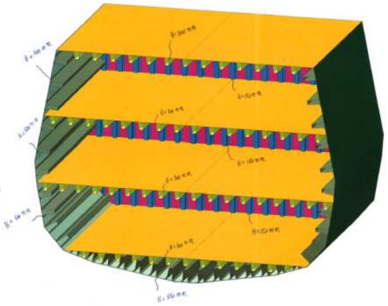
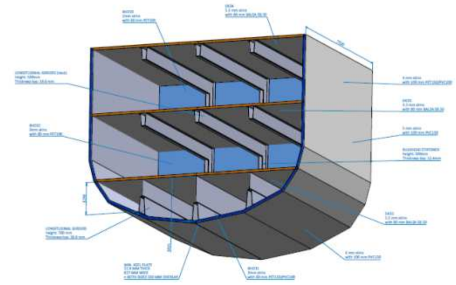
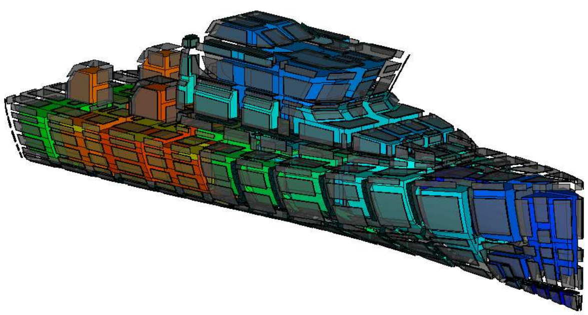
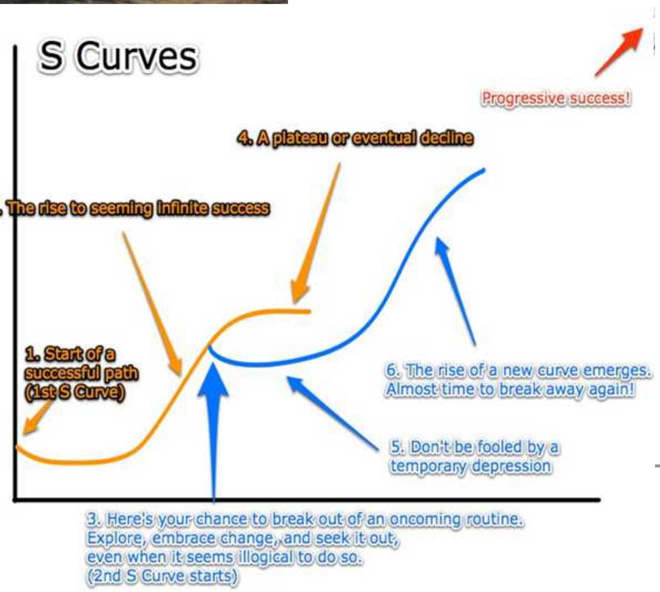
DAMEN Cooperative Research

