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Manufacturing Processes for Bio-based Fibre-reinforced Composite Parts for Structural Applications

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Context

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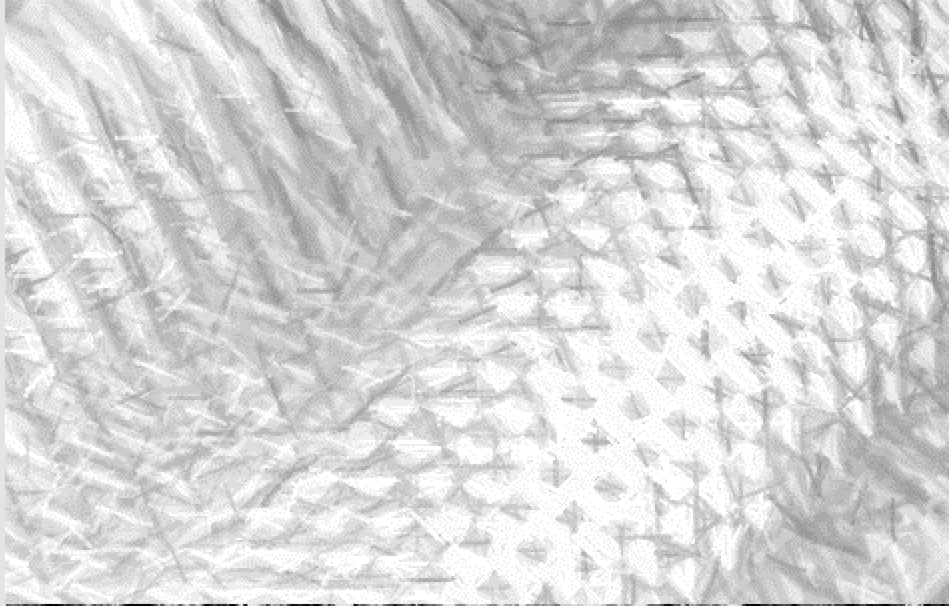
Challenge with current composites

Composites currently rely **heavily on carbon and glass fibers** for reinforcement.

However, the utilization of synthetic composites poses **numerous challenges**.



Environmental impact

+21.3 kg CO_2 generated by 1 kg of **carbon fibre** during production

+1.8 to 4.6 kg CO_2 generated by 1 kg of **glass fibre** during production

-1.8 to -3.0 kg CO_2 consumed by 1 kg of **hemp fibre** during growth

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European reliance on imported fibres

80% of these fibres are **manufactured outside of Europe**.

50% of the remaining part is **produced under foreign licenses**, contributing to a significant reliance on other nations.

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Bio-composites as a solution

Bio-composites, incorporating natural fibers, with hemp and flax being the most prevalent, present a promising solution to reduce this dependence

Hemp cultivation: 150,000 tons annually

Flax production: 80% of the required flax in Europe sourced locally

→ By leveraging natural fibers, the reliance on imported materials can be substantially diminished

→ Bolster the autonomy of the European composites industry

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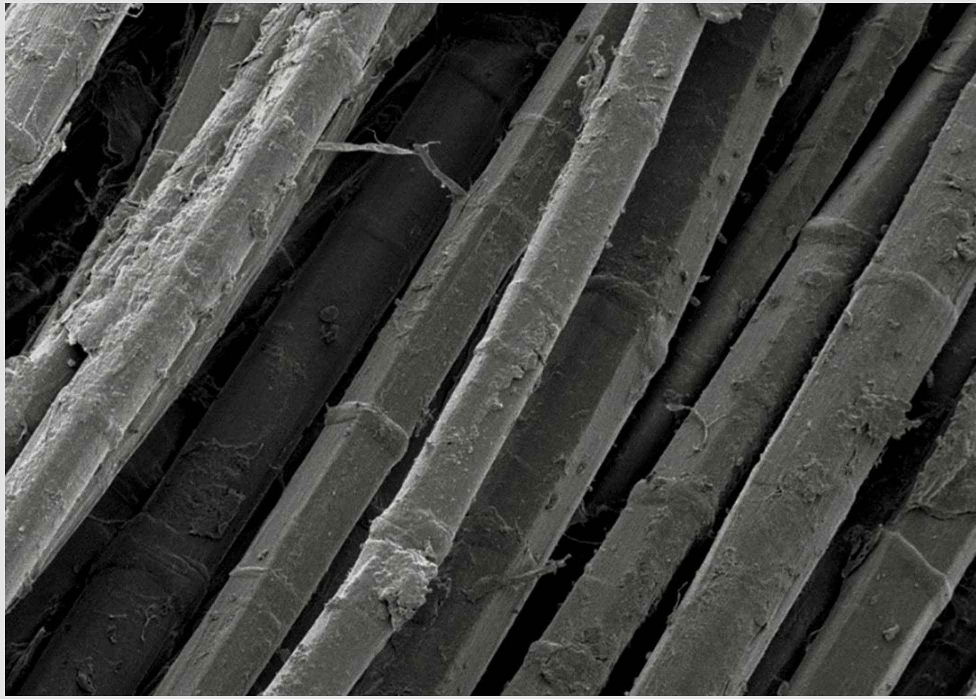
Bio-composites as a solution

