Pro**tech**ting people and planet

Navigating the Hydrodynamics

in Early Ship Design

Paulo Macedo
Hydrodynamics & Development Engineer
KM Ship Design
10/09/2024

To protect people and planet by innovating technology today, for a better tomorrow

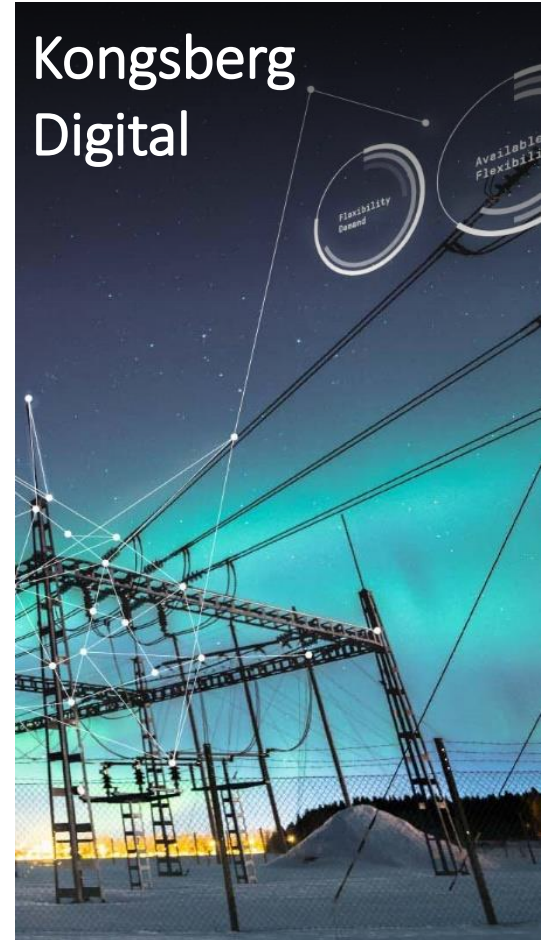# A technology powerhouse with 4 strong business areas

Kongsberg
Maritime

Kongsberg Defence
& Aerospace

Kongsberg
Discovery

Kongsberg
Digital

6,600 employees

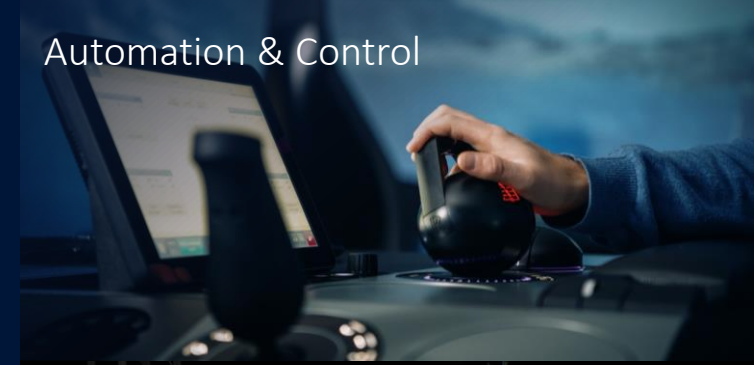**20 BNOK revenues**

33 countries

33,000 vessels

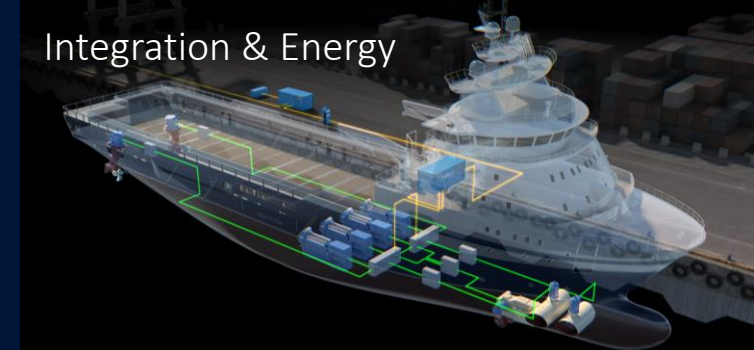Kongsberg Maritime

The ocean space experts of KONGSBERG

Automation & Control

Integration & Energy

Propulsion & Handling

Global Customer Support

KONGSBERG

Broad portfolio breadth and capabilities to deliver
next level customer value

- Ship Design
- Propulsion and manoeuvring
- Bridge
- Deck machinery
- Digital
- Automation
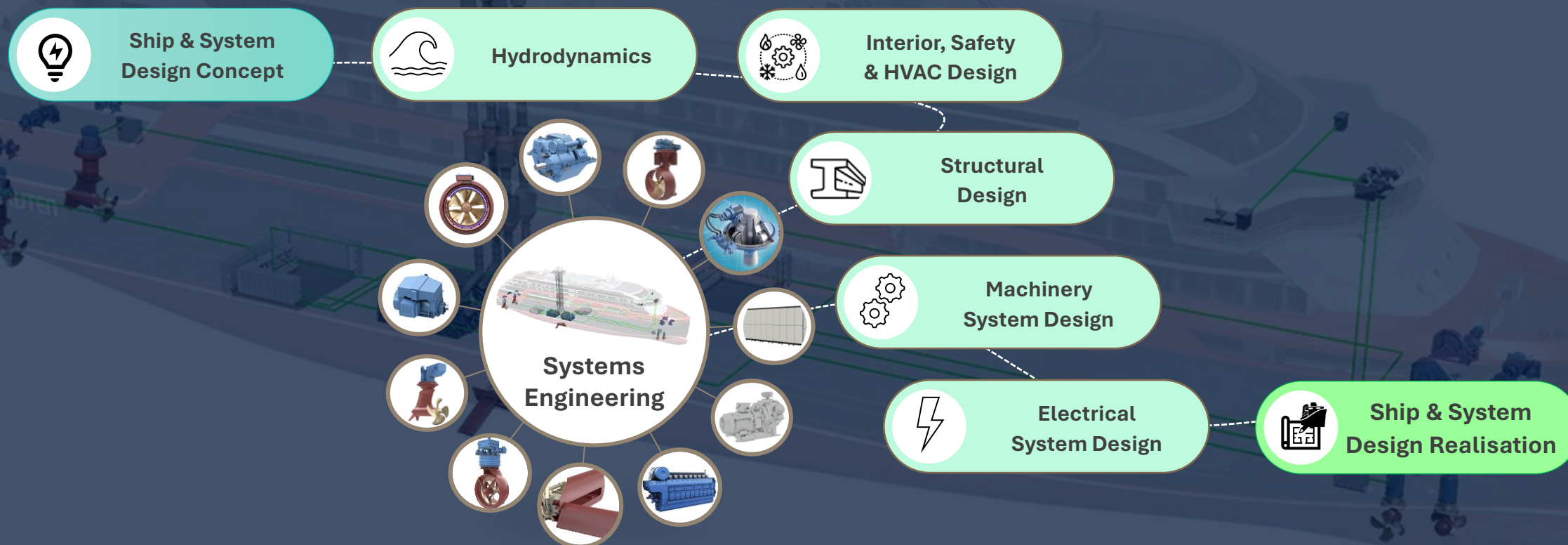- Energy distribution & storage
- Motion control
- Remote service
- Global service

Integrated Projects Engineering
Efficiency & Collaboration in Ship Design Execution

KONGSBERG

- Ship & System Design Concept
- Hydrodynamics
- Interior, Safety & HVAC Design
- Structural Design
- Machinery System Design
- Electrical System Design
- Ship & System Design Realisation

Systems Engineering

Exploiting our deep Ship Design expertise and our extensive product portfolio allows us to design and execute the world's **Safest**, **Operationally Efficient** & **Sustainable** vessels of the future

50 years of evolution – the significant ships

Fifty years young

Our story began 50 years ago and we have always strived to produce the very best ships for our customers around the world. We have designed more than 1,000 ships so far as the market leader for technical innovation and design excellence. Our range is a timeline of true achievement. We're proud of our past and excited about our future – a future that will focus on sustainability and protecting our oceans. The best is yet to come.

