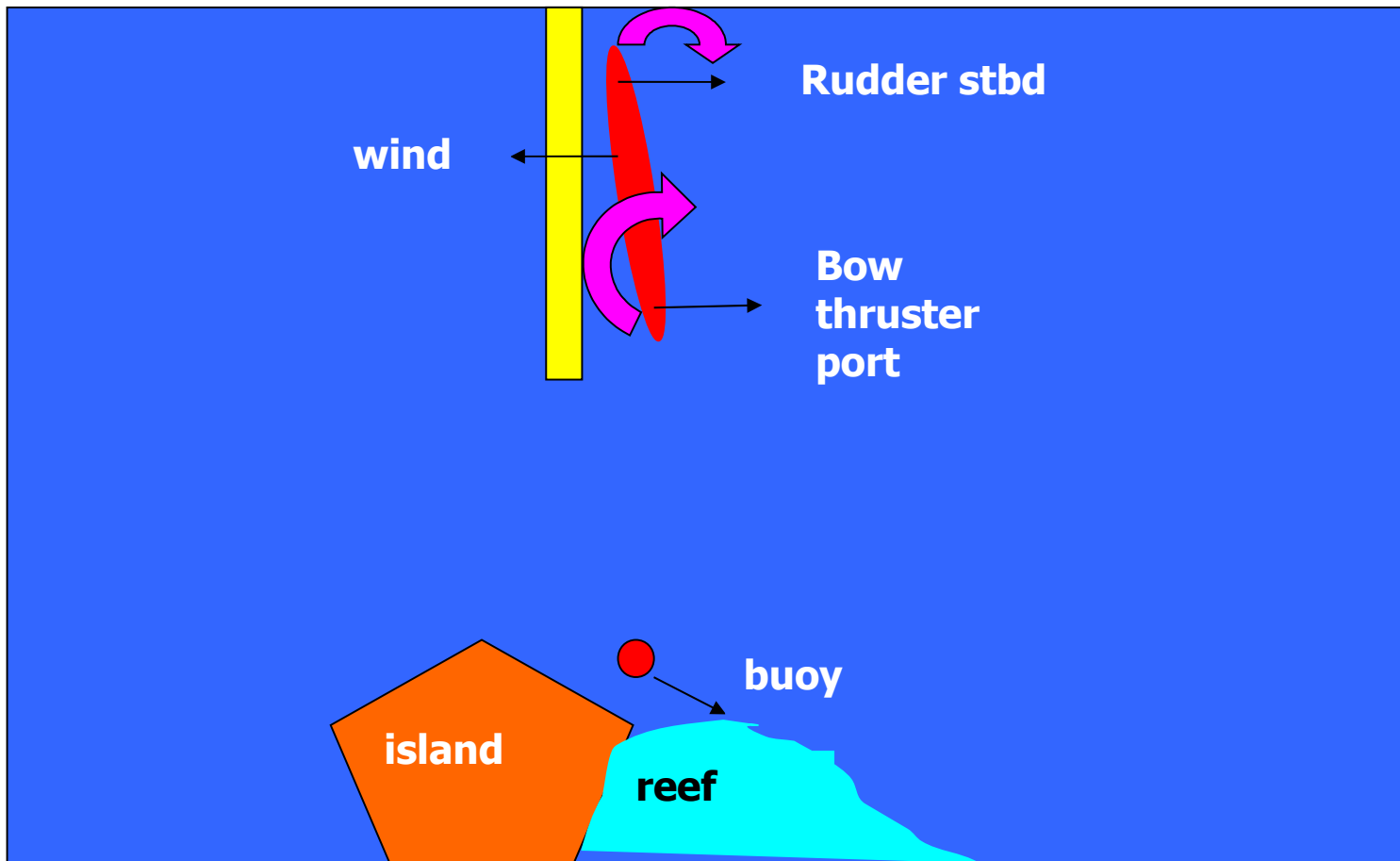
- willingness of the officer to use the system
- attitude during the procedure
- Level of confidence to the results calculated by the system.

