RAMSSES - Realisation and Demonstration of Advanced Material Solutions for Sustainable and Efficient Ships

RAMSSES project – General Presentation

Progress summary until summer 2019

Project Overview

01.06.2017
31.05.2021

Budget: €13.5 M
Funding: €10.8 M

36 partners
12 countries

www.ramsses-project.eu

Call Topic: MG-2.2-2016 Development and Use of High Performance and Lightweight Materials … (IA)

Coordinator: CETENA (Italy) – Financial and Administrative

CMT (Germany) – Technical and Dissemination

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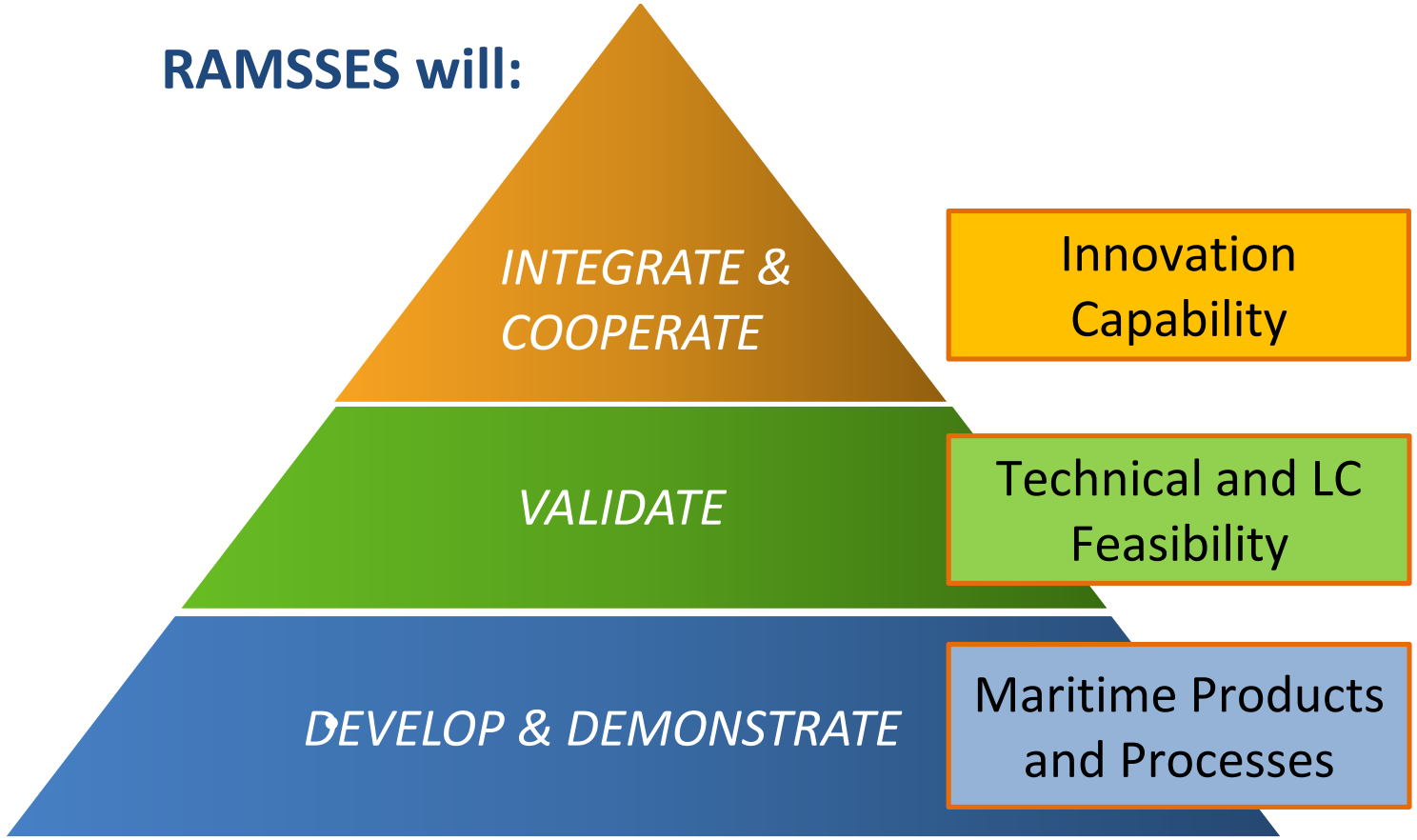
Innovative Materials for Ships:

- less fuel and emissions
- efficient and competitive
- safe and comfortable
- smart and functional

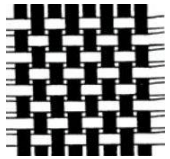
RAMSSES will:



