FIBRE4YARDS
SHIPYARD FOR THE FUTURE

Shipbuilding & Lifecycle Tech 4.0

FIBRE4YARDS

FIBRE composite manufacturing technologies FOR the automation and modular construction in shipYARDS

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WHAT IS FIBRE4YARDS

SHIPYARD FOR THE FUTURE

FIBRE4YARDS is a **EU funded project** which main **objective** is to **maintain European global leadership in ship building and ship maintenance,** through implementation of the **Shipyard 4.0** concept in which **advanced and innovative FRP manufacturing technologies** are successfully introduced

FIBRE4YARDS IN A NUTSHELL

SHIPYARD FOR THE FUTURE

6
EUROPEAN COUNTRIES

13
PARTNERS

ESTIMATED PERSON-MONTHS
995

CALL/TOPIC
H2020-MG-3-7-2020
IMPROVED PRODUCTION AND MAINTENANCE PROCESSES IN SHIPYARDS

GA NUMBER
101006860

START DATE
01/01/2021

PROJECT DURATION
36 MONTHS

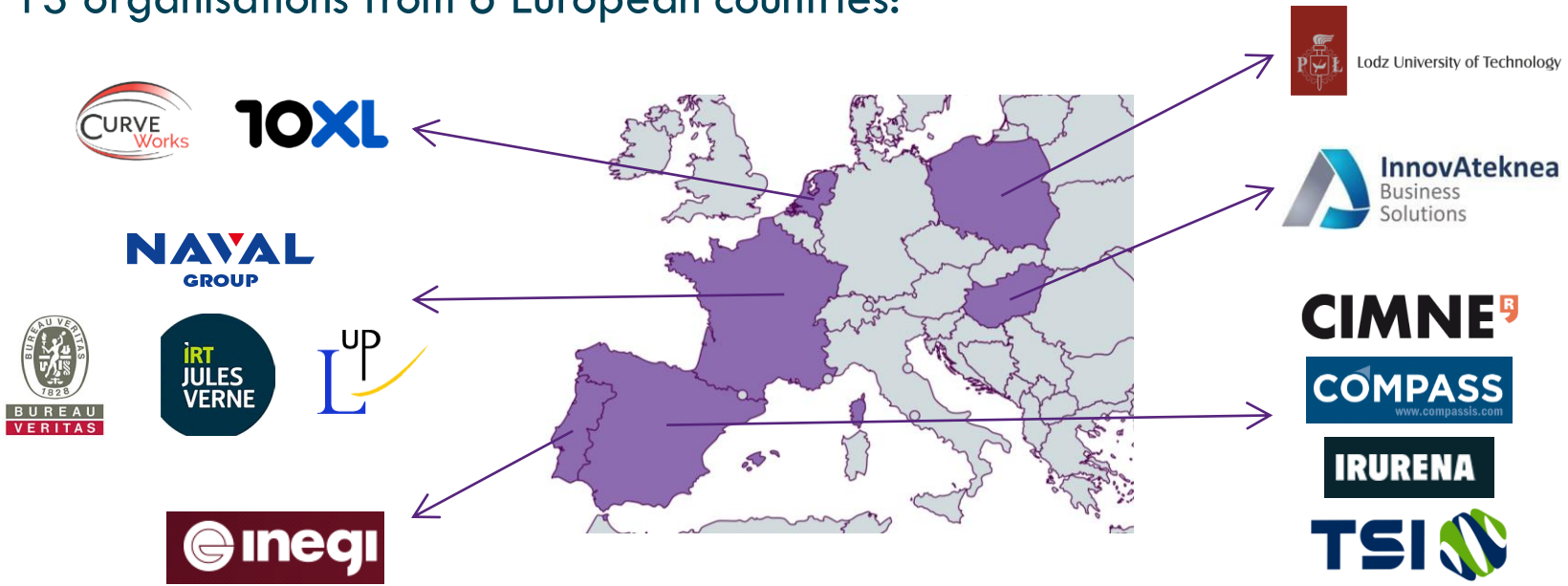
TOTAL ESTIMATED BUDGET
7.6 MILLIONS €

EU CONTRIBUTION
5.9 MILLIONS €

TYPE OF ACTION
INNOVATION ACTION

Consortium

13 organisations from 6 European countries:



Background

- ✓ Fibre-Reinforced Polymers (FRP) materials extensively used for building lightweight hull structures of vessels with length up to about 25 m.
- ✓ FRP also used for even larger lengths (up to 50 m).
- ✓ Most of the leisure craft and sailing yachts, naval ships, patrol and rescue vessels below 25 m length built in FRP materials.

