Environmental Improvements Towards Shipping
Greener and Safer



Keunjae Kim/
Reseach at SSPA RISE AB

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Marseille, France

Questions

- Greener by sea than by road, air? – no but yes
  - ✓ CO_2 emissions from all transports sources
    - 74% from road transport
    - 12% from aviation (2.1% of global CO_2 emissions)
    - 14% from shipping (2.5% of global CO_2 emission)

- Safer by sea than by air? – no
  - ✓ Statistics from maritime and avigation accidents
    - 7000 ships vs 591 aircraft were lost between 1963 and 1996

Environment and Safety at see – a need for improvement!

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- Safer by air than by sea? – no
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    - 7000 ships vs 591 aircraft were lost between 1963 and 1996

Safety and Environment at see – a need for improvement!

Marine & Ocean Engineering Session

Session 1: Maritime safety and Decarbonization with emerging technologies with energy transition I – SNAK-EKMOA session

Session 2: New challenges of Maritime Safety for a safer Shipping Industry (EKMOA-MSRC Joint session)

Session 3: Maritime Policies (EKMOA-KMI session)

Session 4: Maritime Safety and Decarbonization with Emerging Technologies with Energy Transition II (EKMOA-KOMSA-KMC Joint session)

Session 5: Autonomous and Sustainable Ship Technologies (EKMOA-KRISO joint session)

Marine & Ocean Engineering Session

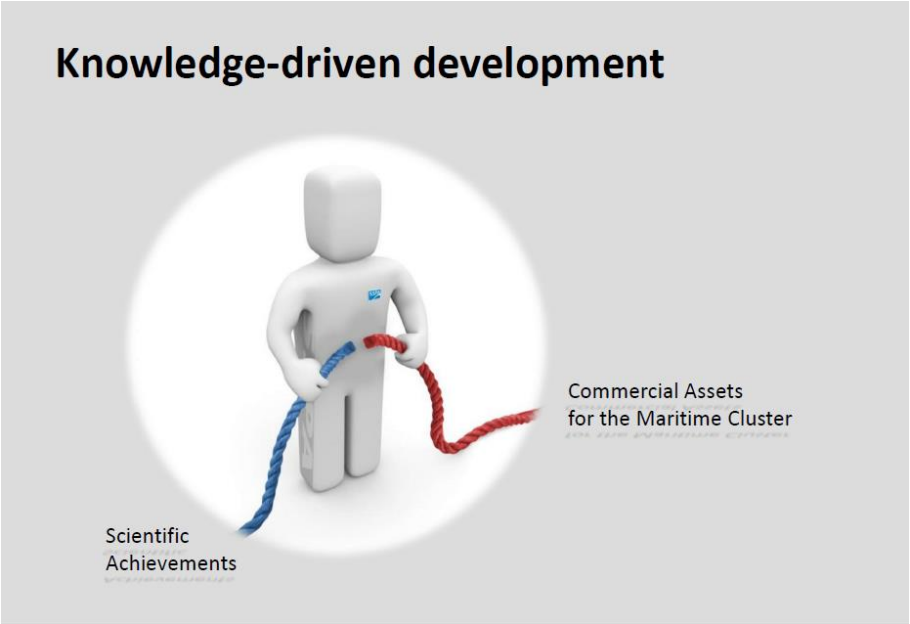
- Ambitious Agenda – addressing global challenges, cutting-edge technology
- Multi-dimensional problem - technical and political dimension
- Discussion – based on cultural and geographical bonds?

- Questions:
  - What and how we can achieve?

- Our goal:
  - Exchanges Ideas and Information
  - Shares Experiences and Knowledges
  - Creates research/commercial/international collaboration

SSPA - RISE

- Providing maritime research and consultancy services on a worldwide basis
- Independent research and consulting company – a part of Research Institute of Sweden (RI.SE)
- Main clients; Maritime operators and ship yards, energy companies, ports, authorities, EU, OECD, IMO, EMSA
- 30% internationally funded research
- 110 employees, 14 Million Euros turnover