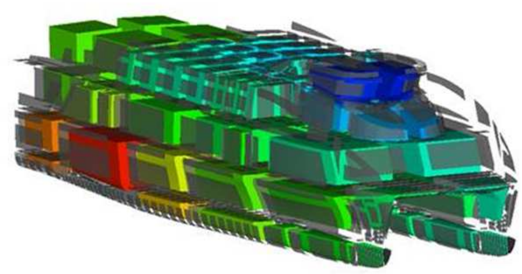
Bluenose-project









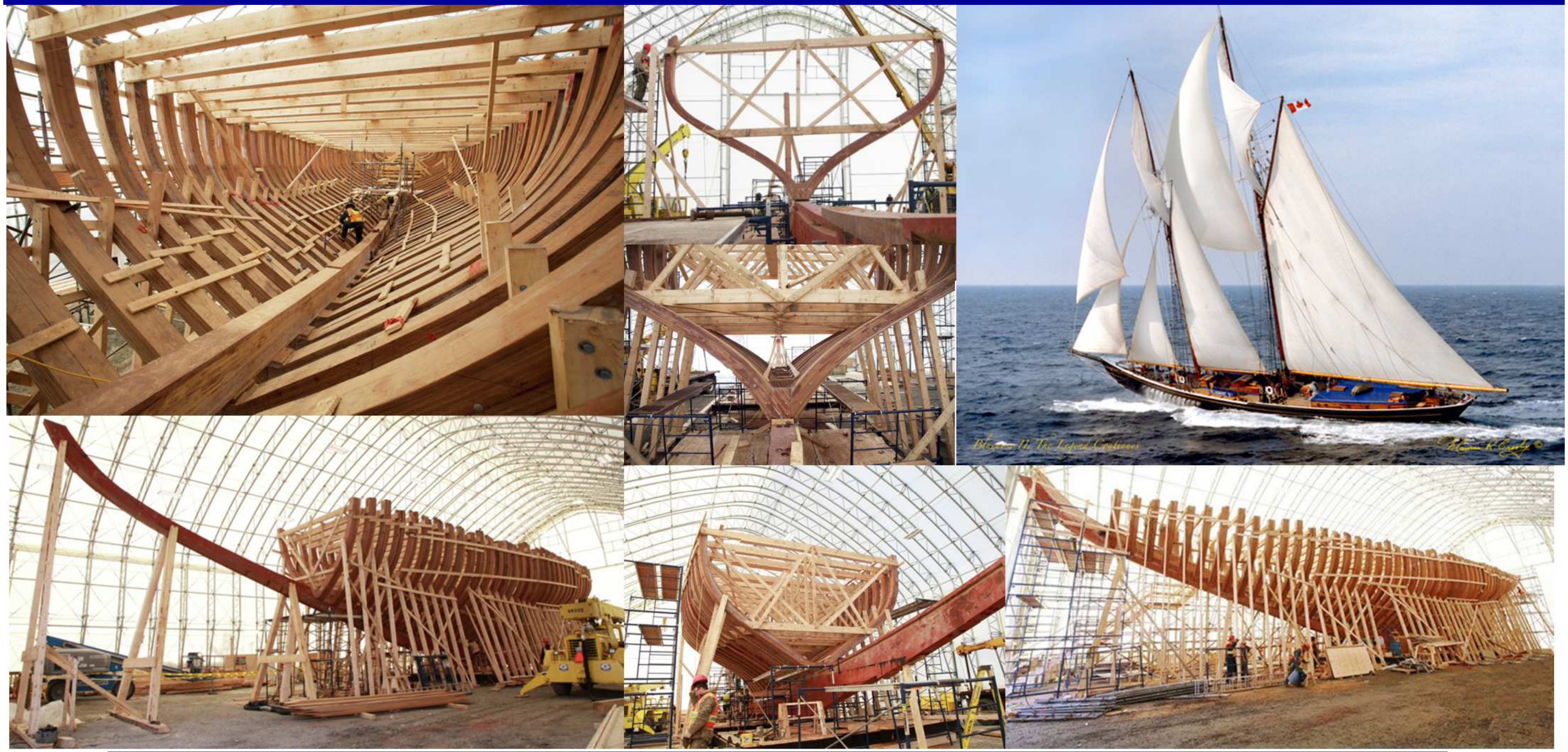


DAMEN Cooperative Research

BLUENOSE?

DAMEN BLUE with a NOSE for BUSINESS

ICONIC SYMBOL of CRAFTMANSHIP & INNOVATION



BLUENOSE PROGRAM

Program objective:

Boost composite development within DAMEN beyond the Class Rules

DCR BLUENOSE PROGRAM

WP 01	EU Project
WP 02	Bending moment
WP 03	Slamming
WP 04	Partial safety factors
WP 05	Structural design tool based on first principals
WP 06	Production technology development for large hulls
WP 07	Fire safe design
WP 08	Quality standard for advanced ship concepts
WP 09	Sounds & Vibrations
WP 10	Thermal insulation