1974
UT 704
Anchor handler
Stad Scotsman

1974
UT 705
Pipelay vessel
Tender Carrier

1975
NVC 361
Trawler
Hvitanes

Late 70s
UT 708
Heavy duty anchor handler
Stad Sailor

Early 80s
UT 706
Platform supply
Northern Fortress

Mid 80s
UT 725
Oil well service vessel
Big Orange XVIII

Late 80s
UT 734
Anchor handler
Star Spica

Mid 90s
First UT 755
Platform supply
(Most common PSV design. Pictured is Dina Merkure, built in 2006)

2015
NVC 405 WP LNG
RoRo cargo
Kvitnos

2013
NVC 386
Live fish carrier
Ronja Polaris

2013
NVC 401 LNG
Fish pellet carrier
Eidsvaag Pioner

2012
UT 754 WP
Platform supply
Far Solitaire
(Ship of the Year award)

2011
UT 830 CD
Seismic survey
BGP Prospector

2009
UT 761 CD
Subsea support
Far Samson

2008
UT 767 CD
Oil well service
Island Wellserver
(Ship of the Year award)

2006
NVC 810
Coastguard
Knud Rasmussen

2005
UT 512
Coastguard
KV Harstad

2005
UT 515
Tug
Abeille Bourbon

2004
UT 737 L
Oil well service
Island Frontier

2000
NVC
RoRo passenger (HS)
Olympic Champion
(Capable of 32 knots)

2000
NVC 367
Fishery
Remøy Viking
(World's first triple trawler)

Late 90s
NVC
Vehicle carrier
Autosky

2017
NVC 374 WP
Trawler
Cuxhaven

2018
NVC 395 Polar
Research
Kronprins Haakon

2018
UT 540 WP
Service operation vessel
Edda Passat

2019
UT 851
Research
Sir David Attenborough

2019
UT 797 CX
Anchor handler
Island Victory
World record bollard pull
(477 tonnes)

2019
NVC 2140
Cruise ship
Roald Amundsen

2021
NVC 389
Live fish carrier
Ronja Vest

2021
NVC 372
Freezer trawler
Sunderøy

2023
UT 5519 DE
CSOV
IWS Skywalker

2023
NVC 336
Trawler
Arctic Fjord

2024
UT 5208 USV
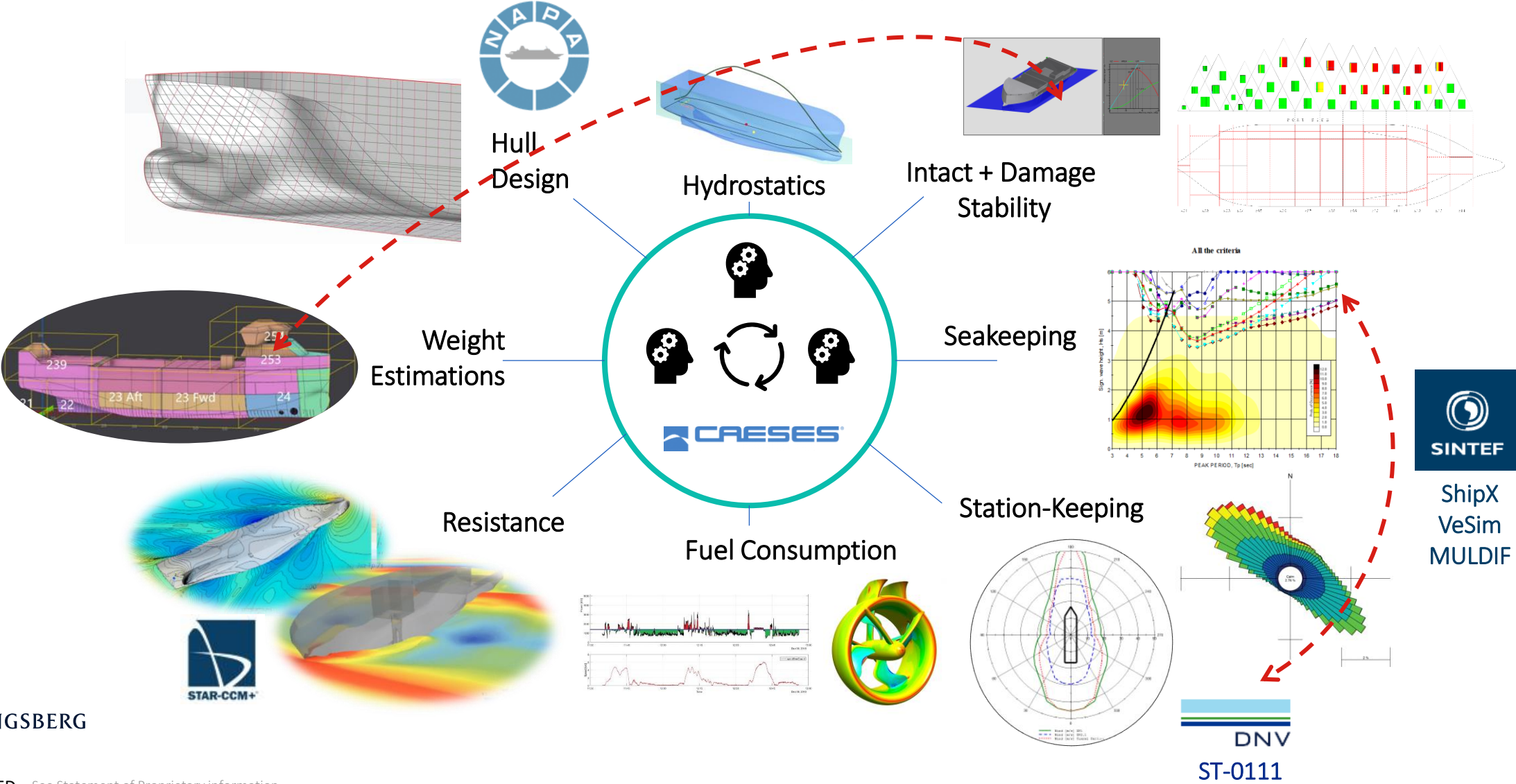Unmanned offshore vessels
for Reach Subsea

2025
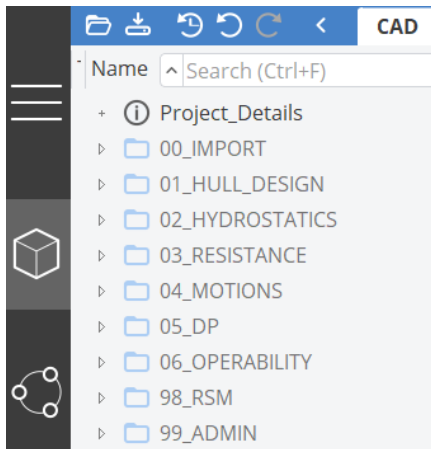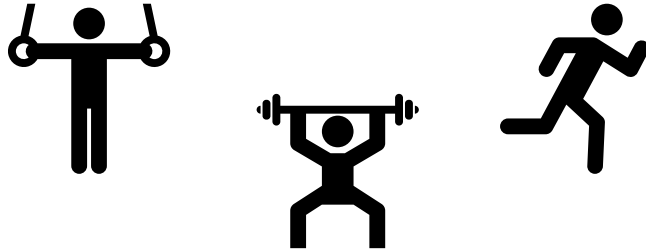NVC 615 CT
Chemical tanker for
Terntank (wind assist)

Multi-Disciplinary Parametric Design & Optimization
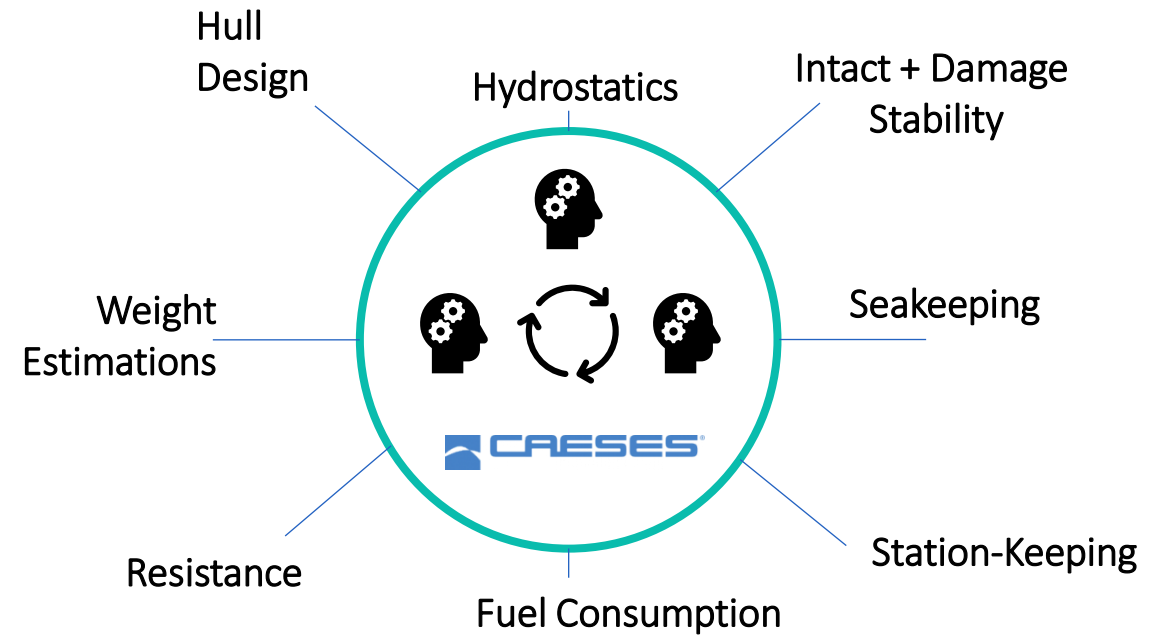
Multi-Disciplinary Parametric Design & Optimization

