



# THE WINDS OF OPPORTUNITY OPTIMISING PROPULSION FOR NEXT GENERATION WINDFARM VESSELS

WELCOME TO THIS WÄRTSILÄ WEBINAR  
FEATURING DEME

# AGENDA

- Introduction and market insight
- Vessel examples and insight from DEME
- Customer centric approach to deliver optimal operations in transit and DP
- Wärtsilä solutions benefits and detail
- Q&A

## MODERATOR



**Jon Nation**

General Manager,  
Propulsion Marketing, **Wärtsilä**

## PANELLISTS



**Vincent Bast**

Sales Manager Thrusters & PCS, **Wärtsilä**



**Jan Gabriel**

Head of Construction and Conversion, **DEME**



**Norbert Bulten**

Product Performance Manager, **Wärtsilä**



**Arnoud Dinslage**

Product Manager Thrusters, **Wärtsilä**



# INTRODUCTION AND MARKET INSIGHT

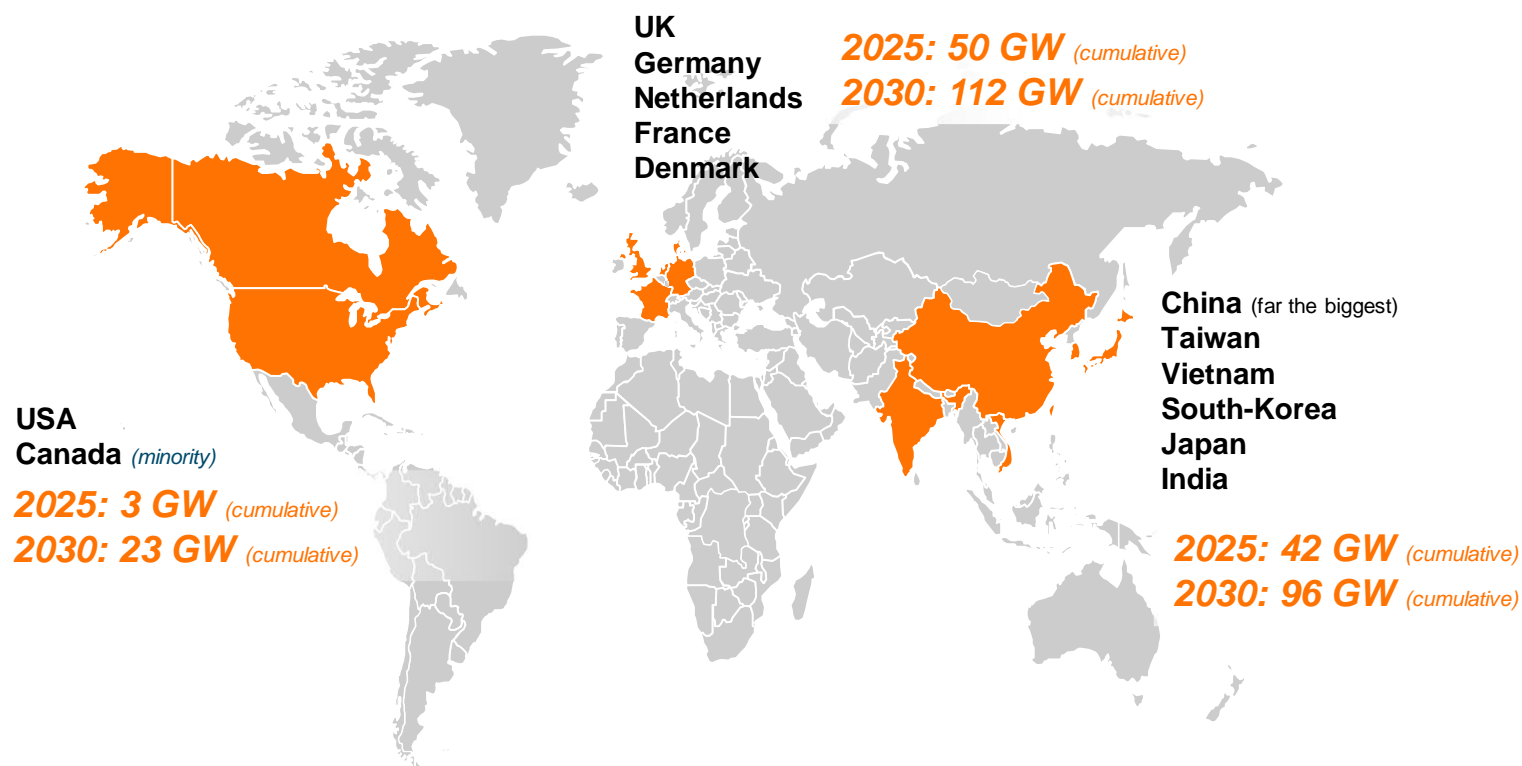
Vincent Bast  
Sales Manager Thrusters & PCS, Wärtsilä

# OFFSHORE WIND MOVES STRONGLY AHEAD

The offshore wind market is growing faster than predicted, push for green investments

2020-2030: Total installed power  
**29 GW → 235 GW** Source GWEC

The sector has risen above that of oil & gas for the first time > **capital expenditure came in at \$51bn versus oil and gas on \$41bn.**



# MULTIPLE SHIP TYPES ARE NEEDED TO SUPPORT OFFSHORE WIND FIELD OPERATIONS

Operational profile and key capabilities vary per ship type



WTIV



SOV



Cable Layers



CTV

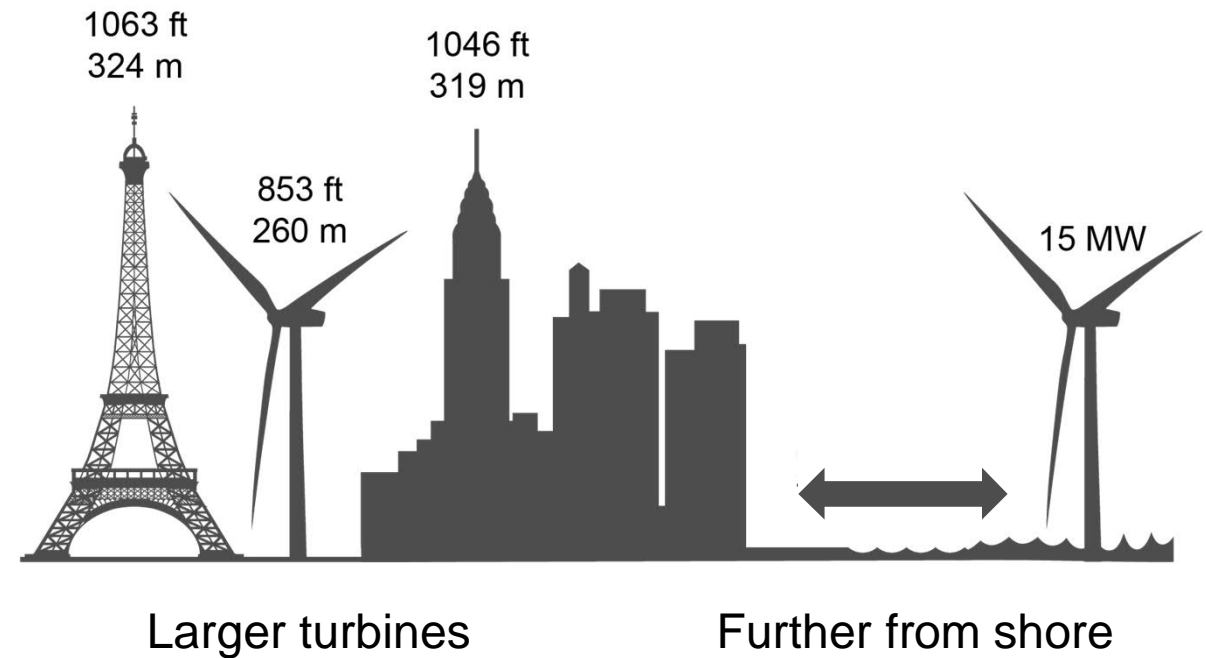


# NEED FOR NEXT GENERATION OFFSHORE VESSELS

Next generation WTIV will be needed to facilitate the growth in offshore wind

## Growing demand for larger installation vessels

- Lifting higher > Larger & heavier turbines
- To carry multiple number of large turbines
- Operating further from shore in more challenging sea conditions (jack-up and floaters)





# SAFE DYNAMIC POSITION (DP) OPERATIONS ARE ESSENTIAL FOR WTIV

**Safe operation** requires thrusters that can deliver DP of the highest calibre in some of the worlds **most demanding environments**.