- ➢ Production capacity in numbers of FRP ships does not achieve its full potential due to high total production costs.
- ➢ One of the main reasons for this limitation: lack of automated procedures, and current semi-artisanal methods used in FRP shipbuilding.

https://www.boats.com/on-the-water/boat-building-construction-resin-fiberglass-cores/

Activities towards the Project Objective

FIBRE4YARDS focuses on the entire value chain (shipyards and their ecosystem) cooperatively working on small and medium length fibre-based ships in a digital environment.

The main objective of the project will be achieved by:

1. Implementing smart and secure engineering, manufacturing and data sharing concepts in ship production.

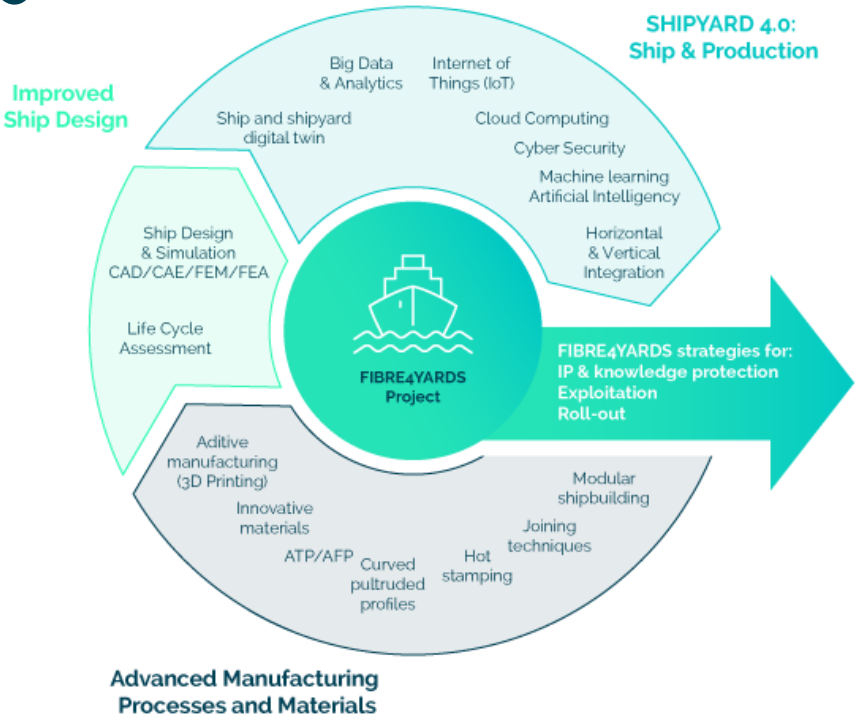
2. Embedding advanced and highly automated FRP production technologies in the Shipyard 4.0, while applying these technologies in ship production, maintenance and dismantling.

3. Developing and validating new (digitalized) engineering and analysis simulation solutions to support modular ship design and construction in the Shipyard 4.0 concept.

4. Facilitating industrial deployment of the FRP Shipyard 4.0 by providing guidelines for design, production, certification, and staff training.

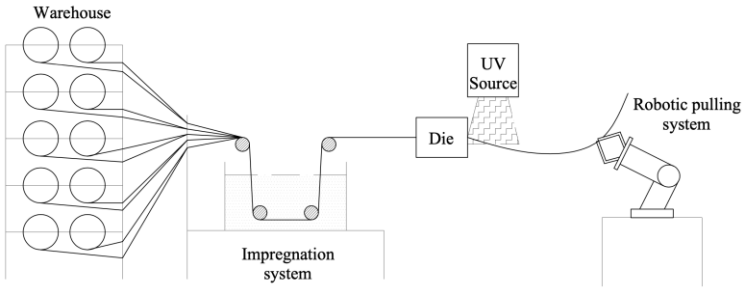
5. Developing business plans and Intellectual Property Rights (IPR) strategies for shipyards.