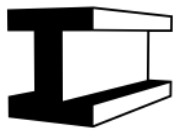
RAMSSES Demonstration – Approach

addressing complexity

All relevant materials and processes



composites



HS steel

Fabrication

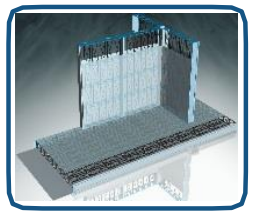
Assembly

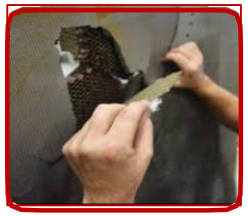
Outfitting

Approval

TRL (5) 6…7

Demonstrating process chain





Innovative materials

Pre-fab Components	Equip-ment	Ship and Process Integration			Repair
		Modular LW System	Custom Specific	Steel	

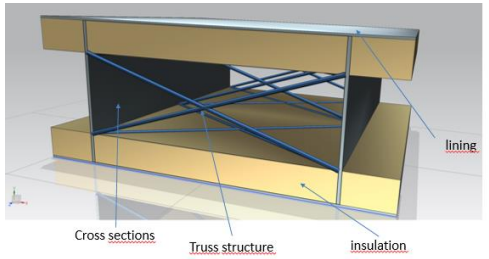
RAMSSES – Demo Cases overview

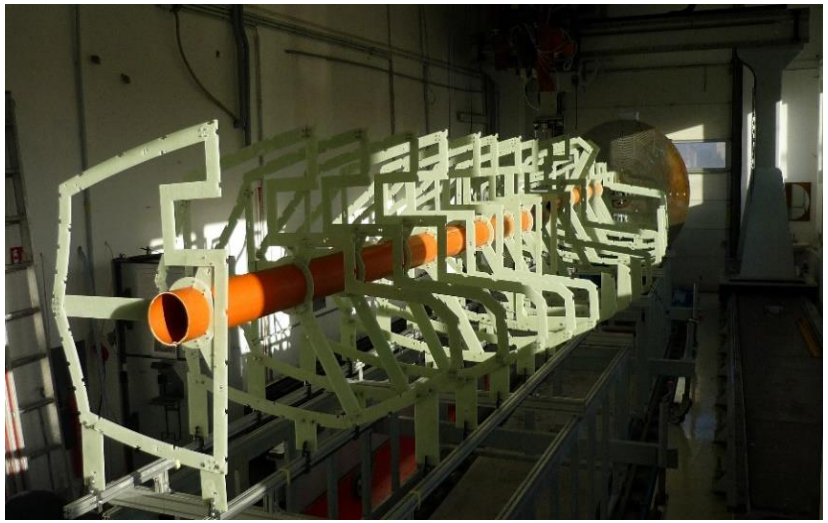
WP No	Cluster Title / WP Title	Lead	Focus Material	TRL Target	Validation
	Components & Equipment	**NetComp**			
WP09	Modular Light System for Less Critical Internal Walls and superstructure	BALTICO	various	6-7	(pre)approval*
WP10	Lightweight Components for High Loads and Fire Class	PODCOMP	composite	6-7	(pre)approval*
WP11	Propeller blades by additive manufacturing	NG	metal	4-5	shore based
WP12	Lightweight Rudder Flap	BMS	composite	6-7	onboard
	Ship integration: Composite	**DSNS**			
WP13	Integration of System for Internal Walls and Superstructure of Cruise Ships into shipyard processes	MW	composite	7	onboard
WP14	Modular Decks for RoRo vessels	FLOW	composite	7	onboard
WP15	Lightweight aluminium and composite walls for Work Boats	MEC	various	6	onboard
WP16	Composite superstructure module on steel deck for multi purpose vessels	NG	composite	6	shore based
WP17	Custom Made Hull for Offshore vessel	DAMEN	various	6	shore based
WP18	Multi material lightweight cabin for passenger ships	CdA	various	6-7	shore based
	Ship integration: Steel&repair	**CET**			
WP19	Highly Loaded structural details from high tensile steel in passenger and research vessels	FC	steel	6	shore based
WP20	Lightweight Decks using High Tensile Steel in cruise ships	MT	steel	7	onboard
WP21	Composite Overlay to repair and improve metallic and non-metallic structures	CARDA	various	7	(pre)approval* onboard

** commercial approval to be done outside the project based on data elaborated in RAMSSES*

Ultra low weight modular system using a highly automatic winding manufacturing process

