



# NEW TECHNOLOGIES FOR AUTOMATED PRODUCTION IN THE FIBRE4YARDS PROJECT

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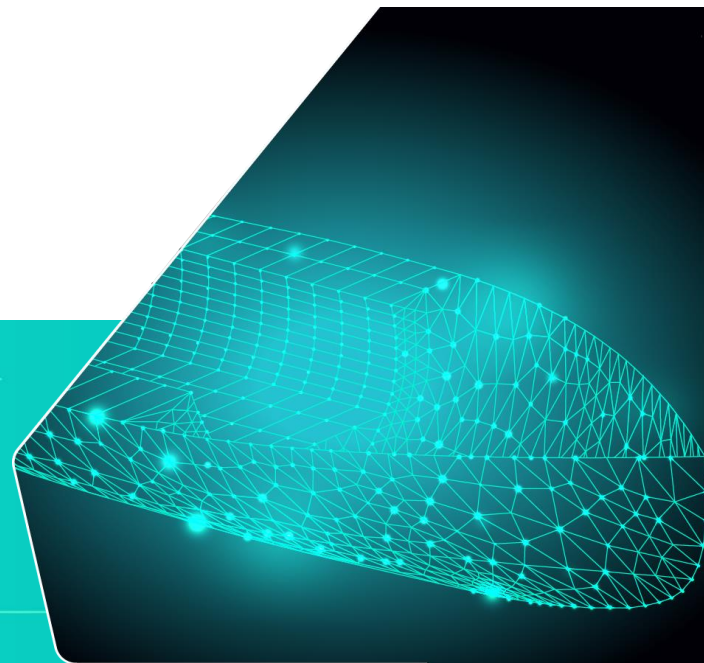
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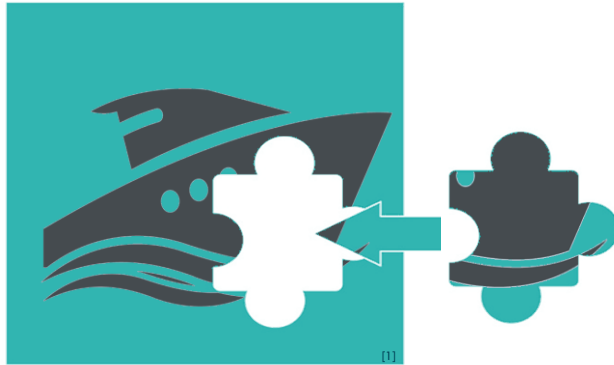
This project has received funding from European Union's Horizon 2020 research and innovation programme under grant agreement n° 101006860



**25/05/2022**

## - Context -

- Today, Fibre-Reinforced Polymers (FRP) materials are extensively used for building lightweight hull structures of medium and large vessels like leisure craft and sailing yachts, naval ships, patrol and rescue vessels. However, the production capacity in numbers of **FRP ships** does not achieve its full potential due to **high total production costs**.
- ⓘ This limitation is due to the **lack of automated procedures and the current semi artisanal methods used in FRP shipbuilding**.



### IMPLEMENTATION OF NEW PRODUCTION PROCESSES

- ✓ Flexibility
- ✓ Automatization
- ✓ Shipyard 4.0
- ✓ Modular shipbuilding
- ✓ Lower costs



# *- New production processes -*

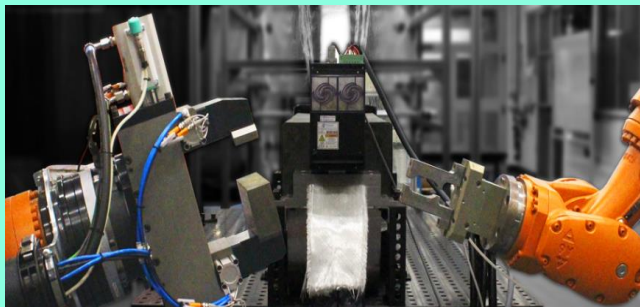
**ATP & 3D Printing**



**Adaptive Moulds**



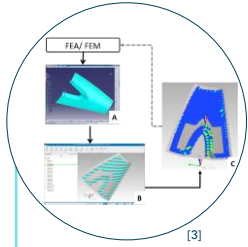
**Out-of-Die UV Cured Pultrusion**



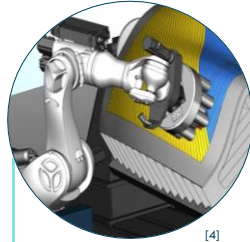
**Thermoplastic Composites Hot-Stamping**