WOOD

STEEL

COMPOSITE

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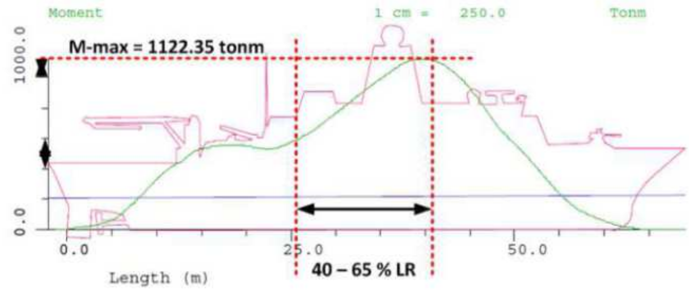
WP 2: Wave bending moment

Goal:

Compare the maximum wave bending moment according to Class with a reliability based approach



Why:

Class wave bending moment **under predicts measured** wave bending moment!

- Steel & aluminum ships **have yielding** capacity.
- Composites **lack yielding** capacity.

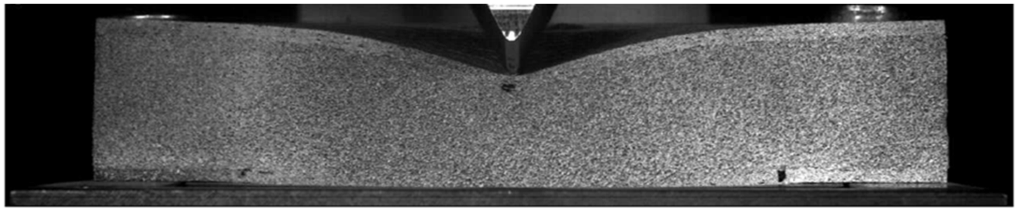
- Composite ships are designed on deflection criteria rather than on strength criteria
  - margin on the failure envelope
  - **Check whether this margin is sufficient to create a fail-safe design.**

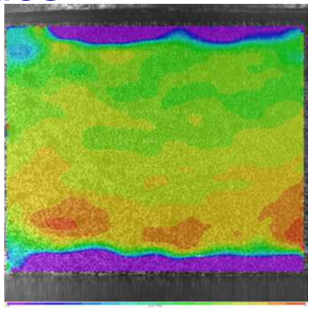
Goal:

Class approved & validated slamming tool for ultimate & cyclic loading on composite panels, including hydro elastic and dynamic analytical impact effects.

Why:

- Large difference between the slamming pressures of different classification societies.
- Slamming considers various dynamic factors for different areas
  - Satisfactory backing from Class is missing
- Dynamic material properties ≠ static material properties





- Initial slamming tests have been performed during FLIGHT.

Goal:

Framework of partial safety factors for 1st principles based composite design.

Why:

- Class partial safety factors are multiplied without clear fundamental background.
- Alternative materials/production processes are not reflected in the safety factors.
- Common practice in other sectors (Aerospace, Offshore wind, …).
  - Material properties
  - Production / assembly
  - Environment
  - Loading: duration, cycles
  - ....

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WP 5: Struct. design tool based on 1st principles

Goal:

Develop a composite design tool based on first principles.

Why:

- Current Class composite equations contain some errors.
- Approach based on partial safety factors & 1st principles leads to safer & better designs.
- 1st principle Rules are common practice in offshore industry, …
- Damen in house tools are ready for Version 2.0.
- ***Unique selling point.***

"We're getting back to first principles ... which means we're going to have some."

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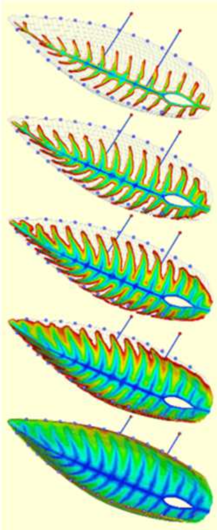
WP 6: Production technology for large hulls

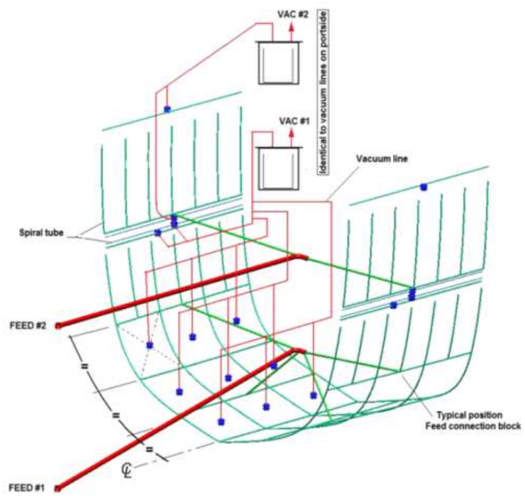
Goal:

Prove that DAMEN masters the vacuum infusion process for ships > 50 meters.

