FIBRE4YARDS
SHIPYARD FOR THE FUTURE

New Production Processes to be implemented in the Project

01/07/2021

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

- Content -

- Brief Introduction

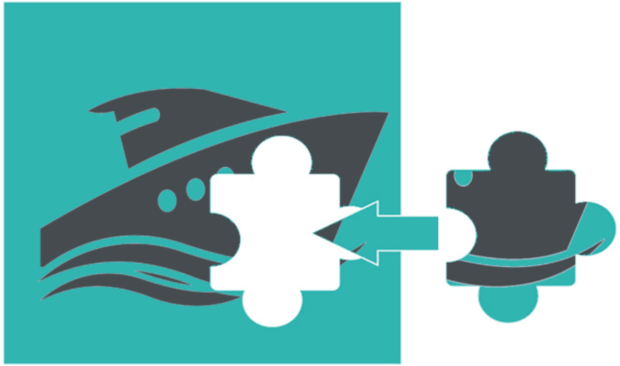
- Process detailing
  - ATP/AFP & 3D Printing
  - Adaptive moulds for composite panel assemblies
  - Out-of-die UV cured pultrusion
  - Thermoplastic composites Hot-Stamping

- Process-Component matching

– Brief Introduction –

- 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 semiartisanal methods used in FRP shipbuilding.**



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IMPLEMENTATION OF NEW PRODUCTION PROCESSES

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

FIBRE4YARDS SHIPYARD FOR THE FUTURE

- New Production Processes -

- ATP/AFP & 3D Printing
- Adaptive moulds for composite panel assemblies
- Out-of-die UV cured pultrusion
- Thermoplastic composites Hot-Stamping

- ATP/AFP & 3D Printing -

CONTEXTUALIZATION

CONTINUOUS FIBRES


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SHORT, LONG AND CONTINUOUS FIBRES

TECHNOLOGY IMPLEMENTATION

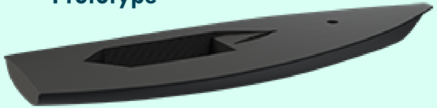
AUTOMATED TAPE PLACEMENT + AUTOMATED FIBRE PLACEMENT

3D PRINTING

FIBRE4YARDS
SHIPYARD FOR THE FUTURE

ATP/AFP & 3D Printing can be implemented at different levels:

Prototype



Mould

Product

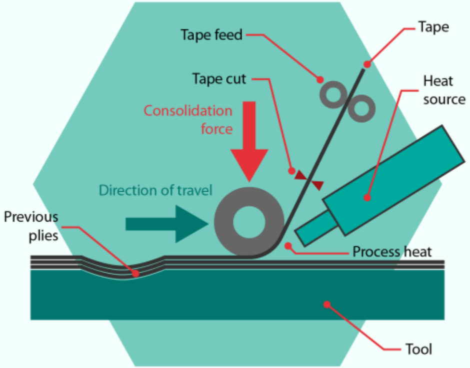
- ATP/AFP & 3D Printing -

FEATURES & APPLICATIONS

Features

- Repeatability
- High accuracy
- Fully automated
- Flexibility of design
- Load-optimized design
- Cost-effectiveness
- Faster cycle times
- Recyclability

ATP/AFP Process



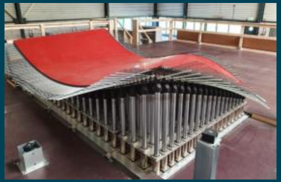
Applications

- Adaptive moulds for composite panel assemblies -

CONTEXTUALIZATION

LIMITATIONS OF FRPs IN SMALL SERIES MANUFACTURING OF LARGE HULLS

- To produce a perfect composite shell structure, like a hull, **one or several large moulds are needed**
- **Long lead-times** due to the design, development, and manufacturing of different and large moulds
- **No flexibility** once the moulds are manufactured
- **High tooling costs** related to the moulds manufacturing process, which does not add value to the product itself
- **Storage** of numerous and large moulds
- **Handling and demoulding** of one-piece large hulls
- **High risky** produce of large hulls at the first time using one-shot processes
- The use of resins that **cure at high temperatures** means that the entire mold is inserted into a **large oven.**



TECHNOLOGY IMPROVEMENT
MODULARITY

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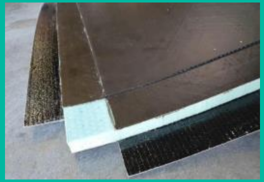
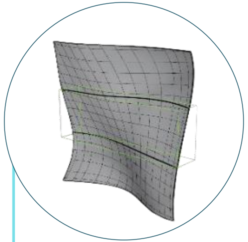
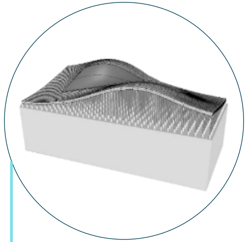
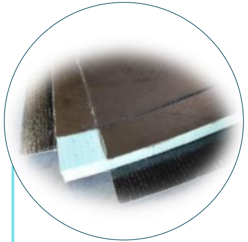