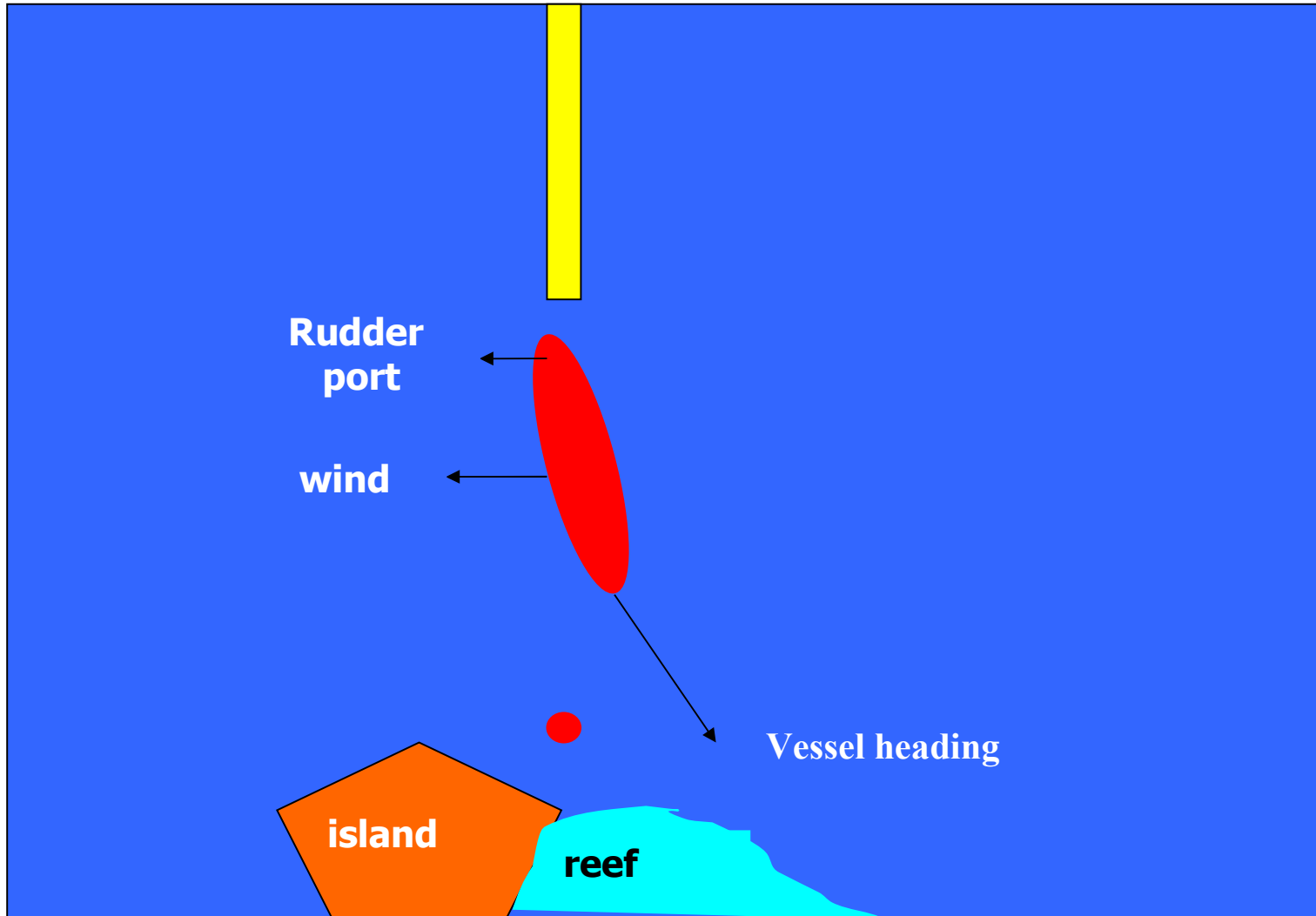


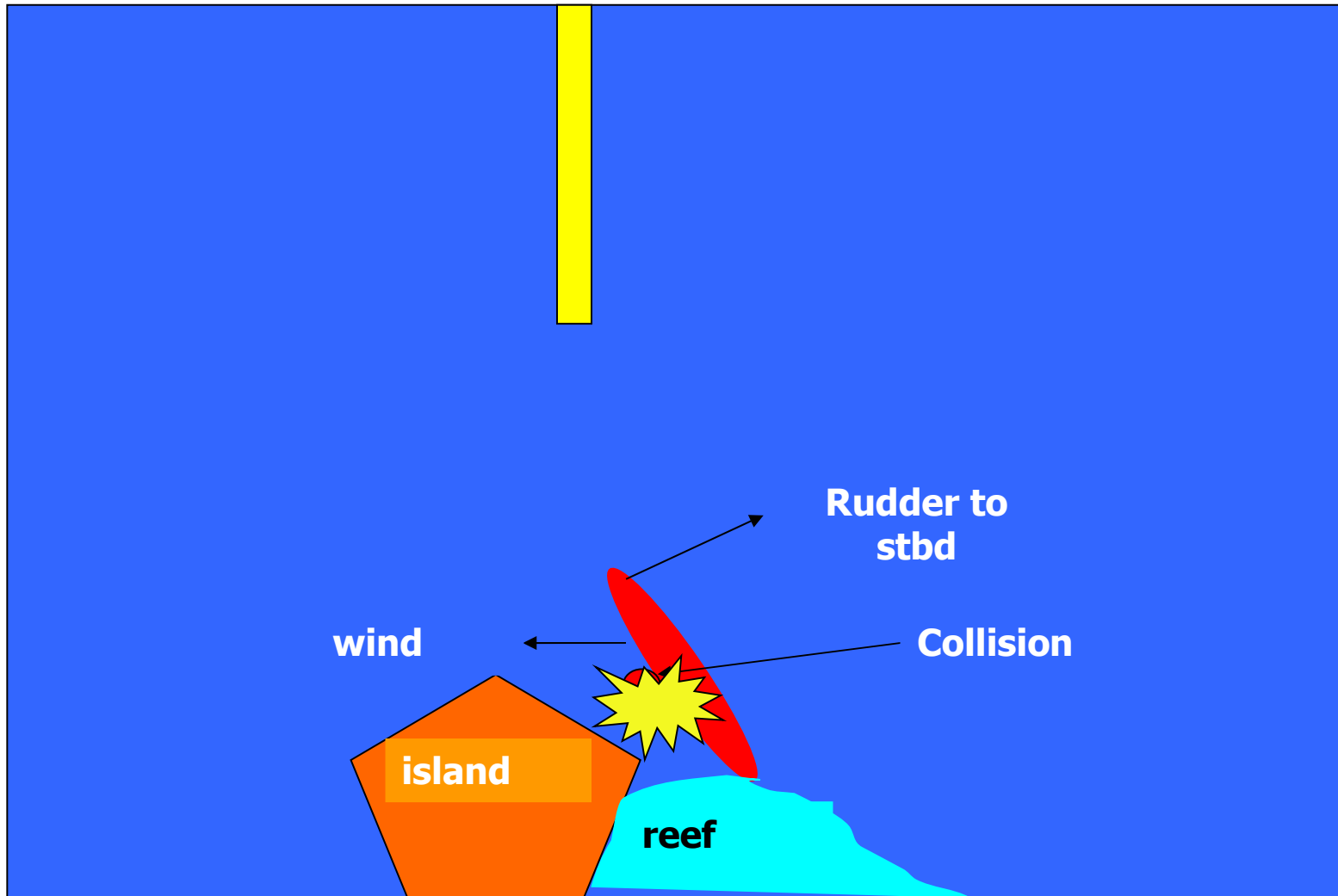
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Marine accidents M/S “FINNCLIPPER”











