Composites UK Trade Association

TWI

INNOVATION IN COMPOSITE MANUFACTURE

FINALIST: TWI

The Novel Composite-to-Metal Joining project introduces a friction stud hybrid joint technology designed for large-scale composite structures in marine, energy, transport, and defence sectors. Unlike conventional drilling, fastening, or hybrid penetrative reinforcement, this innovation embeds large metal studs directly into the composite during vacuum infusion, forming a mechanically interlocked and adhesive-bonded joint in a single step. The displacive forming process requires no additional material and preserves fibre continuity around the stud, enhancing load transfer, shear strength, and post-failure residual strength.

End users apply this innovation during composite manufacturing where robust metal connections are required. It eliminates labour-intensive post-cure drilling, reduces stress concentrations, and provides mechanical redundancy in harsh environments. Applications include ship hulls, composite superstructures, tidal turbines, offshore wind structures, heavy transport panels, and civil infrastructure. The technology streamlines assembly, lowers weight, increases safety, and accelerates production, offering significant commercial advantage.

The innovation phase involved feasibility studies, concept development, numerical simulation (Abaqus/CAE), prototype manufacturing, and experimental validation of large-diameter single studs. Specialist skills in composite manufacturing, finite element modelling, hybrid joint mechanics, and dissimilar-materials integration were essential. The process achieves TRL 4, demonstrating scalability and practicality for industrial deployment.

The global composites market is estimated at 12.7 Mt ($41B material value; $105B assemblies), with growing adoption of hybrid structures. This friction stud joint technology provides a scalable, cost-effective solution for large composite-to-metal assemblies, offering long-term licensing potential and cross-sector adoption.

Developed by TWI under its Core Research Programme, the project was supported academically by Brunel University of London, ensuring both industrial applicability and technical rigour.

Learn more at: www.twi-global.com