- Key factors for successful integration

  - Flexible

  - Robustness

  - Simplicity

  - Responsive

- Hull Character Template

  - 6 Integrated Disciplines

  - 50+ FFeature Definitions

  - Under continuous

    development

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NAPA IGES

Geometry Formats

- Advantages
  - Light / Quick
  - Suitable for Stability
  - Perfect for Linesplan
  - Faired Geometry

- Disadvantages
  - Rhino required (IGES 144)
  - Can't be modified in NAPA
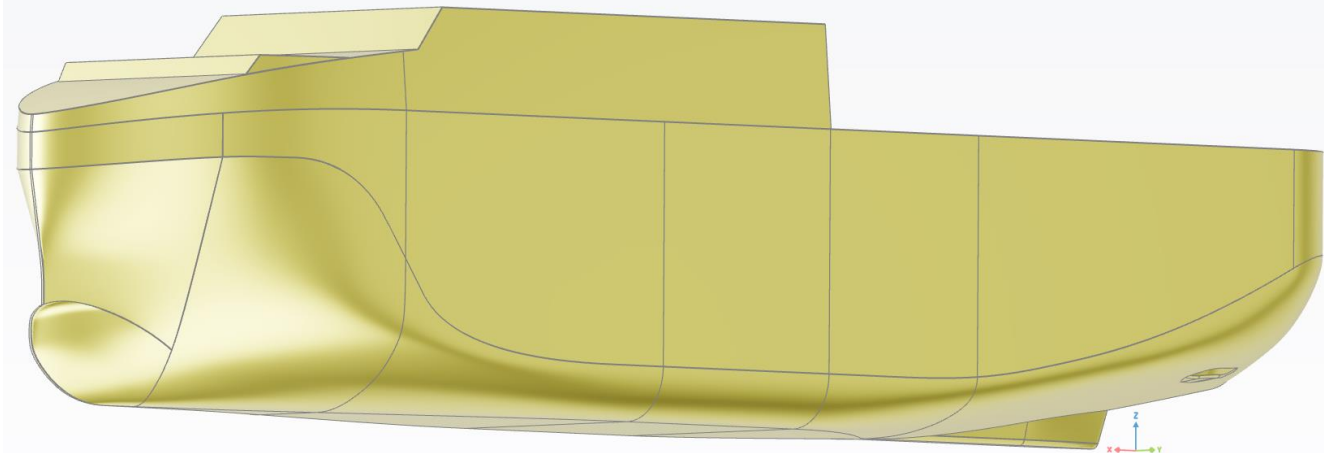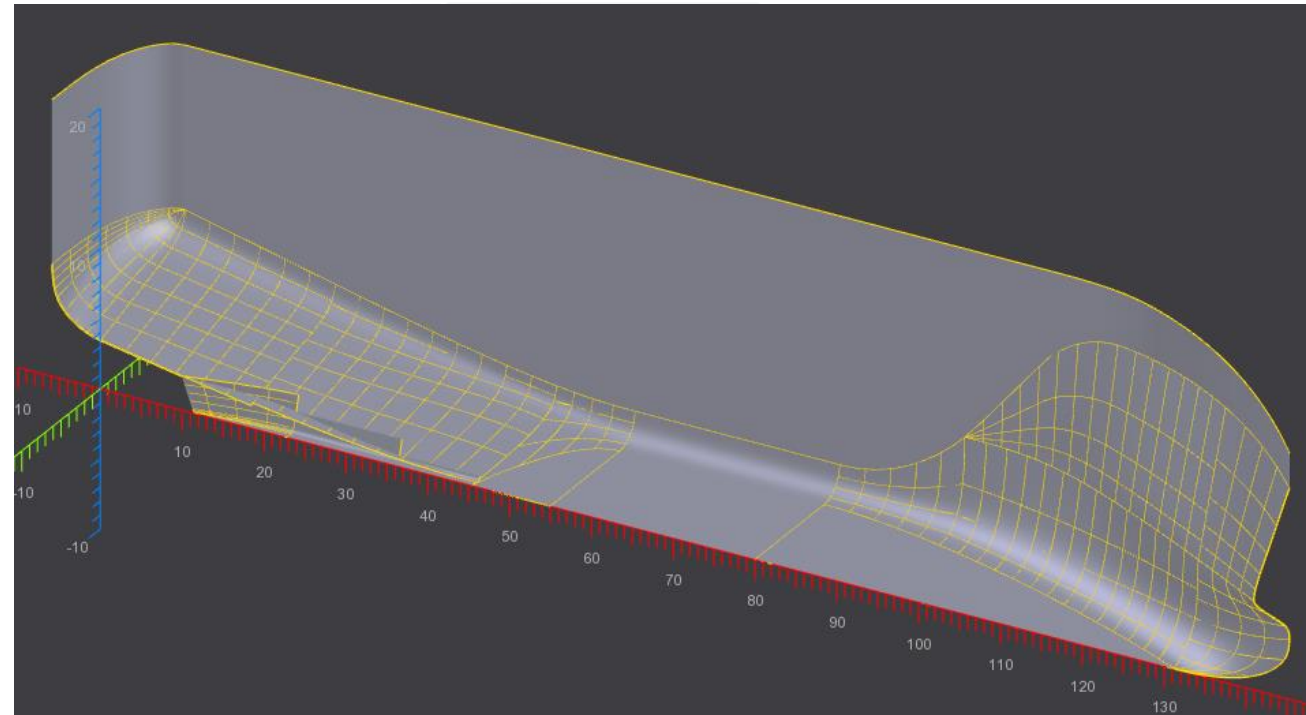 - Not compatible with legacy workflow