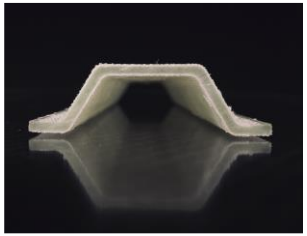
CONCEPT AND UNDERPINNING TECHNOLOGIES



Advanced FRP production and joining technologies (I)

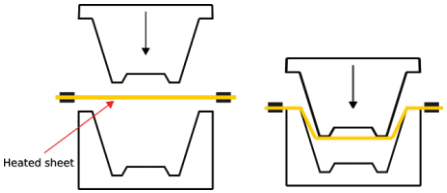
Out of die UV cured pultrusion for manufacturing curved profiles (IRURENA)





Advanced FRP production and joining technologies (II)

Hot stamping of thermoplastic materials (INEGI)



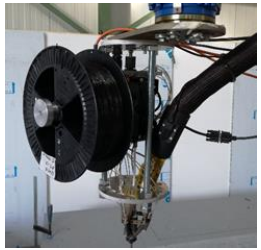
Automatic Tape Placement (ATP)/Automatic Fibre Placement (AFP) (10XL)

https://www.tss.trelleborg.com/en/products-and-solutions/advanced-composites/automation-equipment/fiber-placement

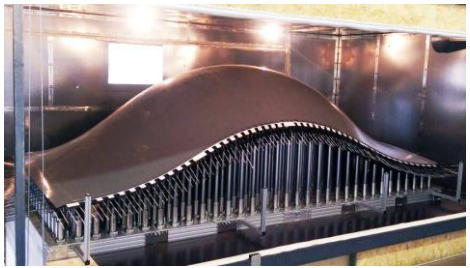
https://www.compositesworld.com/articles/automating-wind-blade-manufacture

Advanced FRP production and joining technologies (III)

Additive manufacturing: 3D printing (10XL)

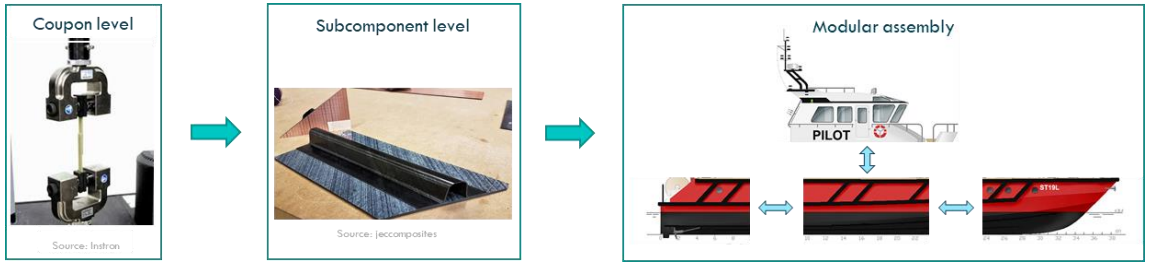


Adaptive moulds for composite panel assemblies (CURVED WORKS)

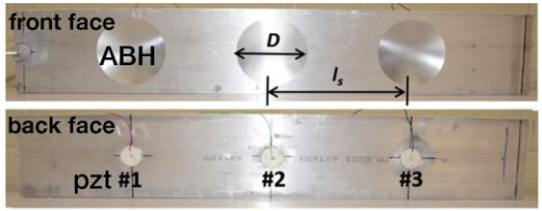


Advanced FRP production and joining technologies (IV)

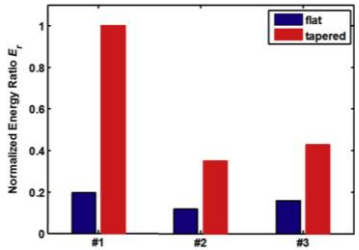
Connection Techniques (INEGI)



Acoustic damping by using "acoustic black holes" (IRT JULES VERNE)