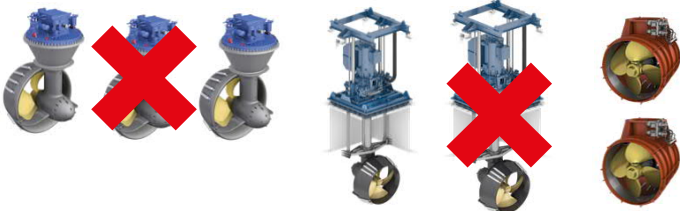
Mix of thrusters (System) to meet safe DP operations

ALL INTACT

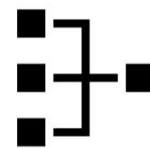


Vessels stay in position within **specific failure case**

FAILURE CASES (DP 2/DP3)



Thruster system & power are important elements to determine the **overall system configuration**.



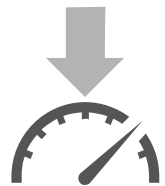
Installed power  
Weight  
Capex / Opex  
Equipment size



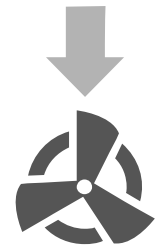
# THRUSTER SYSTEM PERFORMANCE

## More challenging windfarm locations and larger turbines

- Larger & more complex installation vessels
- Operate further from shore in more challenging sea conditions
- Lifting higher, larger & heavier turbines



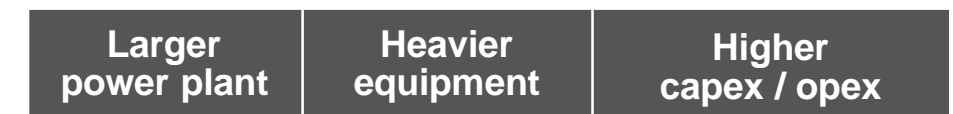
Increased environmental loads



Need for larger & more powerful thruster



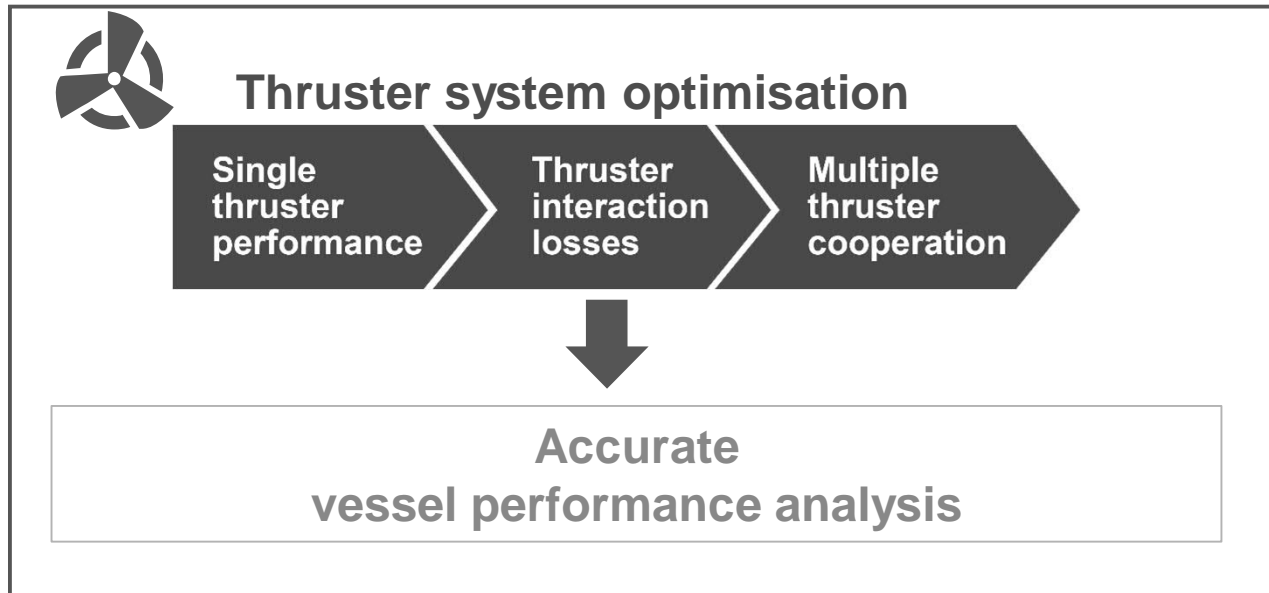
System configuration





# PROPULSION OPPORTUNITY

**Thruster system & delivered performance** are important elements for the vessel's DP performance & overall system configuration



## WHAT DO YOU GAIN?



- Optimal thruster & system configuration (SLD)
- Efficient & safe DP operations

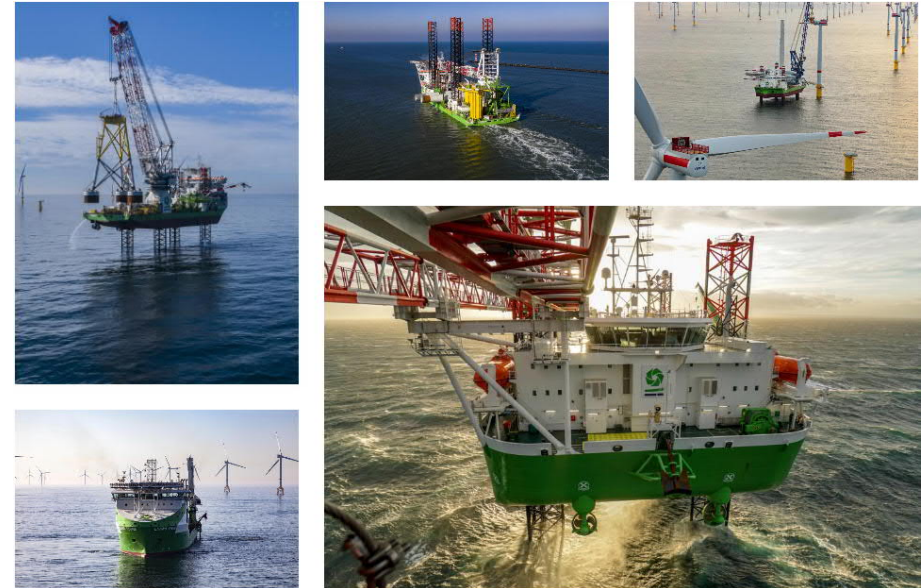


# DEME INSIGHT THRUSTER APPLICATION IN OFFSHORE WINDFARM CONSTRUCTION VESSELS

Jan Gabriel  
Head of Construction and Conversion, DEME



- Operations require Sailing and Dynamic Positioning
  - **Azimuthing thruster** is great solution
- Water depth in marshalling ports is limited
  - Thrusters under bottom may need to be **retractable**.
- Sailing speed of these vessels is typically < 14kn
  - **Ducted propellers** are advised.

