Maximize Hull Efficiency by anti-fouling coating

Reducing OPEX by improve energy efficiency

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Background

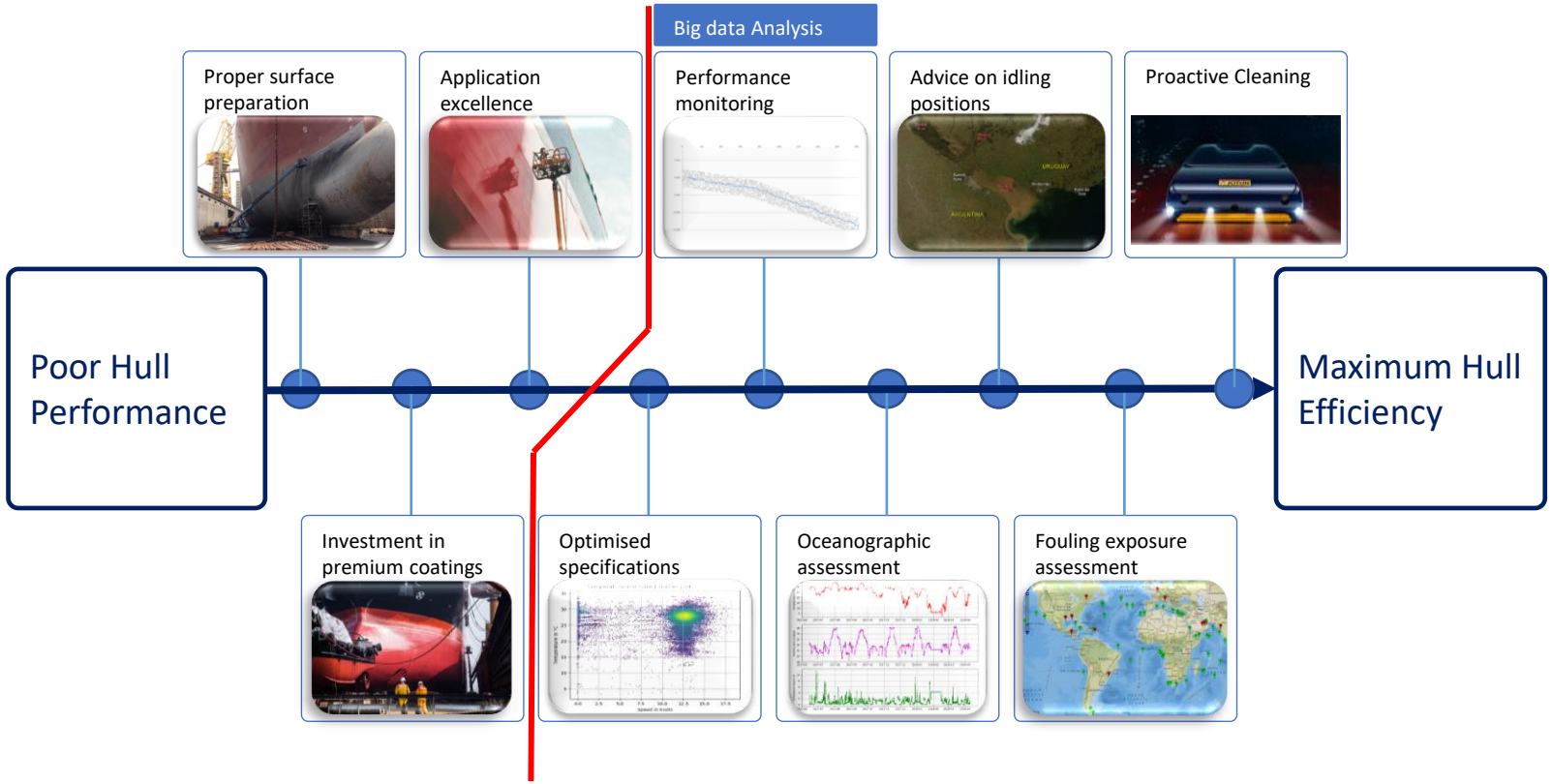
- Increase vessel hull frictional resistance by biofouling
- The effect of biofouling on the powering demand of vessel has been studied, e.g. by Schultz 2007.
  - The additional shaft power required for different types and degrees of biofouling.
- Require additional power caused by biofouling, requires additional fuel.
- Burning additional fuel increase ship operational expenditure and greenhouse gases(GHG)
  - In 2018 the IMO reached a landmark agreement on a 50% reduction in greenhouse gas emissions by 2050 compared to 2008.