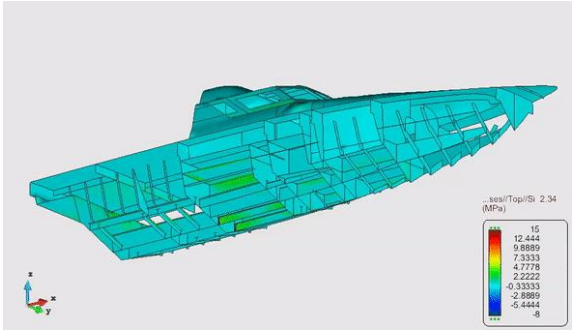


https://doi.org/10.1016/j.jsv.2020.115316

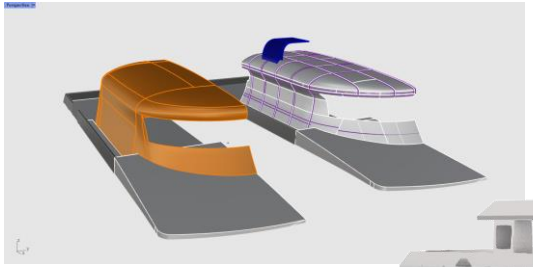


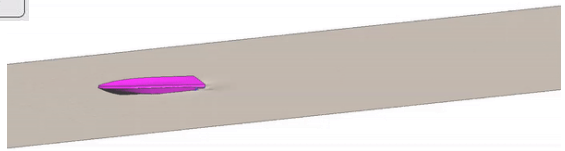
Design and engineering for vessel production improvement

- ✓ FIBRE4YARDS will design two ships (a Patrol Boat and a Service Catamaran), optimized by means of the developed production methods, and enabled to be produced in a Shipyard 4.0 environment.



- ✓ Numerical methodologies will be developed to predict the performance of composite structures manufactured with the advanced technologies investigated in the project, and will be included in the design/engineering tools (FEA)





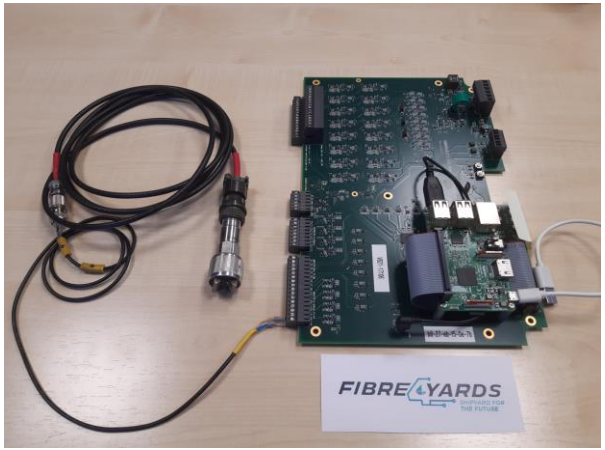
Smart manufacturing for Shipyard 4.0 (I)

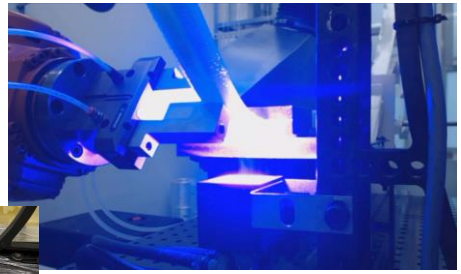
In order to define a new generation of 4.0 shipyards, FIBRE4YARDS will:

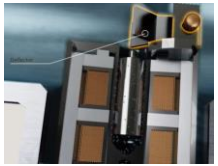
- Develop monitoring strategies to obtain required data for continuous quality control and factory maintenance
- Develop a Digital Twin Model of the shipyard which, based on the continuous monitoring and the Internet of Things (IoT), will control the different production and maintenance processes
- Define applications of smart technology based on the IoT to shipbuilding to develop the Shipyard 4.0 concept and improve production and maintenance processes
- Define cyber-security measures in the Shipyard 4.0

Smart manufacturing for Shipyard 4.0 (II)

- ✓ **Sensor and digital acquisition system analysis**
- ✓ IoT Platform development
- ✓ Digital Twin Model development