- Develop **ultra low weight** panel, with truss core and laminates
- **Demonstration** of module production and assembly integration in a lightweight **catamaran** (0e-n, non SOLAS ship), powered by solar energy
- **Self-supporting** modular system, 2 hulls and 2 decks modules
- **Production process** of catamaran to be finished by mid of 2019
- Fire, sound and vibration screening test result will be done by RISE by the end of 2019



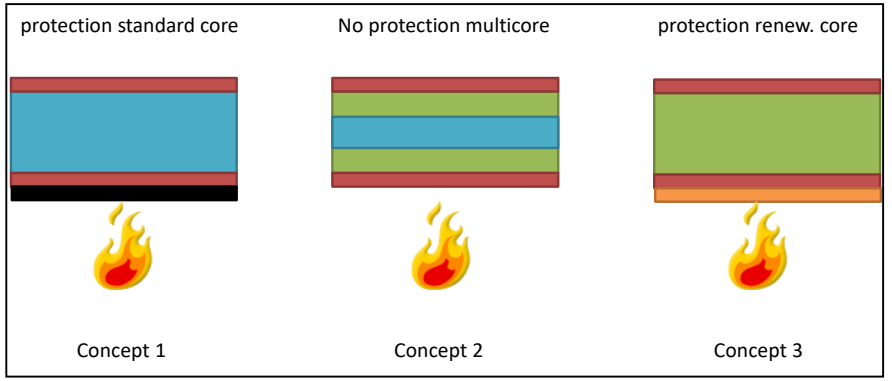


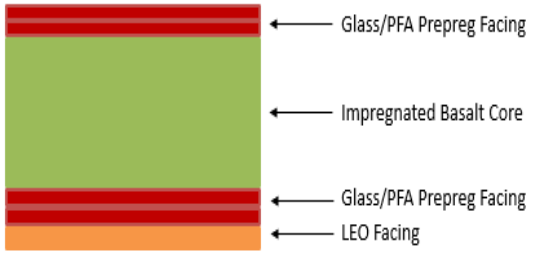
Fire retardant, bio based, and competitive price material for maritime lightweight components

- The potential WP10 composite solutions can answer to **three different types** of the indoor/outdoor panel
- **Tested** the three sandwich concepts based on PFA/Glass prepreg with different core material
- For **industrialisation** of production, the Glass/PFA resin prepreg manufacturing stepped up from pilot scale to production scale through a new prepreg production line launched by Composites Evolution
- Through **cone calorimeter** and **single burning test** by RISE, only concept number 3 passed the criteria
- The next step is to develop the concept number3 further in order to **reduce cost and weight further**

Table 1: Different panel types

Properties	Floor	Ceiling	Wall
Sound barrier	x	y	z
Fire barrier	1	2	3
Load carrying	I	II	III