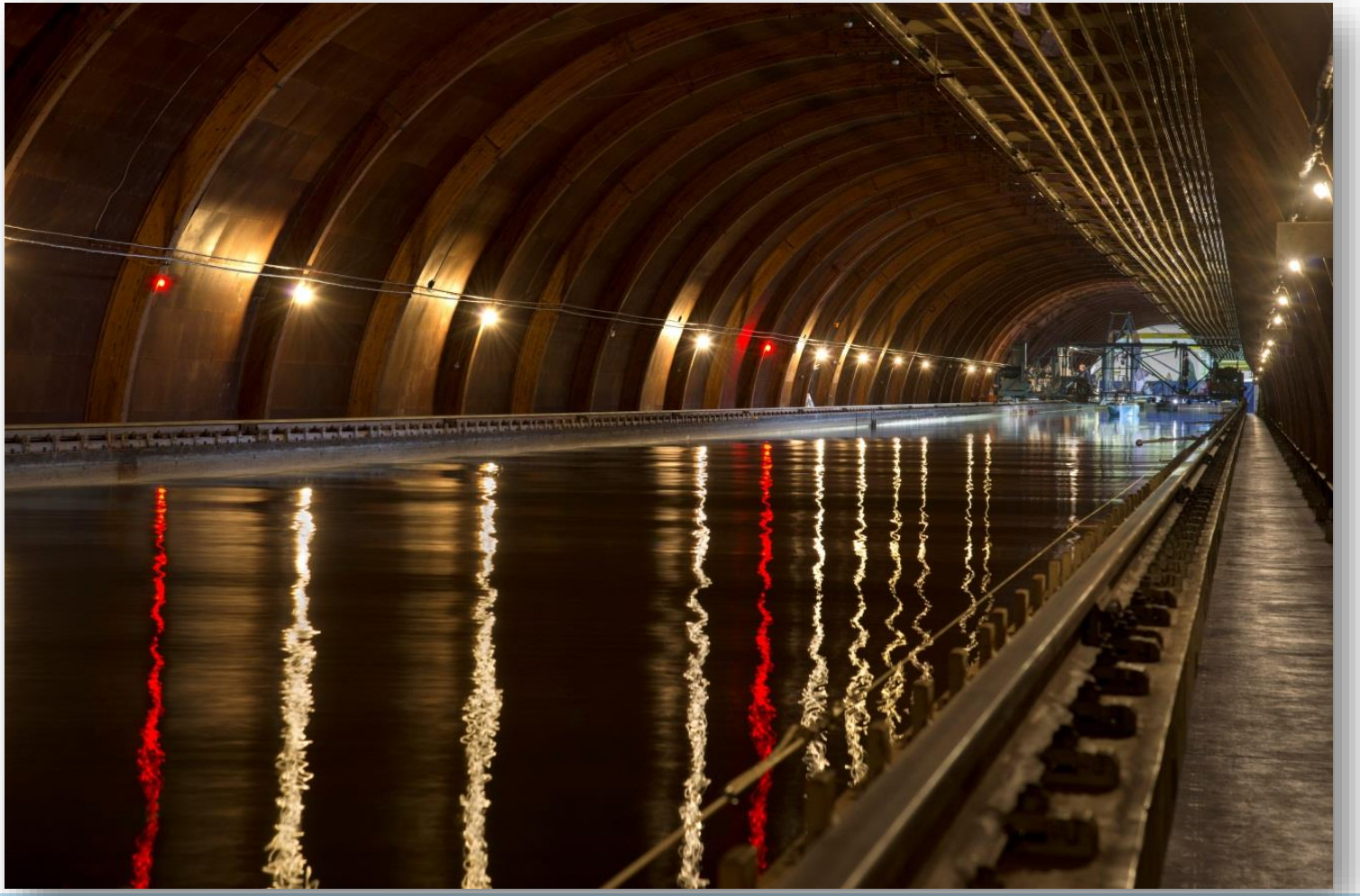
The bridge between theory and practice….

SSPA Towing Tank

Basin
L x B x D 260m X 10m x 5m

Carriage
speed: 0-11 m/sec,

Waves
Length: $0.4 < \lambda < \infty$ [m]
Height: $0 < H < 0.3$ [m]
Frequency: $0 < f < 2$ Hz



SSPA Cavitation Tunnel





Tunnel section	1	2	3
Length [m]	2.5	9.6	8.0
Test section [m^2]	Diam 1m	2.6 x 1.5	2.1 x 1.22
Max sped m/sec	23	6.9	9.9
Min cav number	0.06*	1.45**	0.30**

- Empty tunnel

** With the propeller in a position 0.2m below ceiling

SSPA Maritime Dynamics Laborratory

Basin

L x B x D	88 X 39 x 3.5 [m]
Deep Pit	5 x 9 [m], Depth: 8 m

Carriage

X speed:	±3.5 m/sec
Y speed:	±3.0 m/sec
Ψ:	±30°/sec

Waves

Length:	$0.2 < \lambda < \infty$ [m]
Height:	$0 < H < 0.4$ [m]
Frequency:	$0 < f < 3$ Hz