Why:

- Overcome the infusion height (+ 6 m) in relation to infusion pressure.
- De-gas, mix and distribute very large amounts of resin.
- Convince ourselves & our clients that DAMEN can infuse ***A LOT***.
- Optimize and validate cost & weight parameters.
- Reduce the risk levels of the 1st of Class.





WP 7: SOLAS approved fire safety

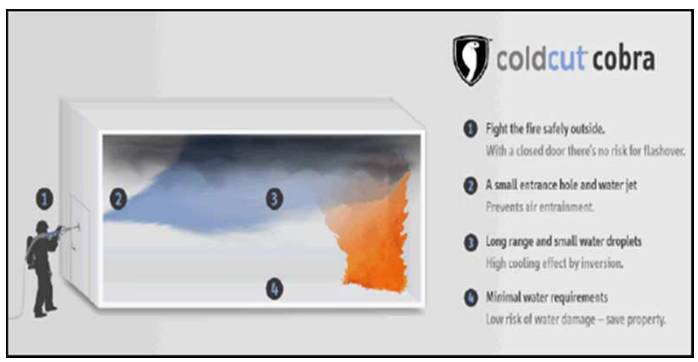
Goal:

Approval of a composite ship with SOLAS requirements



Why:

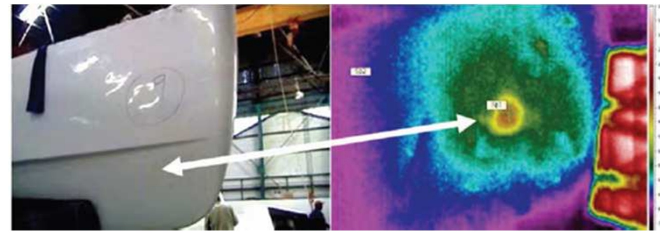
- Occurrence of fire is subjective in this risk based design.
- Create a quantitative risk based design approach for different types of spaces.
- Create a balanced concept of active & passive fire protection & risk control options.
- Convince Class and Flag state and get SOLAS approval on a ship.
- **Unique selling point!**



WP 8: Inspection & Monitoring of large FRP ships

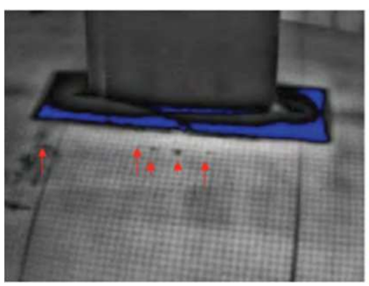
Goal:

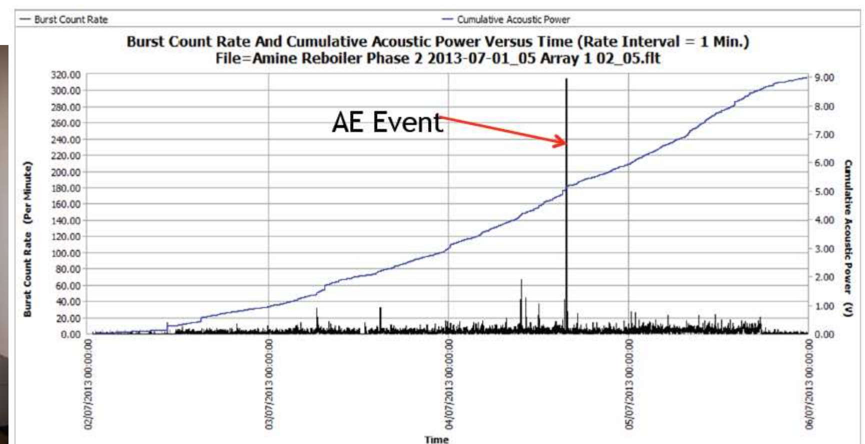
Inspection & monitoring of advanced composite hulls.