CAESES

FBrep
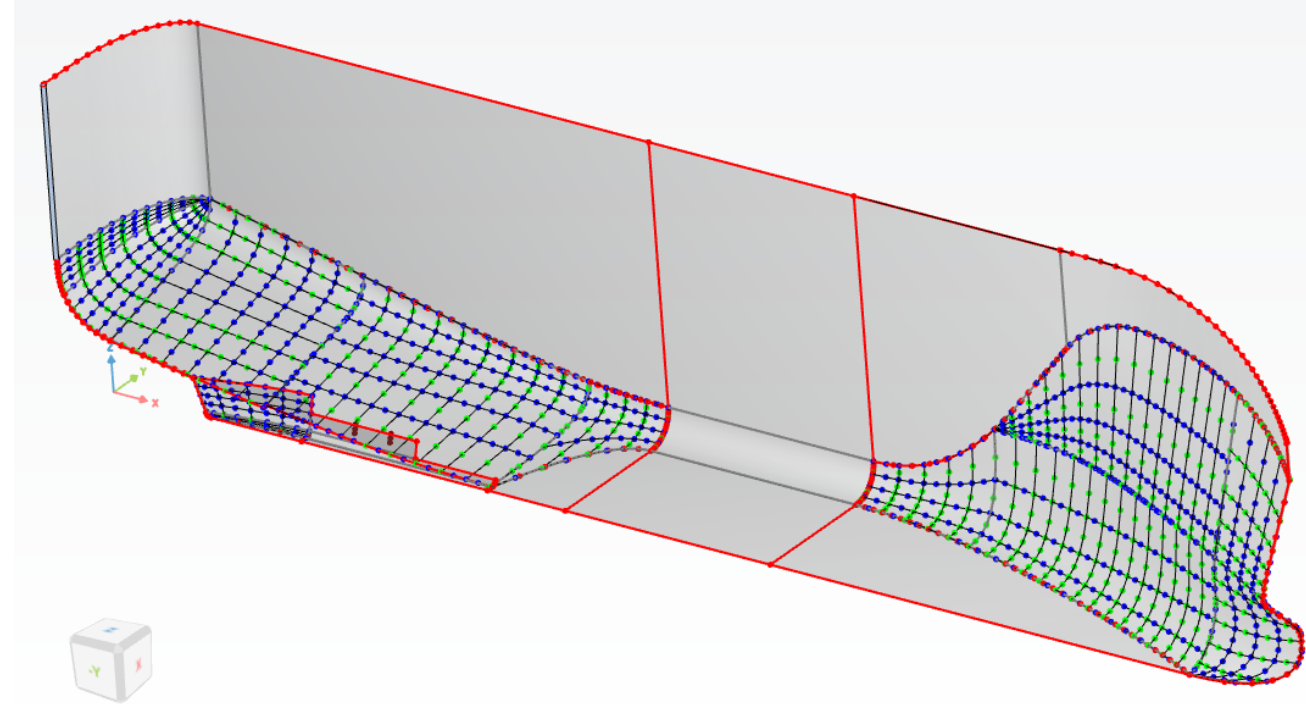
STEP

IGES
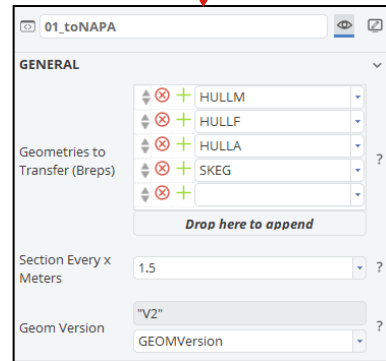
NAPA

KONGSBERG
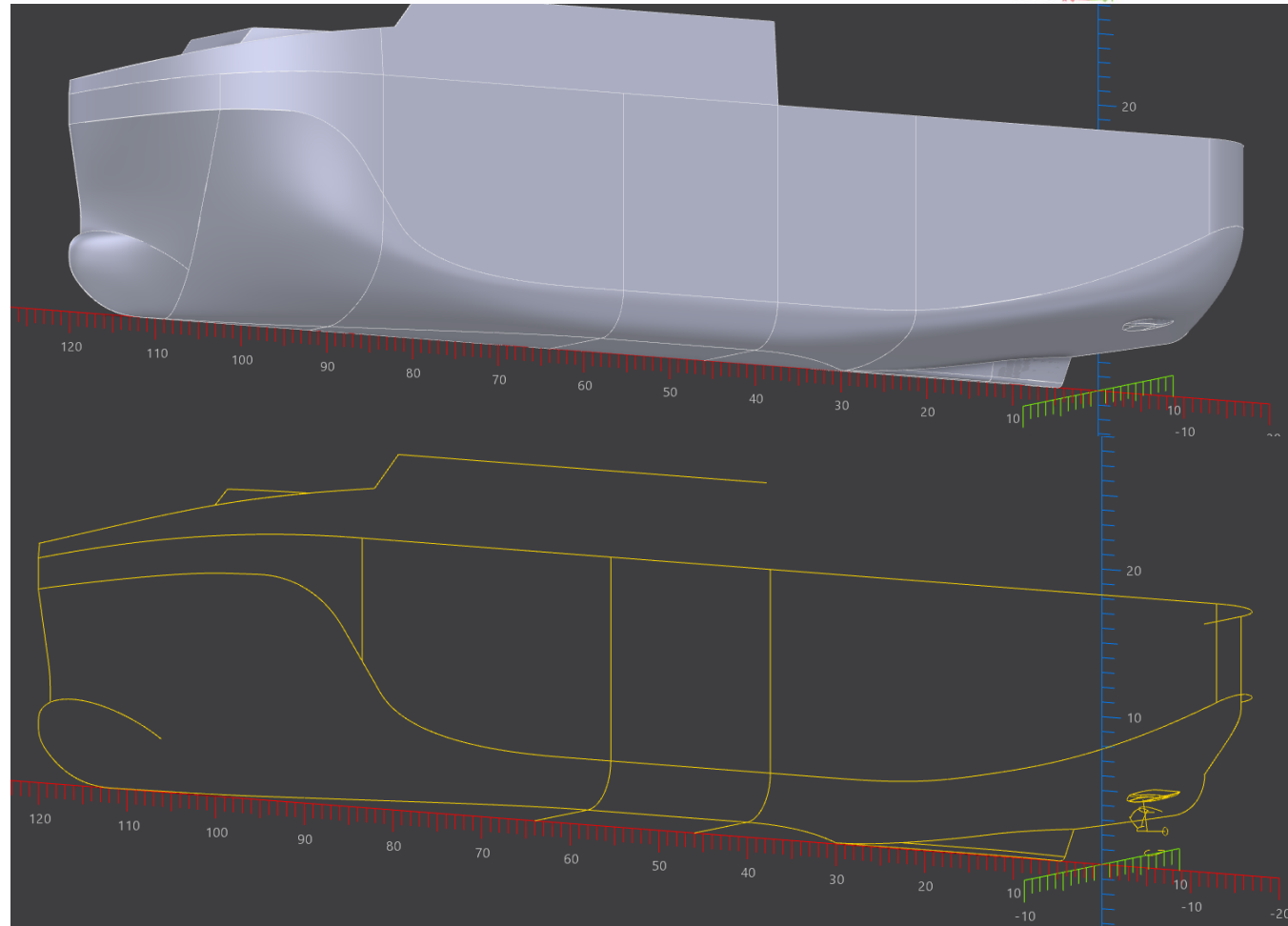
Geometry Formats

- Advantages
  - Legacy NAPA definition
  - Suitable for Stability
  - Can be modified in NAPA

FBrep

- Disadvantages
  - Subject to NAPA fairing
  - Requires Surface topology knowledge in CAESES and NAPA
  - Relatively heavy

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Geometry Formats

- Advantages
  - Light / Quick
  - Parametrizable
    - Faces removal
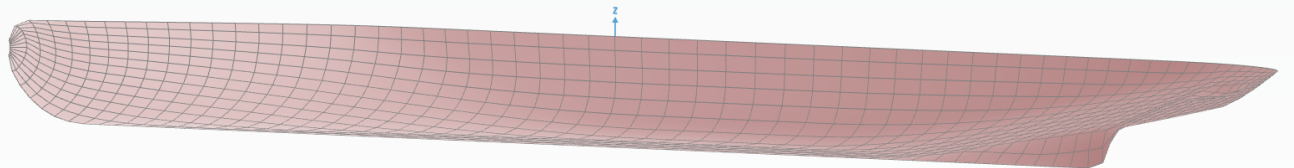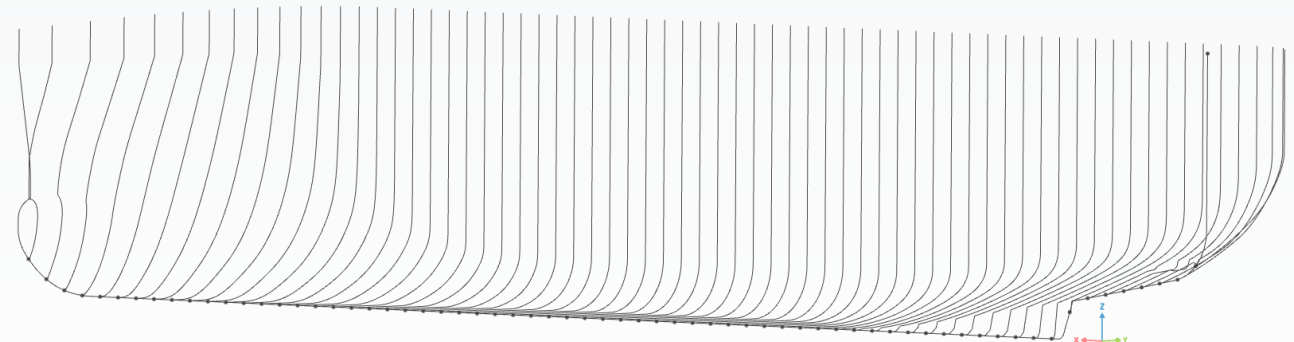   - Number of sections
    - Distributions

