



John Crane's Fortus 450mc 3D printer, located at the company's Slough site.

John Crane Transforms Tooling and Metal Part Replacement with Additive Manufacturing

Founded more than 100 years ago, John Crane is a global leader in rotating equipment solutions. The company designs and manufactures a variety of products including mechanical seals and systems, couplings, filtration systems and predictive digital monitoring technologies. At one of the company's European developmental sites in Slough, United Kingdom, the team is responsible for activities including product manufacturing, testing, service and repair.

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Liam Johnston

**Program Manager, Advanced Manufacturing,
John Crane, Global Operations**



In November 2018, a new Advanced Manufacturing team was created at the Slough site due to the increased importance of additive manufacturing in the company's service offering. This team 3D prints tooling for shop floor personnel to aid with production operations, as well as low-cost, customized jigs and fixtures that enable R&D teams to rapidly test new design concepts and manufacturing processes.

Overcoming Traditional Manufacturing Challenges With FDM Additive Manufacturing

The team was tasked with overcoming the challenges of producing traditionally manufactured components and parts to evaluate time and expenditure savings. Having tested a number of technologies, the company approached Stratasys' local partner, [SYS Systems](#), to purchase a Stratasys [Fortus 450mc™ 3D printer](#). Key to the decision was the range of engineering-grade materials available, specifically [FDM® Nylon 12CF](#) – an advanced 3D printed composite material comprising 35% chopped carbon fiber. Not only did the material properties enable the team to meet the high-performance demands of traditionally manufactured parts, it also allowed John Crane to expand its 3D printing production capability into new applications as part of its daily operations.

“We invested in the Fortus 450mc as we found it to be the best alternative to CNC machining expensive metal parts,” said Liam Johnston, Program Manager, Advanced Manufacturing, John Crane, Global Operations. “The added capabilities have made an immediate impact on our production process. Using FDM Nylon 12CF, we're able to 3D print parts that perform similar to CNC-produced alternatives.”

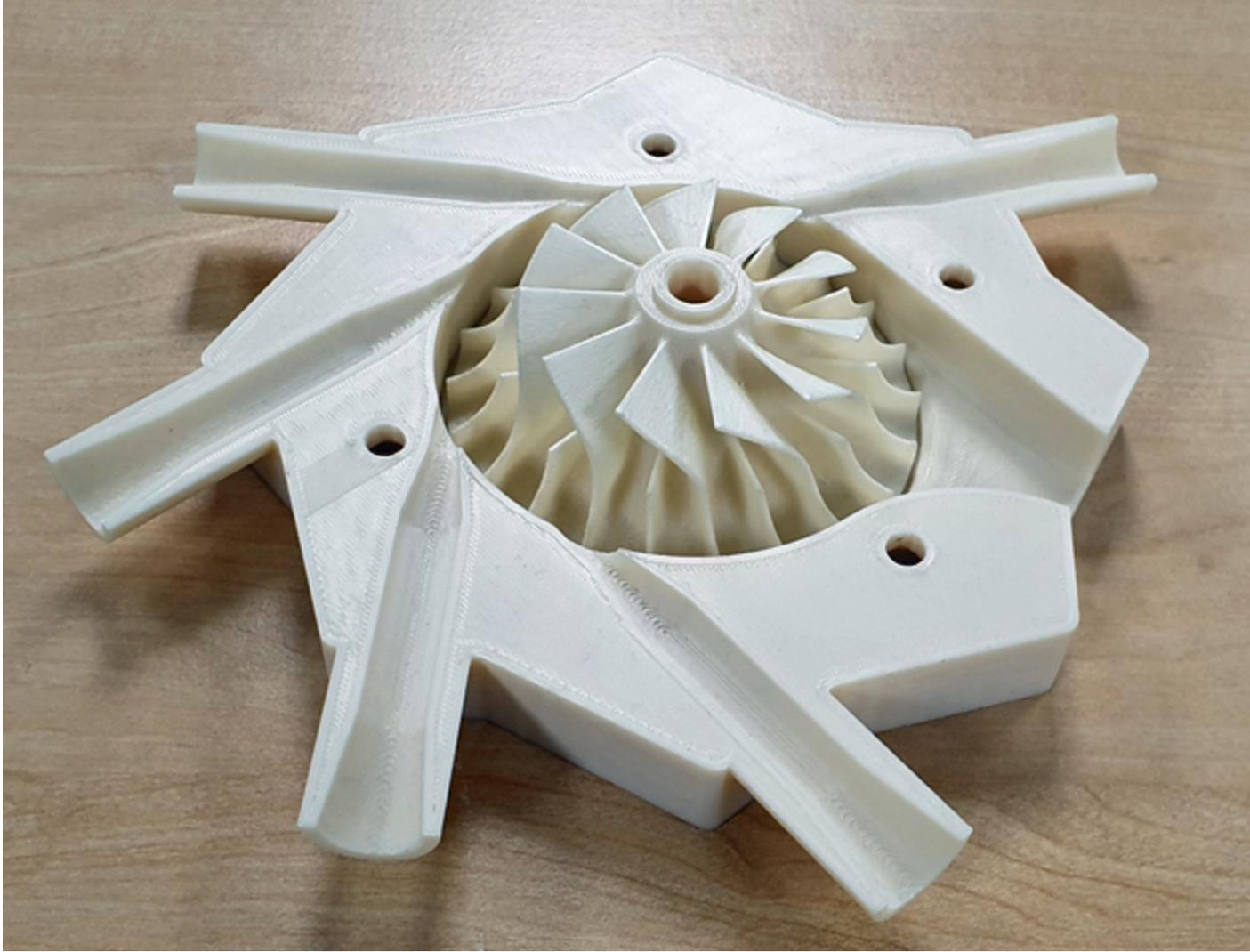
“This not only saves us significant time and cost compared to conventional production methods but having these applications in the field has given end-users the confidence in the materials' and printer's capabilities. It has also raised awareness within our operations teams who are now actively coming to our team with new 3D printing requests.”