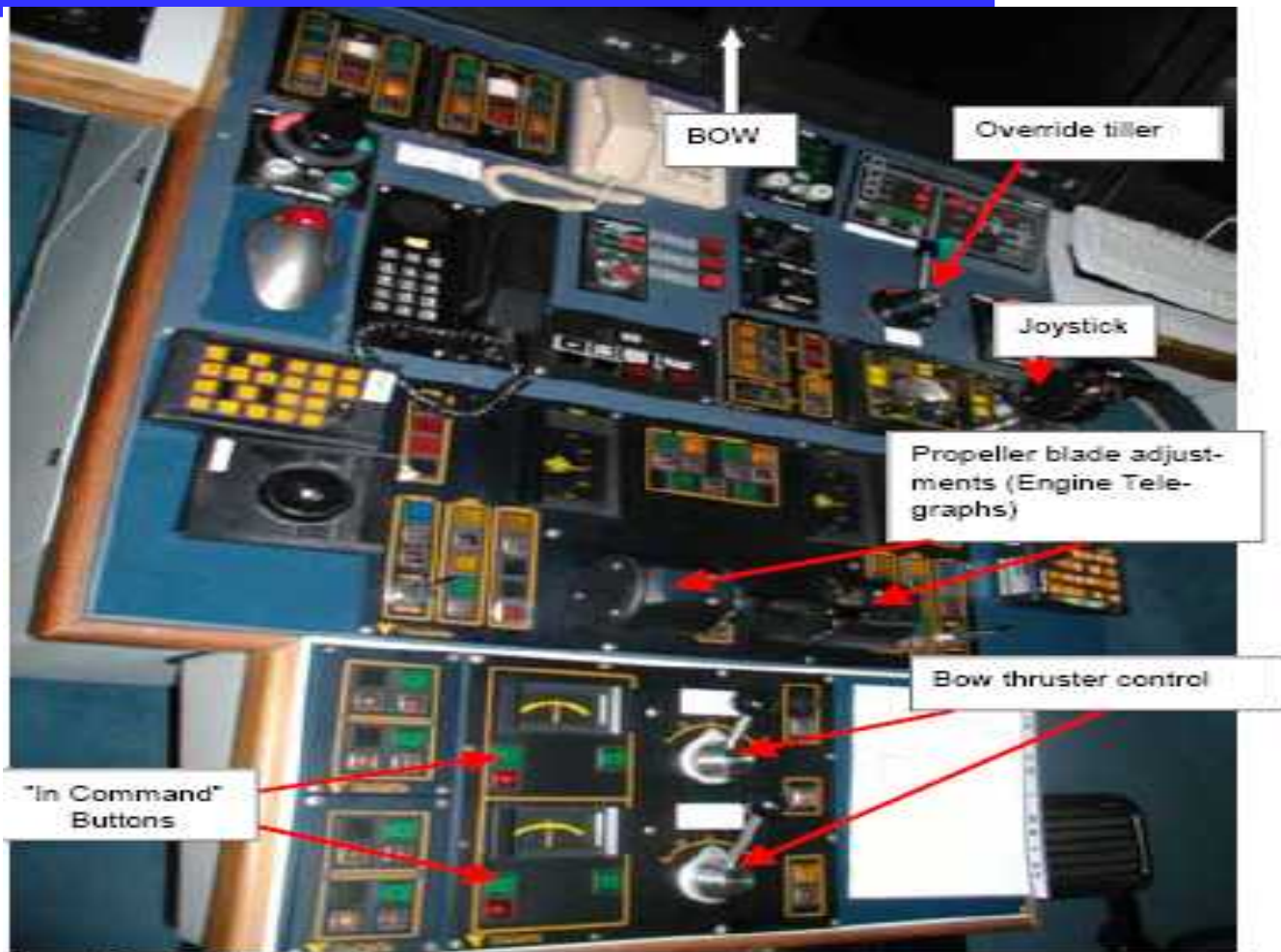
Contributing factors

- Ergonomics (location of bow thruster)
- Override tiller - usability*

*According to Finnlines masters do not fully trust on the joystick because there might be some miss calibrations of the steering equipment.