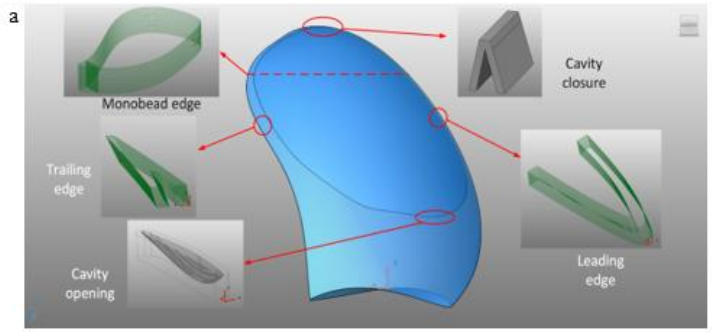


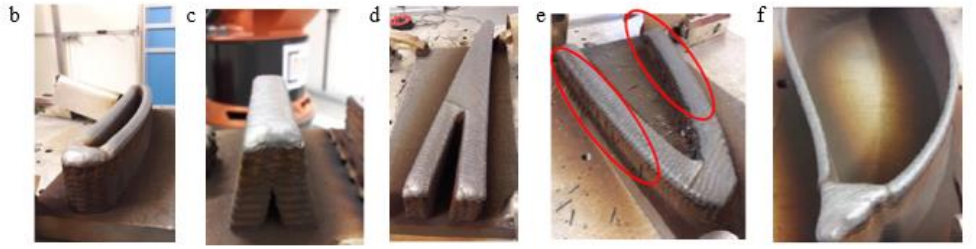


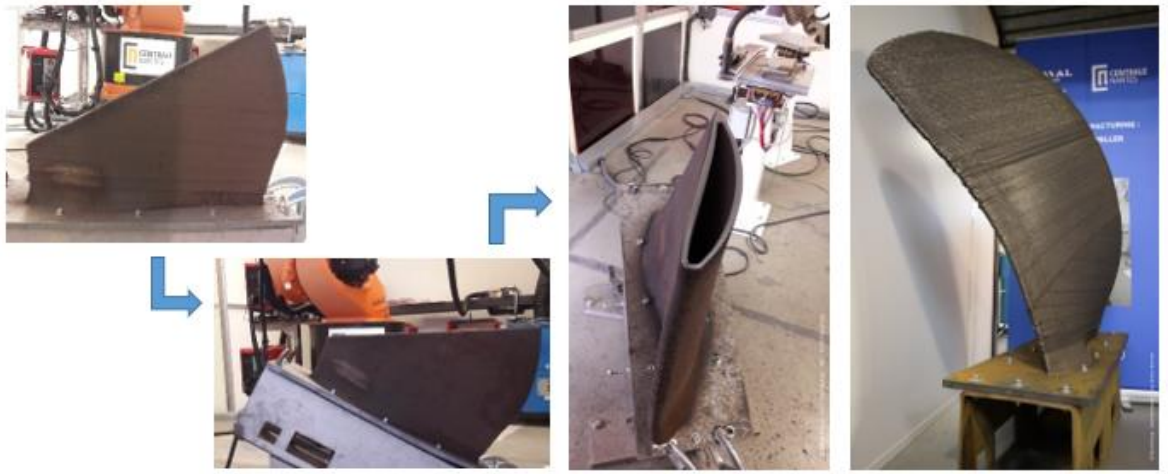
Concept 3 configuration

Propeller blade using WAAM additive manufacturing

- A **design study** had been performed by SIREHNA to optimize the outer blade design and internal structure of the hollow blade by reducing the weight roughly 23% in air and 36% in water
- Naval Group and ECN producing **representative part** of hollow blade and test block for **mechanical characterization** through MIG-MAG electric arc wire melting process
- **The first third scale demonstrator** has been built using ECN robot cell and was produced in 3 successive stages of a different angle