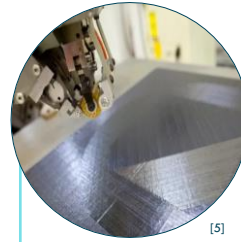
# - Automated tape placement -



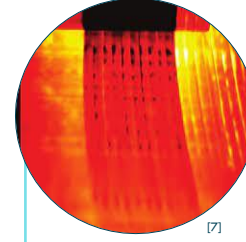
PART DESIGN (CAD)



PATH DEFINITION  
(CAM)



TAPE PLACEMENT

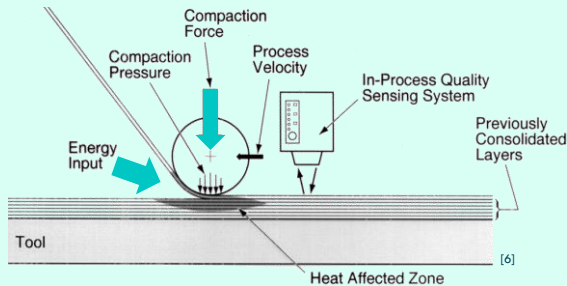


IN-LINE NDI



DEMOULDING

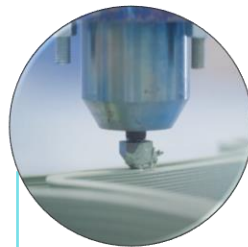
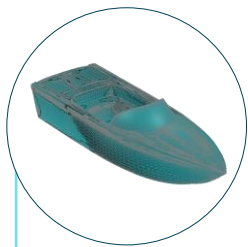
## PROCESS



Automatization of future shipbuilding of high-performance tailored components



## - 3D Printing -



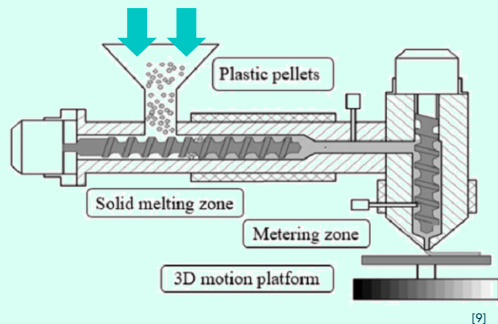
PART DESIGN (CAD)

SLICING & PATHING (CAM)

