The MAMA project, aims to reduce the manufacturing costs of primary titanium aerostructure parts and boost the economic competitiveness of the French aeronautics industry.

Lead by

IRT SAINT EXUPÉRY

5 years
08/2018 · 11/2023

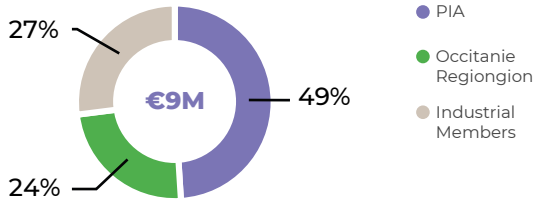
Members

AIRBUS · CIRIMAT Toulouse · INP · ENIT · OPTALM

Objectives

The industrial objectives are to significantly reduce recurring manufacturing costs, reduce the volume of raw materials used, and develop solutions for repairing aeronautical parts with very high added value. The project also contributes to a significant reduction in the environmental footprint of the aircraft manufacturing industry.

Budget



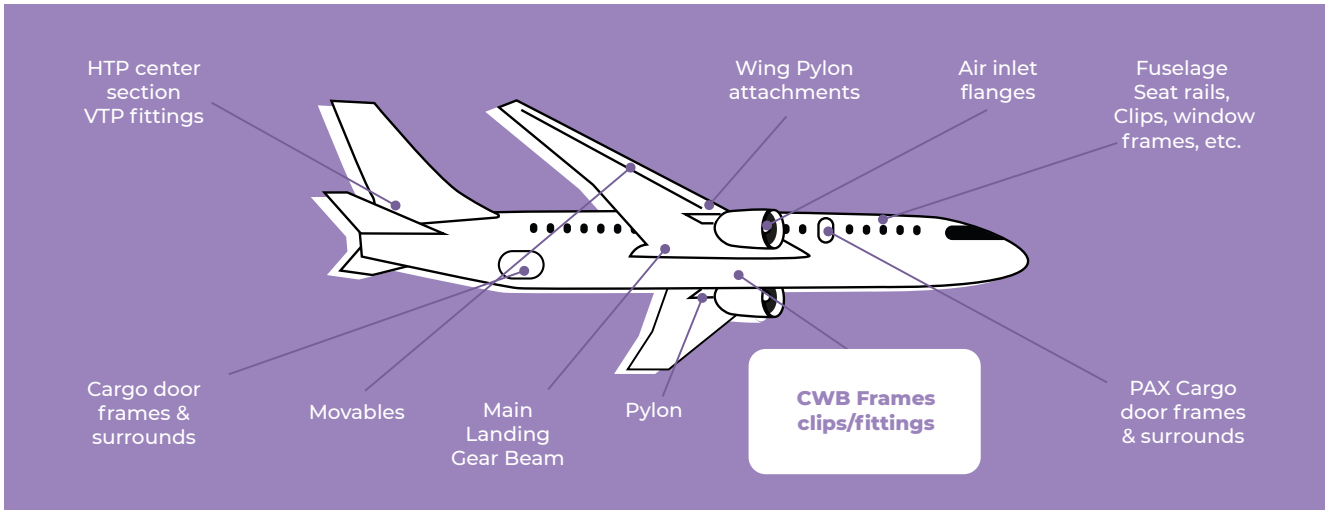


Figure 1 - Complex titanium aerostructure parts project target

The semi-industrial scale at which the project's research work was carried out, the digital tools developed and the levels of maturity reached have enabled us to achieve savings of around 30% on the raw materials used, compared with the current industrial situation. These gains have been consolidated thanks to the strong involvement of the industrial and academic project members (aircraft manufacturers, titanium suppliers, forgings suppliers, machinists).

Reduce the cost of large titanium aerostructure parts

-30% by drastically reducing the weight in use

material purchase cost, machining cost

-10% by simplifying of the manufacturing range

Research field n°1

High-temperature (HT) closed-die-forging in the Ti64 βdomain

Research field n°2

Combining HT closed die-forging with High Deposition Speed Additive Manufacturing

Research field n°3

Simplify the manufacture of ½ die-forged product

Multiple sources of energy savings

Figure 2 - Synthesis of the 1st three batches of the MAMA project to reduce Titanium raw material by 40%.

Methodological approach Based on a TRL scale adapted to process manufacturers

Proof of Concept (PoC) **TRL3** — 1st process step integration Semi-representative geometry **TRL4** — Integration of process steps & representative geometry **TRL5** — **TRL6**

WP4	HT rheology and microstructures
WP8	Surface contamination
WP6	distortions during machining

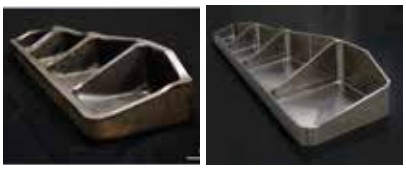
Precise characterization

upsetting of pancakes

Closed-die forged demonstrators: 200*100*60mm

Optimization of process parameters

1,000T pilot press



Demonstrator representative of a section of A350 fuselage frame: 800*220*120mm

Pre-industrial validation

existing industrial tools

TRL 5/6 high-temperature closed-die forging demonstrator

Figure 4 - representative section of an Airbus A350 fuselage frame, TRL 5 & TRL6

Figure 5 – Same section after finish machining

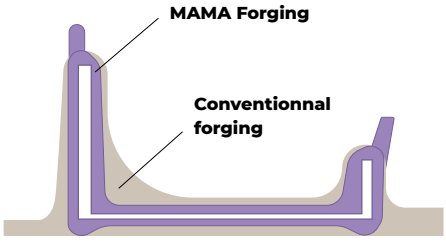


Figure 6 - Principle for reducing the weight of titanium used in closed die-forging

A major change of scale has taken place with a view to validating the TRL5 level (Figure 4) and then the TRL6 level in autumn 2023, on 800 mm long demonstrators corresponding to a representative section of an Airbus A350 fuselage frame.

Manufacturing realism has also progressed considerably, thanks to the introduction of distribution forging prior to closed-die forging and closed-die forging on an industrial press - Aubert & Duval's 22,000-ton press. The other processing stages, hot (heat treatment) and cold (chemical machining, non-destructive testing and mechanical machining), are also carried out on industrial facilities, including that of partner MECAPREC for final machining (Figure 5).

With a total of 8 closed-die forged demonstrators, all of which, after chemical machining, meet the requirements of dye penetrant inspection and dimensional control, and confirmation that the buy-to-fly ratio has been reduced by 30%, the MAMA project offers exciting prospects for the aerospace industry.

Other A350 fuselage frame demonstrators are currently being manufactured to validate TRL6. This would pave the way for industrialization of the process by AIRBUS, AUBERT & DUVAL and MECAPREC.

Contact

Arnaud Hacquin
arnaud.hacquin@irt-saintexupery.com

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