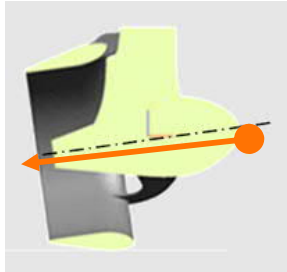


### Three typical topics encountered in propulsion design

1. Need for high thrust with limited power. Tilted propeller shaft and nozzle → thruster wake/hull interference drops and bollard pull increases.
2. Need to split main propulsion power over 2, 3 and even 4 thrusters because of draft and redundancy constraints. Careful positioning of thrusters. Avoid excessive “forbidden sectors” when in DP but also avoid ventilation when the vessel is rolling and pitching.
3. Requirements on thrusters to be allowed by Class and flag state to go for an Extended Drydocking System (7,5 yr).

# 1 - 8° TILTED (RETRACTABLE) THRUSTERS IMPROVING VESSEL DP PERFORMANCE

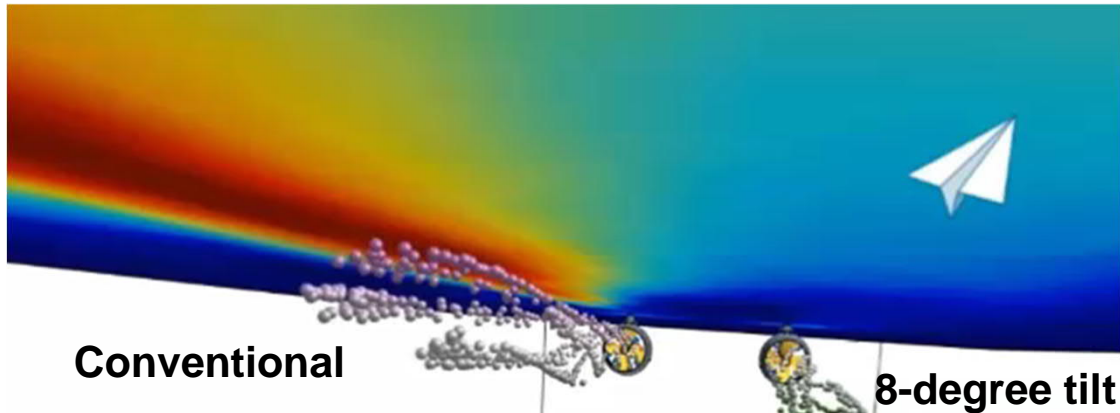
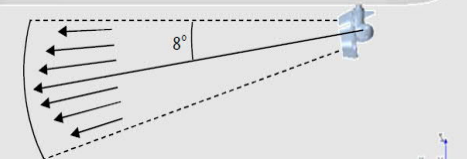
8-degree tilted units → **high effective thrust**



Jet out of thruster is deflected downwards  
to avoid interaction with the hull.

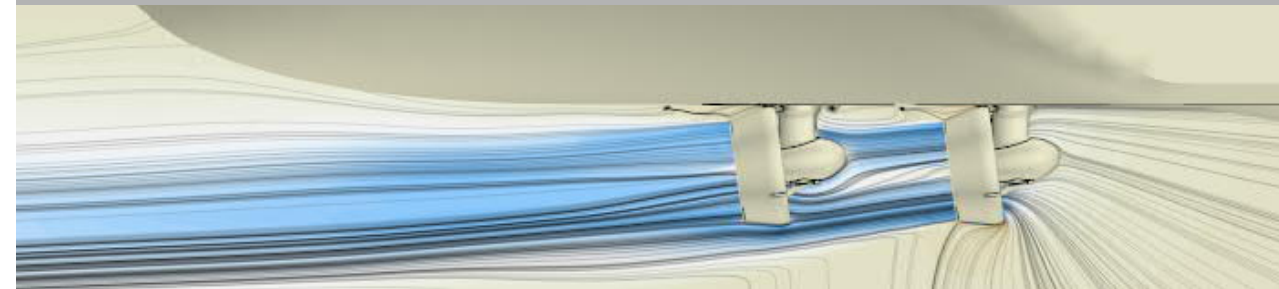


**avoiding thruster-hull interaction losses**



Flow simulation of **conventional unit (0° shaft)** and the **Wartsila 8-degree tilted shaft unit**.

CFD simulation: 8 –degree tilted Retractable thrusters in the bow

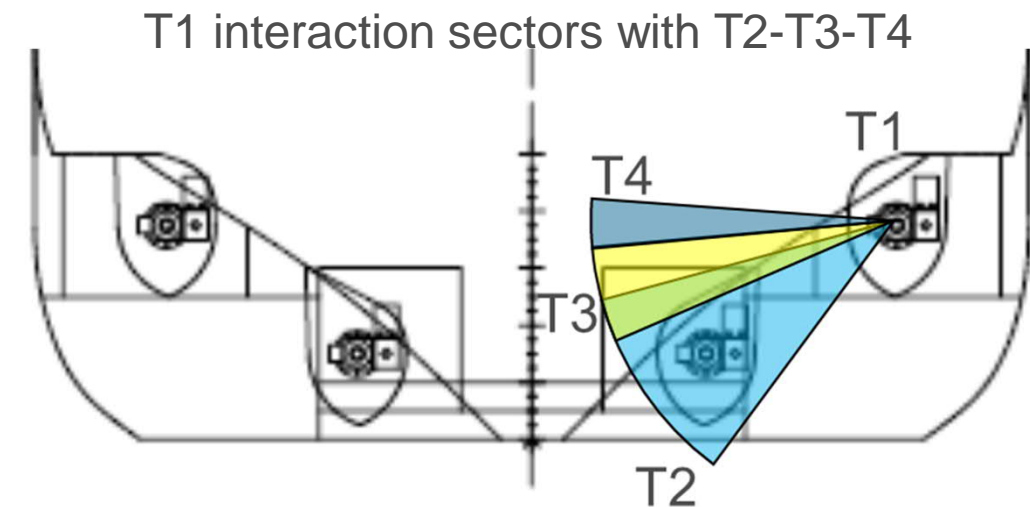
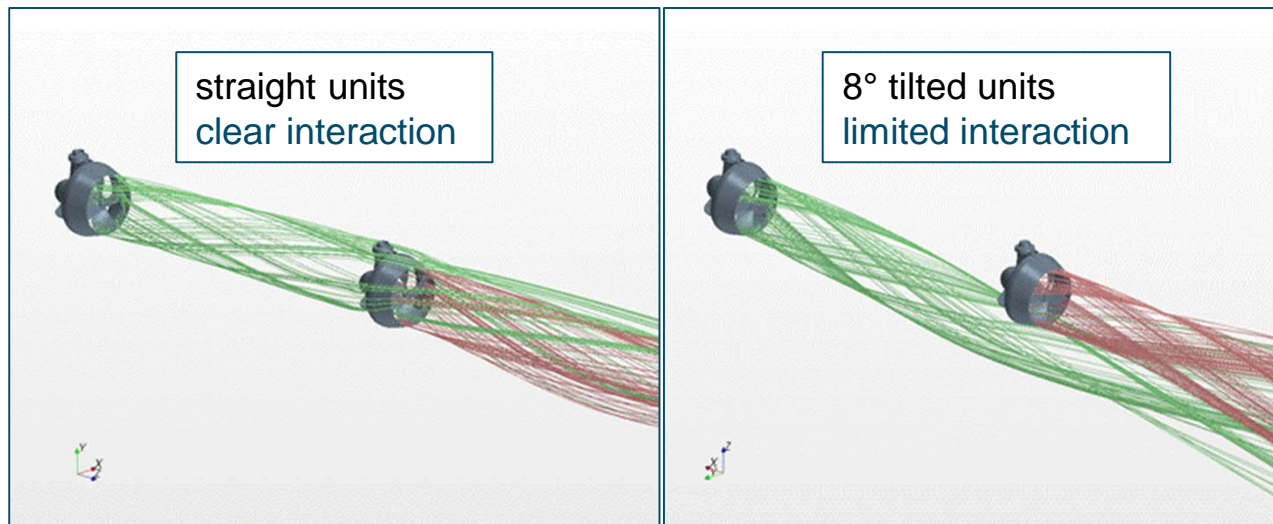


- 8-degree tilted units avoiding thruster-hull interaction losses
- Excellent **thrust** performance in DP, **up to 23% higher** versus conventional units under flat hull.