Why:

- Some clients require inspection & monitoring of their composite ships.
- Health monitoring techniques are risk control options in a risk based design approach
  - lower safety factors // higher safety.
- **Unique selling point!**



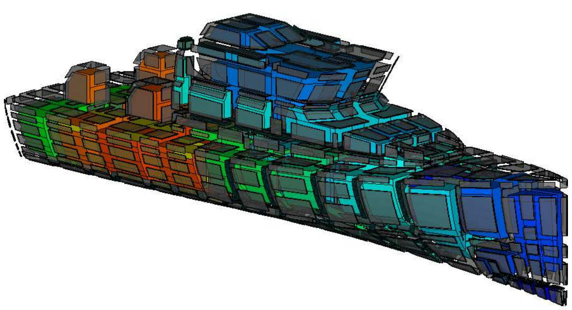



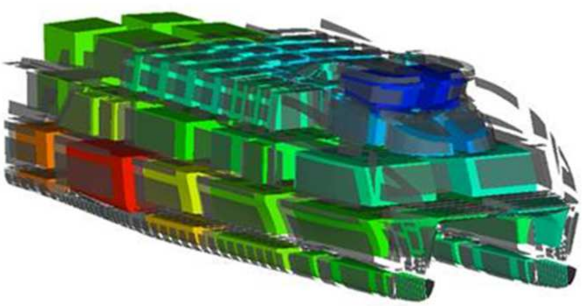
Goal:

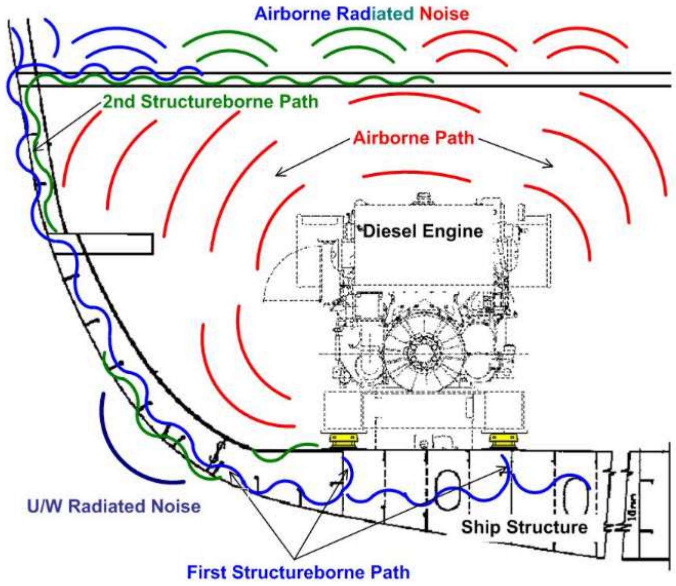
Predict the noise and vibrations levels on-board of composite ships

Why:

- Challenging to predict noise & vibration levels on-board of composite ships.
- Operational composite ships show that the levels can be quite high.
- Large composite ships could only comply to Class, with additional measures.
- **Unique selling point!**







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WP 10: Thermal insulation

Goal:

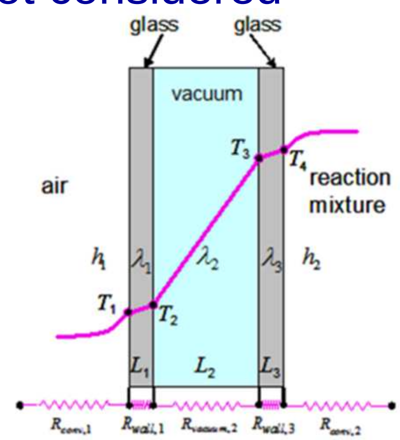
Use the thermal insulation benefits of sandwich composites in the HVAC design.

