

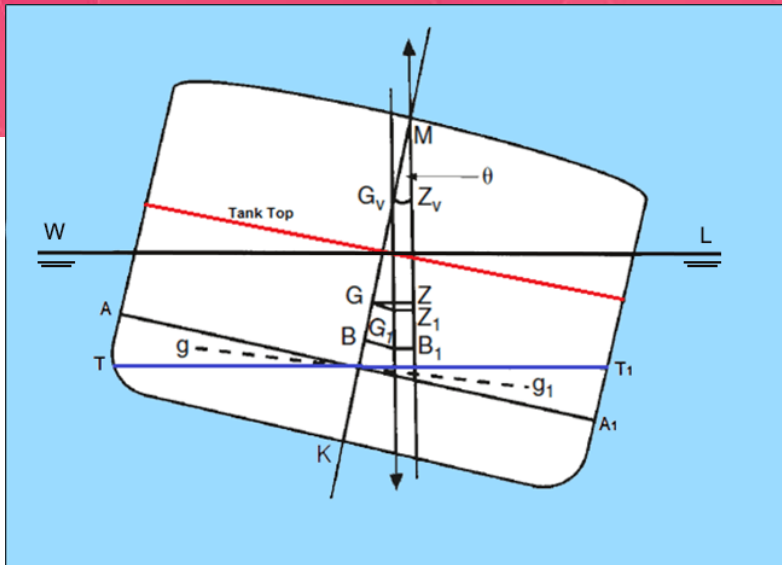


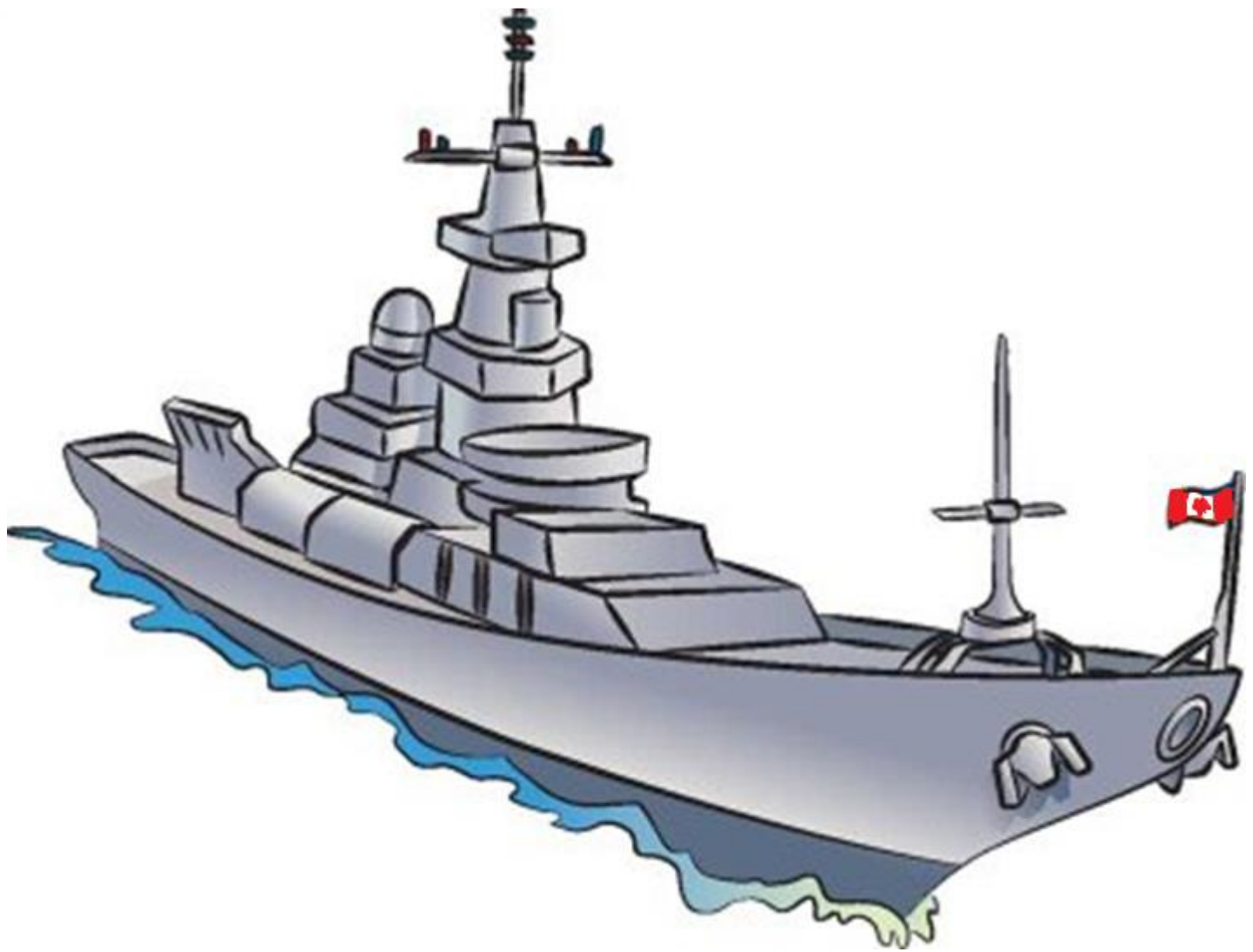
Shipboard Environment and Human Factors

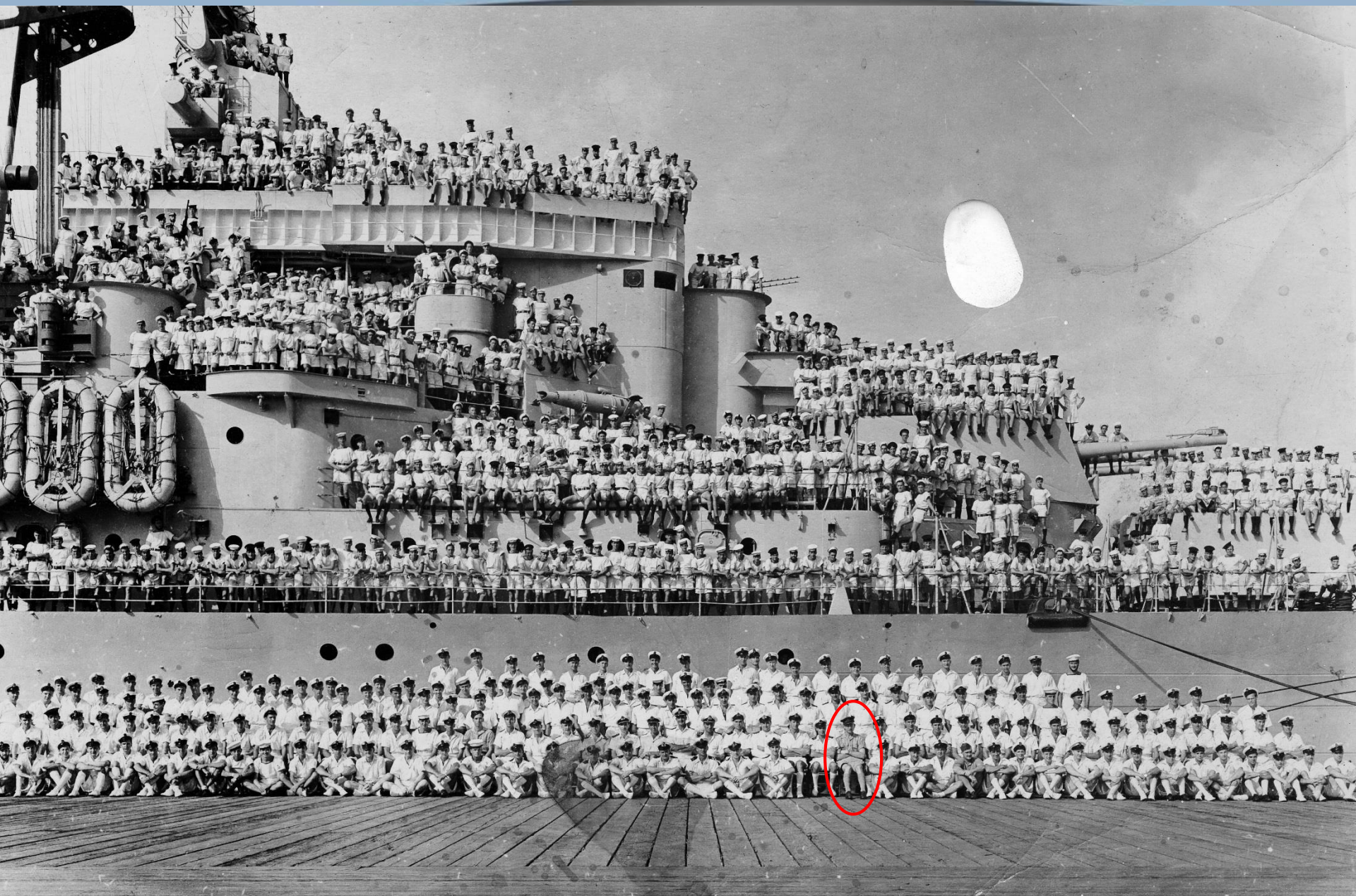
Maj Andrea MacEachern
Human Systems Integration,
Royal Canadian Navy



LET'S TALK ABOUT YOU!







Crew of *HMCS ONTARIO*, November, 1945.



What is HSI?

Human Systems Integration (HSI) is a systems engineering process that ensures all human-related concerns are properly addressed during system planning, design, development and testing.