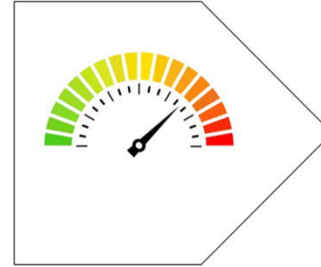
## 2 - ARRANGEMENT OF STERN THRUSTERS

- Typical wide shallow hull  $\rightarrow$  2, 3 or even 4 main thrusters needed to attain desired sailing speed.
- Thrusters cannot be too far from CL for risk of ventilation.
- Thruster-to-thruster interaction results in lower overall DP performance
- Avoid by careful positioning and with forbidden-zones in the operational sectors
- Due to tilt-benefits, the thruster-to-thruster interaction sectors can be reduced further



### 3 - EXTENDED DRY DOCK SYSTEM (7,5YRS) – WITH IN WATER SURVEY

- Classification societies mandate thruster inspections every 5 and 10 years
- Extended (7,5 yrs) docking possible by:
  - OFS3 propeller shaft seal
  - Painting and cathodic protection
  - Wärtsilä Propulsion Condition Monitoring Service (PCMS)



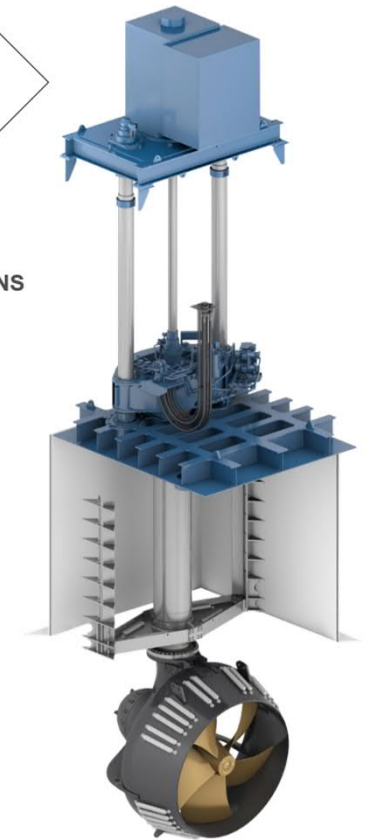
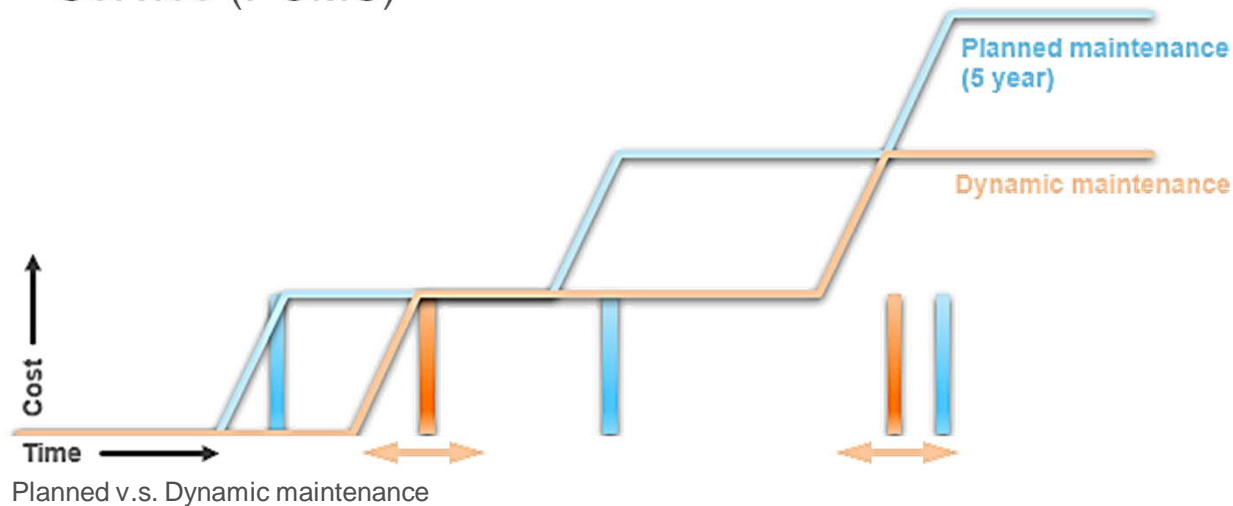
MEASUREMENT



ANALYSE



REPORT AND SOLUTIONS





# CUSTOMER CENTRIC APPROACH

Norbert Bulten  
Product Performance Manager, Wärtsilä

# STATION KEEPING

- Keeping position (station keeping) is crucial part in Wind Turbine Installation Vessel (WTIV) operation
- Wind, waves and current will push the vessel away ⇒ The **environmental** forces
- Counteracting forces are generated by active propulsion units ⇒ The **thruster** forces
- WTIV will stay in position as long as environmental forces are counteracted by thruster forces





# PROPULSION EQUIPMENT FOR WTIV

## Propulsion equipment for Wind-Turbine Installation Vessels

1. Vessel **transit operation** to reach windfarm location
2. Vessel Station keeping / **Dynamic Positioning (DP)**
  - Short period for jack-up vessels to lower the legs and lift the vessel
  - Continuous operation for floating vessels