Wind

Speed approx: 0 – 10 m/s

Current

Towing up to 3.5m/sec

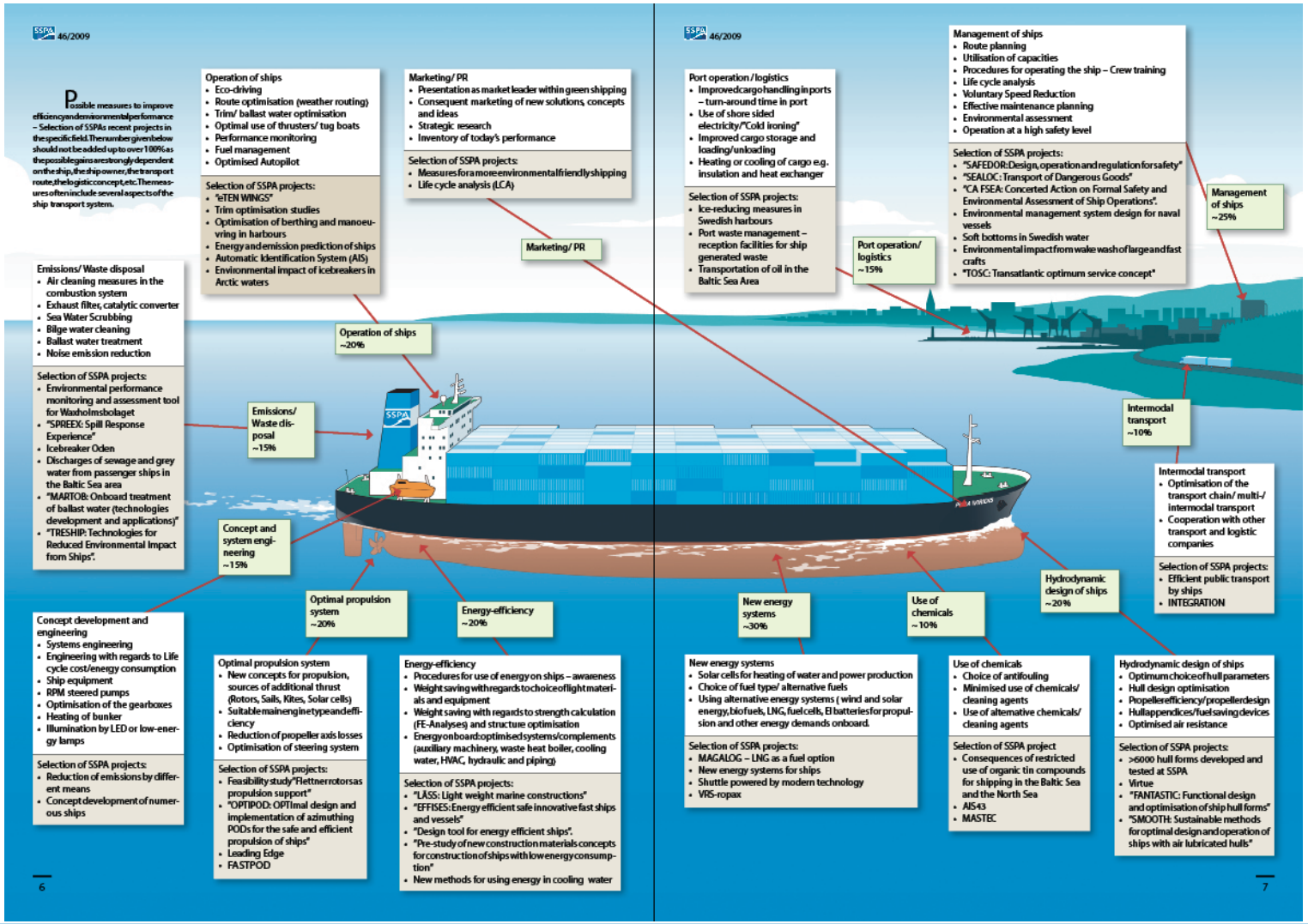
Pump up to 1.0 m/sec



SSPA Researh, Development & Innovation - Areas

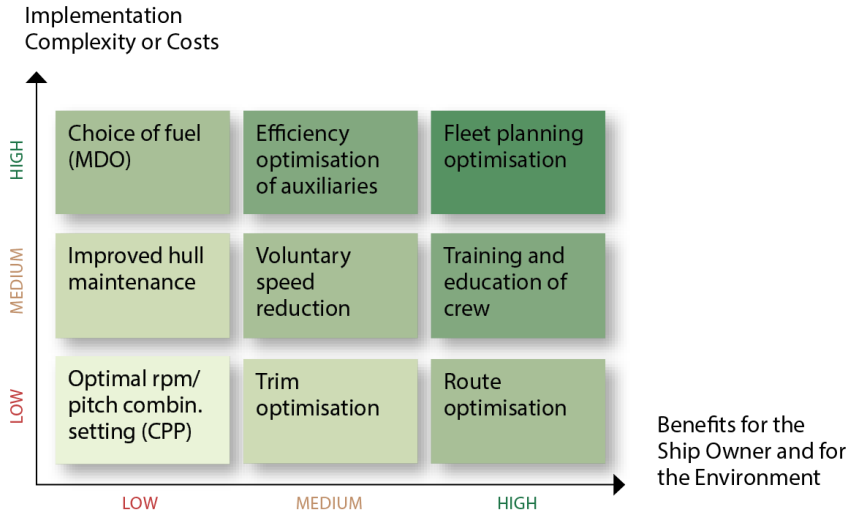
- Hydro and Aerodynamics
- Computational Fluid Dynamics – CFD
- Skin Friction
- Ocean Energy Conversion
- Maritime Human Factors
- Zero-Carbon and Low-Carbon Fuels and Propulsion Technologies
- Sustainable Maritime Logistics
- Fluid Structure Interaction – FSI
- Sports and Technology
- Naval Research