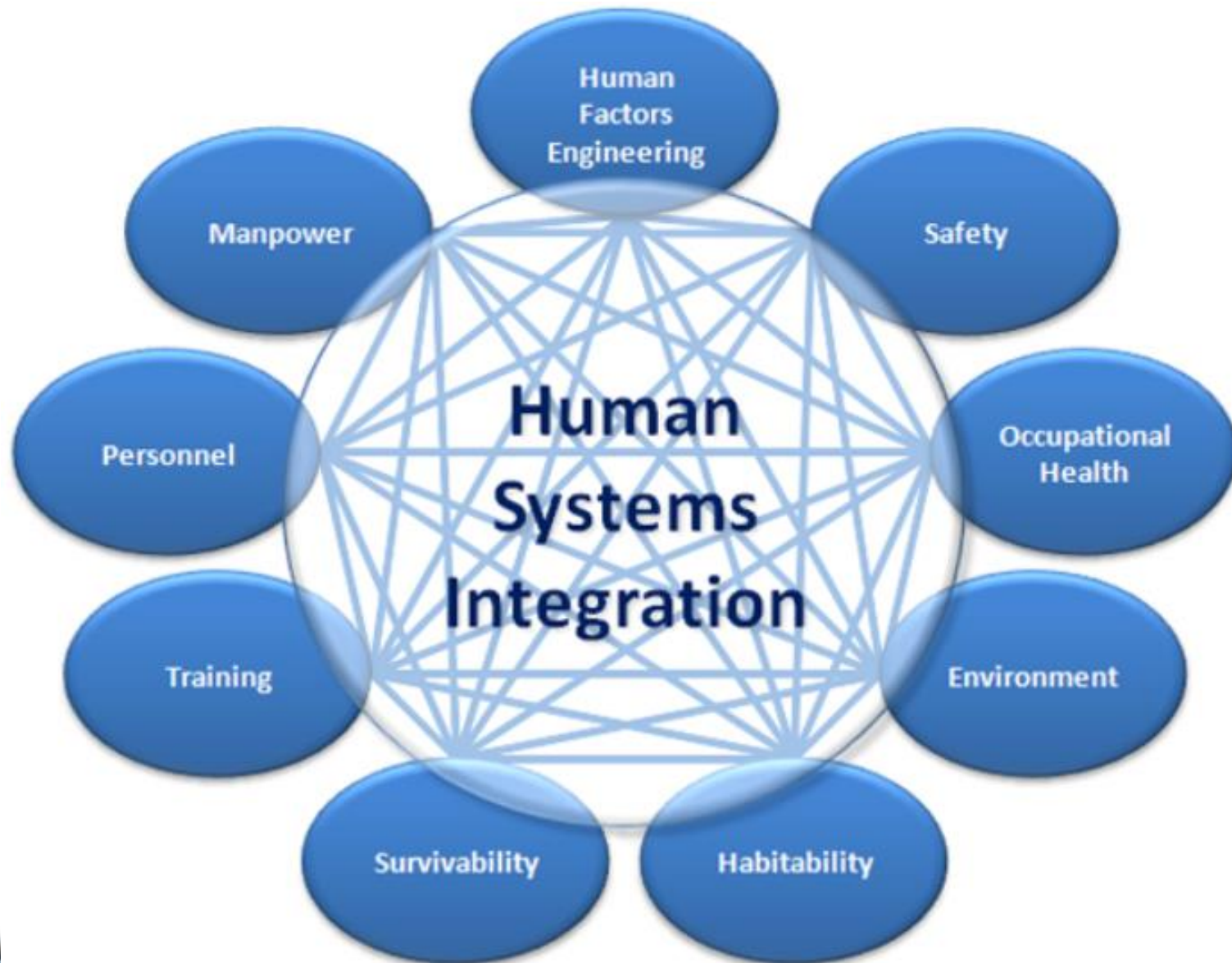


Goals of HSI

- Ensure that system, equipment and facilities incorporate effective human-system interfaces;
- Achieve the required levels of human performance;
- Manage risk of loss or injury to personnel, equipment or environment;
- Allocate sufficient space to human occupied areas; and
- Minimize life-cycle costs.



HSI Characteristics





Personnel





The design features and operating characteristics of a system that serve to minimize the potential for human or machine errors or failure that cause injurious accidents (DAU, 2010)

Survivability factors consist of those system design features that reduce the risk of fratricide, detection, and the probability of being attacked, and that enable personnel to withstand man-made hostile environments without aborting the mission, objective, or suffering acute chronic illness, disability, or death. (DAU, 2010)

