

# CARIM

## Deliverable

### Report



**Report title:** D3.3 Process chain ready for production of prototypes

**Nature:** DEM

**Dissemination level:** PU

**Grant agreement number:** H2020-FTIPilot-2015-1 - 690915

**Project acronym:** CARIM

**Project title:** Commercialization of a full carbon wheel manufactured with automated high-volume process for the automotive market

**Funding scheme:** Fast Track to Innovation

**Coordinator:** Mr. Philipp Rosenberg  
Fraunhofer ICT  
+49 721 4640 417  
[philipp.rosenberg@ict.fraunhofer.de](mailto:philipp.rosenberg@ict.fraunhofer.de)

**Project website:** [www.carimproject.eu](http://www.carimproject.eu)

**Responsible partner:** FHG

**Date of submission:** 30/06/2017

**Table of contents**

1. Introduction ..... 3

2. Preforming and Assembling..... 3

3. HP-RTM process ..... 4

4. Summary ..... 5

# 1. Introduction

In work package 3 of the CARIM project – **Setup of manufacturing process chain for carbon wheel** – the consortium is working on four tasks.

- In task 3.1 the preforming molds were designed and manufactured (see also the public deliverable *D3.1 – Preforming mold and manufacturing equipment ready to be taken into operation*). Task 3.1 ended after the first project year in December of 2016.
- In task 3.2 the HP-RTM was designed and manufactured (see also the public deliverable *D3.2 – HP-RTM mold for manufacturing of the wheel ready to be taken into operation*). Task 3.2 was closed by end of the first project year 2016.

The activities and results of the *task 3.3 – Process chain ready for production of prototypes* – were established in the first six months of the second project year and will be outlined in the current deliverable report. The following activities were carried out in task 3.3.

## 2. Preforming and Assembling

Setup of the preforming process chain and iterative modification and improvement of the preforming molds during manufacturing of the first prototypes.

The preforming process chain did not only involve the draping of the fabrics. Before the forming, the fibers have to be cut from the fabric roll having suitable near net shape geometry. In the following step the stacking of the different fabric materials needs to be carried out to obtain the required thickness of the preform and correct fiber orientation. After the forming, the preform is ready.

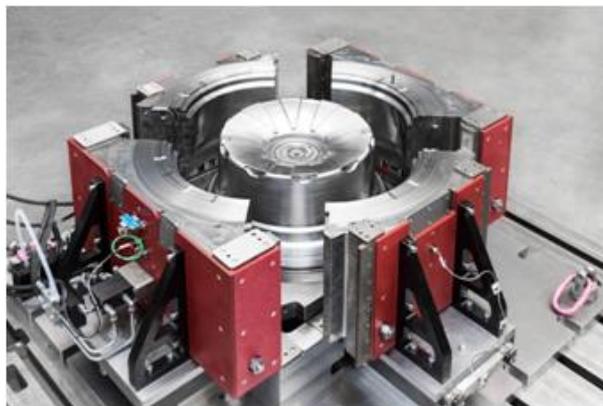
Some of the preforming mold had to be reworked and optimized to increase reproducibility and quality during forming of the preforms.

During the process development the highly complex wheel shape required more than one preform to achieve the dry, not impregnated wheel. Due to this additional requirement, an additional assembly step was integrated into the process chain: the preform assembly.

For successful assembly of the different sub-preforms an assembly station was developed and installed by Fraunhofer ICT. The focus during the development and design of the assembly station for manufacturing the wheel preform was to prove and establish an automatable process. Due to the low number of parts required, some of the process steps within the assembly were carried out manually, although they can be automated easily in the next generation of the assembly station (mainly handling steps).

### 3. HP-RTM process

The setup of the mold was done at ALPEX which included the installation of system hydraulics, vacuum connections, temperature distribution media, ejectors and sliders. Final checks and the geometrical fine tuning of the rim roundness and overall part thickness was measured using 3D optical measurement and adjusted with integrated distances. The production of the mold was finalized as scheduled in advance.



*Figure 1: CARIM HP-RTM: Lower part of the mold with open sliders*

Prior to delivering the mold to the facilities of Fraunhofer ICT for prototype manufacturing and process cell setup a holistic quality assurance protocol was carried out to prove the mold functionality. (...omissis...)

## **4. Summary**

Task 3.3 involved intense work and close cooperation and coordination of several activities to realize and setup the CARIM process chain within the given time. Initial prototypes were preformed, assembled and infiltrated successfully. A second trial session at Fraunhofer ICT was scheduled for mid-July 2017 to implement several improvements on the material and equipment side, to obtain a reproducible, quick and robust manufacturing process. The partners are therefore working intensely on the optimization of the different processes to achieve the project goal – a lightweight high-quality full carbon wheel made in a high-volume-capable manufacturing process.