MATERIAL DEPOSITION

DEMOULDING

## PROCESS



Flexibility of future shipbuilding in terms of prototyping and producing



# - ATP & 3D Printing -

## CONTINUOUS FIBRES

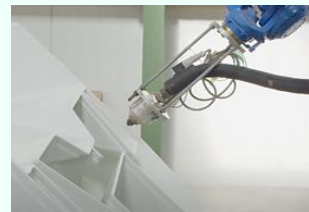


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## AUTOMATED TAPE PLACEMENT

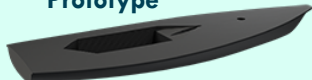
## SHORT, LONG AND CONTINUOUS FIBRES



## 3D PRINTING



Prototype



Mould



Product



Cost



Design flexibility



Automation



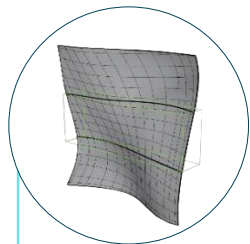
High  
productivity



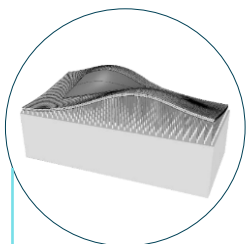
High strength /  
low weight



# *- Adaptive moulds for composite panel assemblies -*



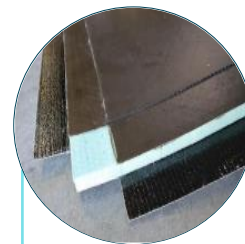
CAD SURFACE



MOULD  
CONFIGURATION



INFUSION




DEMOULDING

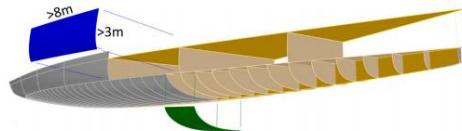
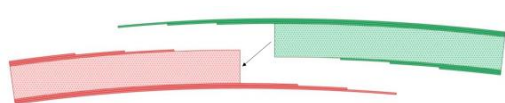


ASSEMBLY

## PROCESS

### ASSEMBLY

-  Cost-effective manufacture of different curved panels capable of being assembled to form a complete hull section



# - Adaptive moulds for composite panel assemblies -

## SMALL SERIES OF FRP LARGE HULLS

! Producing a perfect large composite shell structure:

- Several moulds are needed
- High operational, tooling, storage and assembly costs
- Long lead-times
- No flexibility
- Risky one-shot operations



**ADAPTIVE MOULDS FOR  
COMPOSITE PANEL ASSEMBLIES**

**FIBRE4YARDS**  
SHIPYARD FOR  
THE FUTURE

**TECHNOLOGY  
IMPROVEMENT**



**MODULARITY**



Cost



Flexibility



High  
productivity



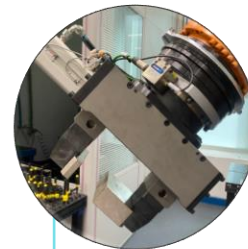
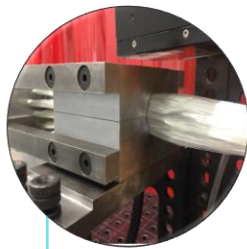
Small  
batches



Modularity



## - Out-of-die UV cured pultrusion -



FIBRE WAREHOUSE

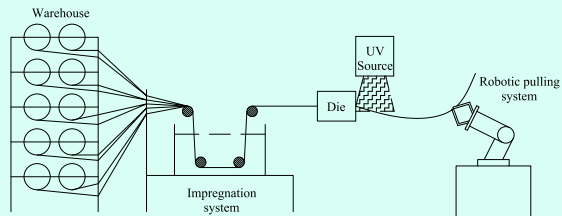
IMPREGNATION  
SYSTEM

MOULD

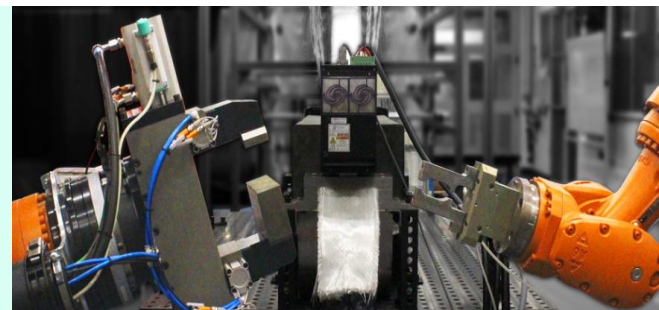
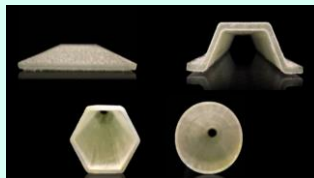
UV SOURCE