FBrep

MGF/N2X

GDF

KONGSBERG
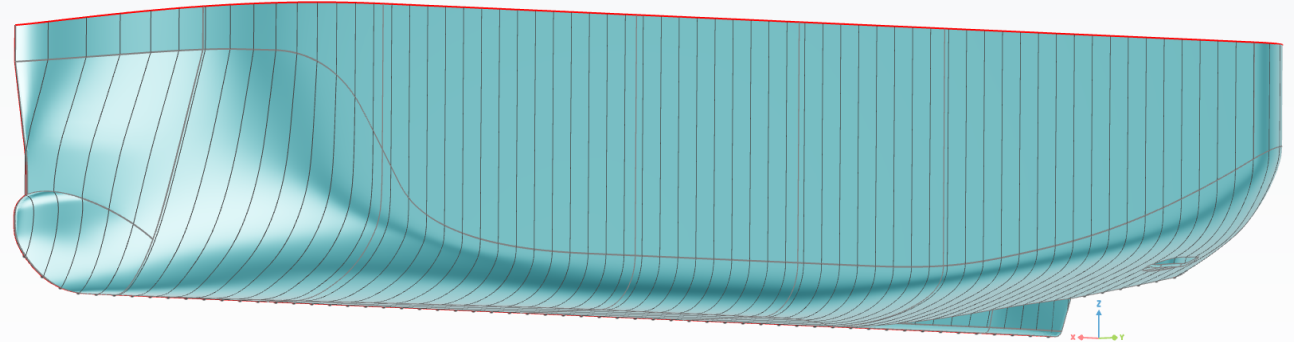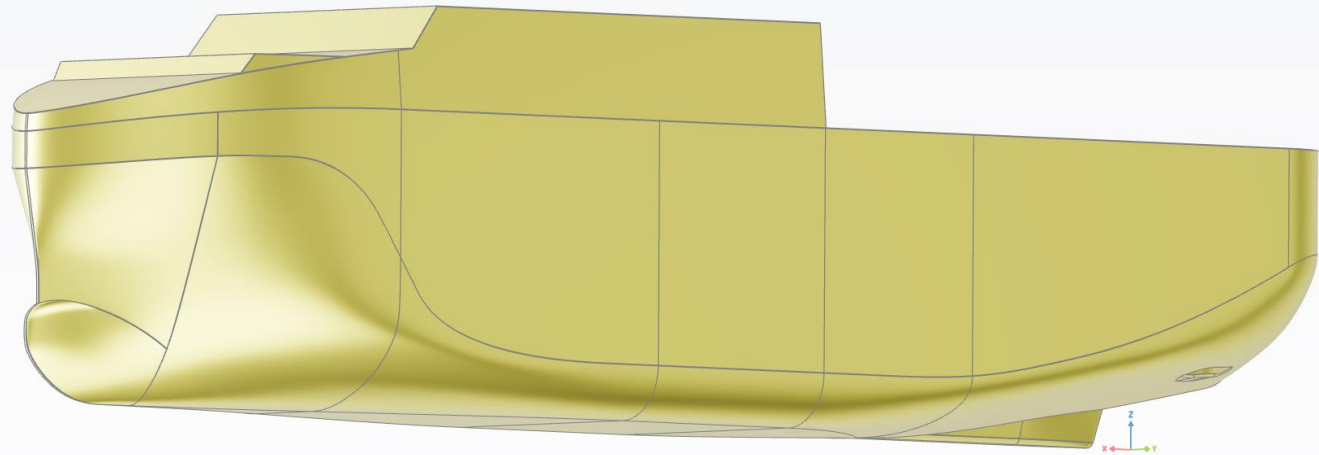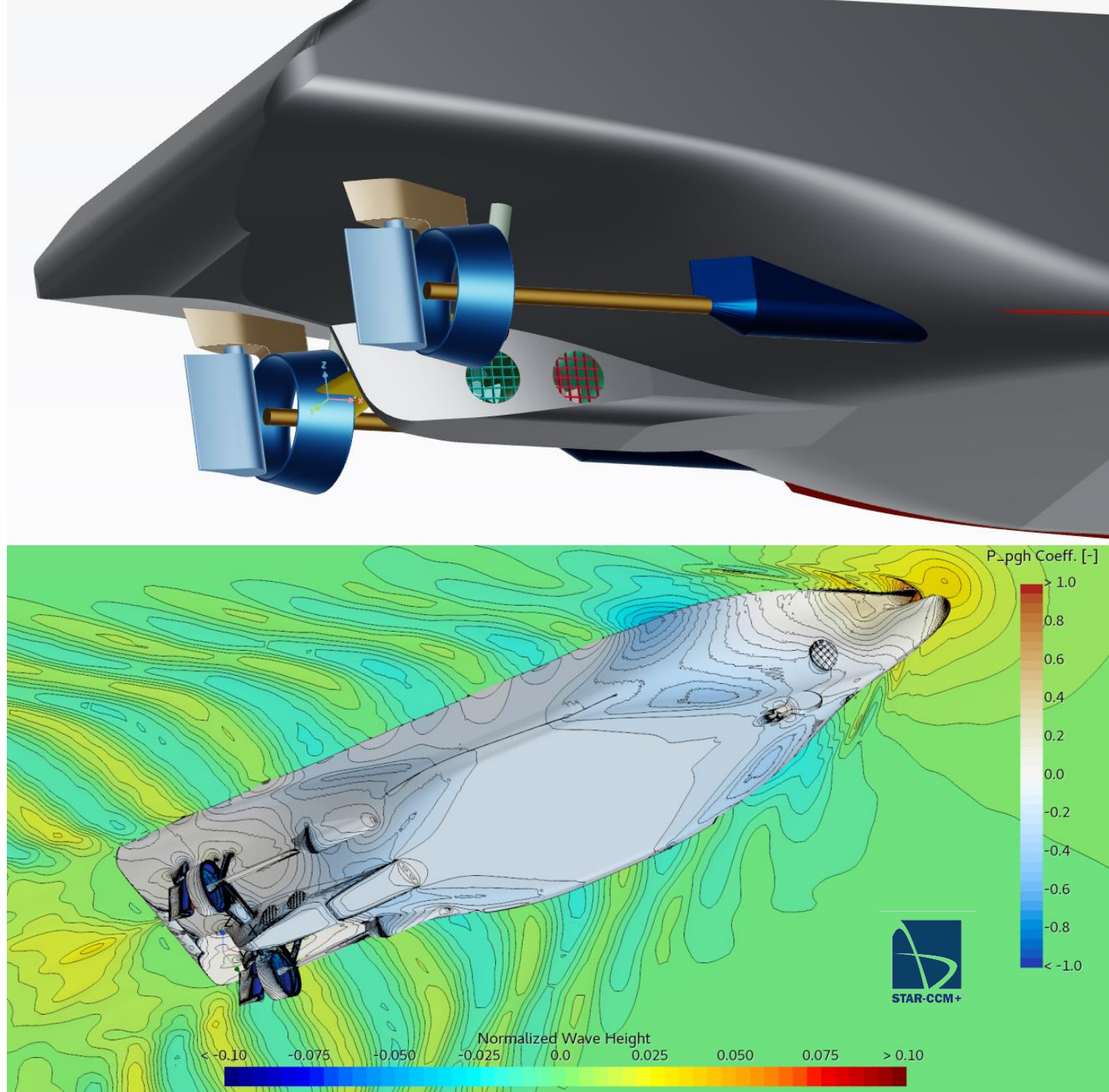
STAR-CCM+

Geometry Formats

- Advantages
  - Very robust
  - Faces coloring
    - Mesh rules
    - Local forces and moments

