ENGINE POWER LIMITATION (EPL)

PRE-INTERVIEW ASSIGNMENT

Background information

In April 2018, the **International Maritime Organization (IMO)** adopted an initial greenhouse gas (GHG) strategy for international shipping. The strategy aims to reduce the carbon dioxide (CO_2) intensity of international shipping by at least 40% from 2008 levels by 2030, and to reduce absolute GHG emissions at least 50% below 2008 levels by 2050. The IMO is now developing regulations to support these goals.

One of the newly proposed measures is the **Energy Efficiency Existing Ship Index (EEXI)**. Subject to adoption at MEPC 76 in June 2021, the requirement will enter into force in 2023, and will be applicable to all vessels above 400 GT falling under MARPOL Annex VI. The EEXI is a 'design' efficiency index which requires a vessel to achieve a minimum level of technical efficiency. Compliance is determined by the vessel's design and arrangements, which means an attained EEXI can only be changed through alterations to the vessel's design or machinery, and not through day to day operational action such as optimized routing. In its simplest form, the attained EEXI is the vessel's grams of CO_2 emitted per capacity tonne mile under the vessel's specific reference conditions. This is a function of the installed engine power (kW), the specific fuel consumption of the main and auxiliary engines, a carbon factor representing the conversion of fuel to CO_2, vessel capacity and vessel reference speed.

Different improvement measures are possible to reach EEXI compliance, such as the installation of energy saving devices (e.g. sail rotors) and a retrofit to enable the adoption of alternative fuels (e.g. LNG).

However, the easiest way for older ships to meet EEXI is **Engine Power Limitation (EPL)**, as it requires minimal changes to the ship. At the same time, the majority of ships operate well below their design speed, thus EPL would enable them to improve their EEXI with very limited impact on their daily operations.
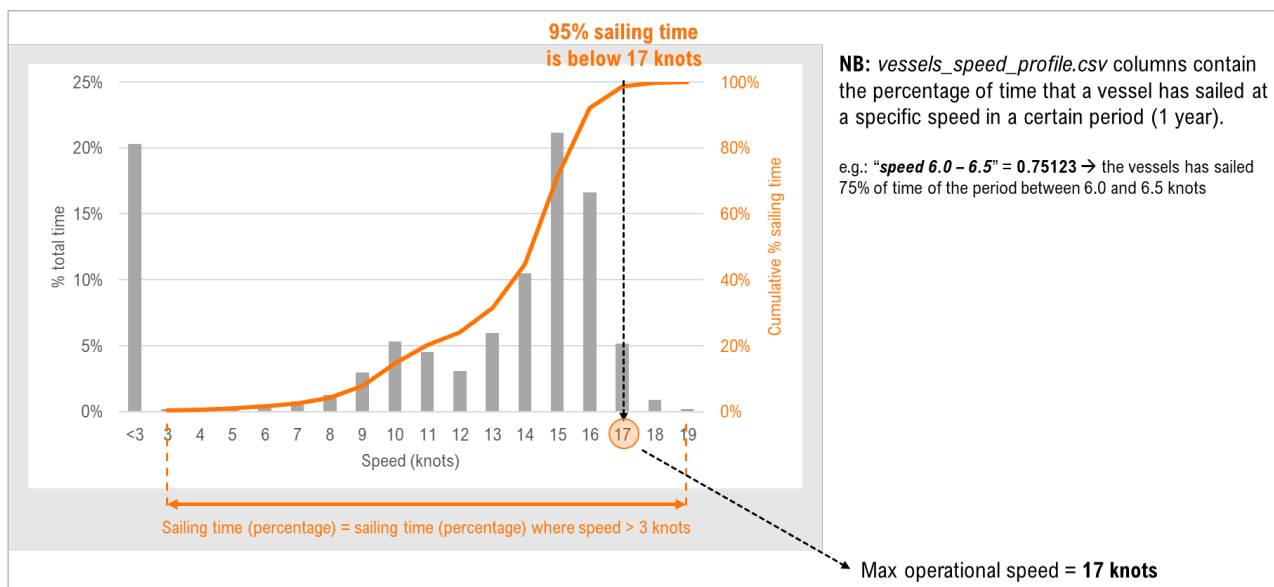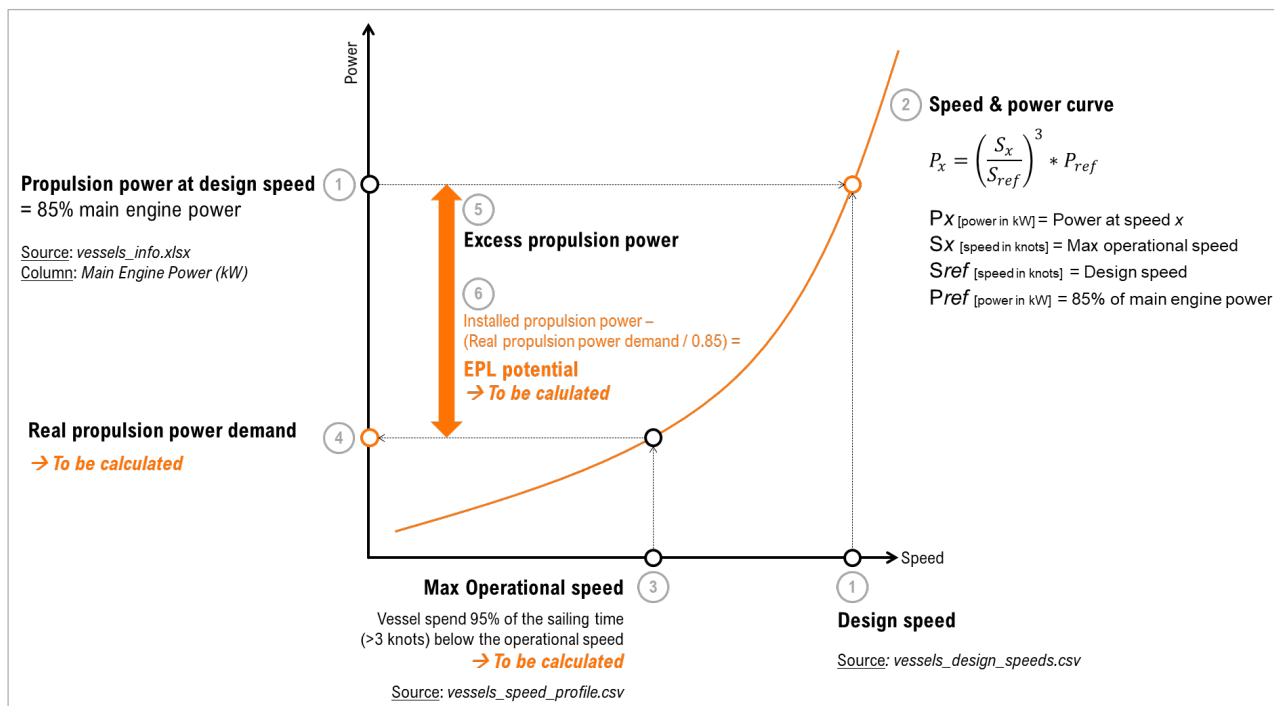
Main objective