SSPA Environment research projects

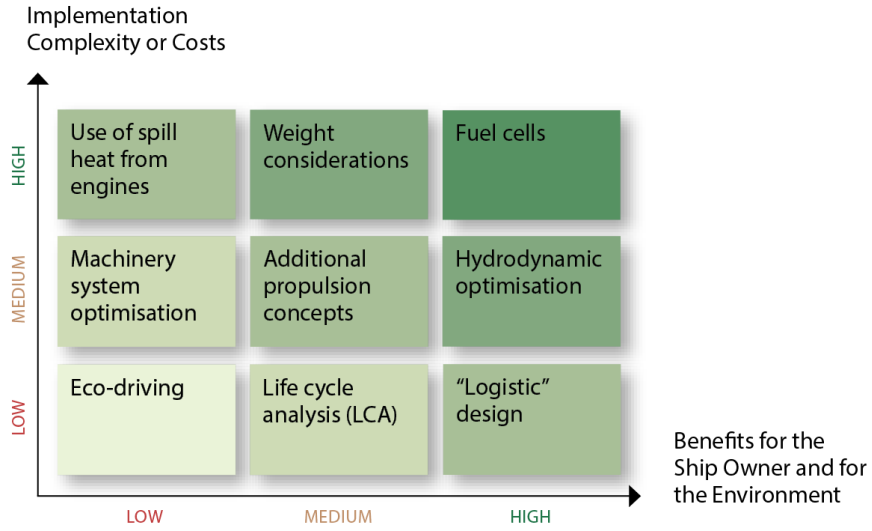


SSPA Analysis – Ecological Performance Matrix

Cost Effectiveness of different measures: The complexity of implementation implies a cost for the ship owner, while the benefit for the environment are often connected to a reduction of the operational costs.



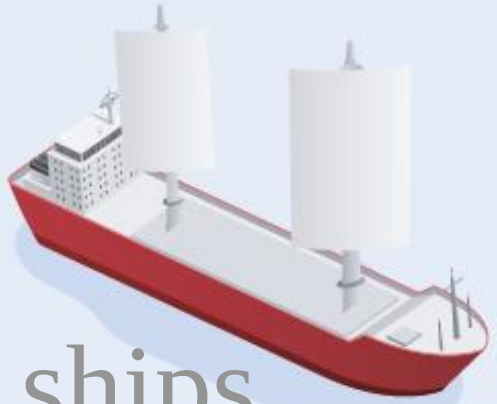
Existing ship



New building ship

Improvement of Environment – Paradigm shift





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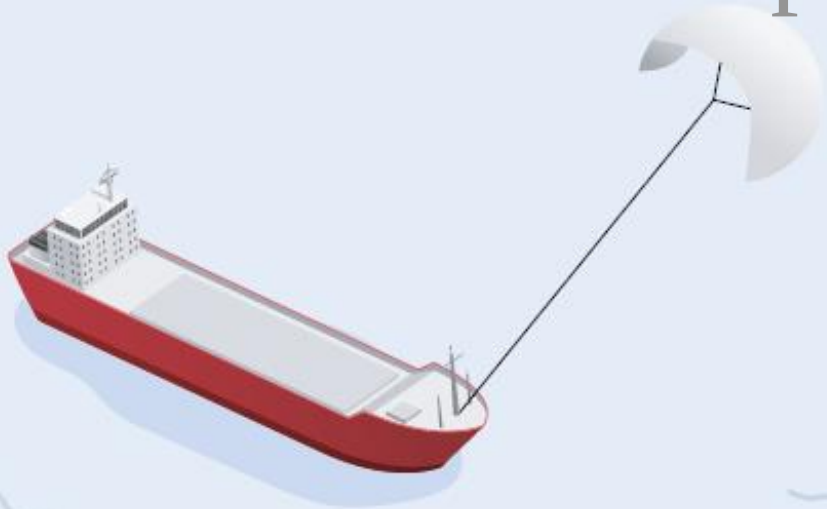
Wind powered ships.