Contributing factors



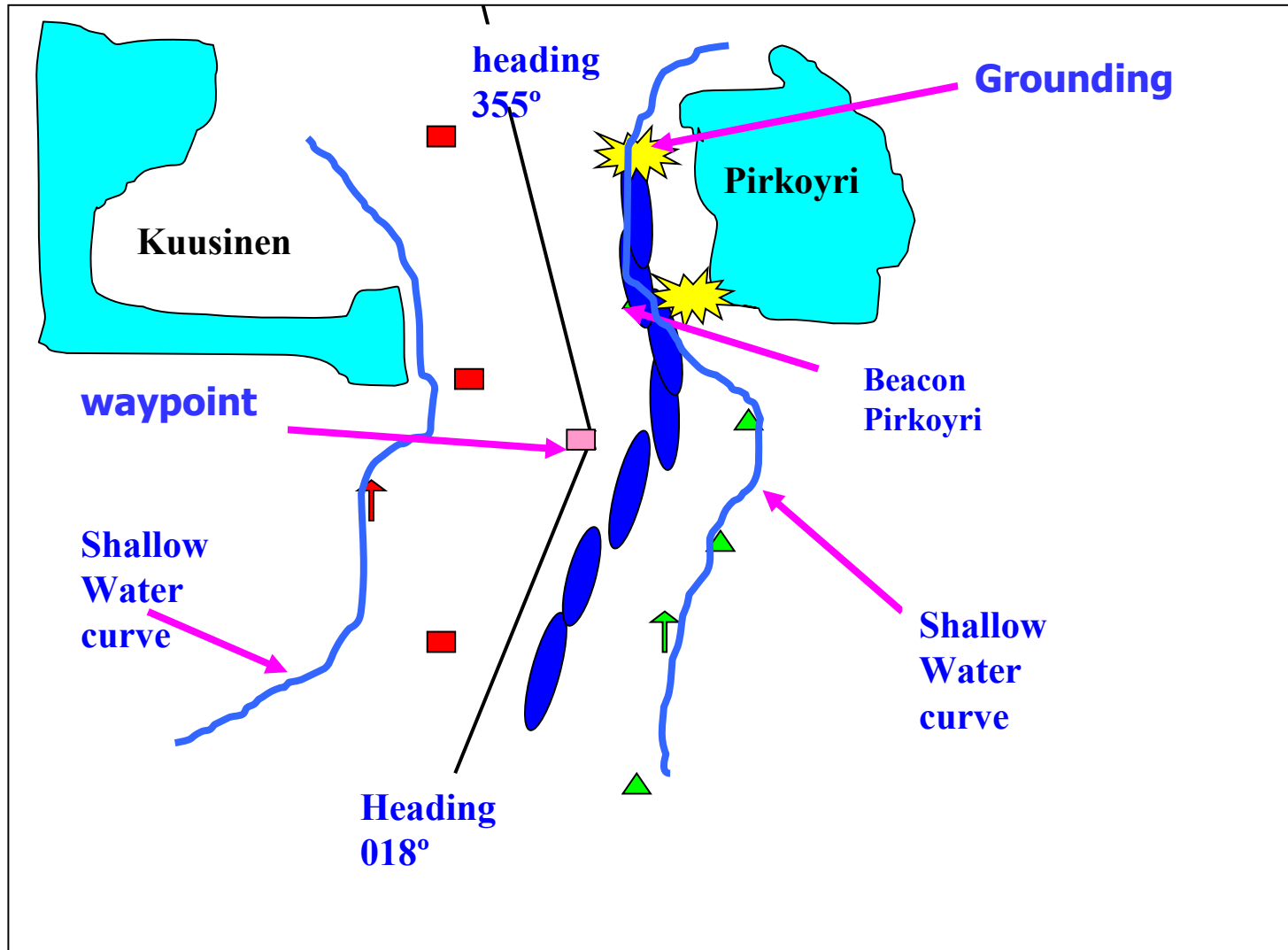


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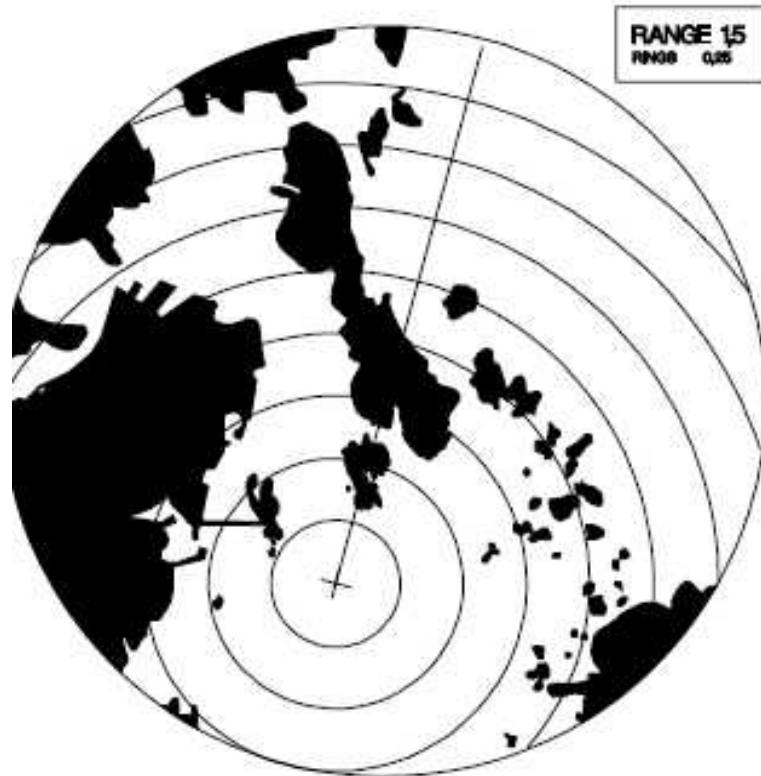
Causes of the accident