GRIPPING SYSTEM

## PROCESS



Design flexibility in terms of profile section and curvature radius



25/05/2022

MARTECH 2022

6<sup>th</sup> International Conference on Maritime Technology and Engineering

**FIBRE**  **YARDS**  
SHIPYARD FOR  
THE FUTURE

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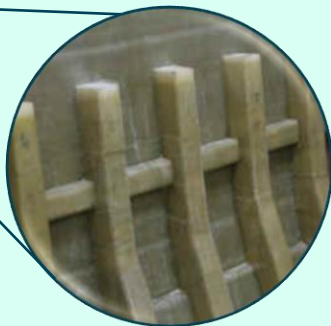
## - Out-of-die UV cured pultrusion -

### COMPOSITE STRINGERS/BEAMS



**Curved profiles for ships are manually manufactured in straight sections**

- High operational and assembly costs
- Restriction to the modular construction
- No flexibility

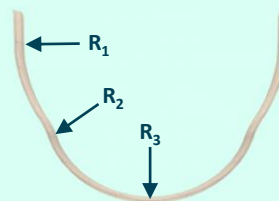


**OUT-OF-DIE UV  
CURED  
PULTRUSION**

**FIBRE4YARDS**  
SHIPYARD FOR  
THE FUTURE



**Straight Profile  
Assembly**



**Continuous  
Curved Profile**



**Cost**



**Flexibility**



**Greener**

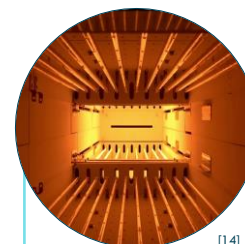
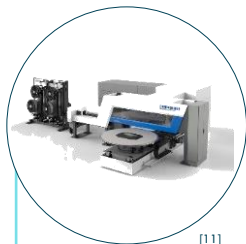


**Automation**



**High  
productivity**

# - Thermoplastic composites Hot-Stamping -



AUTOMATED LAYUP

CONSOLIDATION

GRIPPING

HEATING

HOT-STAMPING

## PROCESS



- Small-to-medium sized parts
- Accurate and fast production
- Major player in the modularity scenario of future shipbuilding



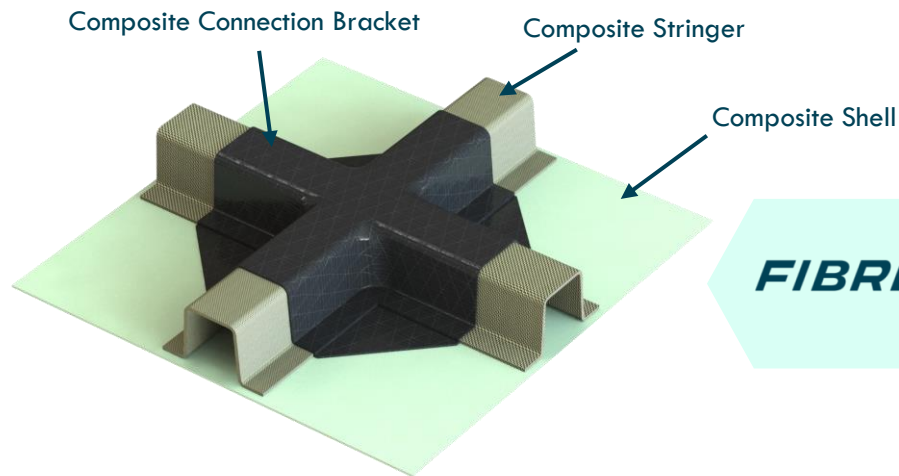
# - Thermoplastic composites Hot-Stamping -

## LARGE ASSEMBLIES

- Assembly of flat or light-curved primary structures using small and complex secondary structures like **clips and brackets**

## NEEDS

- High production rate manufacturing processes
- Feasibility and ease of automation