The current application of bio-composites is **confined to less critical uses without significant mechanical performance requirements.**

Natural fibres, as bio-based materials, **exhibit greater variability** in:

- dimensions
- weight
- appearance

Compared to regular, smooth, and solid synthetic fibers.



→ This disparity in properties necessitates a deeper understanding to tailor weight-to-performance systems and adapt manufacturing processes accordingly.

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BioStruct project overview

The BioStruct project, a European initiative, is dedicated to developing **manufacturing processes** for **bio-based fiber-reinforced composite** parts in **structural applications**.

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HORIZON-CL4-2023-TWIN-TRANSITION-01-02

Project overview

January 2024 – December 2026

10 partners from 7 countries

8 M€

2 pilots

Consortium

The partners of BioStruct are:

Profactor (Austria, coordinator)
CIDETEC (Spain)
Enginsoft (France)

Amura (Spain)
NOMA RESINS (Poland)
Blade works (Italia)

Ideko (Spain)
Lumoscribe (Cyprus)
Abel Ingenieure (Germanie)

Techtera (France)

Objectives of BioStruct

Developing an Accurate Draping Process to Control Fibre Orientation

Creating Material Models to Capture Natural Variability

Integrating Nano-Structured, Bio-Based Sensors for Load Monitoring

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Use cases & Outcomes

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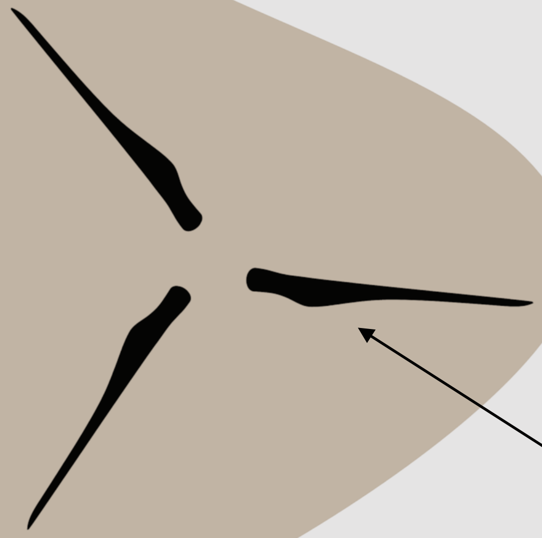
Use cases