- Wrong distance estimation
- Delayed turn



Distance estimation

Due to complicated procedures of VRM of the radar pilot used the traditional rings. The result is the wrong estimation of the distance

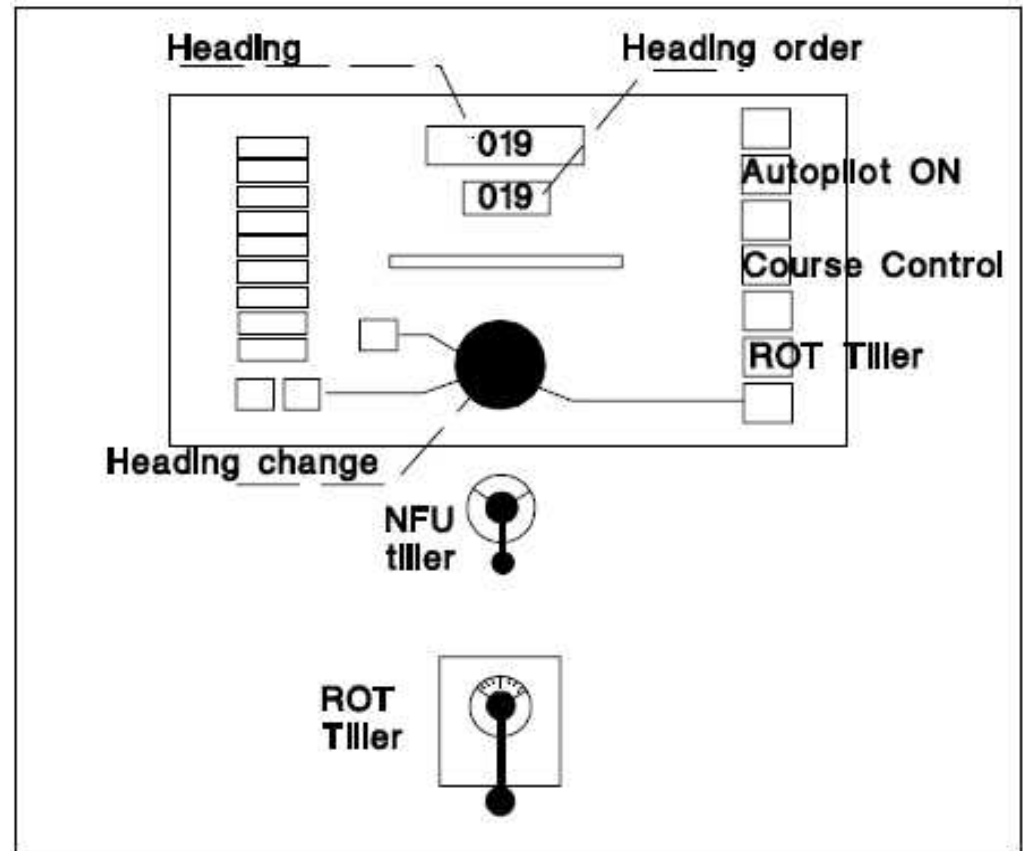




Steering

Steering method used
for the turn “autopilot”

Pilot is not confident
with the other means





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Case study: docking system usability