Why:

- The additional thermal insulation benefits of sandwich panels are not considered during the HVAC engineering phase.

- Quantify the reduction in cost of the HVAC system.

- **Functional integration!**



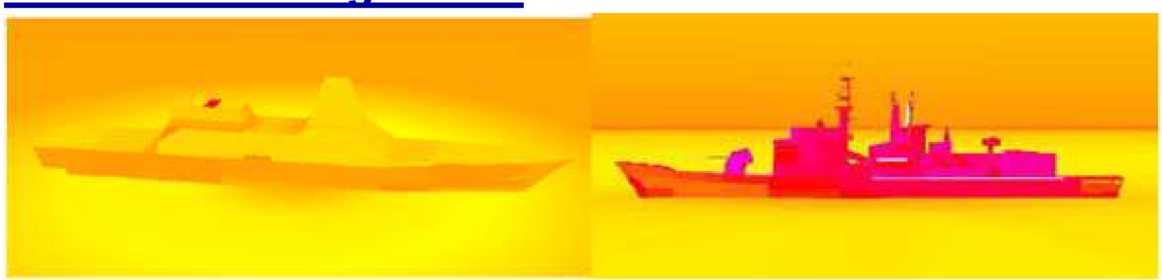


Figure 9. Typical results from infrared signature analysis using the NTC/ShipIR code by Davis Engineering.
Left: A Visby-like ship, ie, with composite hull, waterjet propulsion and underwater/stern exhausts (Kockums).
Right: A conventional ship (Doug Fraedrich, US Naval Research Laboratory).

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WP costs

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Category:	Work packages:	Costs:
General		
	WP 00: Management	50 kE
	WP 01: EU project FIBRESHIP	0 kE
Loads		
	WP 02: Bending moment	30 kE (*)
	WP 03: Slamming	150 kE
First principal based design		
	WP 04: Partial safety factors	100 kE (*)
	WP 05: Structural design tool based on first principals	150 kE (**)
Production		
	WP 06: Production technology development of large hulls	400 kE
Safety		
	WP 07: Fire safe design	150 kE (*)
	WP 08: Quality standard for advanced ship concepts	100 kE
Integrated design		
	WP 09: Sounds & Vibrations	150 kE
	WP 10: Thermal insulation	20 kE (**)
Total budget		
		1300 kE
		1020 kE (*)
		850 kE (**)

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Planning

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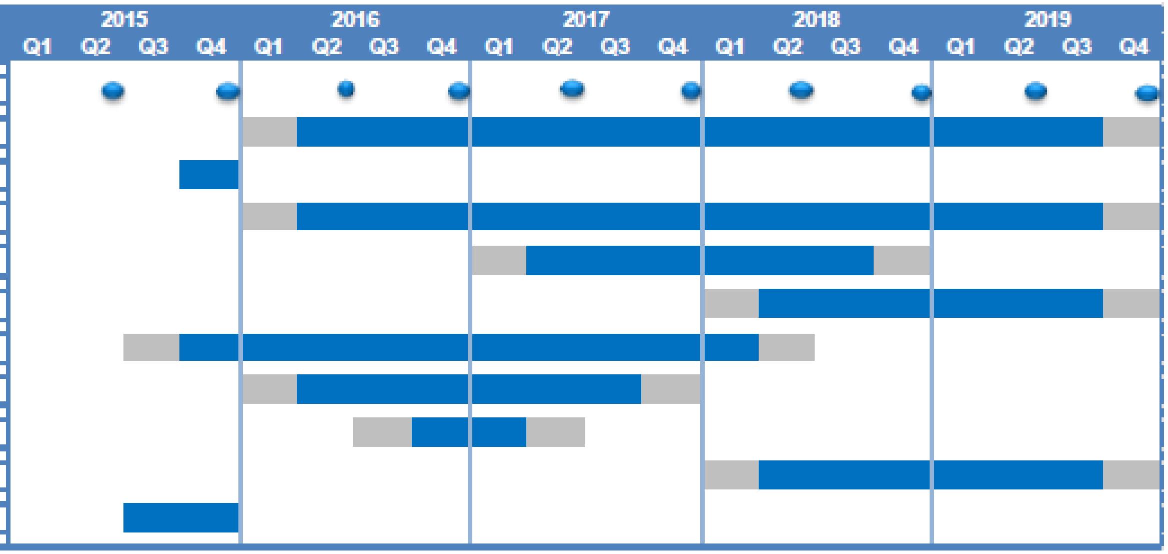
Nb:	Work packages:	Time:
WP 00	Management	-
WP 01	EU project	48 months
WP 02	Bending moment	2 months
WP 03	Slamming	48 months
WP 04	Partial safety factors	24 months
WP 05	Structural design tool based on first principals	24 months
WP 06	Production technology development for lager hulls	36 months
WP 07	Fire safe design	24 months
WP 08	Quality standard for advanced ship concepts	12 months
WP 09	Sound & Vibrations	24 months
WP 10	Thermal insulation	6 months