**FIBRE4YARDS**  
SHIPYARD FOR  
THE FUTURE

## SOLUTION



## HOT-STAMPING PROCESS



Low cycle  
time



Modularity



Cost



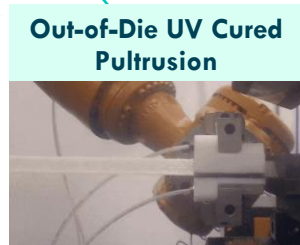
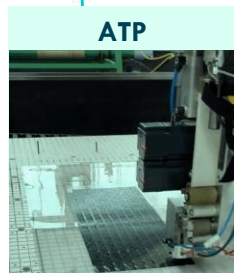
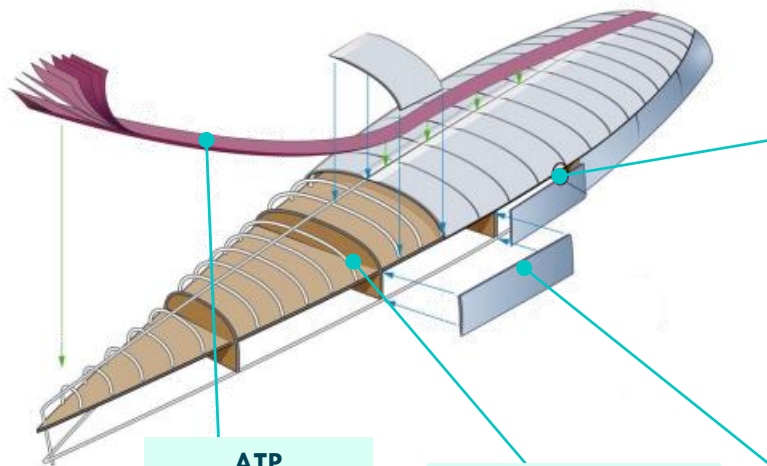
Automation



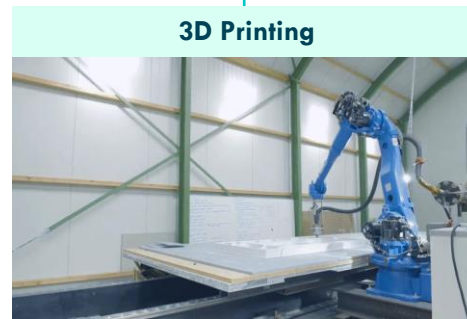
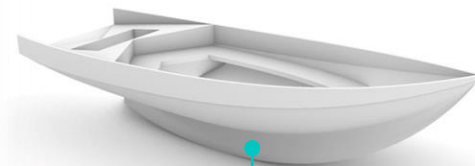
High strength/  
low weight

# - Process-Component matching -

## MEDIUM TO LARGE VESSELS



## SMALL VESSELS



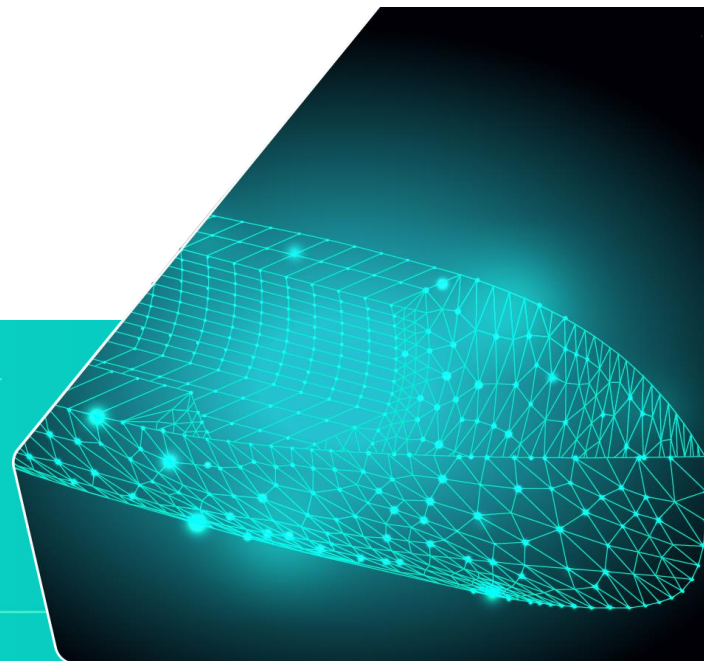


# Thank you!

More info at: <https://www.fibre4yards.eu/>



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