Survivability



radiation

noise

vibration

Occupational Health

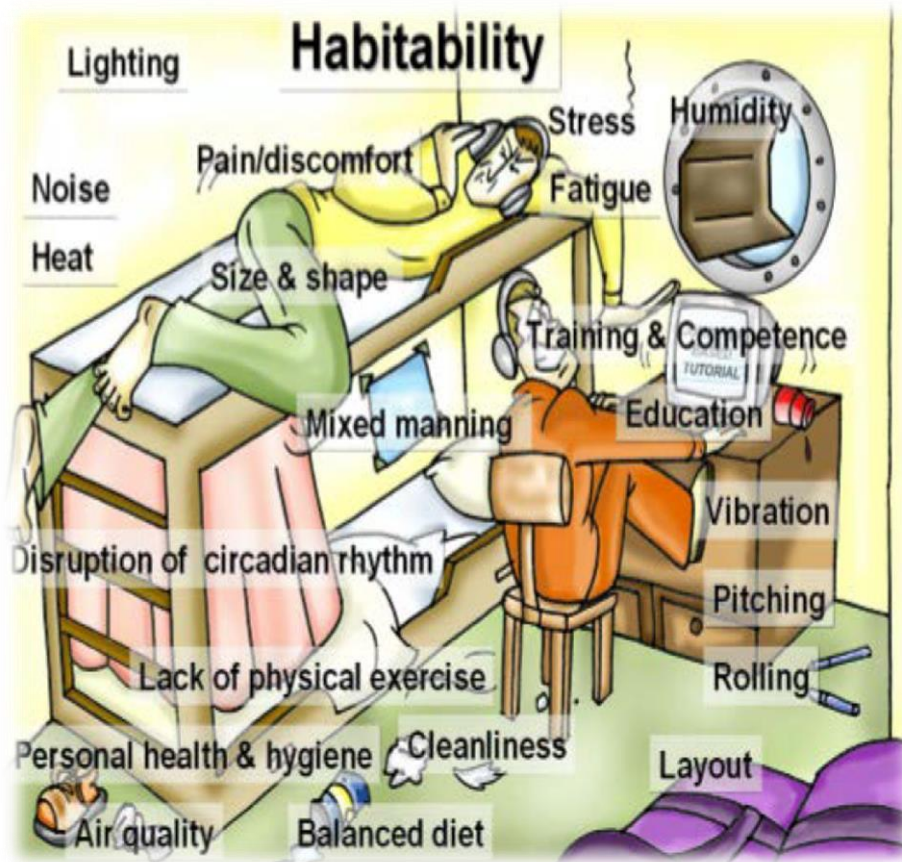
Repetitive motion diseases

air quality

chemical safety

Occupational health factors are those system design features that serve to minimize the risk of injury, acute or chronic illness, or disability, and/or reduce job performance of personnel who operate, maintain, or support the system. (DAU, 2010)



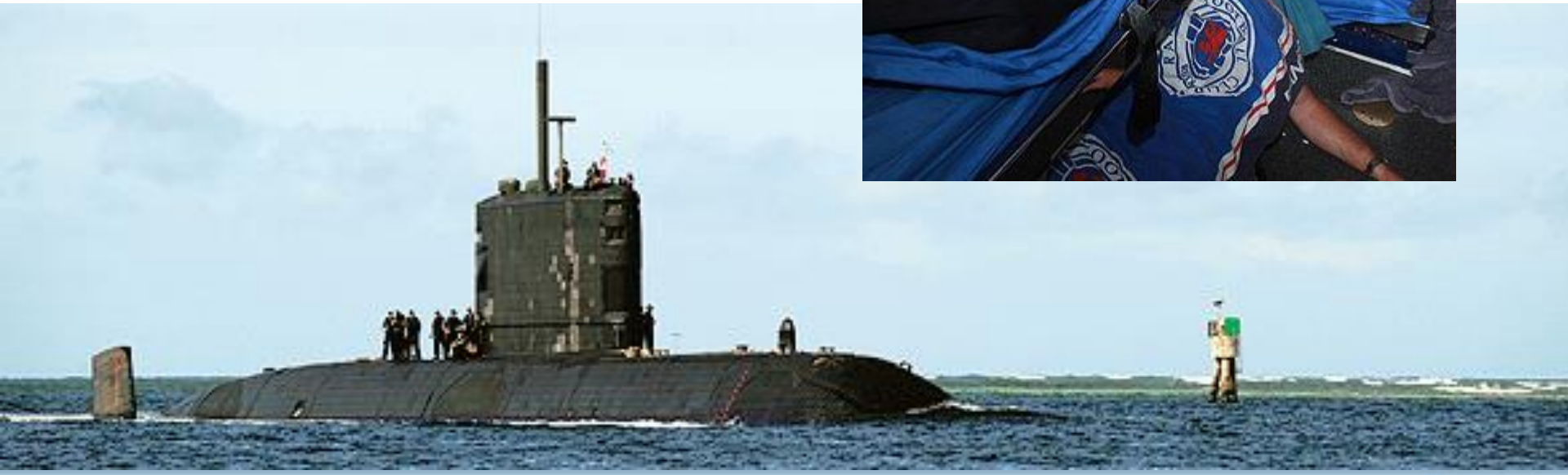


Habitability factors are those living and working conditions that are necessary to sustain the morale, safety, health, and comfort of the user population. (DAU, 2010)