Manufacturing of 6m long rotor blades for wind energy power plants

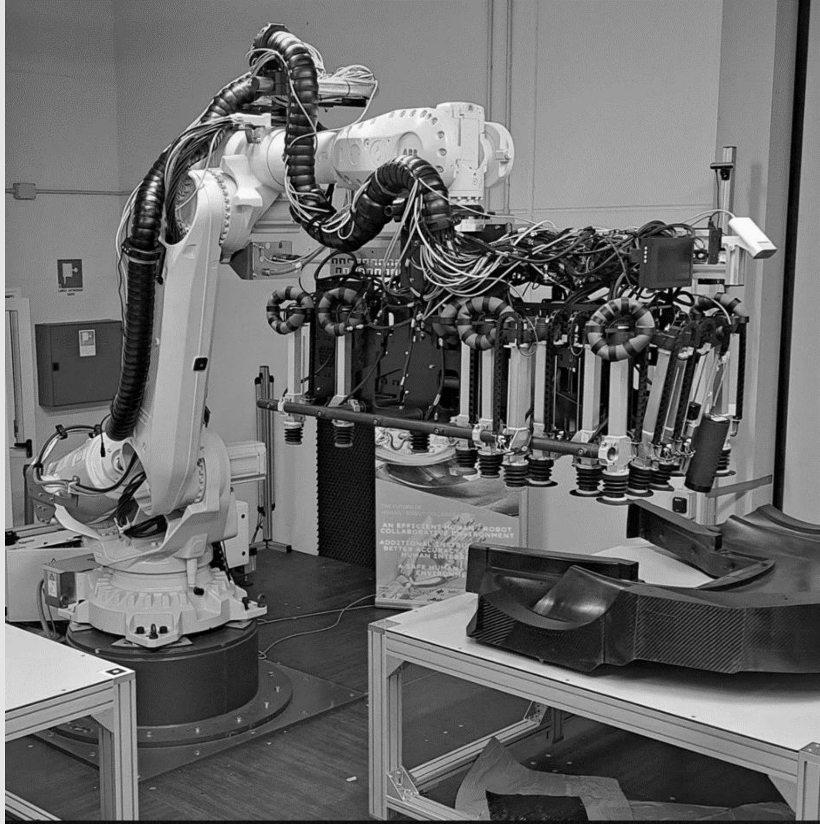
- Manufacturing of the hull, spars and other structural components of a 6m long power boat

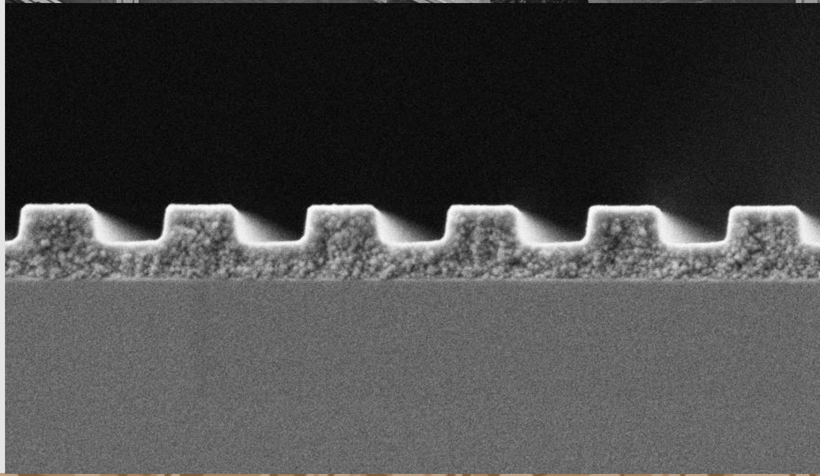
Outcomes

Outcome 1: High-precision manufacturing

BioStruct increases the accuracy of material handling during draping processes with natural materials by **developing a flexible, robotic gripper with integrated sensor system for the measurement of ply position** before pick-up and during handling. Sensors will also monitor the **re-orientation of fibre direction** during the actual draping process.

In parallel, a nanoimprint-based process will be developed to embed an **optical, Bragg grating based strain sensor**.





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Outcomes

Outcome 2:Highly resilient and flexible production lines

Flexibility: The gripper that is handling the material for the automatic draping of the fabric will consists of up to 24 suction heads that can be individually adjusted **to adapt to the local shape of the mould**. Furthermore, the power of the suction heads can be adjusted individually which will allow it to be **adapted to a range of different materials**.

Strategic autonomy: BioStruct project directly targets **25% of the total composite market share**, through the use cases in the field of boatbuilding and wind energy. However, there is also a big potential for applications in sports equipment and automotive, which will **increase the share to 45% of the market**.

Outcomes

Outcome 3: Reductions in GHG emissions

The BioStruct project has a potential of saving **between 2.5 and 4.3 Mt of CO_2 per year**, assuming that a significant market share in non-aerospace applications can be achieved

Outcome 4: Fostering the competitiveness of the European manufacturing industry

Bio-materials will have **a cost advantage** over carbon fibre, while they will be more expensive than glass fibre. In any case, the additional automation will **reduce the manufacturing costs**.

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Useful links - Contact

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