Purpose of study

- Maximize hull efficiency by anti-fouling coating and big data analysis for given hull design
- Guidelines to provide consistent approach to the management of biofouling
  - Reduce fuel costs
  - Reduce environmental footprint
  - Reduce risk of spreading invasive aquatic species

** Schultz et al. 2011, Economic impact of biofouling*

PATH TO MAXIMUM HULL EFFICIENCY



Methodological approach

- Biofouling increase frictional resistance – Area below water, Surface condition of hull
  Roughness of hull include roughness of Biofouling
- The additional shaft power required for different types and degrees of biofouling.
- Biofouling can significantly increase power requirements
- Increase fuel to increased power requirements
- Fuel increasement is cost increasement
- Increase fuel increasing GHG (greenhouse gas)
- If we can maximize hull efficiency, contribute not only OPEX but also environmental footprint

Verification method

- Study the impact of biofouling on ship hull
- Study of anti-fouling coating technology development
- Vessel operational Profile analysis by big data analysis (AIS data and Oceanographic data)
- Study for ISO19030 (Measurement of changes in hull and propeller performance)-big data
- Study for Market Average hull performance
- Investigate IMO new regulation and published guidelines

Verification

- Practical case study of Hull performance monitoring – **verification by ISO19030-2**

- ISO 19030 : Measurement of changes in hull and propeller performance

Part 1: General principles

Outlines basic principles

Defines 4 performance indicators:

- In-service performance
- Dry-docking performance
- Maintenance trigger
- Maintenance effect

Part 2: Default method

- Default method for **measuring changes** and calculating the basic performance indicators
- High frequency data with automated logging

ISO 19030-2
(default method)

+/- 0.3 to 0.5 p.p. accuracy depending on indicator

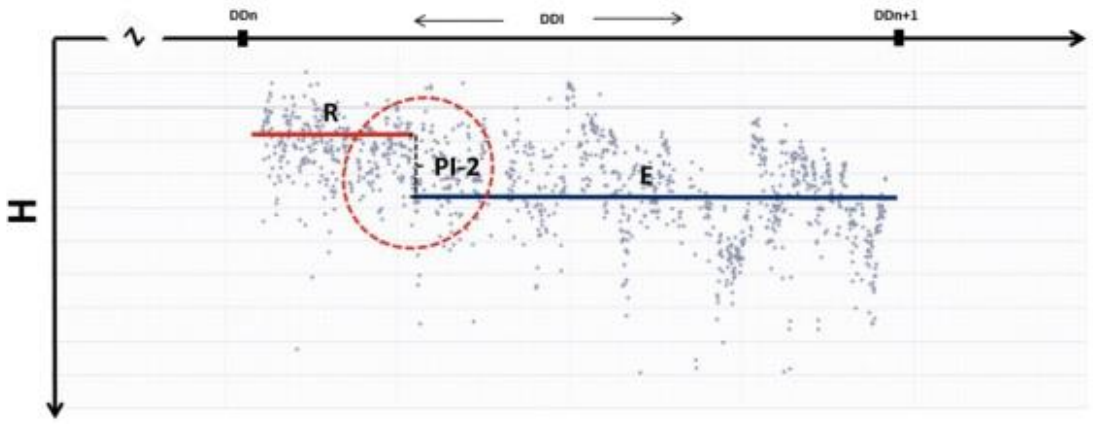
Part 3: Alternative methods

- Alternative methods for measuring and calculating the basic performance indicators
- Based on **typically available measurement infrastructure**

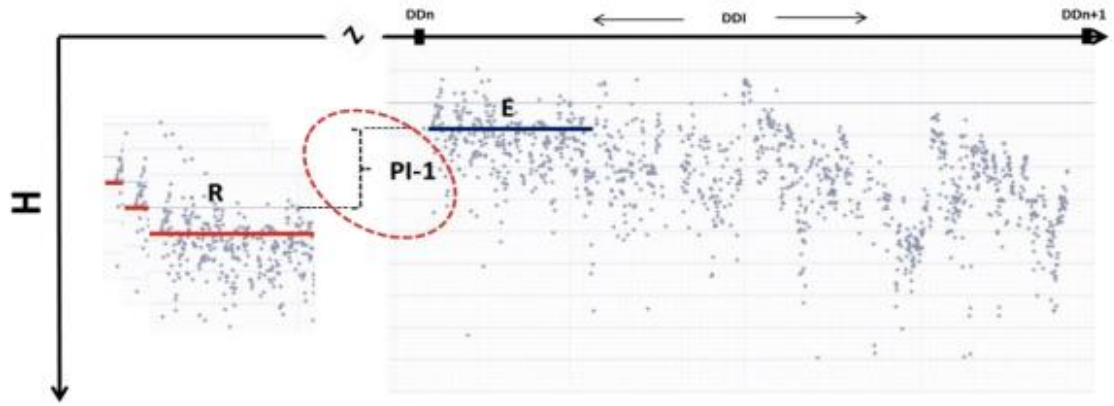
ISO 19030-3
(alt. methods)