Myles (2015) The Human Element in Ship Design

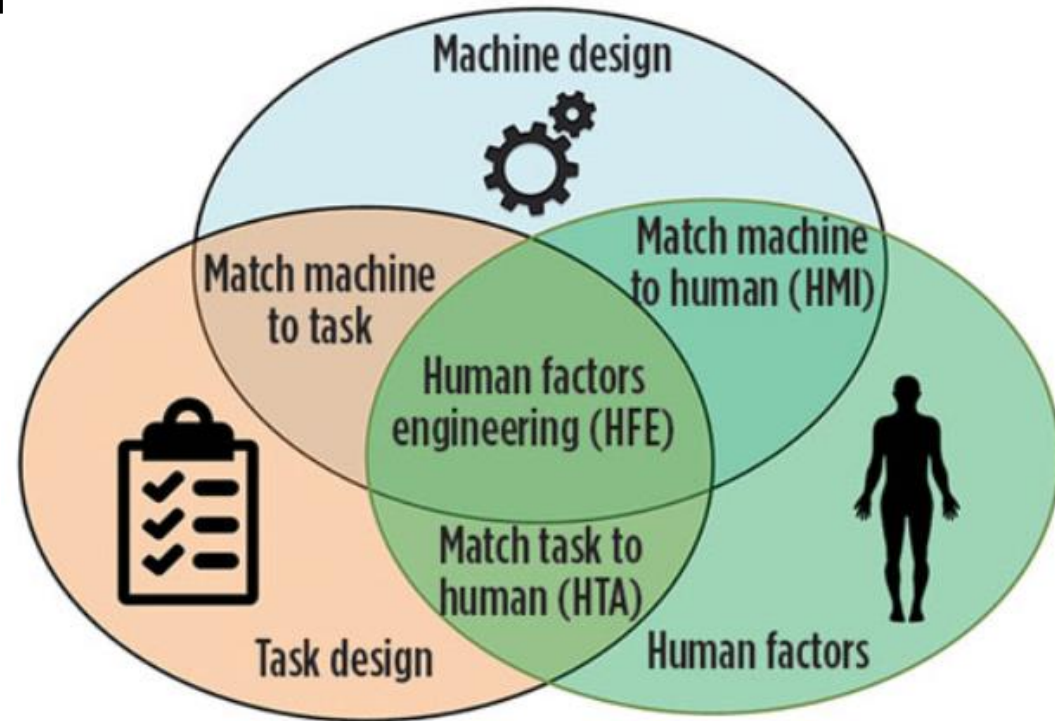


Optimizing
habitability
on a
submarine =
challenging



Human Factors Engineering

- The comprehensive integration of human capabilities and limitations into system definition, design, construction and validation.
- To promote effective human/machine integration for optimal total system performance and to minimize physical and mental fatigue.



User input



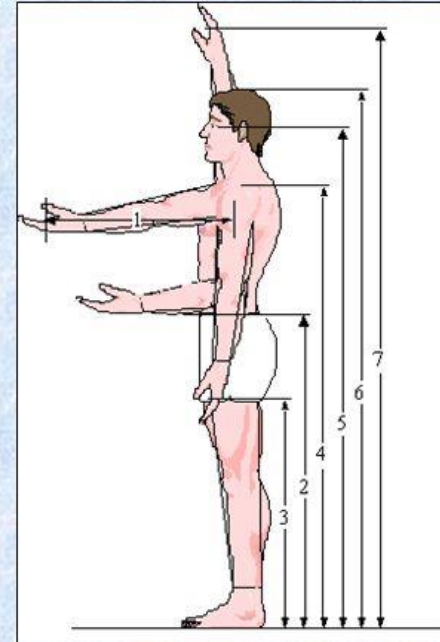
Human Factors Engineering specialists conduct task analyses to assess operator workloads and human performance

Talking to the users is critical to identify capability gaps with current system and to hear their views on how to improve a system

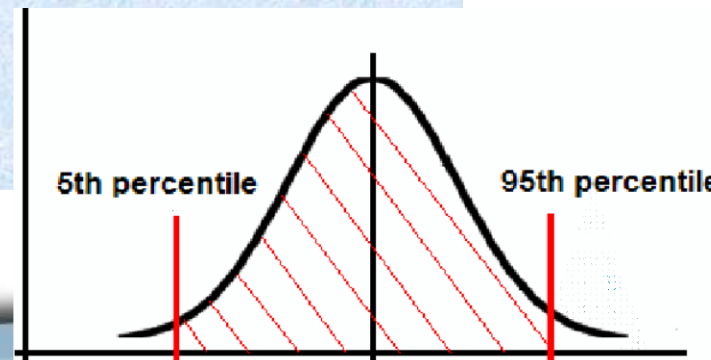


Anthropometrics

Measurement	Percentile			
	Male		Female	
	95	5	95	5
1. Forward Reach	26.9	24.0	25.1	22.2
2. Elbow Height	44.6	39.5	41.5	36.1
3. Knuckle Height	31.0	27.2	28.6	24.8
4. Shoulder Height	60.1	53.2	55.8	48.8
5. Eye Height	68.4	60.9	63.7	56.0
6. Stature	73.2	64.4	67.7	59.5
7. Overhead Reach	84.8	75.2	78.8	69.2



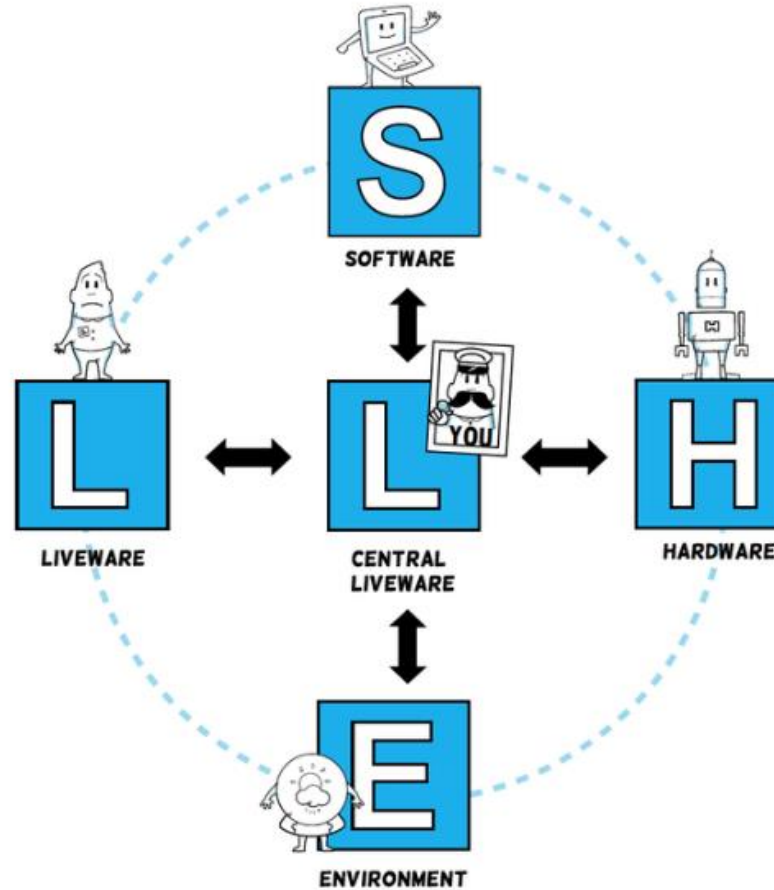
Anthropometrics is the comparative study of human body measurements and properties.