Supporting the maritime industry with independent guidance and assessments of wind powered ships.

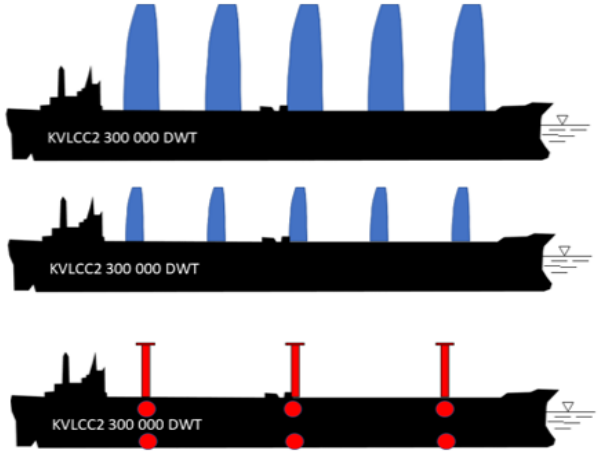


Business case support for ship owners

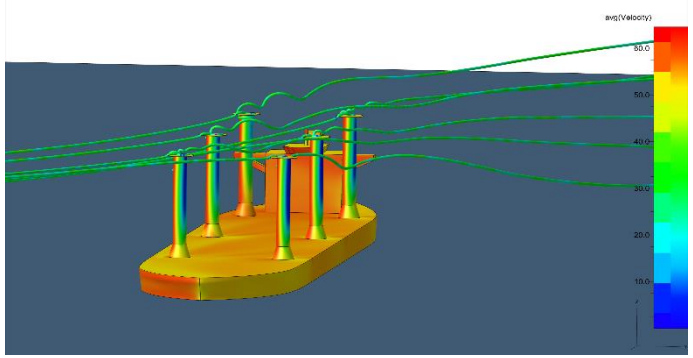
How do you select a WPS



SSPA: Broad Range of Methods, Toolbox



Business case



Aerodynamics



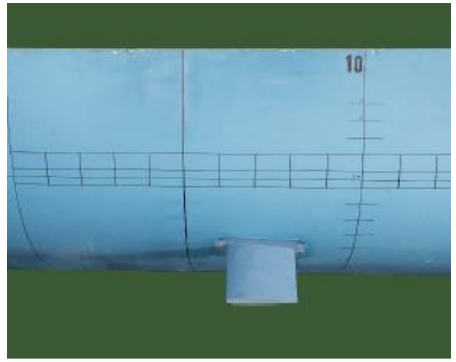
Seakeeping



Oceanbird



Manoeuvring



Appendages



Sea trials



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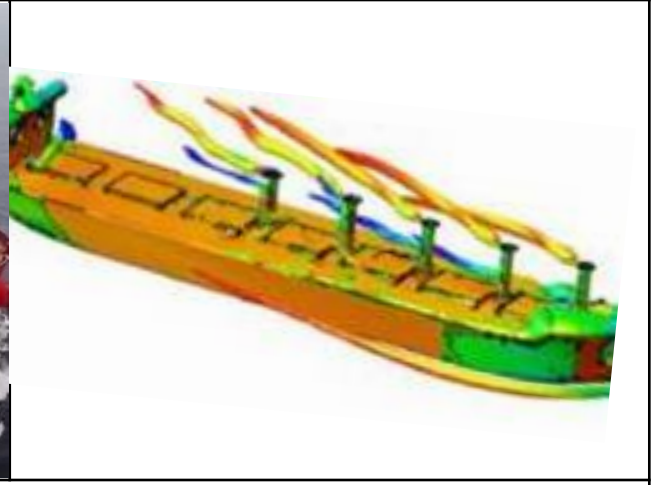
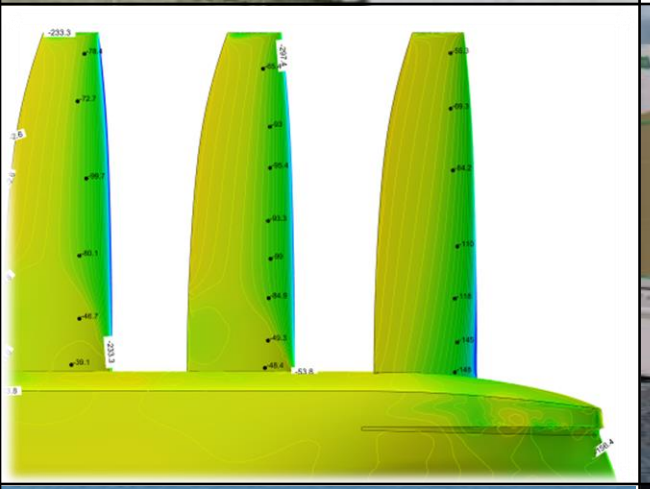
An established player









Recognised and experienced

Long track record of supporting the development and assessment of wind powered ships.





