CARACOL

Leading Additive Manufacturing Beyond

COMPANY OVERVIEW

2022



EXTREME ADDITIVE MANUFACTURING SOLUTIONS, WITH NO SCALE LIMITS, FOR ADVANCED INDUSTRIAL APPLICATIONS.

OUR VALUE PROPOSITIONS

TECHNOLOGY

Working with a wide range of advanced tech solutions: from state-of-the-art industrial printers to our robotic AM system, to manufacture parts with no limits in size.

INTEGRATED PROCESS

Integrating all core competences across the value chain, starting from know-how on materials and a network of partnerships with suppliers, as well as on hardware, software and on our client's industries.

ENGINEERING

We use the most advanced design for additive manufacturing techniques – working with generative and parametric design, and topological optimization of parts to improve geometries.

SOLUTION-ORIENTED

We accompany clients starting with identifying their needs and opportunities, and we customize our solutions to provide the most out of their adoption of additive manufacturing, addressing the most demanding requirement of the most advanced industries.

We accompany clients throughout the production process



TECHNOLOGY

An integrated process Engineering parts for AM from Design to Production

DESIGN TOOLS

From **parametric design tools** of parts to iteratively find the ideal solution based on performance and geometric requirements, to **computational design** inputting variables to define and manipulate complex geometries.

ANALYSIS TOOLS



We also perform **topological optimization** and **FEM analysis** while designing and optimizing parts, for example to anticipate part's mechanical or thermal behavior and more.

Caracol's Additive Manufacturing Technologies

ROBOTIC LFAM + CNC

Caracol's proprietary AM robotic system for large-scale, advanced parts, with a wide range of composite materials.

8 operating robots for AM Up to 3 x 3 x 12 m

CNC Post-Processing

Accuracy $\pm 0.05 \text{ mm}$ (small part smaller than 100 mm; $\pm 0.1 \text{ mm}$ for bigger parts) Both for metal & plastics/composites



INDUSTRIAL 3D PRINTERS

We have **40+** industrial 3D printers and work with a variety of state-of-the-art technologies.

FDM up to 100cm Accuracy \pm **0.3mm** (with a lower limit on \pm 0.3 mm)

MJF up to 38cm Accuracy ±0.3mm (with a lower limit on ± 0.3 mm)

SLA up to 30cm Accuracy ±0.2mm (with a lower limit on ± 0.2 mm)

DMLS up to 500cm Accuracy ± 0.2 mm (with a lower limit on ± 0.2 mm)

SLS up to 60cm Accuracy ±0.2mm (with a lower limit on ± 0.2 mm)





TECHNOLOGY

HERON AM, our LFAM platform, was developed to provide several benefits



Large Scale Components

Caracol's robotic system prints advanced parts with <u>no scale limits</u>, up to 12 m.

Complex Parts

Caracol's software algorithms and use of a 6-axis robotic arm allow to manufacture a higher number of applications and more complex geometries.

Lower Operating Costs & Flexibility

A highly flexible that adapts to productive needs, it works efficiently with low operating costs without compromising on quality and performance.

Lower Raw Material Costs

Works with a wide range of composites: from advanced techno polymers blended with fibers (e.g., carbon, glass) to recycled material shreds.

Drastically Cuts Material Waste

Can reduce up to 60% raw material used in production, using only material needed and printing without supports, it can also manufacture using recycled material.



We process a wide variety of polymeric materials

FILAMENTS & RESINS

We work with best-in-class 3d filament and resin providers who manufacture advanced and high-quality techno polymers, often also reinforced with fibers.

We also work with biodegradable and recycled filaments.

PELLETS & SHREDS

Our robotic system works with raw material in the form of pellets or shreds.

This allows us to work with a much broader variety of materials compared to the ones available traditionally in 3d printing and for much lower costs.

Polymers are blended with carbon, glass, and natural fibers, up to 40%.

RECYCLED MATERIALS

Collecting production waste from clients we can process the material, transforming into a reusable blend that we can work with on our robotic systems to manufacture new projects that enable companies to achieve circular economy.

MATERIALS

An overview of the materials we process



СЛRЛCOL

Our process guarantees quality and repeatability, and is certified with AS/EN 9100



EN 9100

SAI GLOBAL

ISO 9001

Quality

CARACOL

9

CLIENTS

The main industries we serve



CLIENTS

Some of the companies we've been working with



We provide several benefits to their manufacturing processes



Overview on our Services

Design & Concept Development

Using the most advanced AM software and design techniques we can bring to life products and components

Engineering

We optimize design for production in AM and we can test components' mechanical and thermal performance

Prototypes & Pre-Series with no size limit

Using both a variety of industrial 3D printers and an advanced robotic system for meter large prints Line Production of Finished Parts

Our flexible manufacturing set up can be organized to print multiple series of pieces

Production Tool Manufacturing

Large-scale tools, jigs, fixtures, molds, and beams for manufacturing – e.g., positioning, drilling, cutting, assembly, and other operations

Materials characterization and waste recycling

We develop 3D printing materials in filament or pellet form, starting from production waste materials or according to specific needs

Support Internalizing Additive Manufacturing solutions

We assist in understanding needs, identifying and providing the best tech, we install it and provide after service assistance

Additive Manufacturing Training and Workshops

We train company employees on 3D printing tech: project planning, tech use, identifying and knowing materials

CASE STUDY

Large Scale Tooling Jig

Large scale jig for suction and positioning of aircraft belly fairing panels



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PRODUCT	
Material	PP + 30% GF
Prod. Process	Robotic printing + CNC post-production
PERFORMANCE CRITERIA	
Size	84,8 cm (w) x 125 cm (l) x 32,7 cm (h)

SAVINGS vs. CURRENT SUPPLIER

Parts Integration	From 30+ to 1 piece
Production Time	From about 2 months to 2 weeks
Cost saving	35%



Rear Wing for Luxury Automotive OEM

High performing, aerodynamic, rear wing in PA12 reinforced and laminated with carbon fiber



Material	PA12 + Carbon fiber
Prod. Process	Robotic printing + Carbon fiber laminatior
PERFORMANCE CRITERIA	
Size	160 cm (w) x 40 cm (l) x 3.5 cm (h)
SAVINGS vs. CURRENT SUPP	LIER
SAVINGS vs. CURRENT SUPP Weight Reduction	LIER 33%
SAVINGS vs. CURRENT SUPP Weight Reduction Production Time	LIER 33% From 6 weeks to 5 days



CASE STUDY

Beluga Sailing Dinghy



PRODUCT	
Material	

Recycled PP + Glass fiber

Prod. Process

Robotic printing + post processing for hydrodynamics

PERFORMANCE CRITERIA	
Weight (hull)	48 kg
Size (hull)	280 l x 129 w x 32.5 h

EFFICIENCY

Production Time	40h
Customizable	100%
Cost saving	40%



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17

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