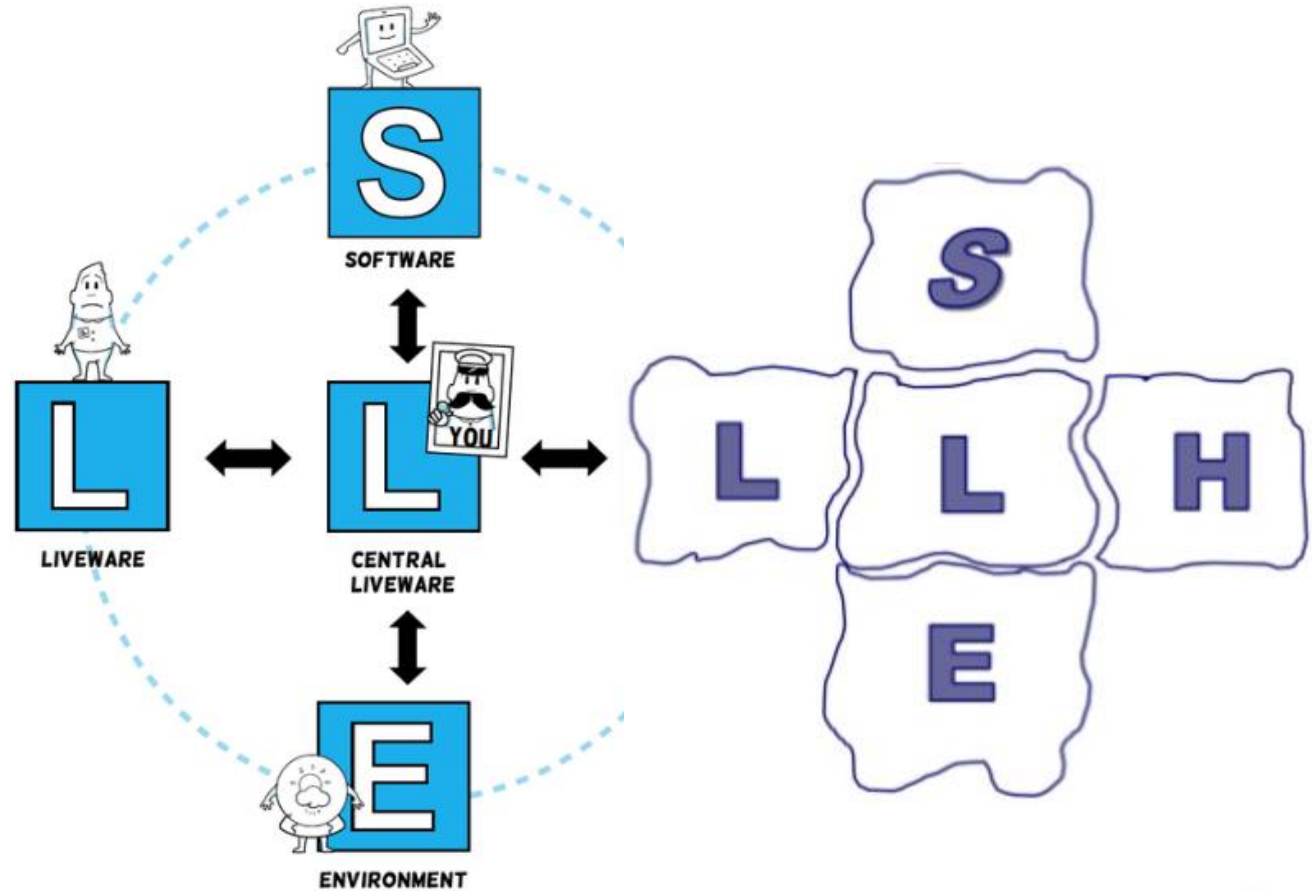
Canada's new Arctic/Offshore Patrol Vessel – HMCS Harry DeWolf