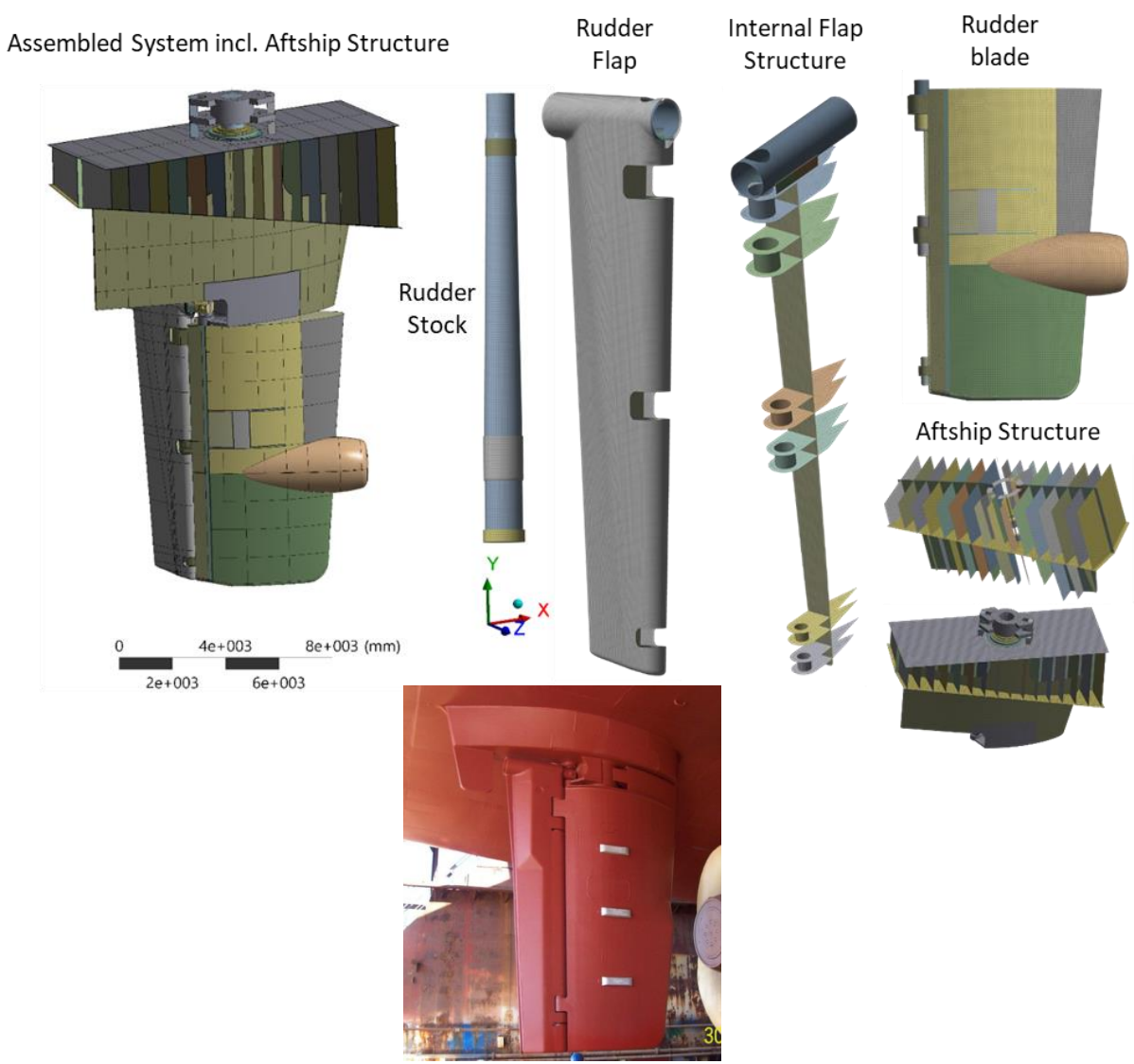




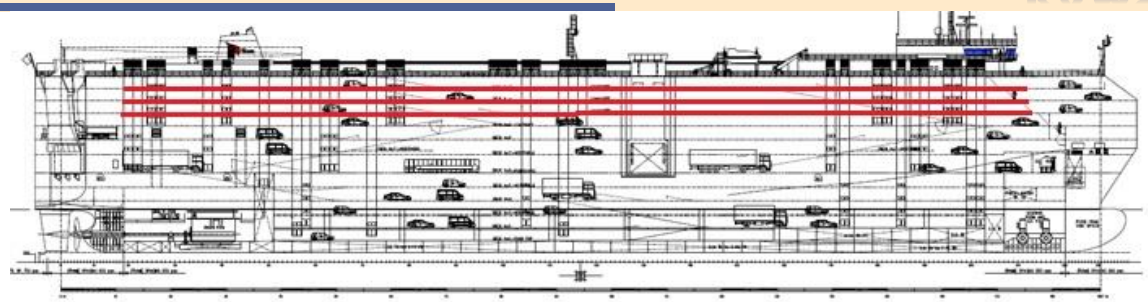


Flap rudder using lightweight and high-performance material for container ship

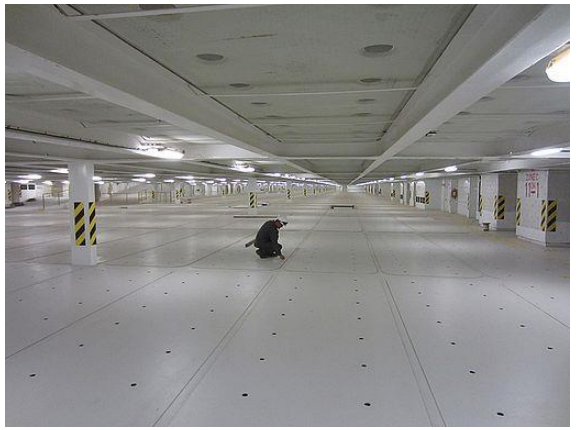
- Produce **real scale** rudder flap demonstrator for onboard application
- Hydrodynamics **investigation** as an input for preliminary design development
- Development of a **design catalog** including several design options for the shell, vertical & horizontal stiffeners, and joining methods of different structures
- **Practical** process development for manufacturing, handling, assembly, and repair
- The **comparison and assessment** of requirements for different manufacturing principles (contact moulding, and one shot infusion) are still under execution



Development of a modular deck system to reduce deck weight and flexibility in ship design