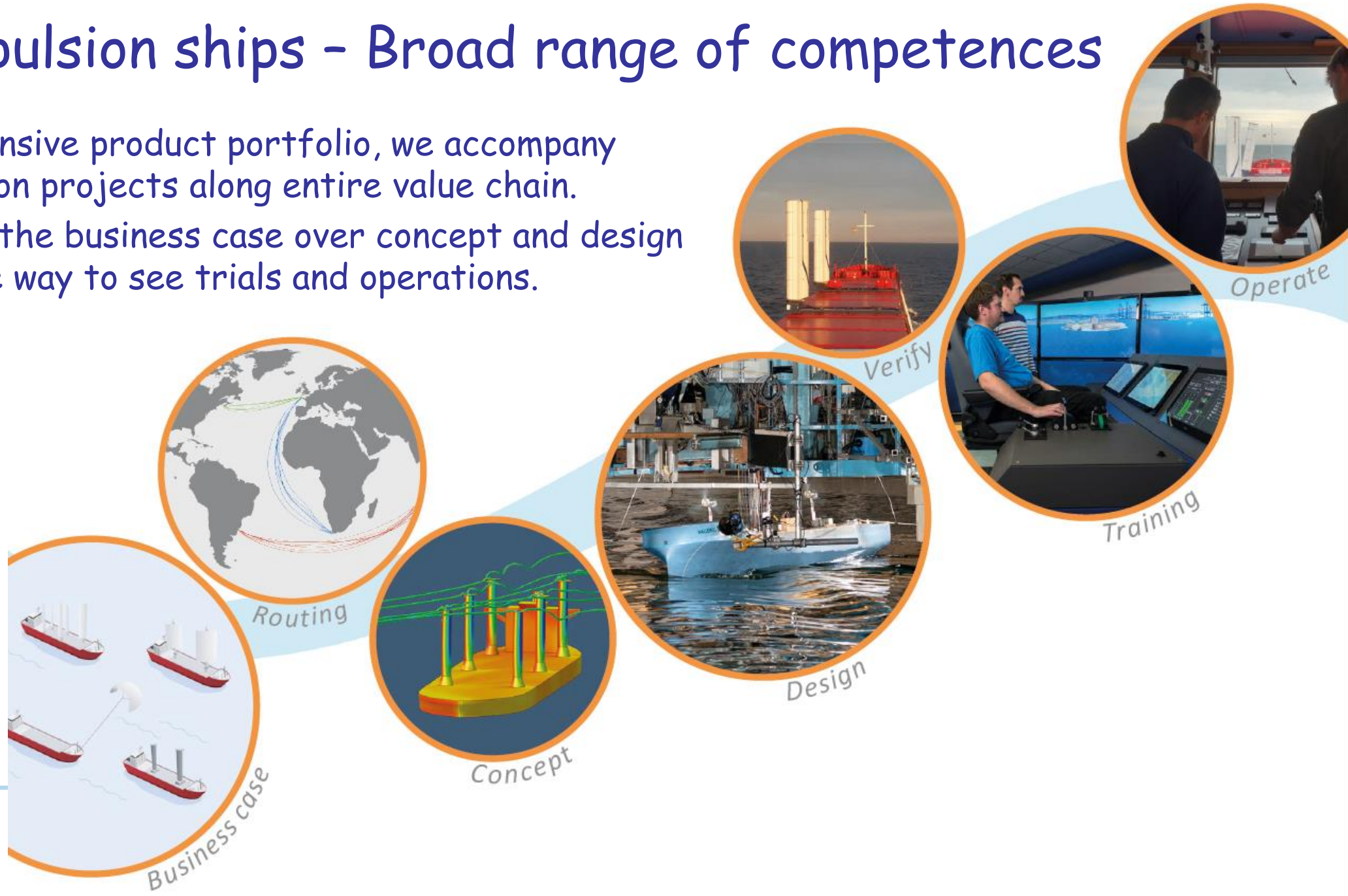




Wind propulsion ships – Broad range of competences

With an extensive product portfolio, we accompany wind propulsion projects along entire value chain.

From making the business case over concept and design stages all the way to see trials and operations.