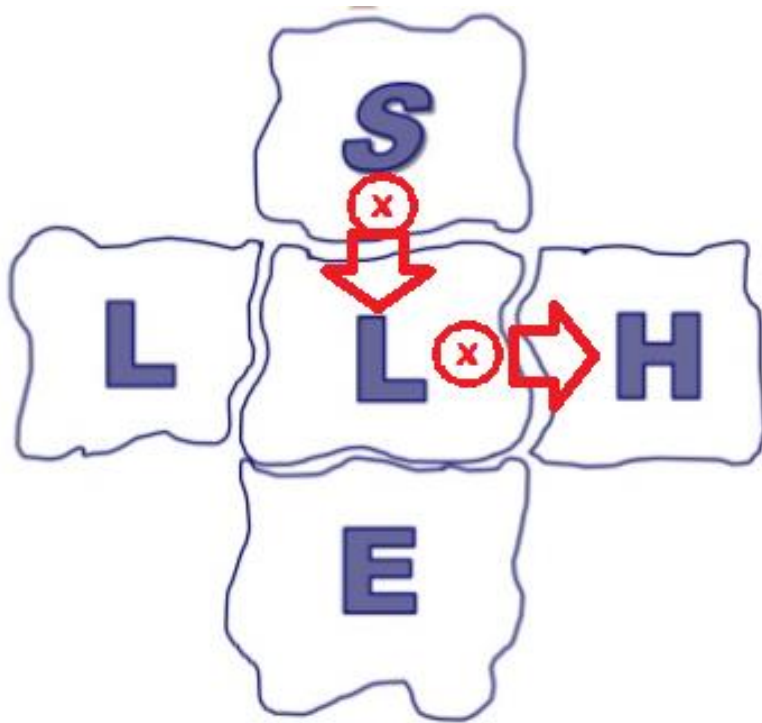
SHELL Model for HSI



SHELL Model for HSI



Breakdowns in interfaces

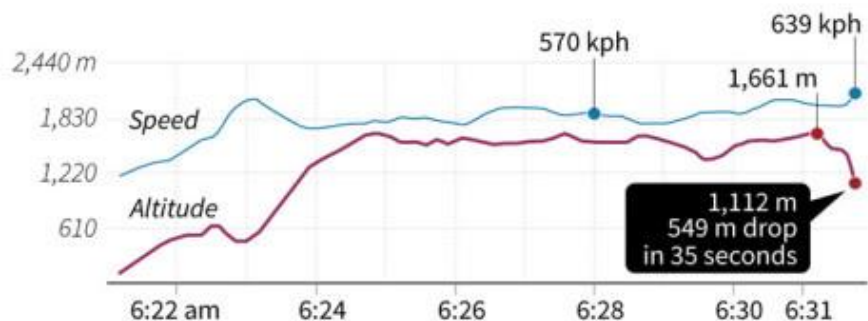


=

potential
MISHAP



Indonesia plane crash

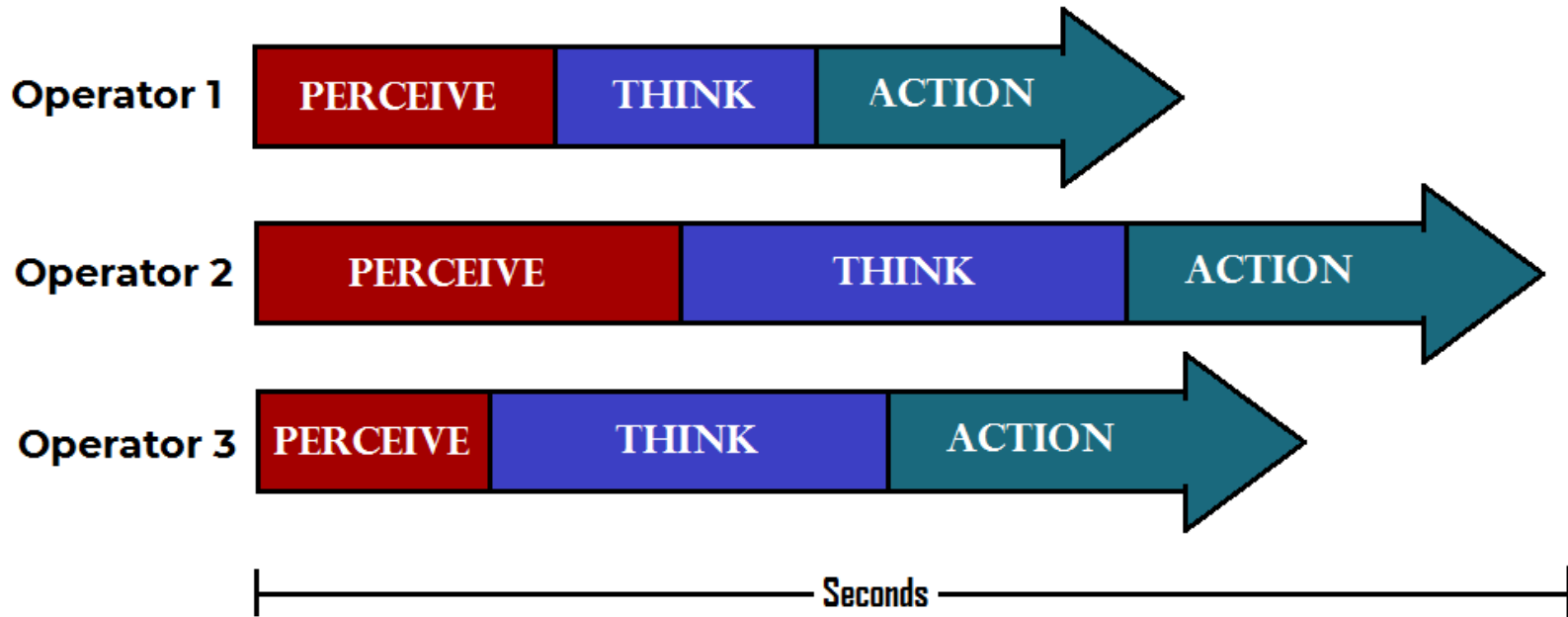


COMPUTER SOFTWARE UPDATE BUT NO FLIGHT MANUAL OR TRAINING UPDATE

- Senior pilot
- Boeing installed a new system on 737 MAX jets that could command the plane's nose down in certain situations to prevent a stall.
- This new system could lead to the plane being forced to descend sharply for up to 10 seconds even in manual flight leading to difficulties controlling the plane
- Pilots could stop this automated response by pressing two buttons if the system behaved unexpectedly
- Flight manual was never updated to include this information and pilots were not aware of change