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Project management

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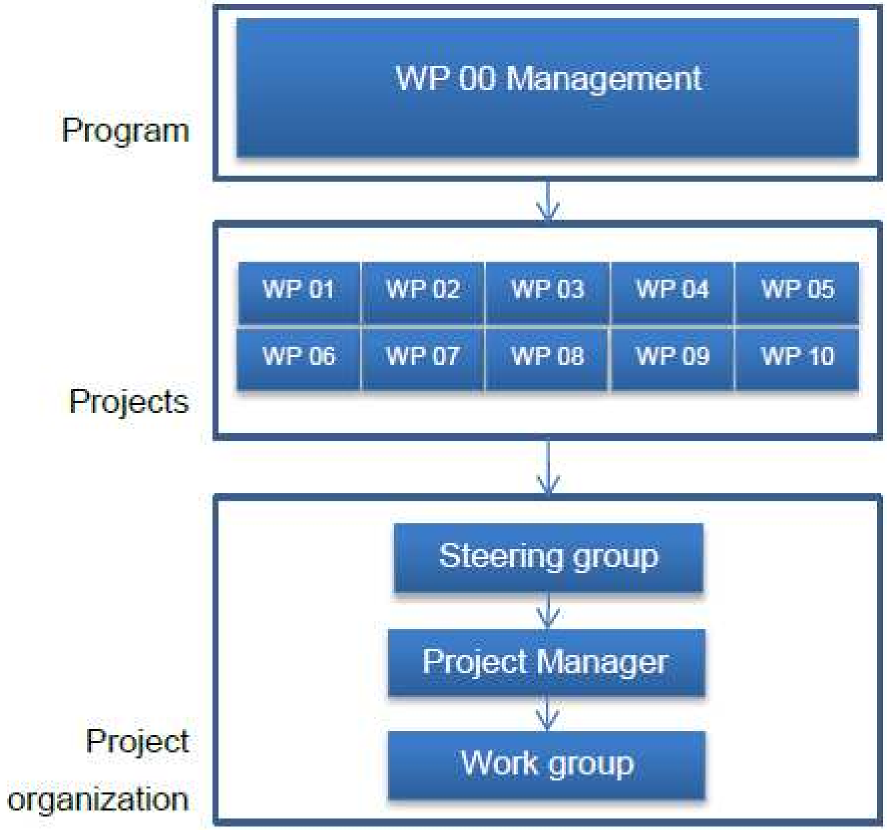

Work packages:	Company:	Project Manager:
WP 01	DSGo	Don Hoogendoorn
WP 02	DSNS	Joep Broekhuijsen
WP 03	DSGo	Don Hoogendoorn
WP 04	DSGo	Olaf de Swart
WP 05	DSGo	Olaf de Swart
WP 06	DSNS	Laurent Morel
WP 07	DSNS	Laurent Morel
WP 08	DSNS	Laurent Morel
WP 09	DSGo	Olaf de Swart
WP 10	DSGo	Kees Custers

DESIGN STUDY REPLACEMENT MCMV [PRE-FINAL]

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Thank you for your questions!