



www.adam4eve-project.eu

# ADAM4EVE

Adaptive and smart materials and structures for more efficient vessels

## ABOUT THE PROJECT

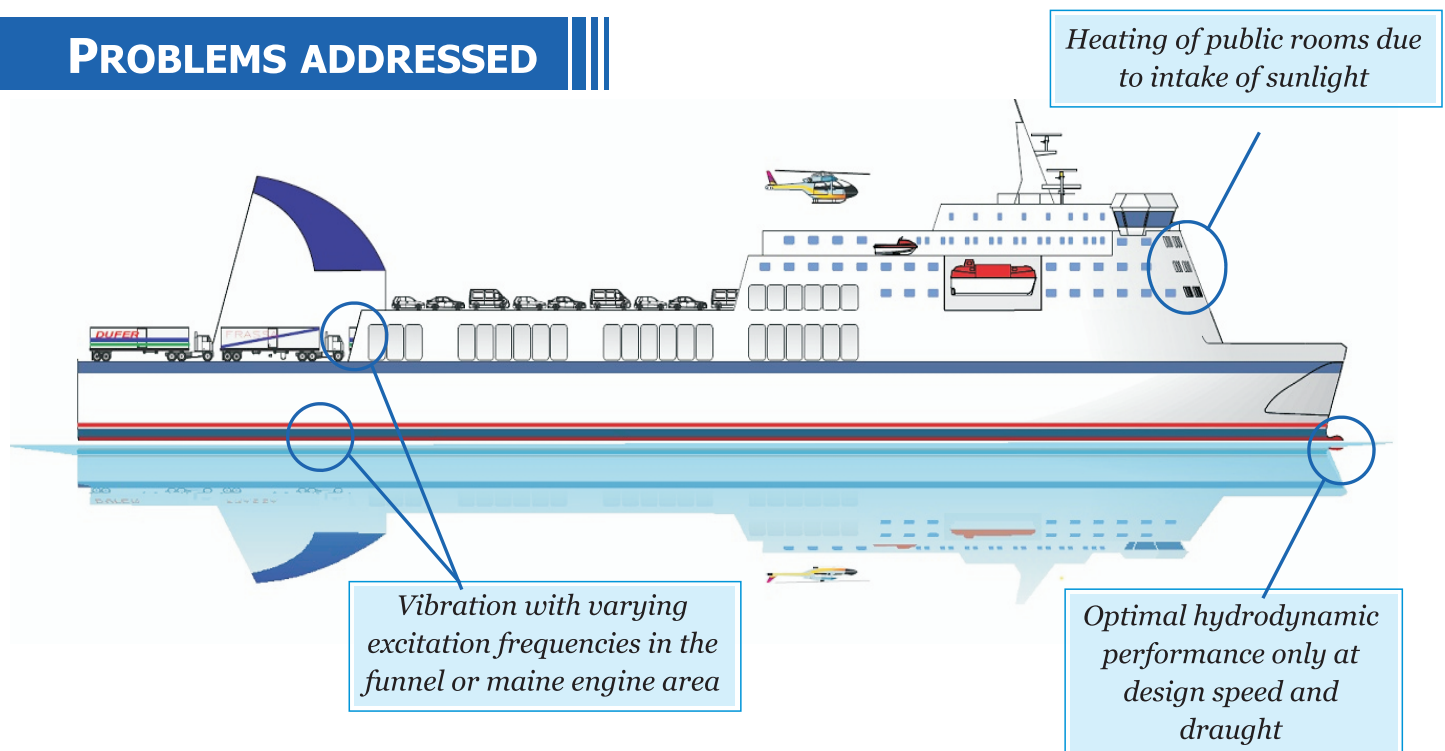
**ADAM4EVE** – is an [EU FP7](#) project that focuses on the development and assessment of applications of adaptive and smart materials\* and structures in the [shipbuilding industry](#).

The main idea of ADAM4EVE is to explore the potentials of adaptive materials and structures in ships and pave the way for [industrial application](#). This will allow ships to react more [flexibly](#) to the changing operational and environmental conditions and thus to provide a more [efficient](#) and [environmentally friendly](#) operation while maintaining the safety level. Moreover, the use of smart and intelligent materials will allow offering [new functionalities](#), making ships more attractive to operators and passengers.

The project is scheduled for 36 months starting from January 2013.

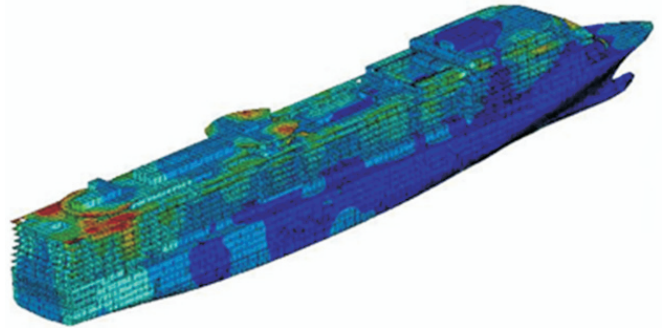
\* *Materials and structures are called [adaptive](#) if they can change certain properties in a predictable manner due to the forces acting on them (passive) or by means of built-in actuators (active). Those materials and structures are referred to as [smart](#) if they provide best performance when operation circumstances change.*