## Mix of propulsion products to address the operational requirements

- Main stern thrusters
- Retractable bow thrusters
- Tunnel thrusters



# OPTIMUM PROPULSION PERFORMANCE

**Single  
thruster  
performance**

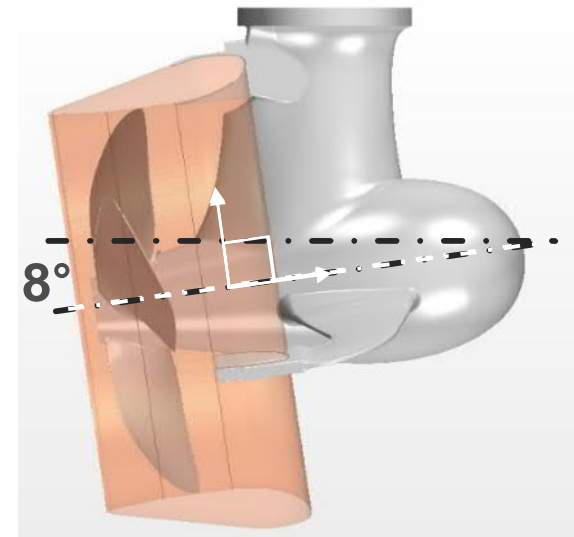
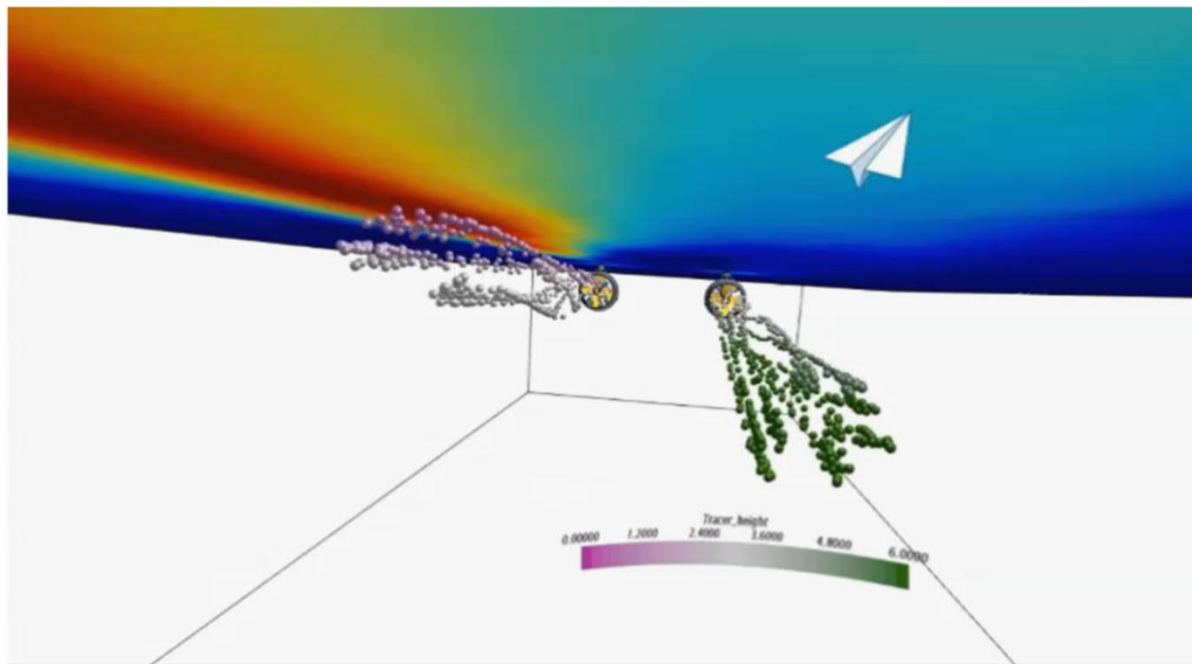
**Thruster  
interaction  
losses**

**Multiple  
thruster  
cooperation**

# 8°-TILTED THRUSTER PERFORMANCE

Hydrodynamic performance determination of the thruster based on full scale CFD simulations

- Conventional unit shows interaction with hull surface

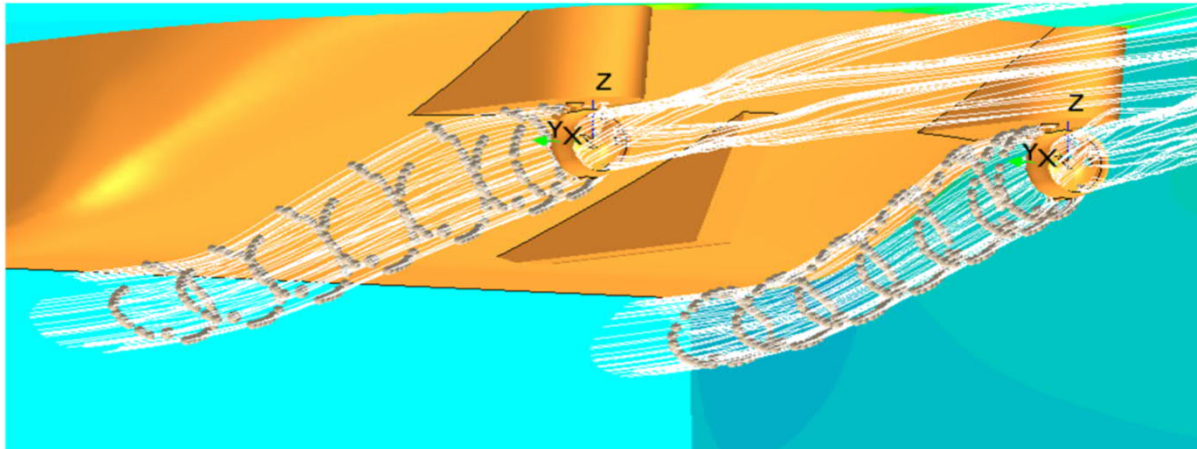


Single  
thruster  
performance

Thruster  
interaction  
losses

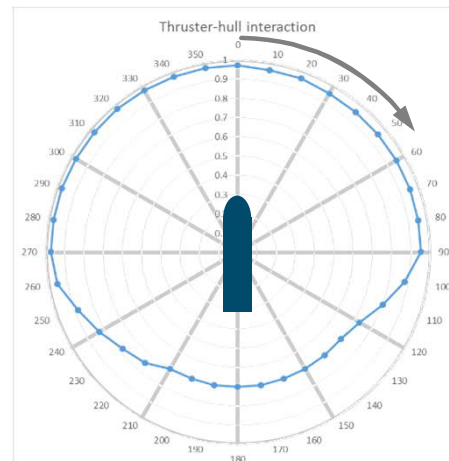
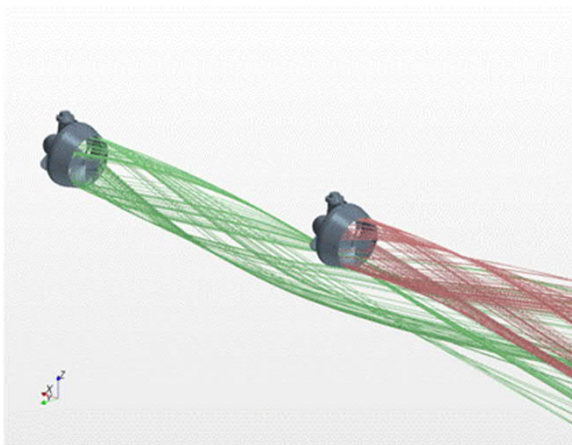
Multiple  
thruster  
cooperation

# THRUSTER INTERACTION LOSSES



Improved DP performance  
based on thruster performance  
for **360° circumference**

- Accurate **thruster-hull** interaction loss modelling  
(main thrusters – aft ship interaction)
- Implementation of forbidden zones  
(**thruster-thruster** interaction losses)



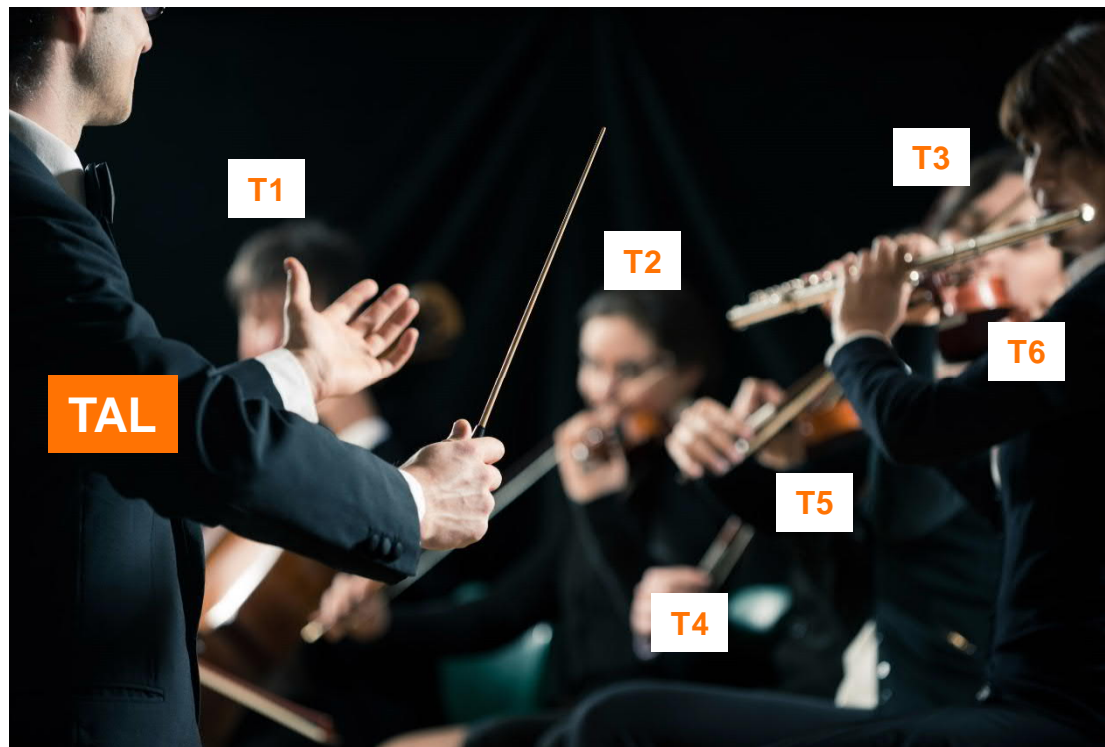
Single  
thruster  
performance

Thruster  
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losses

Multiple  
thruster  
cooperation



# MULTIPLE THRUSTER OPERATION



Thrust Allocation Logic (TAL) is the **conductor of all thruster units** in operation.