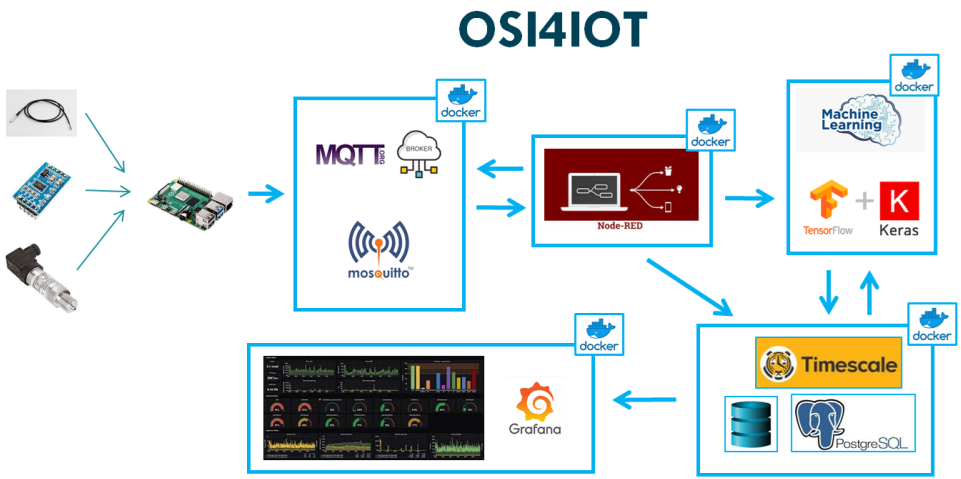




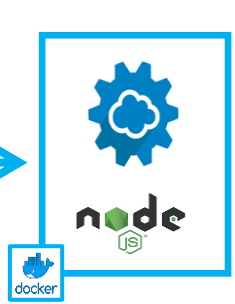
Smart manufacturing for Shipyard 4.0 (II)

CIMNE

- ✓ **Sensor and digital acquisition system analysis**
- ✓ **IoT Platform development**
- ✓ Digital Twin Model development



Web user interface



Backend admin API

User registration

Create organizations

Create private groups

Devices registration

Sensors registration

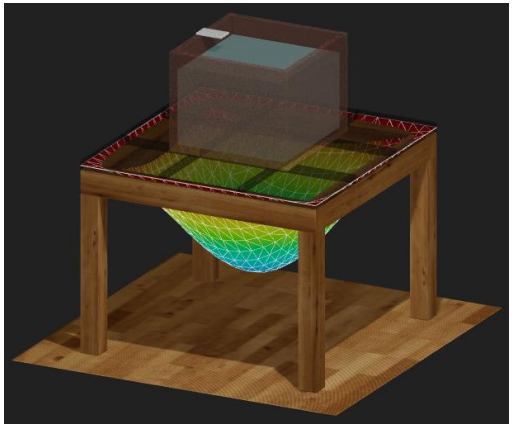
Alert geolocation

Digital Twin model

Smart manufacturing for Shipyard 4.0 (III)

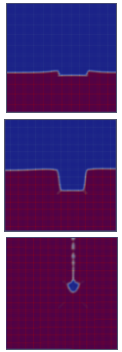
CIMNE

- ✓ **Sensor and digital acquisition system analysis**
- ✓ **IoT Platform development**
- ✓ **Digital Twin Model development**

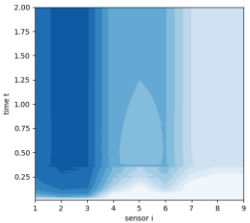


Digital twin model represented by 3D model and FEM simulations.