These benefits were shown by the Additive Manufacturing team in the design and production of an impeller casing for a spin test rig. The rig uses gas flow to spin seal components at high speeds to validate their capability to endure the high forces experienced during service. However, certain components required higher speeds than the current rig's capabilities. As a result, they had to be shipped to subcontractors for spin testing, adding cost and increasing lead times.

The team overcame these drawbacks by designing and 3D printing a new casing. It improved the air flow around the impeller, enabling higher speeds on the in-house rig. According to Johnston, two design iterations were created, manufactured, and tested over a one-week period, significantly less time compared to subcontracting.

Johnston explained, “The internal shape and flow distribution are difficult and expensive to achieve with conventional machining. However, the single 3D printed piece replaced an assembly of 22 machined metal components and is about 98% cheaper to manufacture. The upgraded rig can now be used for testing all seal components, which reduces test costs by 65% and lead time by three weeks compared to subcontractor spin testing. This is a huge result for our business.”





One of the 3D printed impeller casing design iterations, produced using the Fortus 450mc.

Furthermore, additive manufacturing supports the company's commitment to a positive health and safety culture. The team 3D printed replicas of carbon seal components that are used to train employees in seal assembly. These pieces are much lighter and safer to handle as they eliminate the risk of carbon splintering if a piece is damaged. Along with custom guards for equipment and tooling, they have allowed John Crane to rapidly address a number of potential safety hazards.

Machining jaw accessories are another example of significant time and cost savings provided by 3D printing. As John Crane tends to produce a range of products in small batches, setup operations comprise significant downtime within its CNC machining centers. This involves swapping out metal clamping jaws to match the diameter of the part being machined. These metal jaws and other CNC tooling can take up

valuable storage space and are not always in stock, requiring extra time for ordering, delivering and machining new tools to the required profile. To solve these issues, the team created new designs of standard chuck jaws supported by interchangeable 3D printed clamping inserts and alignment sleeves using FDM Nylon 12CF. Several jaw accessory designs can now be printed before the start of each shift to match the profiles and sizes of the parts to be machined.

"These new printed work holdings can reduce average machine setup time by up to 80% and free up additional CNC capacity that would be used for machining metal jaws. Those typically unseen costs and delays associated with raising and shipping orders for new jaw types are now eliminated. For most of our tooling applications, Nylon 12CF provides the best combination of strength, cost and surface finish," said Johnston.



A 3D printed jaw accessory produced in FDM Nylon 12CF – these parts save up to 80% of machine setup time.

Looking Ahead to the Future

As the appreciation of additive manufacturing's benefits continues to grow within John Crane, Johnston sees the move to using 3D printing to produce end-use parts as a natural next step.

"Having used our Fortus 450mc for much of our production work has enabled us to better understand the significant potential of additive manufacturing for the replacement of production parts and tooling," said Johnston. "Having an

industrial-grade FDM machine on our shop floor has enabled us to demonstrate the capabilities of the technology to shop floor personnel and managers, educating all of our teams in the process. This has naturally led us to explore how we optimize this technology even further for end-use part production where we see real potential for a range of low volume manufacturing applications."

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