+/- 0.4 to 9 p.p. accuracy depending on implementation and indicator

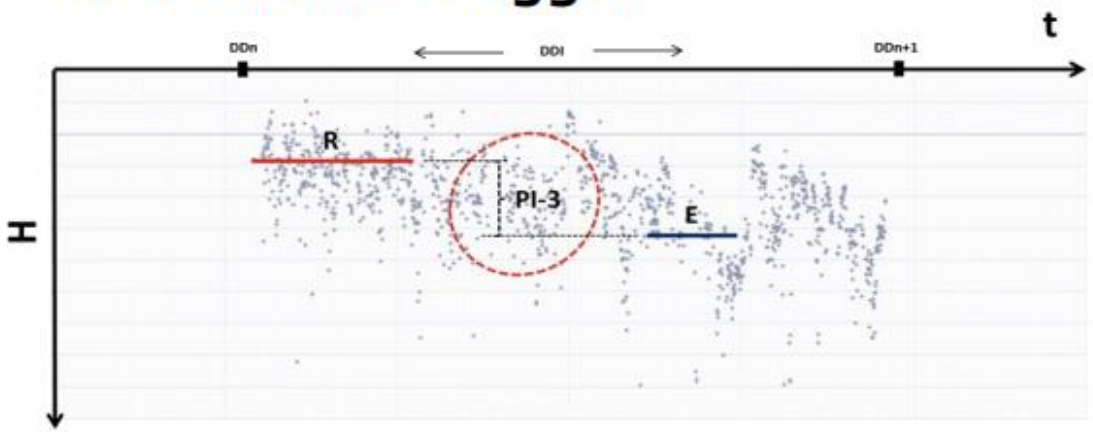
In-service performance



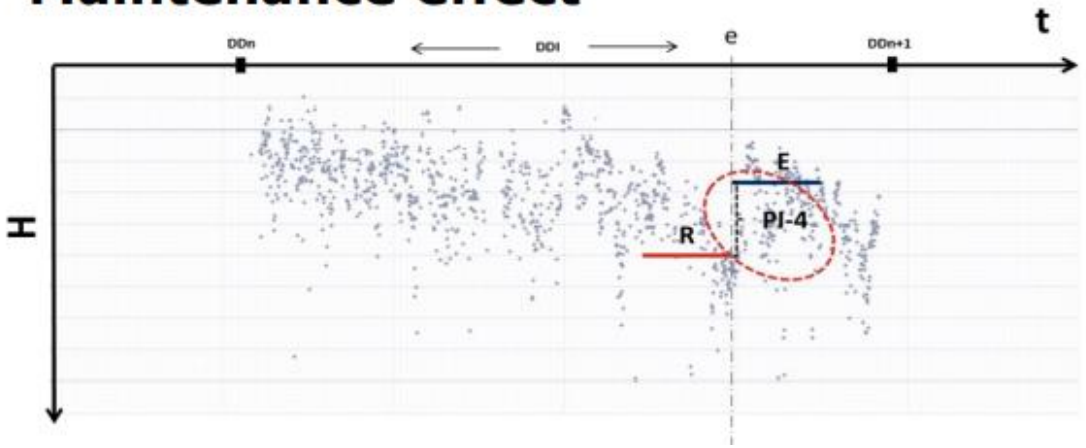
Dry-docking performance

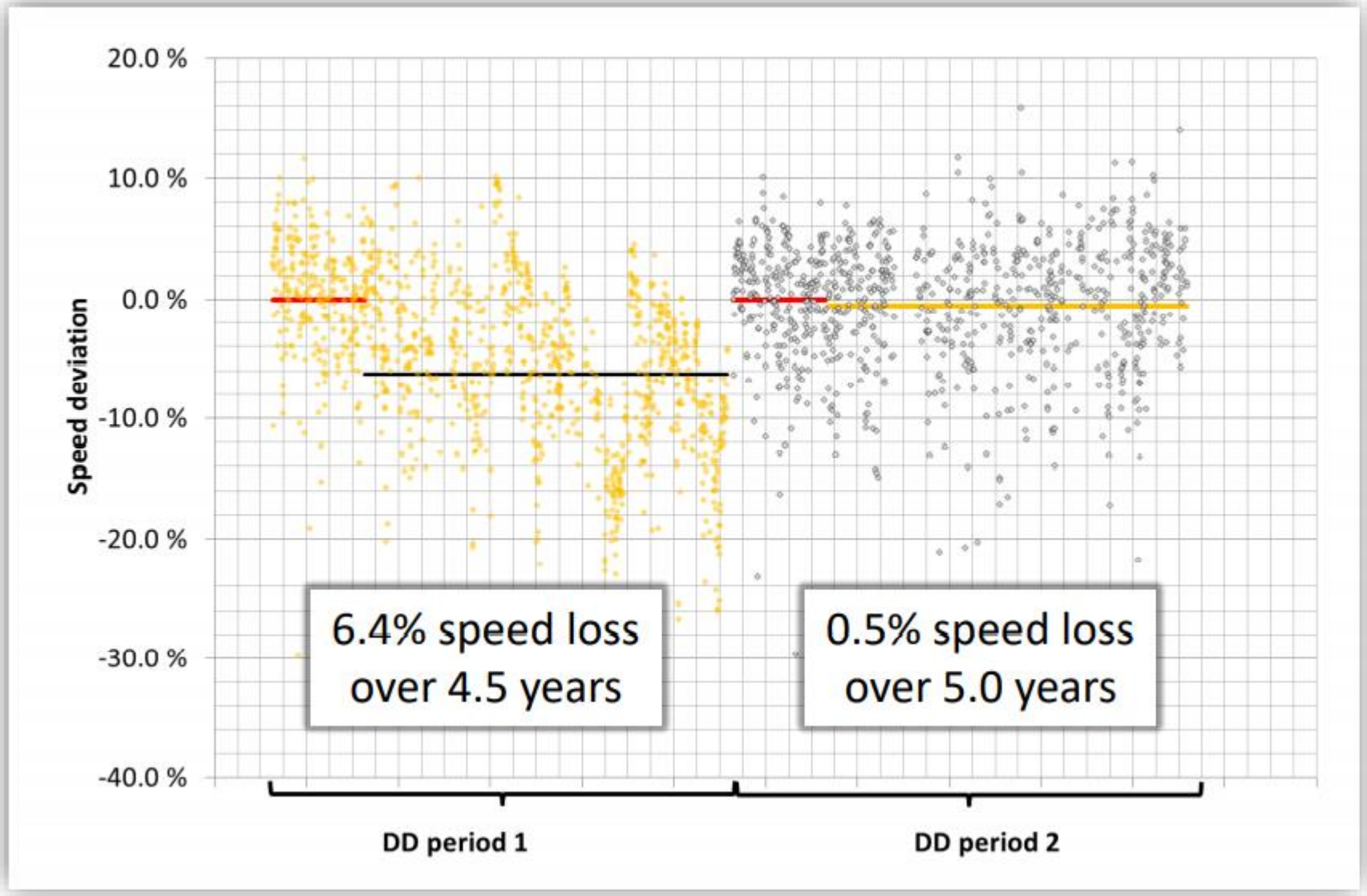


Maintenance trigger



Maintenance effect





51K dwt Bulk Carrier

- High frequency data (every 15sec) analysis based on ISO19030-2
- Different Anti-fouling coating applied between DD period 1 and DD period 2

Conclusions

- Average speed loss deviation comparison between DD period 1(6.4%) and DD period 2(O.5%) is 5.9%.
- This means that power saving percentage due to Anti-fouling coating would correspond to approx. 3.16times the speed increase percentage. DD period 2 could be verified that power saving **18.64%** compare to DD period 1
- Performance of anti-fouling coatings can manage impact of biofouling on ship hull
- Hull fouling risk quantification can be done by big data analysis
- Maximize hull efficiency reduce OPEX, environmental footprint and risk of spreading invasive species

Further study

- Fouling forecasting by fouling risk assessment
- Limitation of fouling protection by anti-fouling coatings during challenge operation

- Thank you