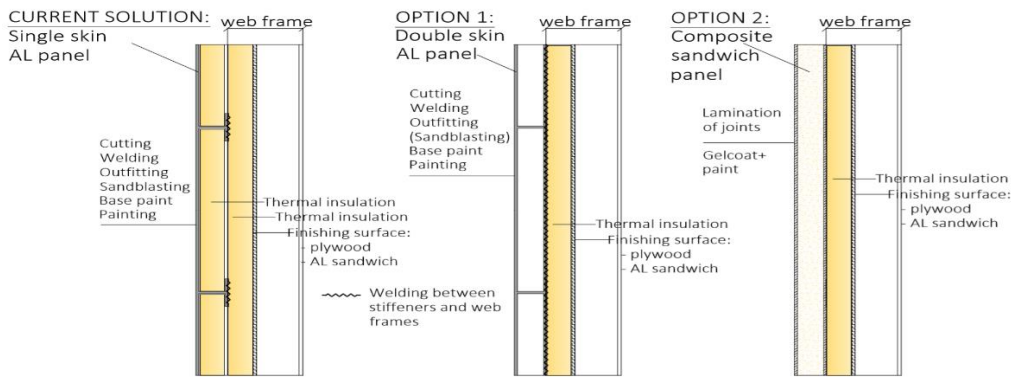


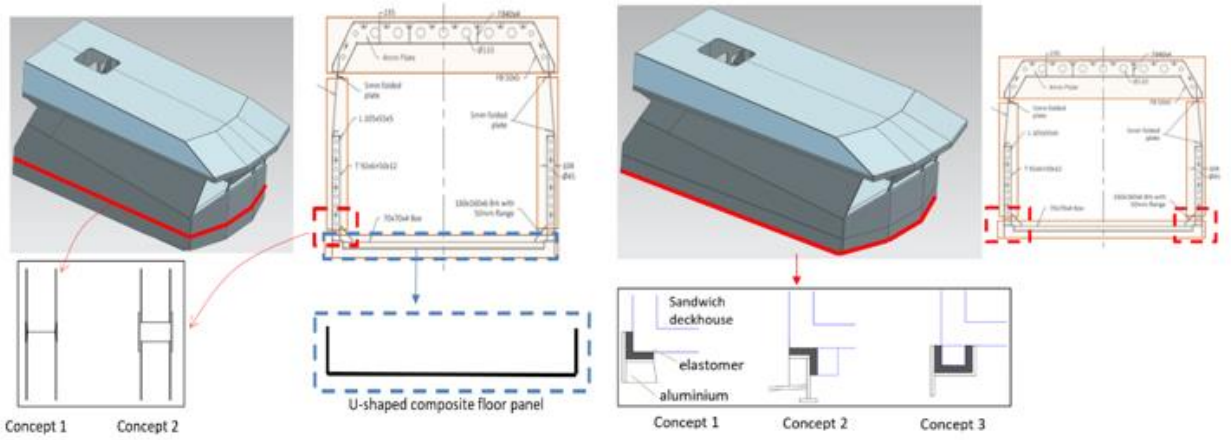
- Produce new design by using **highly automated** pultrusion process
- **5 design alternatives** have been investigated, and the most promising one has been selected by performing numerical and analytical analysis
- To prove **the feasibility** of the new material, production, and assembly process, the design will be applied on **onshore demonstrators**
- **Fire workshop** with RISE have been done to assess the design based on the fire requirements
- Ongoing **discrete event simulation** by CMT for 5 different scenarios to optimize the assembly process



Pre-outfitted stiffened lightweight panel system of superstructure and deckhouse for small aluminium crafts

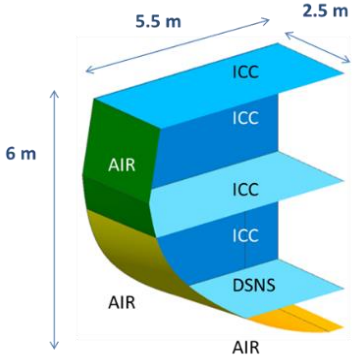
- Development of the design for lightweight (Aluminium/composite/foam) and **space-efficient panels** for the deck houses of work boats/mid-size vessels
- Demonstrate onboard installation to prove **the feasibility** of the new material and joining process
- **3 design alternatives for panels** in the form of double-skin aluminium panels or composite sandwich panels
- The **detailed design of the panel,** its connection with other panels and to the rest of the deckhouse structure, structural analysis procedures and the insulation solution are still to be developed