FBrep

STEP

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Resistance Workflow

Legacy

CFD Portal

Input:
- Geometry
- Draughts
- Speed range

Output:
- Resistance table

Input:
- Resistance Table
- Additional Resistance
  - Appendages
  - Wind

Output:
- Appended Resistance

ShipX
Speed and Powering

Input:
- Appended Resistance Table
- Propeller curve
- Power Configuration

Output:
- Speed Prognosis
- Propulsive Efficiency
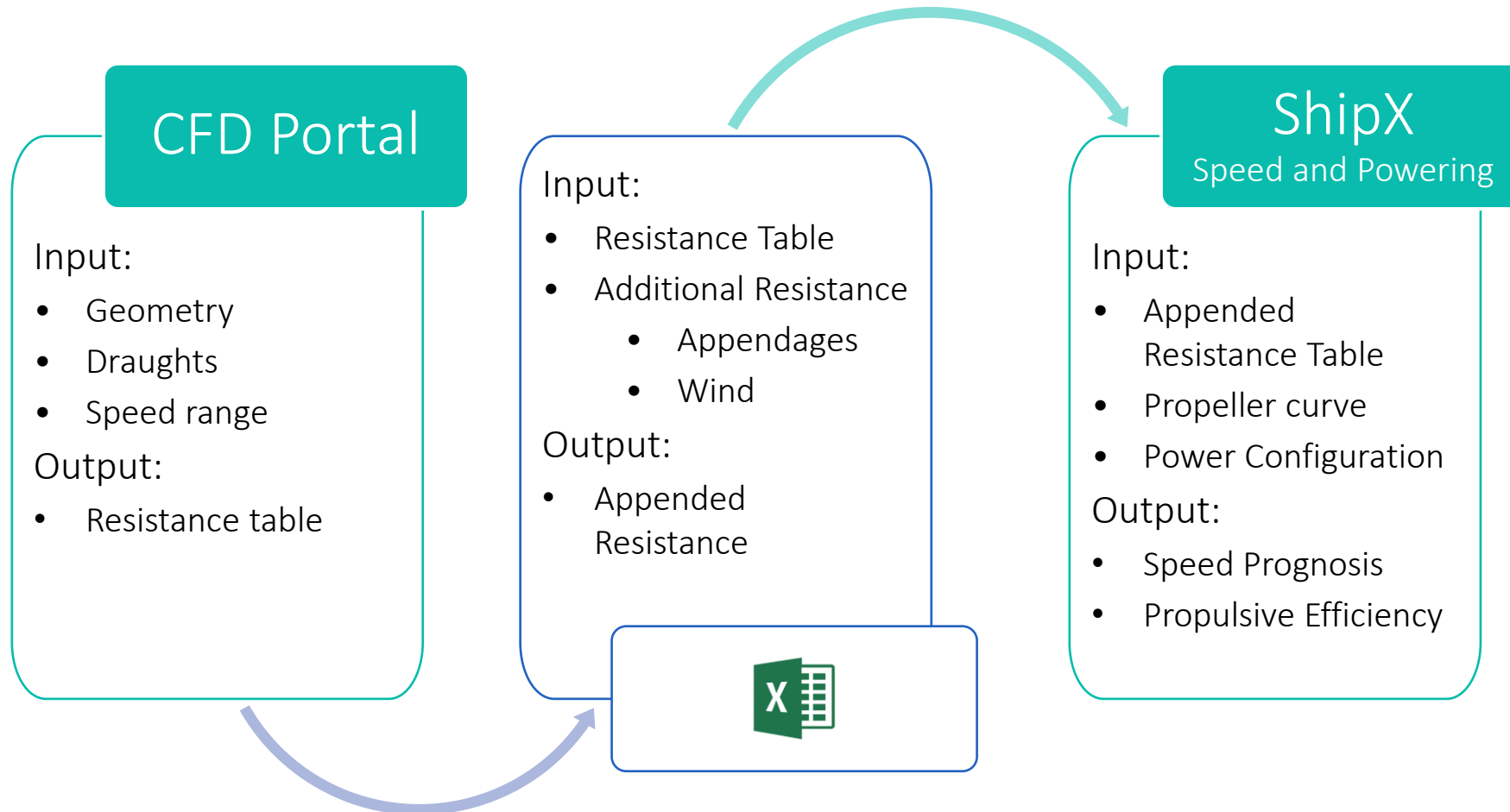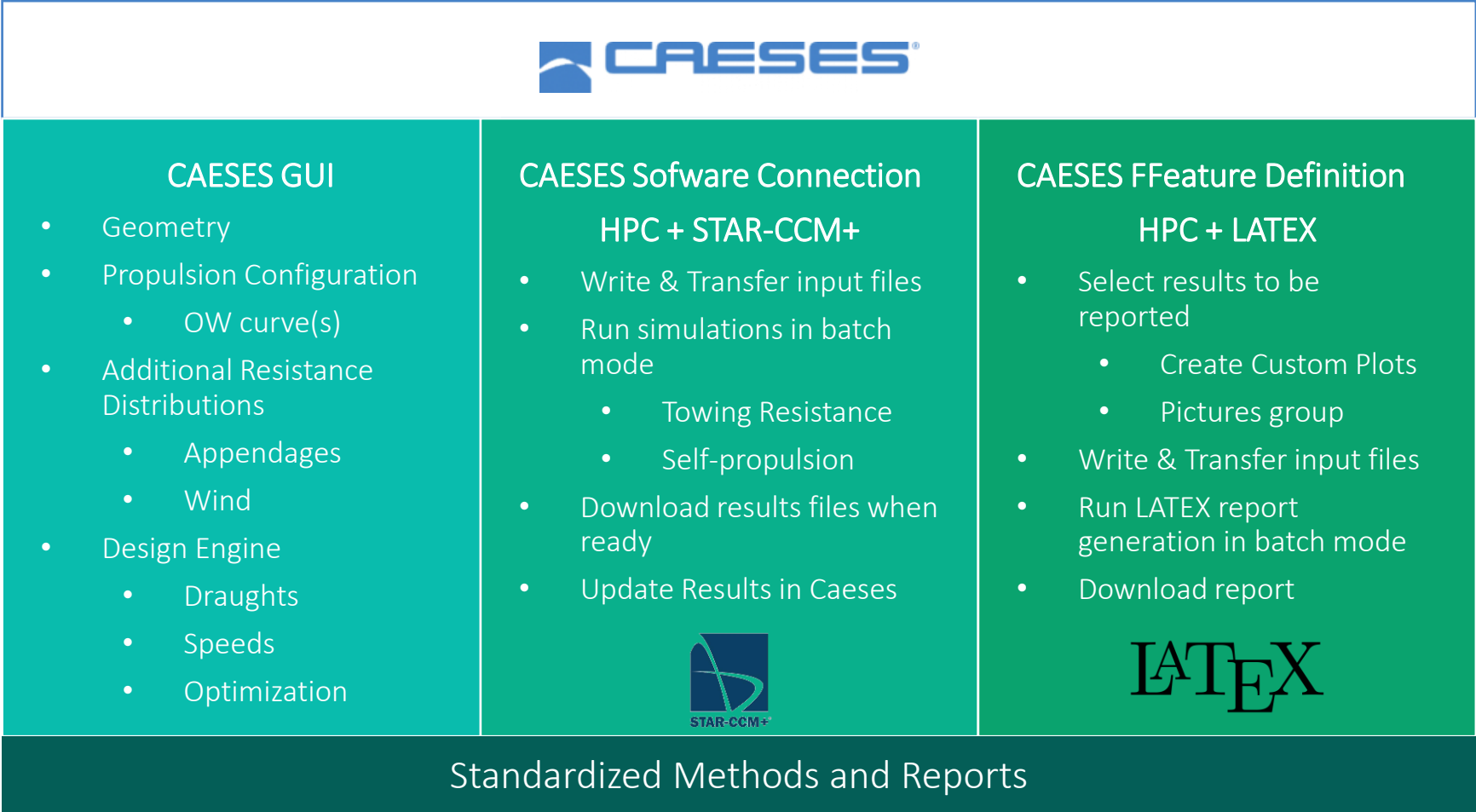
- Human Interaction throughout the whole process
  - Multiple possible source for errors
- No consistency between different projects/engineers
- Multiple software interfaces
- Not optimization-friendly

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HC Template – Streamlined Process

CAESES

CAESES GUI

- Geometry
- Propulsion Configuration
  - OW curve(s)
- Additional Resistance Distributions
  - Appendages
  - Wind
- Design Engine
  - Draughts
  - Speeds
  - Optimization

CAESES Sofware Connection
HPC + STAR-CCM+

- Write & Transfer input files
- Run simulations in batch mode
  - Towing Resistance
  - Self-propulsion
- Download results files when ready
- Update Results in Caeses

STAR-CCM+

CAESES FFeature Definition
HPC + LATEX

- Select results to be reported
  - Create Custom Plots
  - Pictures group
- Write & Transfer input files
- Run LATEX report generation in batch mode
- Download report

LATEX

Standardized Methods and Reports

- Only One user interface
  - CAESES project is shareable with the team
- Standard Reports
- Optimization ready