TAL determines:

- Thruster loading (%)
- Thruster azimuth angle

Resultant force and moment of all units together balance the environmental forces and moments.

Single  
thruster  
performance

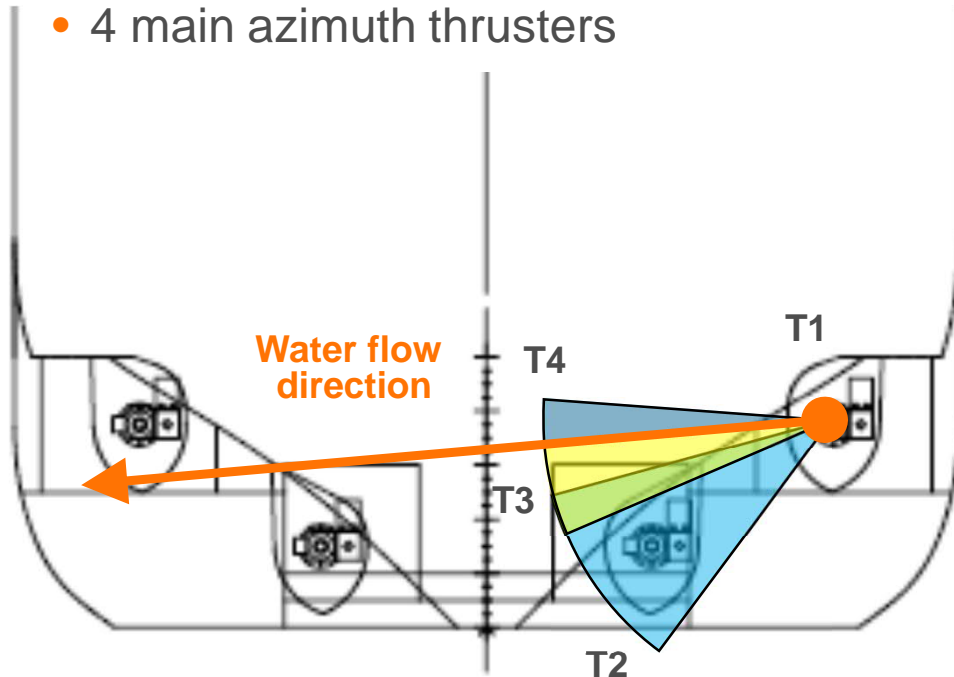
Thruster  
interaction  
losses

Multiple  
thruster  
cooperation

# EXAMPLE CASE

## Propulsion layout

- 2 tunnel thrusters
- 2 retractable thrusters
- 4 main azimuth thrusters



1. Thruster hull interaction benefits due to tilt
  - Wärtsilä **Retractable thrusters with 8°-tilted shaft**
2. Forbidden zone determination of 4 aft main thrusters
  - **Corridor approach:**
    - ⇒ thruster jet T1 allowed between units T3 and T4
3. **Enhanced TAL** (Thrust-Allocation-Logic)
  - Utilisation of thrust-reserve of main units

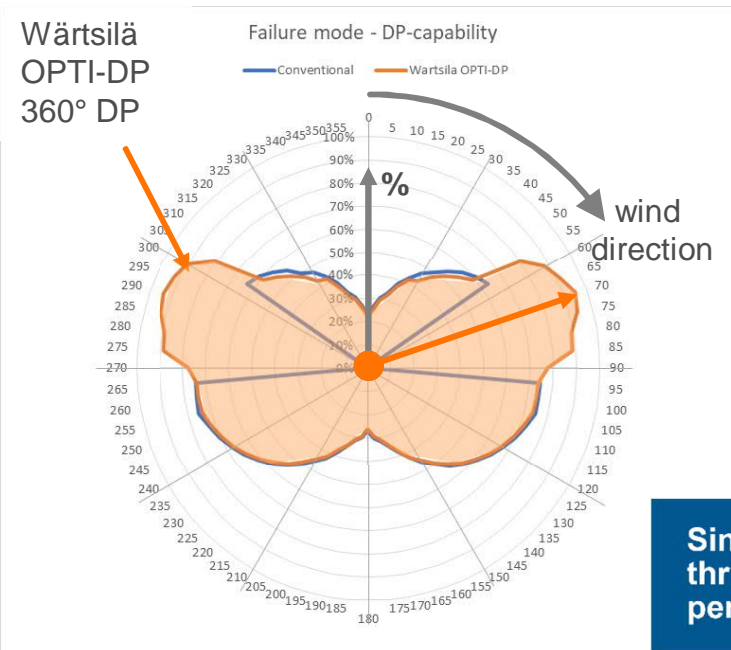
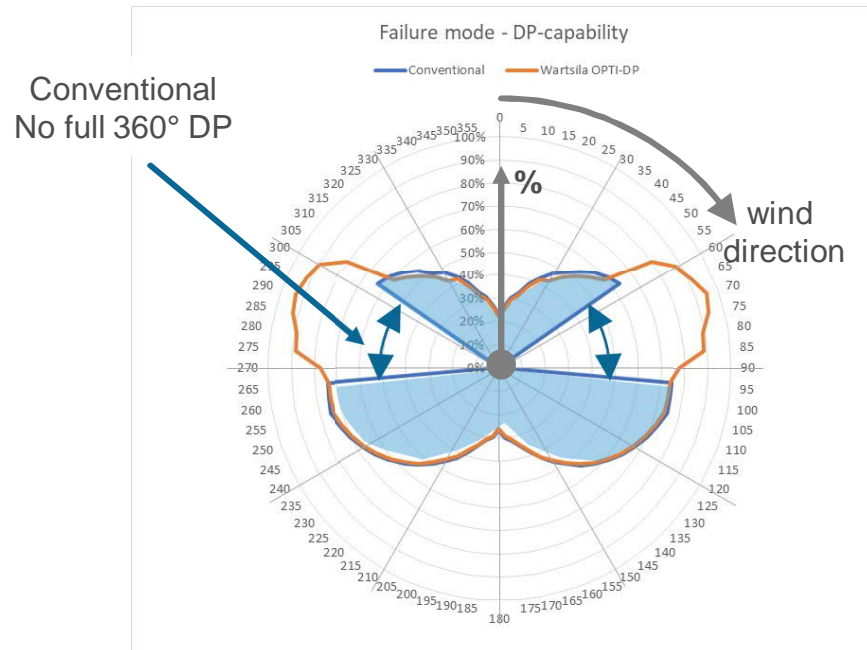
Single  
thruster  
performance

Thruster  
interaction  
losses

Multiple  
thruster  
cooperation

# EXAMPLE CASE

- During operation wind and waves can come from every direction (360°)
- In order to keep position during operation 360° DP-capability is required
- Thrust utilisation plots show DP-capability