Resin infusion process

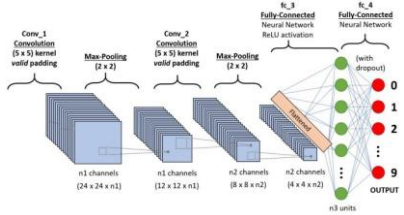


Pressure

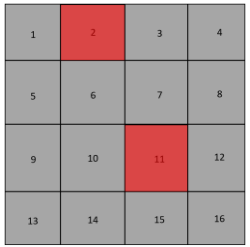


Convolutional neural network

Input

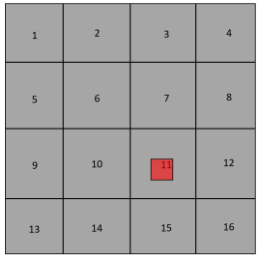


Area of failure



Precision > 99%

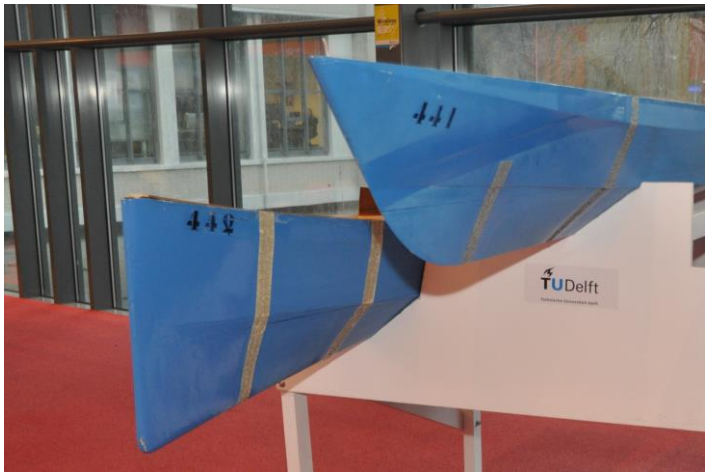
Exact failure



Manufacturing and testing of demonstrators (I)

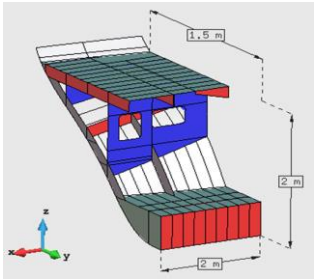
All developments made in FIBRE4YARDS will be evaluated by means of two demonstrators.

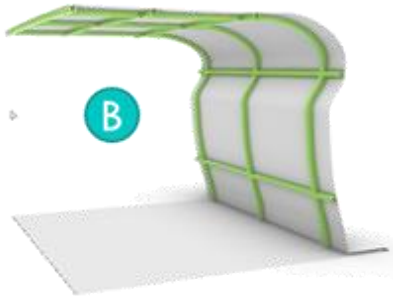
- **First demonstrator:**
  - ✓ 3D printed axe-bow.
  - ✓ This demonstrator will be also used to evaluate the performance of the IoT and the Shipyard 4.0 elements implemented during the project.



Manufacturing and testing of demonstrators (II)

- **Second demonstrator:**
- ✓ Structural part containing elements produced with each of the production technologies developed.
- ✓ Designed with the numerical tools developed in the project.
- ✓ Will also help evaluate the performance of the Shipyard 4.0 elements developed within FIBRE4YARDS.

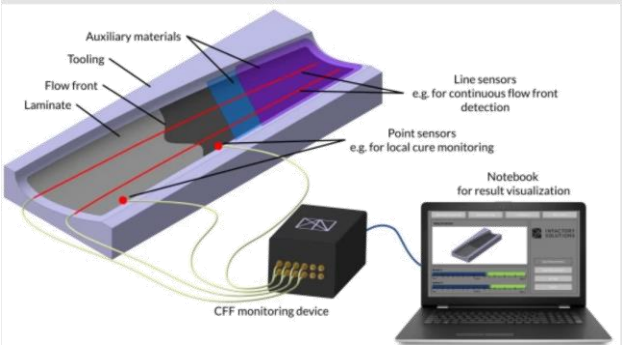


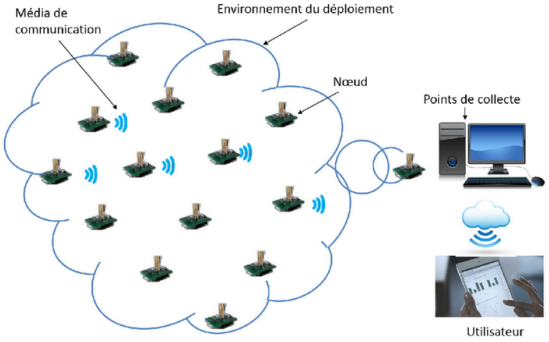


Perspective from the Shipyard: Naval Group (I)

Focus on digital twin and monitoring

- **Key point:** monitoring to learn physical and chemical behaviour
- **KPIs:**
  - Degree of curing, glass transition
  - Resin position
  - Pressure
  - …
- **Sensor Network**
  - Prototype step
  - Data acquisition
  - Real time knowledge of behaviour