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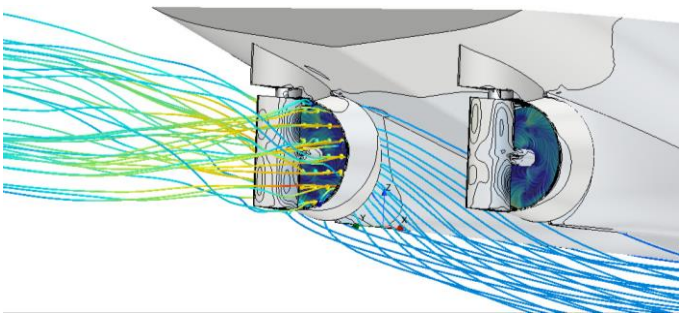# HC Template – CFD Model Tests
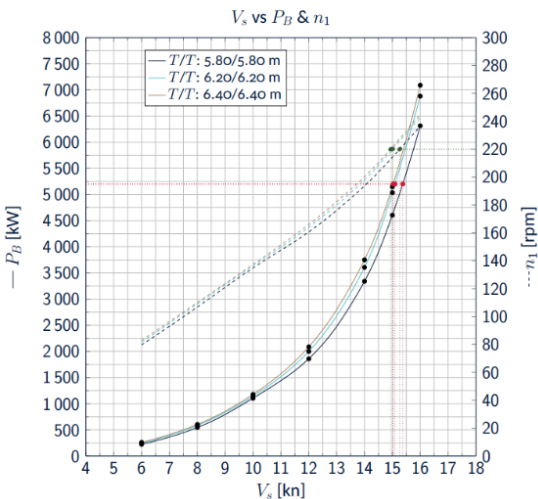
Hull Resistance
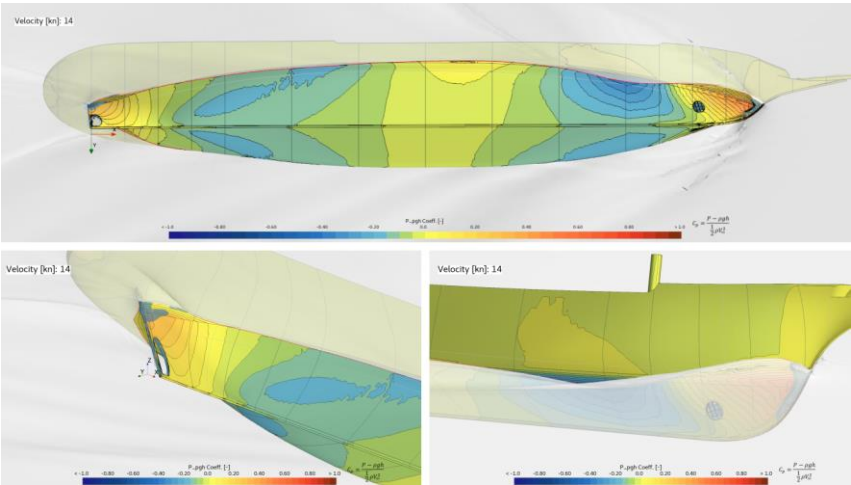
Self-Propulsion

Performance Prediction

w & t Fractions
Hull Eff.
Propulsive Eff.

Propeller Power, P_D
Propeller Thrust, T
Shaft speed, n

Resistance, P_E

Attained Speed

Propulsion – Hull Interaction Optimization

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Student Projects

- Master Thesis – Appendages Resistance
  - Rea Vickovic
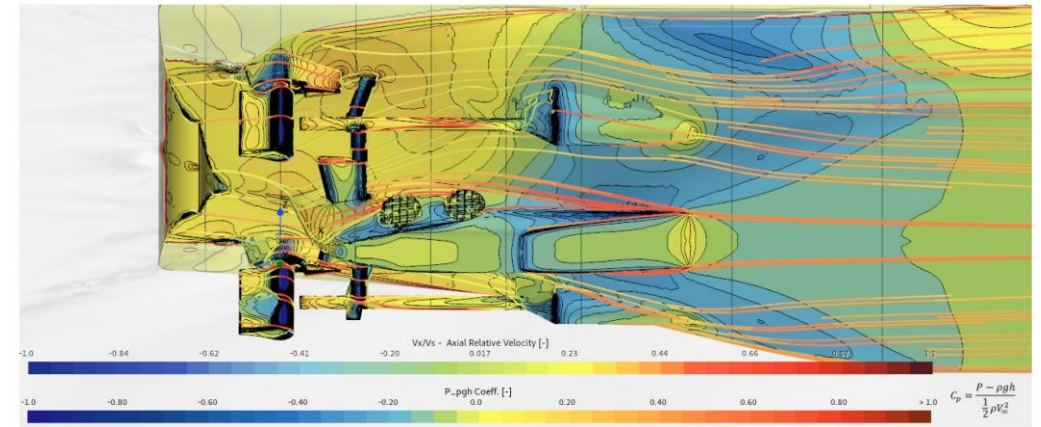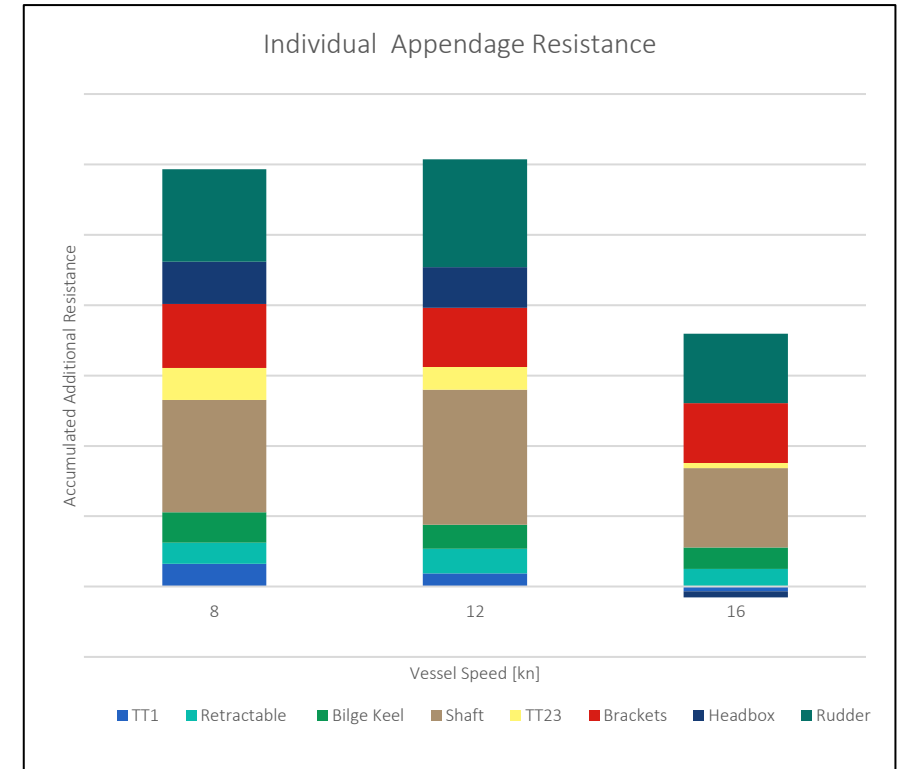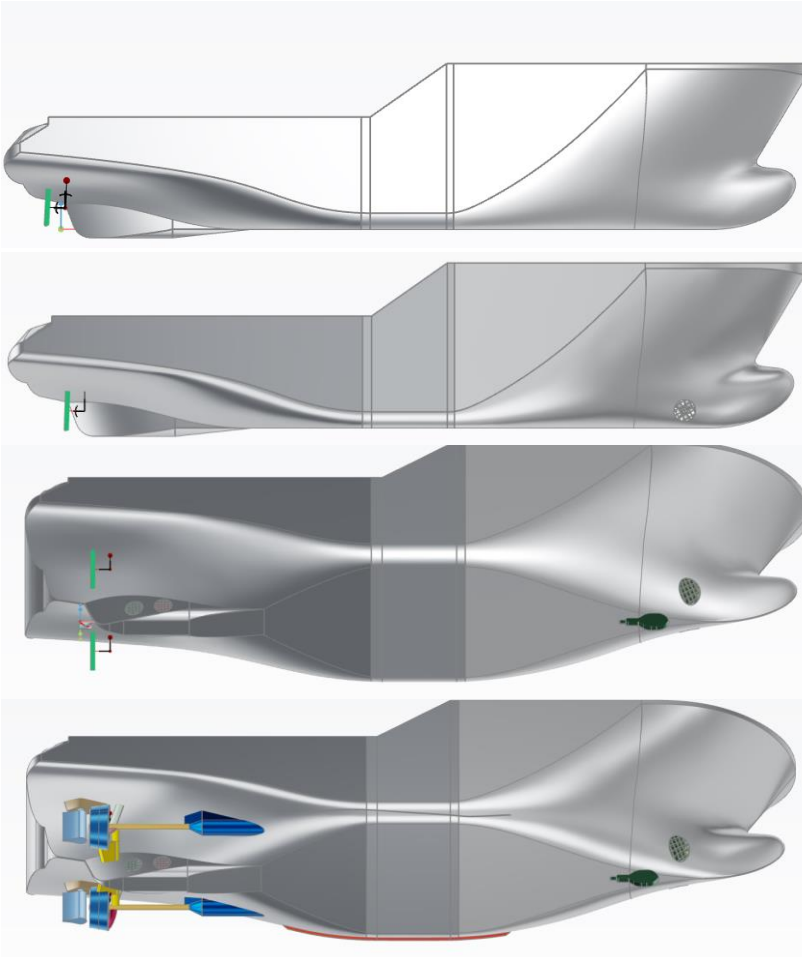
Individual Appendage Resistance