Operator Reaction Time



Training



Sleipner Ferry Incident

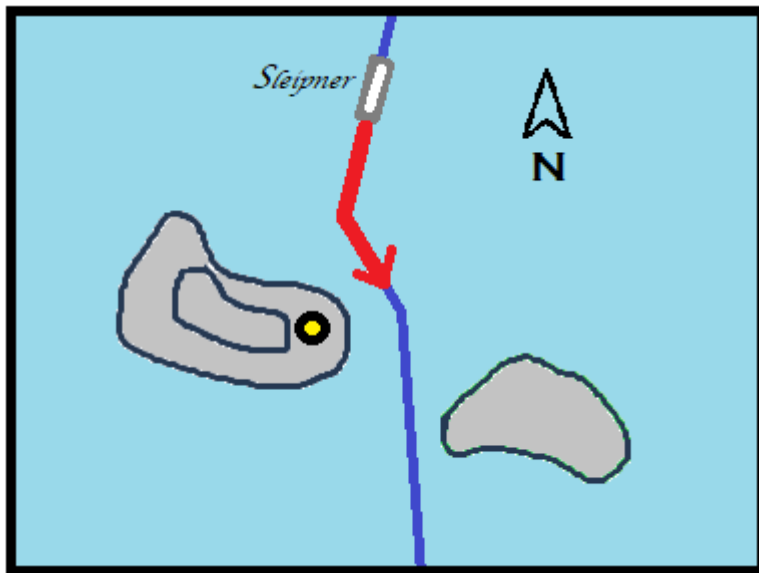


- 3 months after commissioning
- Crashed into rock
- 16 passengers and crew drowned

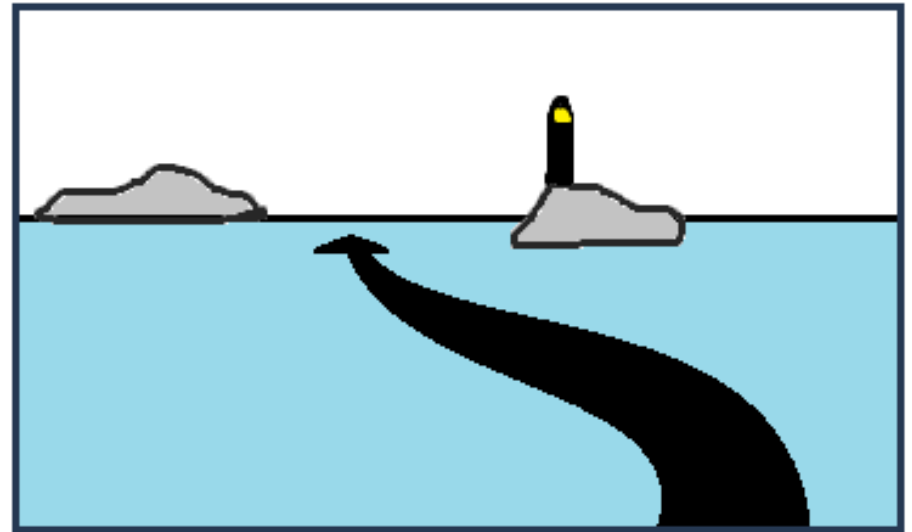
- Lack of experience with navigation system
- Disorientation
- Design of information was insufficient



E-Navigation information displays



Exocentric (North-up) orientation



Egocentric orientation



Man vs machine



“MAN – A creature that was created at the end of the week when God was very tired.”

Mark Twain



Automation





How do we keep up?





Halifax Class bridge





Integrated bridge systems



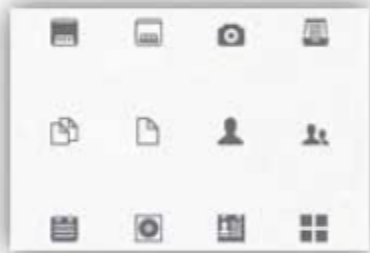
Photo courtesy of Sperry Marine



Photos courtesy of Wartsila



Internationally Recognized User Interface Components



Icons



Radio Buttons



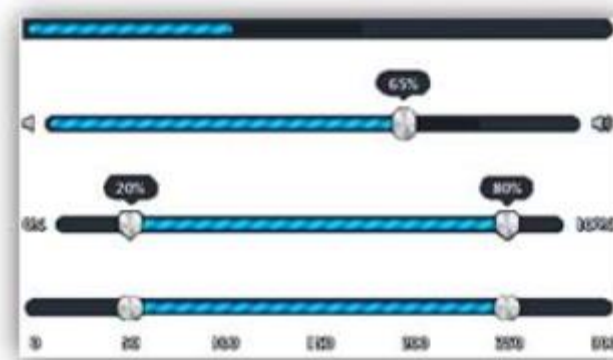
Breadcrumbs



Toggles



Date pickers



Sliders



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