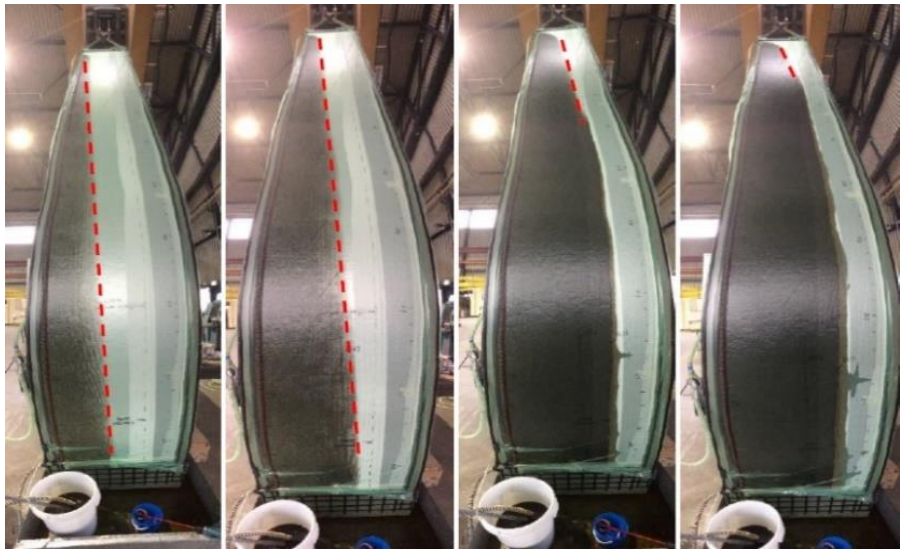




First approved (complete) fibre-reinforced polymer (FRP) SOLAS ship

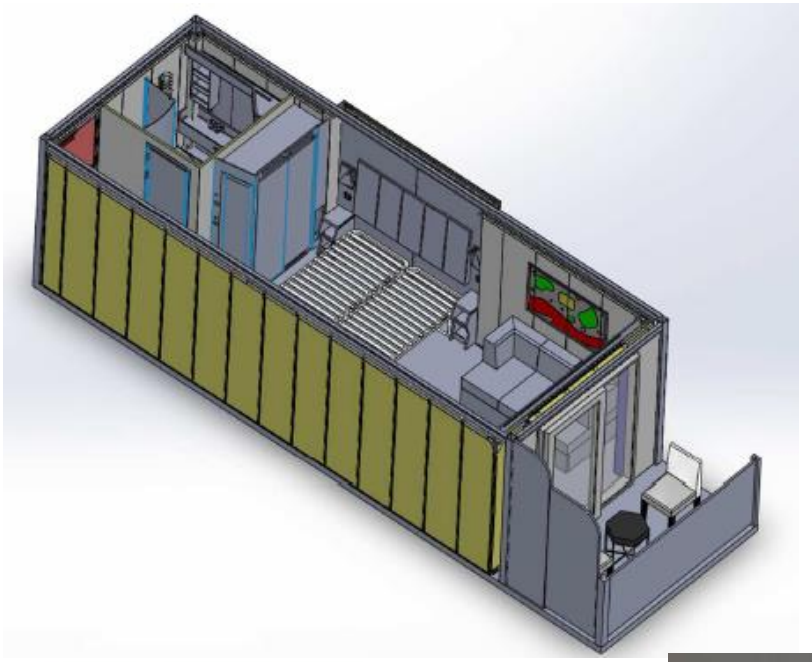
- Damen Shipyard Gorinchem prepared **the baseline design**. An analytical approach, as well as FEA approach was performed and documented.
- The **novel resin** has been developed by EVONIK in various iterations on the different infusion temperature and mechanical properties in close collaboration with the production partners
- The strategy for the **vertical infusion** is ongoing by both production partners AEL as well as ICC. Initial trials have been performed on small scale as well as larger scale for which a 6-meter-high tooling has been developed.
- For site testing, TNO will perform tests in relation to **quality management and structural performance**
- Damen with close cooperation with BV, RISE, and NMTF has defined a **first draft of the approval process** to be considered within RAMSSES project

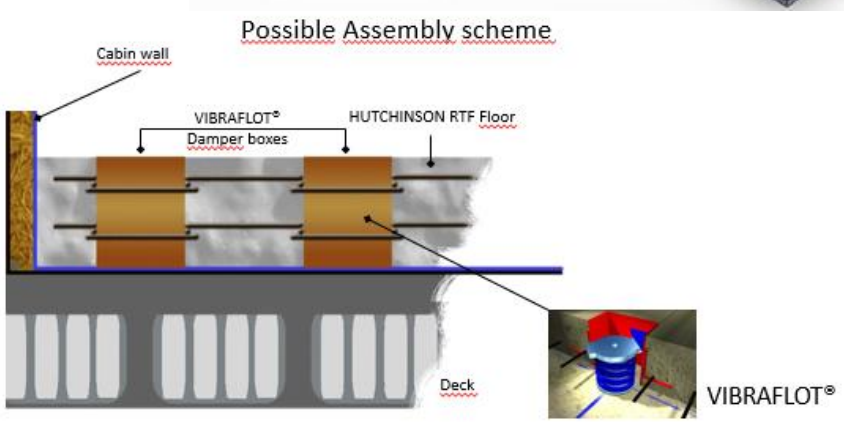


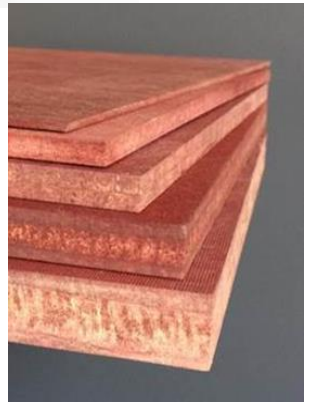


Innovative cabins and ship structures using lightweight material to reduce the production and assembly time