Student Projects

NTNU

- Summer Internship – Coastal Ferry
  - Tobias Nerland
  - Leander Korsedal
  - Ludvig Vartdal
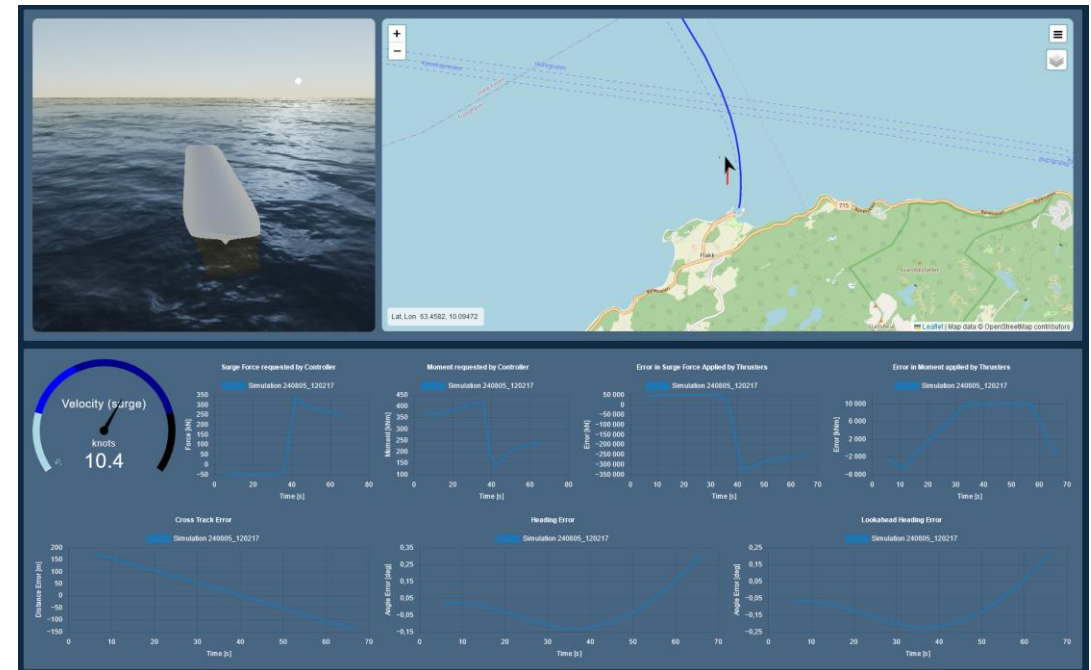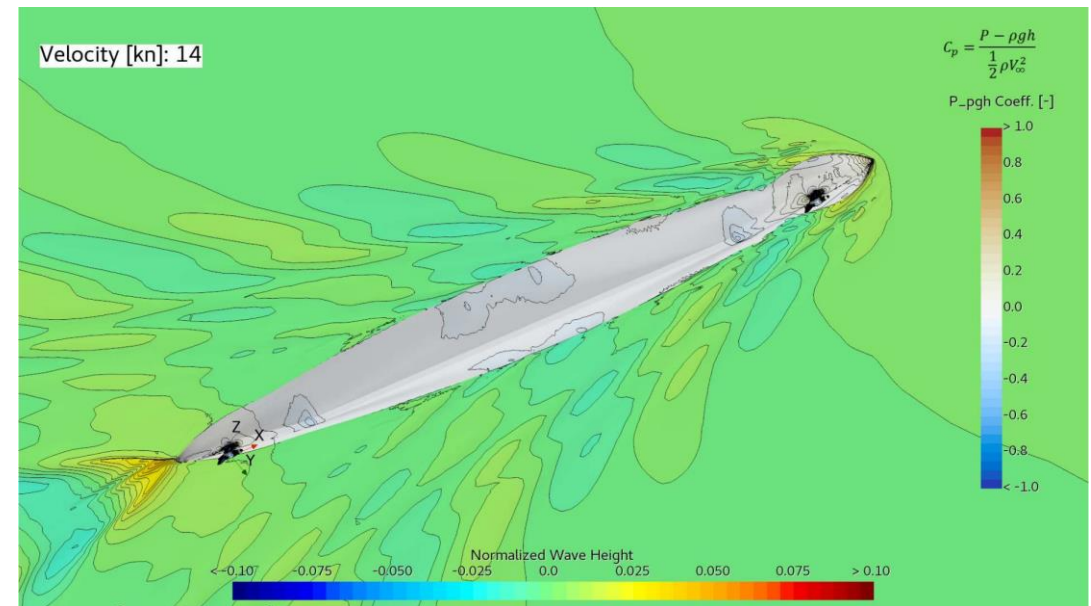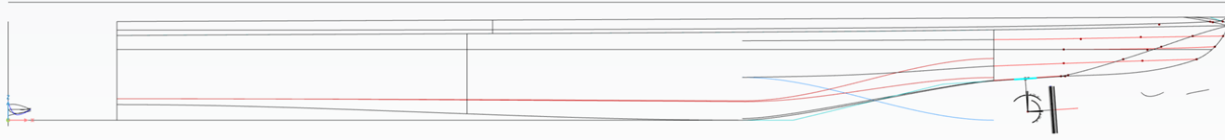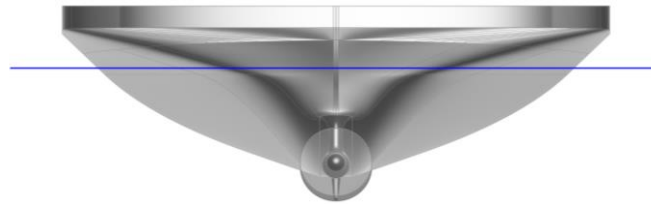
Success Cases

IWS Skywalker – UT 5519 DE

- First Double-Ended CSOV into the market
  - 4 Azimuth thrusters
- Highly Optimized
  - Hydrodynamics
  - Electrical Systems
- Winner of the Kongsberg Technology Award 2021

Success Cases

Reach Remote – UT 5208

- Unmanned from day 1

- Developing class rules

- Highly Equipped

  – Work Class ROV up to 1000m depth

  – Advanced sensors package

- Winner of the Ship of the Year 2024

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NEXT WAVE OFFSHORE MARKETS
Next Generation Vessels

UT 540 - SOV

UT 776 - PSV

UT 731 - AHTS

Drivers for design updates

- **Developing market requirements**
- **Changes in regulation**
- **New markets**
- **Shift to alternative energy sources**

Competence unlocking each vessel's potential

OPERATIONAL EXPERIENCE
Domain competence understanding the operations

DISRUPTIVE SOLUTIONS
Change/challenge traditional ways of working and existing practises

ELECTRICAL
electrification of our product offerings

ENERGY EFFICENCY
Advise our customers through the energy transition and deliver optimized solutions

DIGITAL
Improving operations at sea and helping to automate work and drive value

UT 5500 series

UT 7400 Series - PSV

UT 7800 series - AHTS

UT 7900 Series - FWIV

We are recruiting!

Project Engineer - Stability & Hydrodynamics ✓ ✕
Kongsberg Maritime
Ålesund, Møre og Romsdal, Norway (On-site)

Naval Architect - Ship Design ✓ ✕
Kongsberg Maritime
Ålesund, Møre og Romsdal, Norway (On-site)

Thank you!

paulo.macedo@km.kongsberg.com

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