The Head of Sales has asked the Business Intelligence (BI) Team to carry out a market study on EPL.

The analysis shall indicate which vessels, among those powered by Wärtsilä, are already operated far below their design speed, and therefore would maintain their operational profile even if subject to EPL. The analysis shall also identify the products, vessel segments and customers with the highest market potential.

The selected approach is to include in the "EPL addressable" fleet all the vessels built after 2005 that could reduce their main engine power by at least 10% without affecting 95% of their sailing time. "Sailing time" is intended as the time spent at speeds higher than 3 knots. All vessel segments other than cruise, ferries, gas tankers, containerships, dry bulk and wet bulk are to be excluded.

The main information on the vessels equipped by Wärtsilä can be found in our internal database, the vessels' design speed is provided by Clarksons, while the operational profile must be derived from historical AIS-based vessel positions, supplied by MarineTraffic.

Methodology

Propulsion power at design speed ①
= 85% main engine power

Source: *vessels_info.xlsx*
Column: *Main Engine Power (kW)*

⑤ **Excess propulsion power**

⑥ Installed propulsion power –
(Real propulsion power demand / 0.85) =
EPL potential
→ *To be calculated*

Real propulsion power demand ④
→ *To be calculated*

② **Speed & power curve**

$$P_x = \left(\frac{S_x}{S_{ref}}\right)^3 * P_{ref}$$

Px [power in kW] = Power at speed x
Sx [speed in knots] = Max operational speed
Sref [speed in knots] = Design speed
Pref [power in kW] = 85% of main engine power

Power

Speed

Max Operational speed ③
Vessel spend 95% of the sailing time
(>3 knots) below the operational speed
→ *To be calculated*
Source: *vessels_speed_profile.csv*

Design speed ①
Source: *vessels_design_speeds.csv*

95% sailing time is below 17 knots

Max operational speed = **17 knots**

NB: *vessels_speed_profile.csv* columns contain the percentage of time that a vessel has sailed at a specific speed in a certain period (1 year).

e.g.: "**speed 6.0 – 6.5**" = **0.75123** → the vessels has sailed 75% of time of the period between 6.0 and 6.5 knots

Sailing time (percentage) = sailing time (percentage) where speed > 3 knots

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Data files

- Wärtsilä installed base (source: Wärtsilä DB) → ***vessels_info.xlsx***

- Speed profiles based on AIS data (source: MarineTraffic) → ***vessels_speed_profile.csv***

- Vessels design speed (source: Clarksons) → ***vessels_design_speed.csv***

Data provided in this assignment is pseudonymized.

Important columns (*vessels_info.xlsx*)

- **IMO** is the unique identifier of a vessel

- Vessel date of construction → "*Inst BuiltDate*"

- Vessel segments → "*Inst Cluster*"

- Wärtsilä engines → "*Product*"

Vessel segment definition ("*Inst Cluster*" column)

- **Cruise**: Cruise Vessels

- **Ferry**: Passenger & Cargo Vessels, Passenger Vessels, RoRo Vessels

- **Gas Tankers**: Gas Tankers

- **Containerships**: Container Vessels

- **Dry Bulk**: Cargo Vessels, Bulk Carriers

- **Wet Bulk**: Tankers

- **Others**: Fishing Vessels, Service Vessels, Inland Vessels

- **OSV**: Offshore Support Vessels

- **Oil & Gas**: Oil & Gas

- **Navy**: Navy & Coast Guard Vessels

Deliverables

Presentation and Python code to be sent to daniel.zotti@wartsila.com by **18/03/2021 – 2:00 PM CET**. The presentation will be also discussed during the interview.

- **Presentation**
    - o Contents: market study as required by Head of Sales (see *Main objective*)
    - o Format: PDF
    - o Language: English
- **Python source code**
    - o Traditional Python project or Jupyter Notebook project
    - o GitHub/GitLab/BitBucket repository is preferred, but a .zip folder is also acceptable

Contacts

If you have any questions or doubts about the assignment, **do not hesitate to contact us**.

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