- **Assessment** on the walls, ceilings, and bathroom unit to optimize the design of new generation's cabin
- Replacing the stiffened deck plate by composite structure would make a weight gain estimated at 125 kg/m². Therefore, WP18 decided to focus on the floor to introduce composite materials since it has great potential for weight reduction at an expected low final cost penalty.
- For **noise and vibration**, all the requirements have been listed and some of those criteria will be tested on sub-assemblies using when necessary the IRT Jules Verne multi-axial test bench
- HUT proposes the use of its **innovative ZALTEX +** material which is a sandwich composed of a core of ZALTEX
- "U shaped connector" will be used to join the composite floor and the deck floor



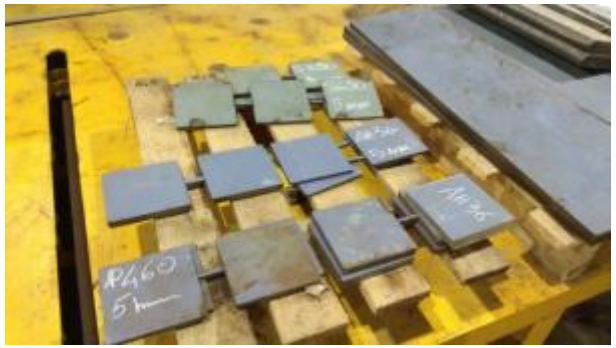




Zaltex material

Demonstration of mechanical performance improvement and effectiveness of welded joint by using low HSLA thickness in marine structures

- **The test matrix** based on the welding techniques, welding parameters, and two post processing methods and DoE (Design of Experiment) have been developed
- The **welded coupons** for laboratory tests were cut in Fincantieri Shipyard. The steel plates were cut using plasma cutting system and welded using the FCAW (Flux cored arc welding) process
- In this period, the study of **corrosion properties** for the parent metals, including the microstructure characterization, have already started by NTUA
- AIMEN has performed the non-destructive tests, macro and hardness tests, tensile tests, impact tests, and fatigue tests for all material combinations (AH36-AH36, X65-X65, AH36-X65, AH36-S690)
- The next step is to conclude all the results and choose the best combination for post processing methods application



FSP preliminary trials performed in AIMEN on homogeneous sample S690 material

RAMSSES WP03 : Technology transfer & Future concepts

Future Concepts

The introduction of new materials or technologies from other industries to the maritime industry by considering the requirements and recommendations from technology end-users for the future concepts of the maritime industry.

Collecting Ideas

TTG
- aeronautic
- automotive
- construction
- rail

MAG
- Ship owners
- Ship operators
- Navys

Other
- RAMSSES partner
- Network

Future concepts

Analyse
- Rate technologies suggested and select the most promising ones

Design study
- verify whether it is feasible to implement the technologies in the Maritime Industry

Way forward
- Define the recommendations on the sets of procedures and processes that are to be adapted

TTG - Technology Transfer Group

- Introduction of innovative materials and technologies from other industries
- Inform on rules and regulation required for maritime application

MAG - Maritime Advisory Group

- Provision of requirements and feedback by maritime technology end-users for future activities or research

Future concepts

- Rating and assessment of collected ideas and recommendation and verification of feasibility for maritime application

RAMSSES – Opportunities for students

RAMSSES Partner	Type	Required qualifications	Project Title	Contact
RISE Research Institutes of Sweden, Dept. of Fire Research Dynamics https://risefr.com/	MSc and BSc Theses	Risk, fire or material development	N/A	Franz Evegren (franz.evegren@ri.se)
CMT http://www.cmt-net.org/	Internship	Minimum student in the 3rd year of Bachelor degree in maritime or shipbuilding studies	• Design study of future concepts in the RAMSSES project	Matthias Krause (krause@cmt-net.org)
MEC Engineering Solutions www.mec.ee	Internship	Structural analysis skills, experience in composite panels (BSc/MSc in Mechanical Engineering)	• Structural analysis of composite panels	Kristjan Tabri (kristjan@mec.ee)
National Technical University of Athens, Dept. of Naval Architecture and Marine Engineering http://stl.naval.ntua.gr/	Diploma Theses	NTUA students in their final year of studies	• Fatigue analysis of overlaminated weldments • Predicting the corrosion behavior in dissimilar steel welds employing numerical methods • Corrosion behavior of weld joints employing microcapillary methods	Nicholas Tsouvalis (tsouv@mail.ntua.gr)