LSAM-OPT
Large-scale AM with optimised fibre reinforcement

smart
advanced manufacturing

Large-scale additive manufacturing (LSAM) integrated with topology-optimized fiber reinforcement

Abstract:

LSAM-OPT aims to transform part design and manufacturing by combining large-scale additive manufacturing with thermoplastic resin-infused fibre reinforcement guided by advanced topology optimization. By pulling fibres through dedicated cavities in LSAM-printed parts, the project enhances structural performance while enabling lightweight, recyclable components. This integrated approach overcomes limitations of traditional composites and supports high-end applications in aeronautics, automotive, and energy, improving efficiency, sustainability, and industrial viability.



Countries involved

Application sectors
Automotive, Industrial components.

Research and innovation domains
Advanced manufacturing processes, Sustainable manufacturing and customer-based manufacturing

Total cost in M€ (millions)
2.35 M€

Starting date
01/01/2026

Duration (in months)
36 months

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RATIONALE OF THE PROJECT

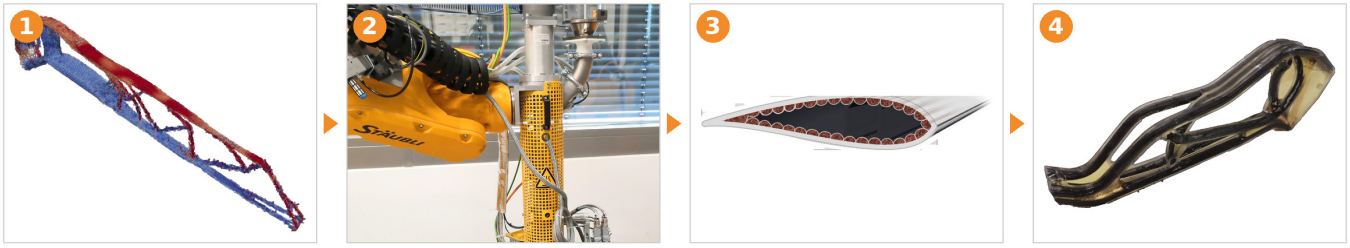
Large structural composite components (wind turbine blades, vehicle structures, energy equipment) are today made from glass or carbon fibre composites by vacuum infusion or resin transfer moulding. The complex shapes make uniform resin distribution and fibre orientation difficult, set-up costs are high, process defects directly reduce stiffness, strength and durability, and the thermoset materials generate in-process waste and are hard to recycle at end of life.

Large-Scale Additive Manufacturing (LSAM) offers remarkable design freedom and up to 95% less material waste than conventional routes, but layer-by-layer deposition leaves weak interlayer interfaces and anisotropic mechanical properties. Existing continuous-fibre AM methods only place fibres in-plane, parallel to the build plate, so they cannot follow three-dimensional load paths or strengthen the build direction.

LSAM-OPT addresses this gap with a two-stage approach: a topology-optimised base structure with integrated channels along the load paths is printed by LSAM, and continuous carbon fibre bundles are then pulled through the channels and impregnated with a thermoplastic resin. Supported by process simulation and a digital twin, the project will develop the materials, design guidelines, fibre-integration equipment and validation methods needed to bring the method from lab-scale feasibility to industrial demonstrators in the automotive and energy sectors, with a Swedish-German consortium of OEMs, SMEs and RTOs.

TECHNOLOGICAL INNOVATION, ACHIEVEMENTS AND RESULTS

The project introduces significant technological innovations beyond the current state of the art by developing environmentally friendly surface treatment solutions for medical implants. These surface treatments incude acid etching and anodization. Hazardous chemicals traditionally used in etching and anodization will be replaced with green chemical alternatives. In parallel, conventional Al2O3 blasting particles will be substituted with other biocompatible media such as hydroxyapatite to eliminate surface contamination. Nowadays, Al2O3 is widely used in the surface treatment of medical implants. However, blasting particles embedded in titanium implant surfaces that are not removed in later processing can pose clinical risks. In addition, novel surface treatment protocols are designed specifically for additively manufactured implants, addressing their unique surface morphology. Combination surface treatment protocols will be adapted on a robotic cell that can reliably produce the same results with every repetition. The project will achieve cleaner, more controlled implant surfaces with improved consistency and reduced environmental impact. The resulting processes are compatible with industrial production and regulatory requirements, delivering validated surface treatment routes that enhance implant safety, performance, and sustainability.



Load-path optimisation
Topology optimisation defines the base structure and fibre channels

Large-scale AM printing
Robot-based extrusion of the thermoplastic base structure

Fibre integration
Continuous carbon fibre rovings pulled and impregnated in the channels

Reinforced demonstrator
Lightweight, load-capable structure validated by static and fatigue tests

MARKET POTENTIAL

The global medical implant market continues to grow, driven by aging population, increasing surgical volumes, and the rapid adoption of 3D-printed implants. Manufacturers face rising pressure to comply with stricter environmental and medical device regulations while trying to maintain innovation, high product quality and competitiveness. The project directly addresses these market needs by providing cleaner, greener, and regulation-ready surface treatment technologies. Consortium partners cover key positions along the value chain, including surface technology providers, implant manufacturers, and research organizations, ensuring strong market access. This positioning enables rapid industrial uptake, integration into existing manufacturing lines, and future commercialization across multiple implant sectors.

IMPACT POTENTIAL

The project is expected to deliver strong environmental, industrial, and societal impacts by reducing the use of hazardous chemicals, lowering waste generation, and improving worker safety. Cleaner implant surfaces enhance patient safety and clinical outcomes, while sustainable processing supports regulatory compliance and long-term competitiveness of European implant manufacturers. The developped solutions will have the potential to be integrated into both custom-made and serial-made titanium implant manufacturing. By enabling greener production of advanced and 3D-printed implants, the project contributes to sustainable healthcare systems and medical device innovation.