## PROBLEMS ADDRESSED

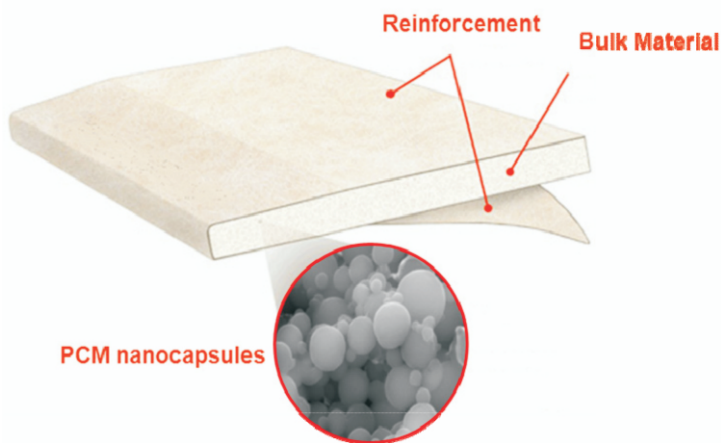


## THE TYPES OF EXPLORED MATERIALS AND STRUCTURES

- ▶ **Adaptable ship hull structures** for optimised hydrodynamic properties depending on varying cruise speed and loading conditions.
- ▶ **Adaptive materials for noise and vibration damping** of ship engines to avoid induction of vibrations into the ship hull.
- ▶ **Adaptive outfitting materials** that improve ships' serviceability and safety - the properties the project makes use of are fire inhibiting characteristics, and adaptive thermal and optical properties.



FEM vibration analyses of global ship structure



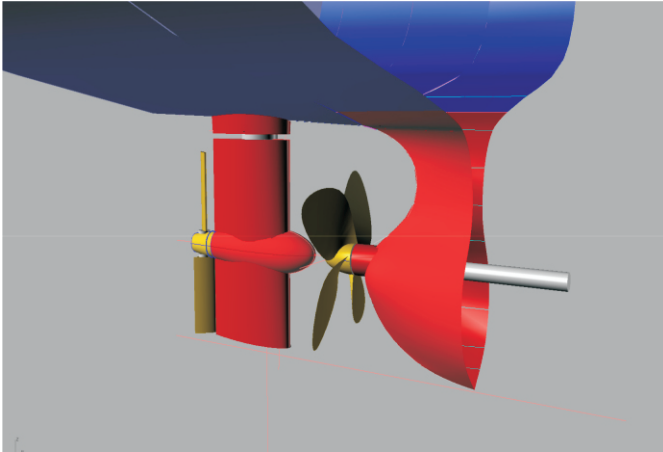
*Phase changing materials' (PCM) adaptability consists in their ability to store thermal energy when room temperature rises, keeping it almost constant within the comfort zone. When room temperature gets low again, heat is automatically released. This physical process saves a significant amount of the air-conditioning systems energy consumption.*

## MAIN IMPACTS OF THE PROJECT

- ▶ **Increase of competitiveness** of European shipyards, ship operators, material suppliers and service providers.
- ▶ **Reduced life cycle cost and creation of new features**, e.g. in the entertainment sector and in the attractiveness to passengers.
- ▶ **Flexible adaptation of ships** to specific external conditions to gain energy savings and a corresponding reduction of fuel costs.
- ▶ **Reduction of gas emissions.**
- ▶ **Improvement of the environmental friendliness** of European built ships.

## TECHNICAL DEVELOPMENTS IN THE PROJECT

- ▶ **Materials and structures development (WP1 and WP2):** adaptive and smart materials and structures will be further developed in order to make them applicable to the maritime industry.
- ▶ **Solution development (WP5 to WP10):** several application case studies will be performed, in order to achieve customised solutions for particular vessel types and their individual requirements.
- ▶ **Assessment of technologies (WP3 and WP4):** The methods will subsequently be applied to assess the novel solutions in terms of technical properties, their economic and ecologic impact and their ability to meet safety requirements.



*Adaptive rudder-propeller - the picture depicts the propeller arrangement for maneuvering*

## WP 01 - Adaptive materials and structures for ship hull application:

Technical solutions for the selected application areas are provided and developed such as mechanical solutions of bars and flaps, metal plates and actuators, reinforced elastomers and vibration damping materials.

## WP 02 – Adaptive and smart outfitting materials:

Material solutions with respect to outfitting purposes for the selected application areas are provided and developed such as materials with adaptive optical properties and phase-change materials with thermal storage properties.

## WP 03 – Assessment of technical and safety properties:

Technical properties of the selected adaptive technologies will be investigated. Risks and safety issues of the intended solutions will be evaluated with respect to statutory and classification requirements and procedures.

## WP 04 – Sustainability assessment:

The selected solutions are assessed towards their environmental impact and their Life Cycle Cost Efficiency.

## WP 05 – Application for cruise ships:

The particular application areas are adaptive damping of engine bed foundations, adaptive damping of boiler casing panels and fire protection.

## WP 06 – Application for Ro-Pax:

The nominated application areas for adaptive solutions are adaptive aft hull structures, adaptive bulbous bow and adaptive heat regulation capabilities in cabins and exterior walls.

## WP 07 – Application for reefer/train ferry ships:

The selected application areas consider the adaptive thermal insulation of panels for cargo decks, the development of an adaptive rudder propeller and climate control of the uppermost deck and side walls.

## WP 08 – Application for inland waterway:

The nominated application areas are the adaptive vibration damping of accommodation compartments of a pusher and the implementation of an adaptive bulbous bow for inland navigation vessels.

## WP 09 – Application for yachts:

The particular application areas to be treated are adaptive windows with variable shading capabilities and adaptive climate control of cabins.

## WP 10 – Application for ship models:

The adaptive hull structure solutions from WP 06, aft hull and bulbous bow area, are selected to be implemented in ship model scale.



*Hydrodynamic efficiency of adaptive structures demonstrated using prototypes in model scale*

# PROJECT COORDINATOR



CENTER OF MARITIME TECHNOLOGIES, Germany



# PROJECT CONSORTIUM MEMBERS



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