- Adaptive moulds for composite panel assemblies -

FROM CAD TO ASSEMBLY

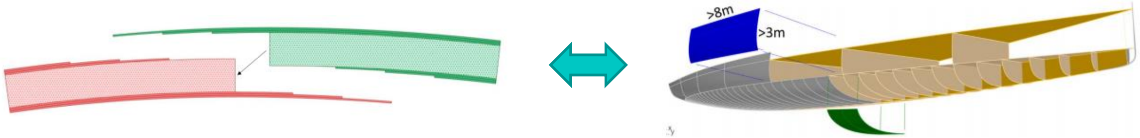



CAD SURFACE → MOULD CONFIGURATION → INFUSION → DEMOULDING → ASSEMBLY

PROCESS

ASSEMBLY

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



- Out-of-die UV cured pultrusion -

CONTEXTUALIZATION

SHIP COMPOSITE STRINGERS/BEAMS

Curved profiles for ships are manufactured manually in straight sections

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

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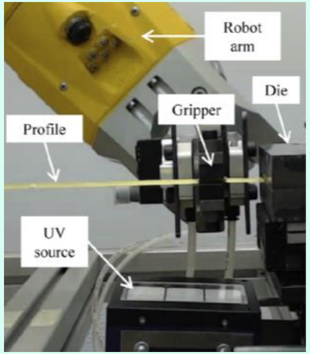
SOLUTION

OUT-OF-DIE UV CURED PULTRUSION



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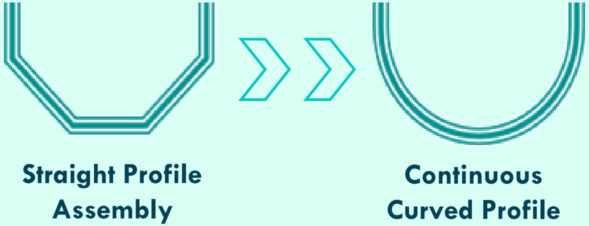
Research Project to be transferred to Naval Industry

CONCEPT



- Out-of-die UV cured pultrusion -

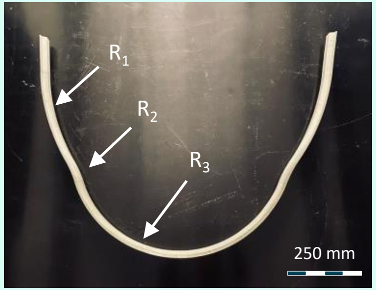
FEATURES & APPLICATIONS

Features

- **Low cost**
  - Raw materials easier to handle and store
  - Small and simple moulds
- **High Flexibility**
  - Same mould for different geometries
- **More environmentally friendly**
  - Less emission of Volatile Organic Compounds (VOC)
- **Unique solution**
  - Curved profiles with different radii and orientations

Applications

Ship Composite Stringers & Beams



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- Thermoplastic composites Hot-Stamping -

CONTEXTUALIZATION

AERONAUTICAL ASSEMBLIES

- **Assembly** of flat or light-curved primary structures using small and complex secondary structures like **clips and brackets**
- Widebody aircrafts such A350XWB need **8000 clips & brackets**

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FIBRE4YARDS SHIPYARD FOR THE FUTURE

TECHNOLOGY TRANSFER

NEEDS

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

SOLUTION

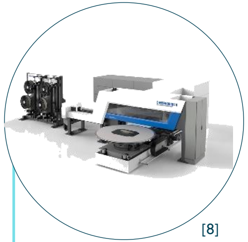
HOT-STAMPING PROCESS

BENEFITS

- **Modularity**
- **Flexibility**
- **Low-cycle times**
- **Automation**

- Thermoplastic composites Hot-Stamping -

FROM CAD TO COMPONENT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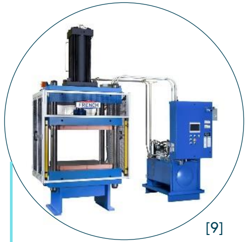
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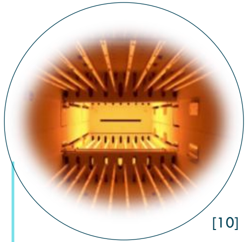
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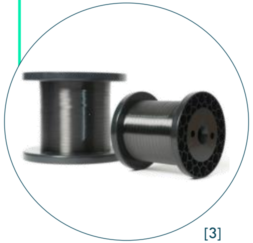
PROCESS

AUTOMATED LAYUP → CONSOLIDATION → HEATING → HOT STAMPING

COMPOSITE TAPE → TAILORED LAYUP → PREFORM → MELTED PREFORM → FINAL PART

PRODUCT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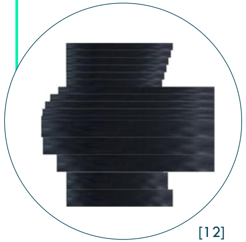
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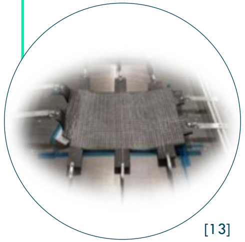
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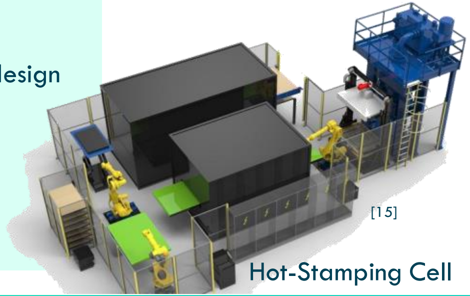
[14]