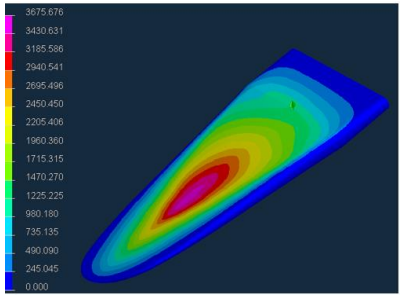


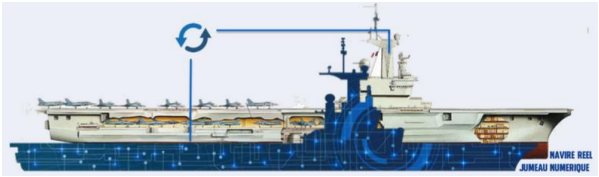


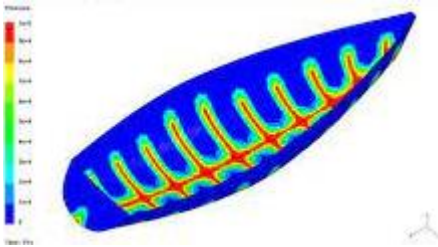
Perspective from the Shipyard: Naval Group (II)

Focus on digital twin and monitoring

- Settings injected to practice process simulation
- Correlation between data process and simulation
  - Make process more repeatable
  - Make infusion industrial process
  - Predict behaviour during process
- Digital/Numerical twin
  - Computing data to improve process







Perspective from Classification Society: BV (I)

Qualifications of new materials and their assemblies:

- Coupon tests for design purpose Small demonstrator for assemblies testing
- Coupon tests for quality production purpose
- Demonstrator testing proof of concept (materials and assemblies)

Perspective from Classification Society: BV (II)

Qualification of new manufacturing process for composites materials and associated safety coefficients for produced pieces:

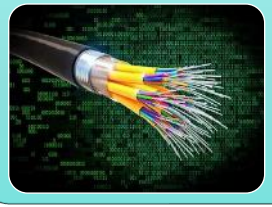
- Adaptation of the Manufacturing and Testing Inspection plan methodology to new manufacturing process.
- Use of traceability file for composite surveys with new manufacturing process
- Implementation of adapted safety coefficients in accordance with qualified process

Perspective from Classification Society: BV (III)

Future implementation Digital classification for FRP ships

3D classification & digital twin : Approval based on 3D model

- Design Data shared using .OCX Open Class eXchange format file
- Shared through a collaborative platform VPM



Survey for new building : in situ monitoring for production purpose, SHM, NDT….

UNDER DEVELOPMENT

Remote and augmented survey for in service ships:

- Offline surveys: data transmitted to BV
- Partly online : data transmitted and shared via video real-time decision.
- Fully online remote surveys: drone surveys

Project impacts

1. **Competitiveness and growth for small and medium shipyards**

   Implementation and deployment of Shipyard 4.0 will increase the competiveness of European shipyards

2. **Employment and skills of European workforce**

   Advanced manufacturing procedures will require workforce with improved skills

3. **Improved environmental performance**

   FRP ships manufactured with advanced production procedures will use less material more efficiently, reducing significantly the ship's weight. A Life Cycle Analysis (LCA) will accompany this change

4. **Multiplication effect within Europe**

   Developments made towards Shipyard 4.0 will be easily adapted to other shipyards besides the ones directly involved in the project, spreading the results easily

5. **Maximise EU added value by minimizing technology leakage**

   Business plans and protection strategies for the IPR generated in the project will be developed

Summary

- ✓ FIBRE4YARDS is bringing together a consortium with the expertise and the willing to improve the productivity of the European shipyards.
- ✓ This will be achieved by implementing automatized production methods that will allow a modular construction of the ship, within a new redefined Shipyard 4.0 environment.
- ✓ New developments will take into account the ship's LCA, and the new ships will be redesigned to adapt them to the new production technologies.
- ✓ Finally, FIBRE4YARDS will develop a business plan to maximize the impacts of the project.

FIBRE4YARDS
SHIPYARD FOR THE FUTURE

Thank you !

https://www.fibre4yards.eu/

https://www.linkedin.com/company/fibre4yards/

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