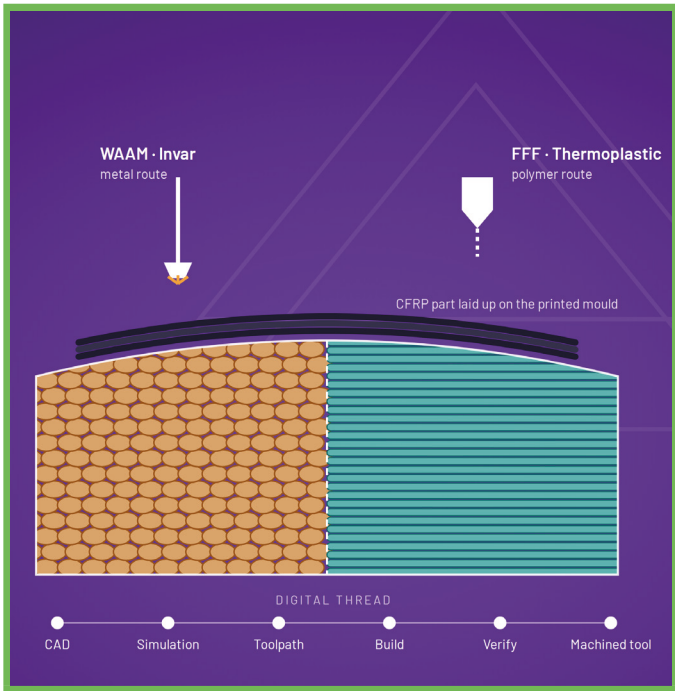
COMPADDITIVE
Advancing Composite Moulding With Additive Manufacturing

Abstract:
COMPADDITIVE develops additive manufacturing routes for composite lay-up moulds as a faster, cheaper alternative to machining tools from solid plate. Two complementary processes are advanced side by side: wire-arc additive manufacturing (WAAM) of Invar and large-format fused filament fabrication (FFF) of high-temperature thermoplastics. A shared digital thread of toolpath planning, fast process simulation and process verification supports right-first-time builds. Demonstrator moulds are validated on aerospace use cases, targeting over 60% shorter lead time and over 25% lower tooling cost.



Countries involved

Application sectors
Aerospace, Automotive, Railway, Marine, Energy

Research and innovation domains
Advanced manufacturing processes, Smart & adaptative manufacturing systems, Digital, virtual and efficient companies, Sustainable manufacturing, Customer-based manufacturing

Total cost in M€ (millions)
2.03 M€

Starting date
01/01/2025

Duration (in months)
36 months

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Project participants
Turkish Aerospace (coordinator); Prodigma; AMRC, University of Sheffield; Additure; Aibuild; voestalpine Böhler Welding

RATIONALE OF THE PROJECT

Composite parts make up a growing share of modern aircraft, and every part needs a lay-up mould that survives autoclave curing (180 °C, 7 bar) and matches the low thermal expansion of carbon fibre. Today these moulds are mostly machined from large Invar plates or built with conventional tooling routes. Lead times are long, most of the raw material is lost as chips, and every design change means a new tool, which slows development programmes and raises cost.

Additive manufacturing (AM) can build near-net-shape moulds with design freedom and no extra cost for one-off or low-volume tools. However, wire-arc additive manufacturing (WAAM) and large-format polymer printing are still at low technology readiness for tooling. The main challenges are reliability, dimensional accuracy, surface quality, airtightness and productivity, together with the lack of validated process parameters for Invar and high-temperature thermoplastics.

COMPADDITIVE addresses these challenges with a consortium that covers the full value chain: wire feedstock, process research, contract WAAM, polymer printing, software and an aerospace end user. The project develops and compares a metal route (WAAM Invar) and a polymer route (FFF thermoplastic), joined by one digital thread, so the most cost-effective tool can be chosen for each part, from prototyping to high-rate production.

TECHNOLOGICAL INNOVATION, ACHIEVEMENTS AND RESULTS

Innovation: COMPADDITIVE develops WAAM Invar and large-format FFF thermoplastic routes side by side for the same aerospace lay-up tools, with a cost method that shows which route suits each part. Instead of feedback control alone, it uses feed-forward control of process parameters based on part geometry, supported by fast thermomechanical simulation and process verification, to reach right-first-time builds.

Achievements to date:

- Invar 36 WAAM test walls and build trials completed and sent for microstructural and mechanical analysis; Additure has started AS9100 aerospace quality system integration.

- Thermoplastic mould material selected (high-temperature PEI-based materials) after a material screening study.

- Aibuild software integrated with the Gefertec WAAM system (MoU signed, G-code generation demonstrated); integration with the Intamsys FFF printer is under way.

- Profiles parameter library released (beta, July 2026) and new slicing tools for mesh analysis, auto-orientation and overlap checks.

- Thermomechanical simulation (FETS) validated against physical prints: layer temperature within ±3.2% of infrared measurements, better than the 5% target; an AI surrogate model runs about 40 times faster than conventional FEA.

- Demonstrator moulds redesigned for AM by Turkish Aerospace and checked against the machine envelopes.

MARKET POTENTIAL

The global composites market is forecast to reach 181.7 bn USD by 2028, with Europe about one third. Additive manufacturing is expected to grow six-fold to 110.1 bn USD by 2033; metal AM in aerospace and defence grows at about 21.5% a year and polymer AM in aerospace at about 22%. WAAM and large-format polymer printing are niche markets with few specialised suppliers, so validated tooling routes give an early advantage.

The consortium has direct market access along the value chain: voestalpine Böhler Welding will sell Invar wire, Aibuild software modules, Additure WAAM Invar moulds as a contract service, Prodigma thermoplastic moulds, and AMRC tooling know-how to its industrial members. Turkish Aerospace, a Tier 1 supplier to major aircraft manufacturers, is the first user. Aerospace is the first market, followed by automotive, marine, energy (e.g. wind blades) and rail.

IMPACT POTENTIAL

COMPADDITIVE targets over 60% shorter lead time and over 25% lower cost for composite tooling, with far less material waste than machining from solid plate. Moulds can be produced on demand and changed quickly after a design change, making aerospace supply chains more flexible. Each partner gains a new or improved product or service, and the voestalpine Böhler Welding wire alone is expected to add about 2 M EUR turnover in five years. The project is expected to create around 12 high-skilled jobs in Türkiye and strengthen European AM capability in Türkiye, the UK and Germany.