- Thermoplastic composites Hot-Stamping -

FEATURES & IMPLEMENTATION

Features

- ❑ Fully automated
- ❑ Repeatability
- ❑ Flexibility
- ❑ Low production cycle
- ❑ High accuracy
- ❑ Low cost
- ❑ Load-optimized design
- ❑ Material saving
- ❑ In-line QC
- ❑ Shop floor



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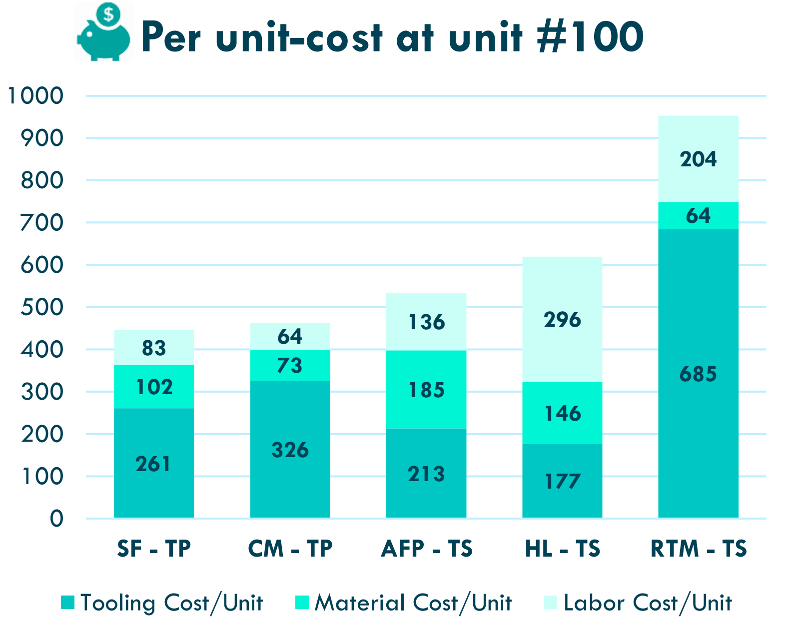
Hot-Stamping Cell

Functional unit:
3D - 600x600x0.6mm

SF – Stamp Forming
CM – Compression Moulding
AFP – Automated Fibre Placement
HL – Hand Layup
RTM – Resin Transfer Moulding

TP – Thermoplastic
TS – Thermoset



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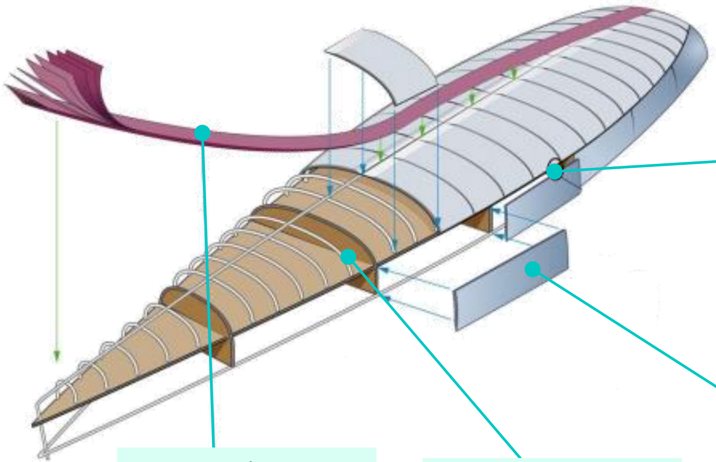
Amortizing tooling and setup initial investments

- Process-Component matching -

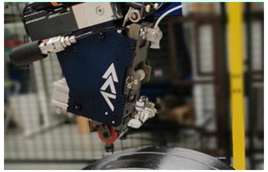
MEDIUM TO LARGE VESSELS



Hot-Stamping

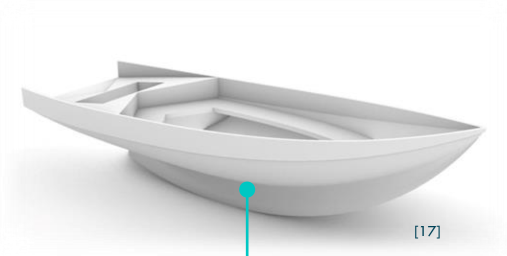
Adaptive moulds

ATP/AFP



Out-of-die UV cured pultrusion

SMALL VESSELS



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3D Printing

FIBRE4YARDS
SHIPYARD FOR THE FUTURE

https://www.fibre4yards.eu/

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

If not acknowledged, images courtesy of the consortium partners.

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