## Propulsion layout

- 2 tunnel thrusters
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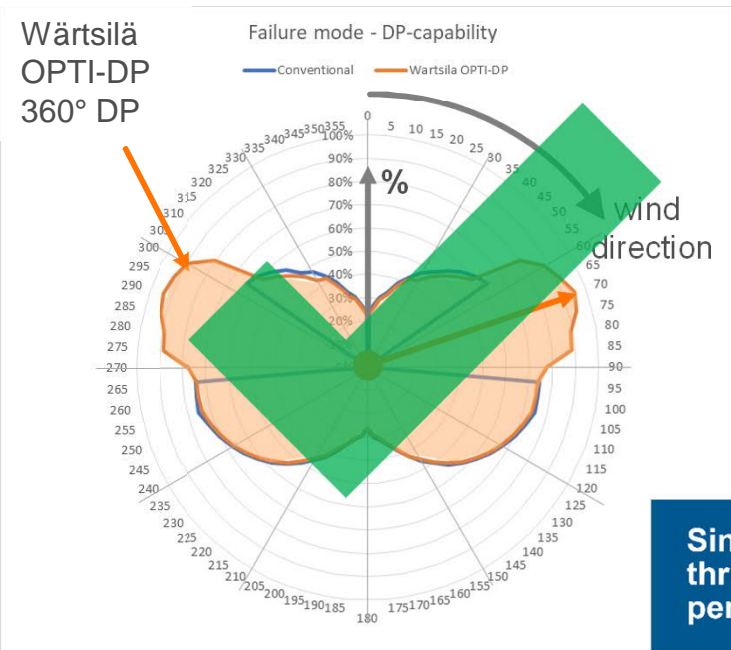
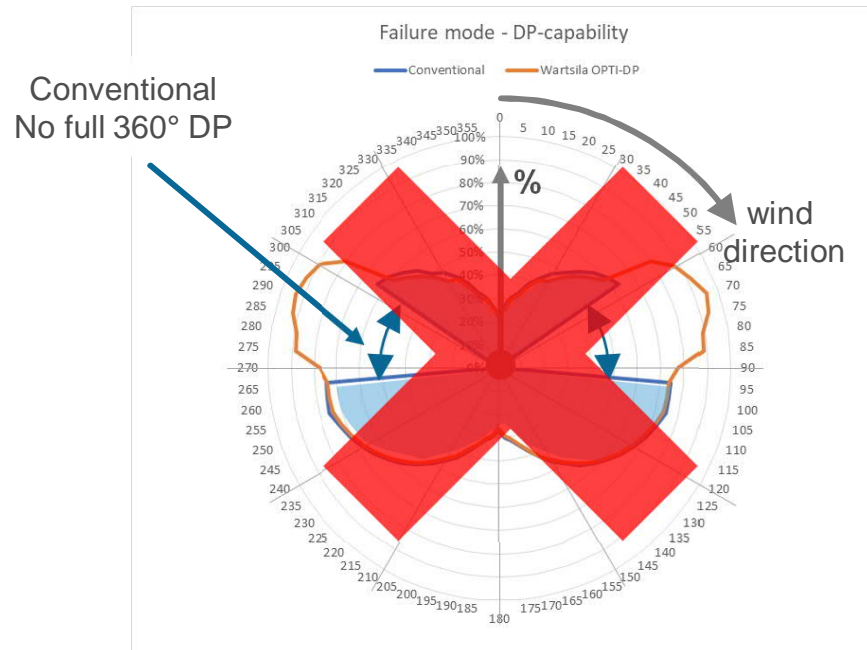
Single  
thruster  
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Thruster  
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# CONCLUSIONS

- Optimum propulsion performance is based on a solid fundament of hydrodynamic knowledge
- The combined operational aspects of WTIV with vessel in transit sailing and Dynamic Positioning are well understood by Wärtsilä experts
- Wärtsilä OPTI-DP tool has this hydrodynamic & propulsion knowledge in its genes
- Thruster and DP requirements directly impact total vessel power requirement
  - starting with OPTI-DP will enable an optimised WTIV solution
- Optimum DP performance is a result of
  1. Best propulsion performance
  2. Well-understood interaction effects
  3. Intelligent TAL (Thrust-Allocation-Logic)

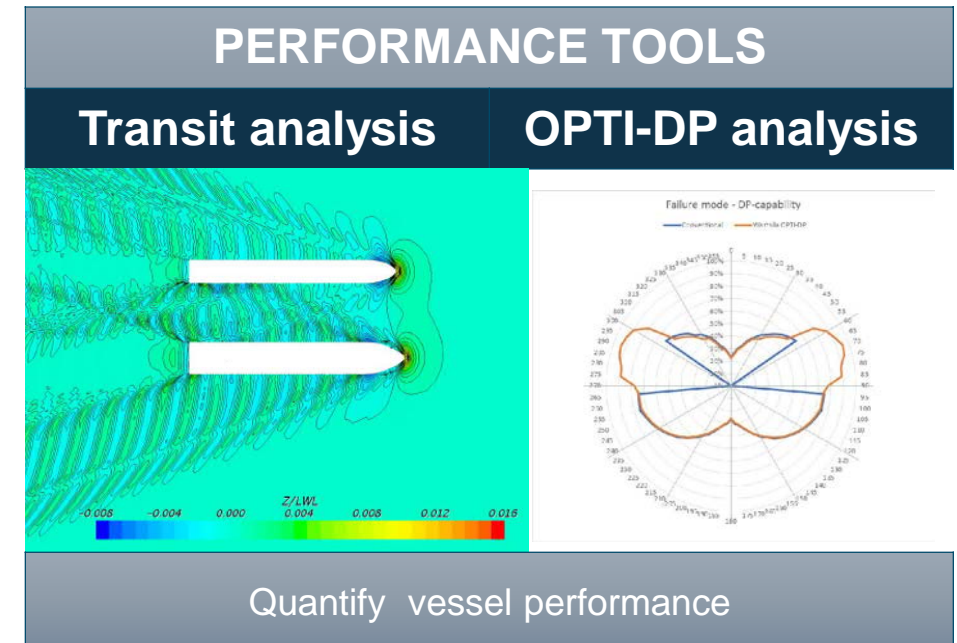


# WÄRTSILÄ SOLUTION INSIGHT

Arnoud Dinslage  
Product Manager Thrusters, Wärtsilä

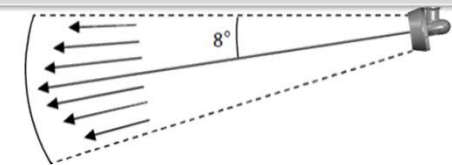
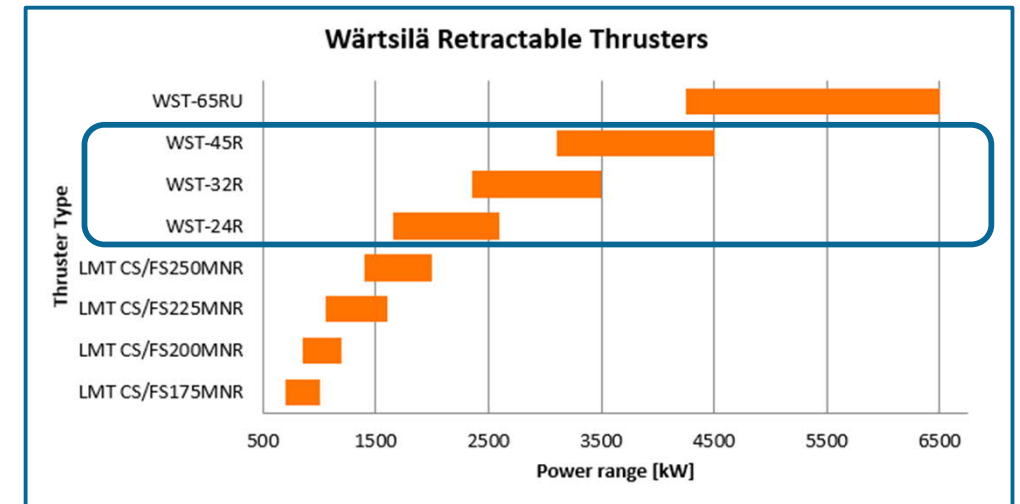
# FOCUS ON VESSEL PERFORMANCE