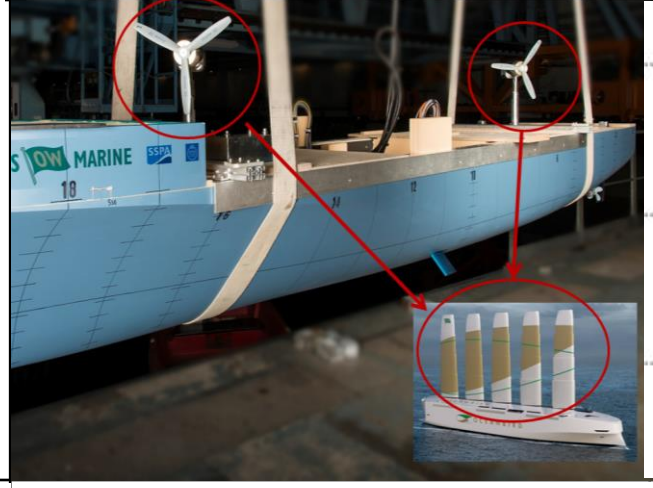


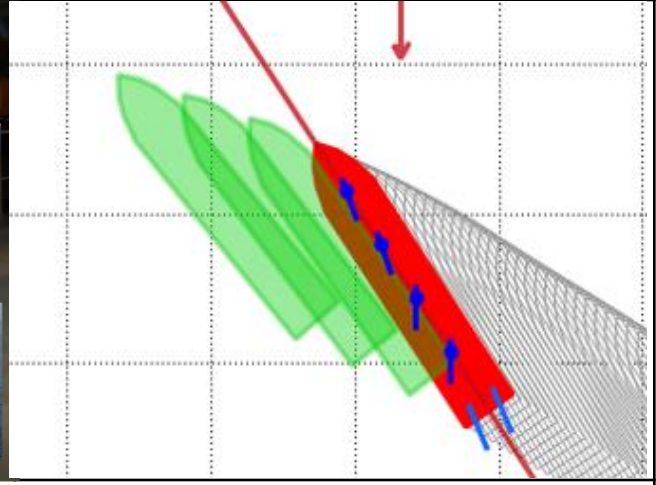
SSPA Your Maritime Solution Partner

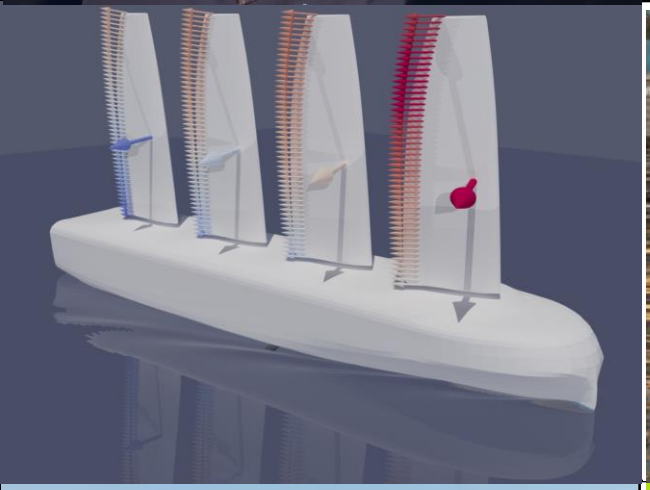


SSPA

Breaking new ground





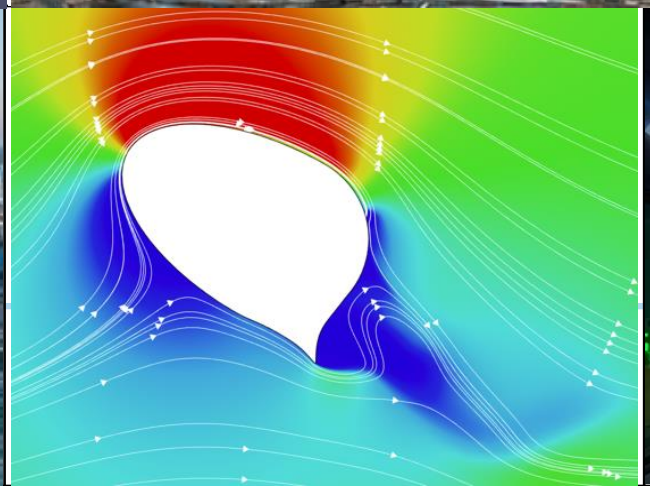


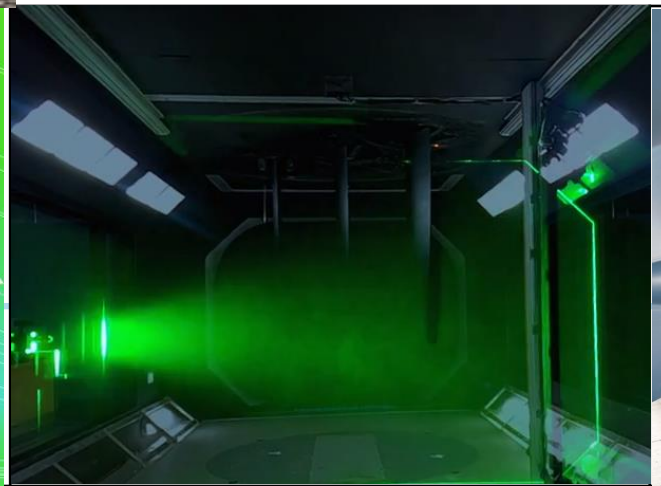


Research, development and cutting-edge tools

As an early entrant to the maritime wind propulsion industry, SSPA has been at the forefront of wind propulsion research and development for the past decade. A position that we strive to maintain.