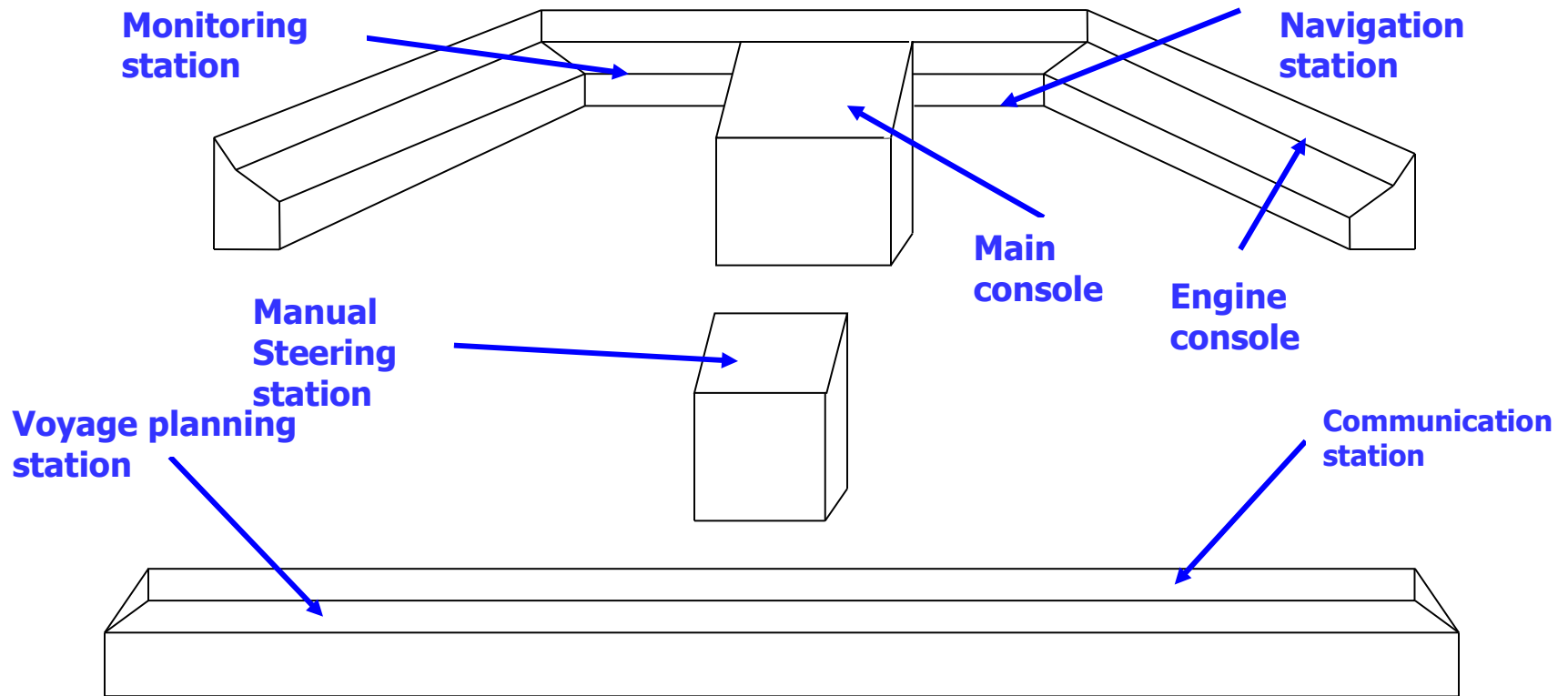
The ships

The research carried out on two sister vessels with same particulars, maneuvering abilities, bridge layout and equipment.

Vessel's type	Ro/ro pass
year of built	2005/2007
country of built	Greece
LOA	141,00
MB	21,00
SERV/SPEED	28
Passengers	1915
Vehicles	418
Cabins	31



Bridge layout





The Users

	Master A	Master B	Master C
Experience	5 years As master on coastal line ships	7 years As master on coastal line ships	3 years As master on coastal line ships
Hardskills	License A	License A	License A
Softskills	High training standards	High training standards	High training Standards
Physical characteristics	Height : 1.70 Weight : 70 kgs Age: 40	Height : 1.65 Weight : 70 kgs Age : 44	Height : 1.90 Weight : 100 kgs Age : 36
Familiarization with the bridge	Excellent	Excellent	Excellent
Personality	Self confident, Cool	Worried, anxious	Self confident, Cool