PRODUCTS			
WST-U	WST	WST-R	WTT
Underwater mountable series	Steerable series	Retractable series	Transverse series
			
3- 5 MW	3 – 5 MW	2.5 - 4.5 MW	3- 3.8 MW



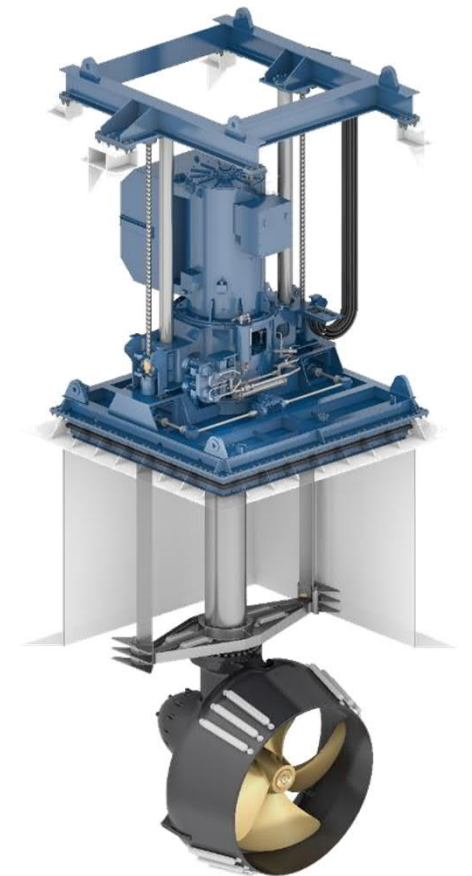
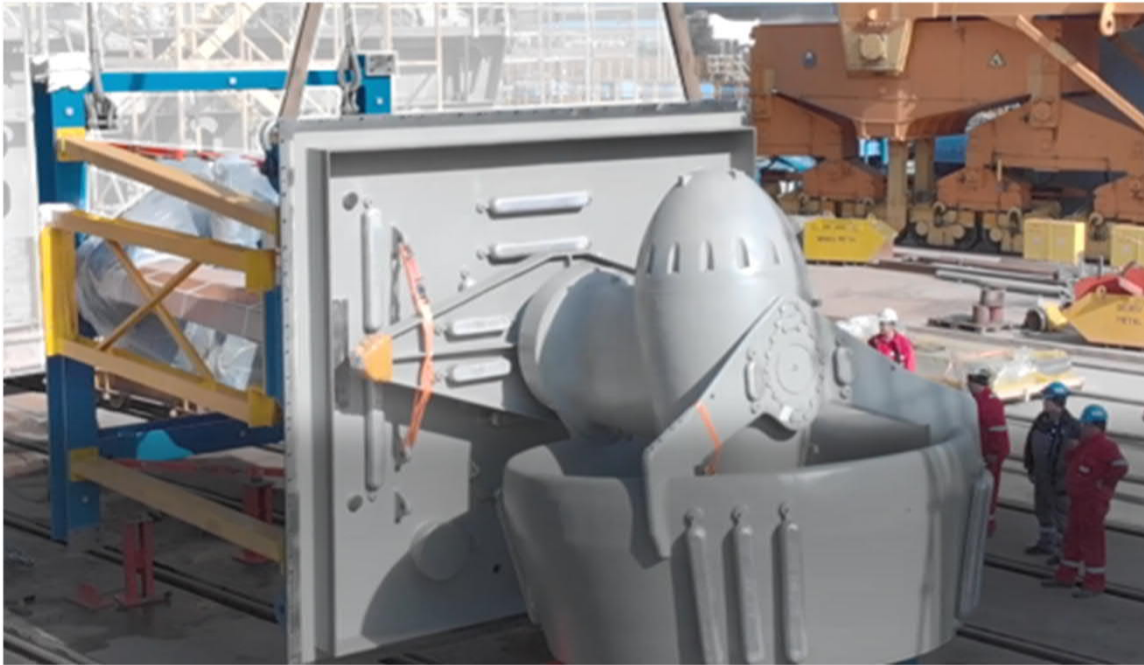
# WÄRTSILÄ'S RETRACTABLE THRUSTER PORTFOLIO

- High thrust performance by WTN type nozzle
- Reduced interaction losses by 8° tilted shaft
- Compact design
  - Small footprint
  - Low weight
- Easy to integrate, install and maintain
- Compliance with environmental regulations
- Reliable



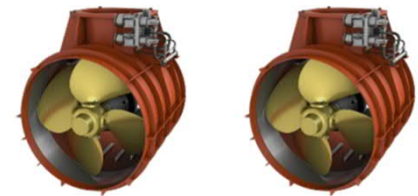
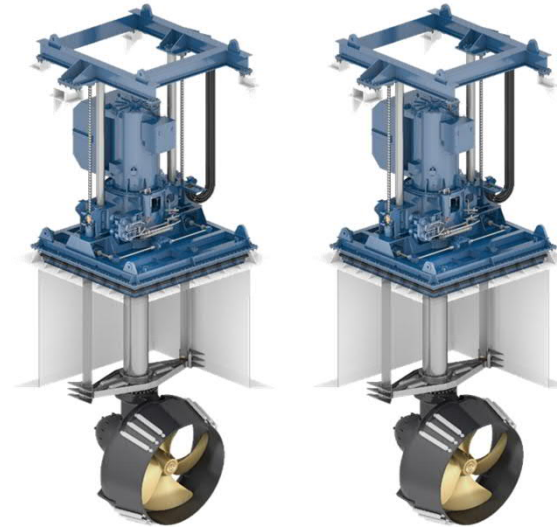
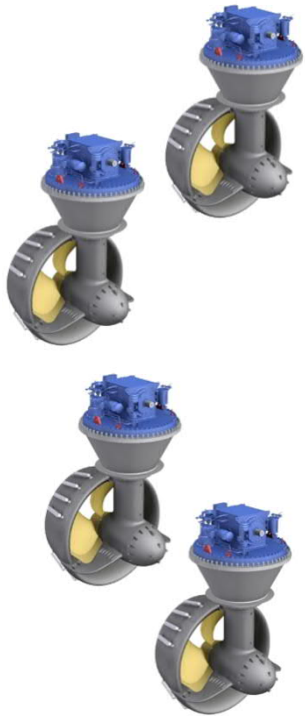


# WÄRTSILÄ'S RETRACTABLE THRUSTER PORTFOLIO



POWER OF INTEGRATION

# UNDERSTANDING THE THRUSTER CONFIGURATION





# LIFECYCLE STARTS AT DESIGN

- Early engagement allows optimised configuration
- Portfolio enables integration
- Active condition monitoring increases up time
- Predictive maintenance extends intervals
- Service network adds flexibility

Integration of Wärtsilä solutions, performance and lifecycle solutions **reduce operational risk**

## Solution Portfolio



Engineering services for upgrades and retrofits



Integrated Dynamic Positioning system



Integrated navigation, electrical and automation systems



Wide range of propulsion machinery



Alternative fuels



Fuel efficient engines and hybrid power systems



CHALLENGE THE TEAM

# Q&A

To submit a question, use the panel on the right.





**WÄRTSILÄ**