Royal visit SSPA: highlights wind propulsion ship

- HRH Princess Victoria of Sweden
- HRH Prince Daniel of Sweden
- HRH Prince Haakon of Norway





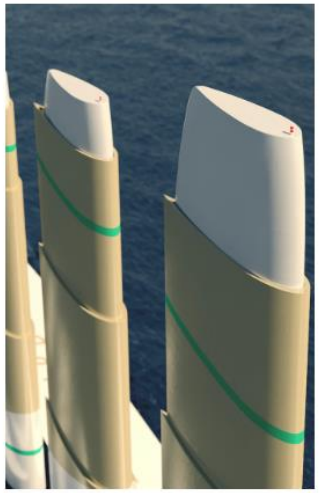
- https://youtu.be/pZVDs4n_a0M

Wallnius - Oceanbird









- 7000 cars
- 200m long and 40m wide
- 5 rigs
- 80m tall wing
- 12 days to cross the Atlantic with the wind as energy source – 10 Knots speed
- Aiming for a possible launch in end of 2024
- 90% CO_2 reduction potential

Reference projects for Wind propulsion ships


M/V Sea Zhoushan. Photo: Vale



Oceanbird project Wallenius Marine



M/V Copenhagen Scandlines









Comparison of Safety Management between Aviation and Maritime transport

Human errors are dominating reason for accidents both in aviation and shipping

(20% - technical failure, 80% - human factors in maritime accident)

Differences:

- ✓ Considerable more money is being spent on safety in the aviation industry -> much more developed safety culture and knowledge
- ✓ Mandatory to report all incidents – staying blameless
- ✓ Extensive education in human factors, brainwashing the operators into safety awareness and frequent training in simulators (every six months)
- ✓ Responsibility for an accident – operator has main responsibility in aviation unless technical failure in design/construction cause the accident. In shipping the situation is much more diffuse, and culture has been to blame the commander primarily.

M/S Estonia accident

- The M/S Estonia accident on the 28th Sept 1994 – 852 people died
- Technical failure – major cause
  - ✓ Bow visor separated due to heavy wave loads, and tilted over the stern
  - ✓ Ramp was pulled fully open, allowing large amounts of water to enter the car deck
- Human factors –
  - ✓ Ship was listed because of poor cargo distribution
  - ✓ Failing to notice water entering the car deck and delaying the alarm
  - ✓ Minimal guidance from the bridge, passive attitude of the crew, Limited rescue services
- National trauma – political consequences
  - ✓ Obsolete theories – Explosion, Collision with submarine



- SSPA contraected by SHK (Swedish Accident Investigation Authority) and national funded by VINOVA for investigation of the accident until sinkage. => SSPA has successfully demonstrated the sinking sequence of Estonia
- Stockholm Agreement for ro-ro passenger ferries
- Improvements on internal design due to leakage, stability and research programs

Sewol Ferry accident



- The Sewol Ferry sank on 16th April 2014 – 304 people died
- Social Corruption – an underlying cause
- Man-made error:
  - ✓ Regulatory violations – overweight of cargo by three times of its
  - ✓ Disorganization – problem of government structure, fumbling bureaucracy/poor communication
  - ✓ Lack of proper training: coast guard – incompetent, rescue operation – delayed
  - ✓ Wrong instructions: Wrong decision (not to move) by wrong person, Untouched lifeboats
  - ✓ Lack of ethical responsibility: Captain/crew abandoned ship first

- National trauma – political consequences
  - ✓ Blaming Culture
  - ✓ Obsolete theories – Explosion, Reef collision, Collision with submarine

- Sewol Investigation Commission – Not answered yet for the cause of rapid turn and fast sinking

Improvement of Safety at Sea

- Paradigm shift
  - ✓ Prevention – education in human factors, training
  - ✓ Safety awareness on all levels
    - Top – bottom perspective on safety – fully integrated
    - Support and consider incident and accident reporting from staff
    - Improved safety as an incentive: bottom-up approach
  - ✓ Safety culture – staying blameless
  - ✓ Organization – a framework for disaster response of national scale

- Leaning from aviation industries
  - ✓ Transfer of knowledge and system

- Learning from experience
  - ✓ Mandatory reporting -> build-up database
  - ✓ Improve regulation, standard and design method
  - ✓ System for lessons learnt from incidents and accidents

Back to origin – Powered by nature