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Task : safe berthing





Equipment - steering

STEERING
MODE
SWITCH



STEERING KNOB
ON INDEP.
STEERING

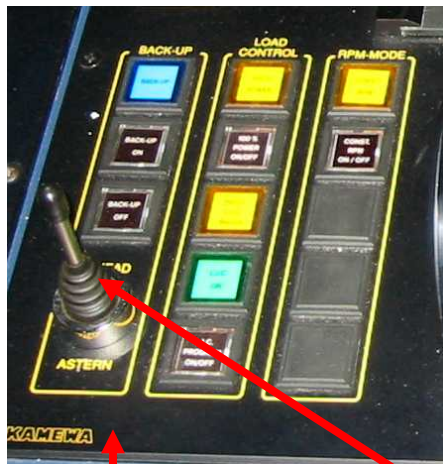


SYNCHRO STEERING
KNOB

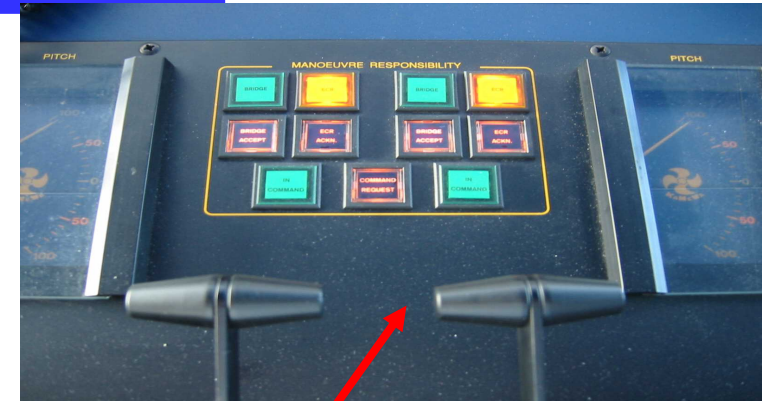
COMMAND SWITCH



Equipment – Engine controls



Emergency joystick





Equipment – bow thrusters controls



Control for
synchro
operation



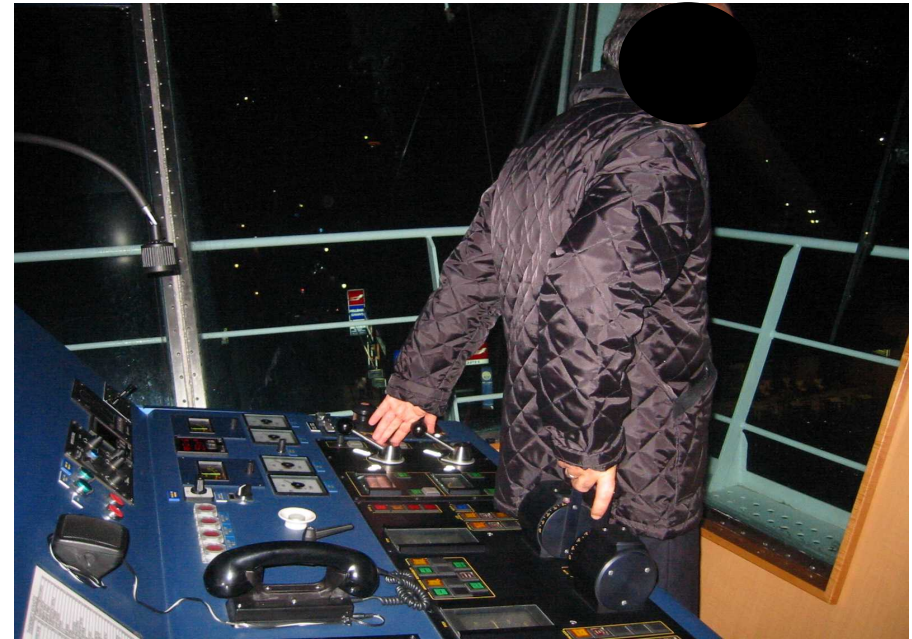
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Usability measures

MASTER A



MASTER B





Usability measures

Usability measures	Master A	Master B	Master C
Effectiveness	100%	100%	100%
Efficiency Efforts	80%	60%	80%
Efficiency Time	60%	60%	80%
Efficiency cost	70%	50%	80%
Satisfaction	50%	30%	40%



Conclusions

- Specific operational needs of the ship should be considered when designing bridge systems.
- Masters prefer to have the physical perception of the ship's motion instead of instrumental readings.
- Masters want to **feel** the power they force by handling the control elements of the docking system.
- Usability of bridge systems is achieved at the maximum level when the design of the systems is providing all the desired options to the users.



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Thanks for your attention