Finishing the Job

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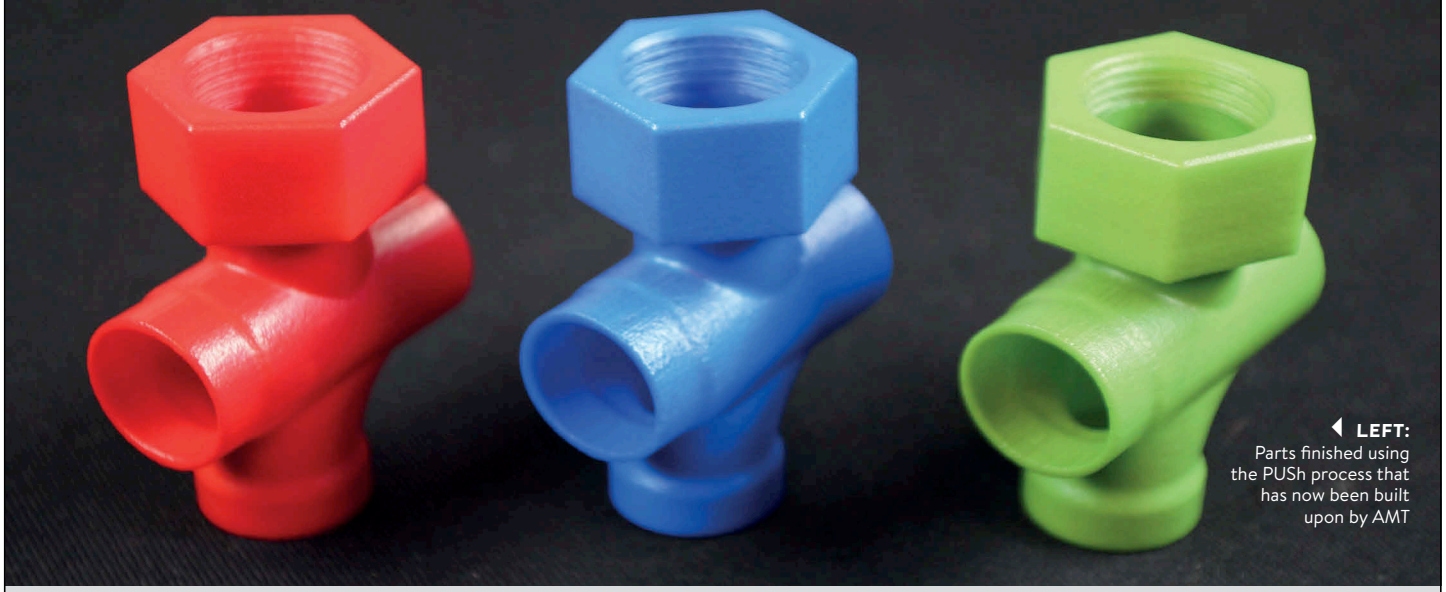


LEFT: Parts finished using the PUSh process that has now been built upon by AMT

DANIEL O'CONNOR BLASTS THROUGH THE WORLD OF POST-PROCESSING POLYMERS TO SEE HOW ONE SHEFFIELD-BASED COMPANY HAVE TAKEN UP THE TASK OF MAKING 3D PRINTING'S MOST ANALOGUE STEP DIGITAL.

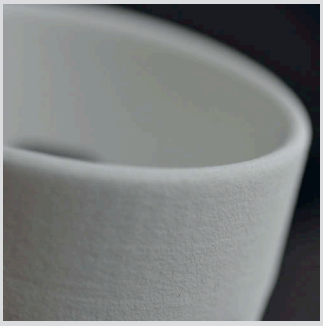
IN MAY 2016, the British Government's innovation agency, Innovate UK posted a funding competition for a share of £4.5 million for collaborative industrial research projects that stimulate innovation in additive manufacturing (AM).

Previous government funding for additive manufacturing has focussed on either additive machinery itself or application specific technologies like the MTC-based Aerospace Research Centre. This latest call was much more prescriptive in what it wanted projects to achieve – digitally connected additive innovations.

"People will tell me that additive manufacturing is inherently digitally enabled," said Robin Wilson, Lead Technologist of High-Value Manufacturing at Innovate UK during the competition's launch. "A lot of what we fund, currently and in the past, has been the machinery and process in isolation. All the fiddling you do before and after the process, some of it is digital but some of it is incredibly manual and physical. What we're inviting you to do is use the principals of Industry 4.0 to connect these up into a digital world."

The "fiddling" after the 3D print is what we know as post-processing and one, Sheffield, UK-based startup knew that the technology it was working on was exactly what Innovate UK was looking for.

"Additive Manufacturing Technologies (AMT) was formed in 2015 to look specifically at the post-processing element of additive manufacturing," CEO Joseph Crabtree says. "With post-processing, there are a couple of key issues, mainly centred around hidden costs - the labour costs and time costs. There have been some interesting studies which have shown that the finishing cost of additional labour and processing per industrial 3D printer accounts for 70-100% of the costs of the parts."



THE PROBLEM

In 2017, 3DPRINTUK is set to more than double its selective laser sintering (SLS) capacity with the purchase of two new EOS machines. The company has streamlined the process of pre-build and build itself to such an extent that Managing Director, Nick Allen says he won't need to bring any new staff for those steps, post-processing on the other hand...

"We will need more people as it comes out of the machine as we get more capacity," says Nick. "In the office today there are seven people down cleaning, on a Monday when we have the most amount of builds from the weekend it draws the whole workforce down there (to post-processing), then you've also got part sorting. We produce about a 1,000 parts a night at the moment and there's usually about four or five jobs that are multiples of 50 to 100 and then the rest are all individual items so sorting them is a nightmare. That's a major bottleneck and very labour intensive."

Nick's not alone with this kind of problem and believes that post-processing is the reason so many big companies outsource 3D printing work. Although Nick's contemporary, Jonathan Rowley, Design Director at Digits2Widgets, disagrees that the post-processing of SLS parts is that bad, ("it's a relative breeze in comparison to some of the other technologies that require UV curing or support removal,") Jonathan does concur that the vibro-finishing his bureau offers as an additional finishing service is far from perfect. ››

RIGHT: Vibro-polishing by D2W

"With vibro-finishing there's a limit to how delicate a part can be," says Rowley. "There are also issues about details and undercuts on parts, the chips aren't always small enough to get into certain spaces so you get a nice finish on the open surfaces but the bits where the chips can't get in remain unpolished."

THE SOLUTION

Joseph Crabtree's AMT has developed a proprietary technology called PostPro3D that is based on a University of Sheffield technology project by Professor Neil Hopkinson and Adam Ellis called PUSh. Two years ago Hopkinson, now 3D Printing Director at Xaar, told TCT Magazine that the PUSh process was able to finish 25 palm-sized Nylon 12 sintered parts in under an hour. "With PUSh, you are getting the best of both worlds, a really clean finish that is not line of sight," said Neil at the time.

The PUSh process was used to finish several notable 3D prints, the most prominent being AMUG Technical Competition winner for Advanced Concept, The Under Armour Architech training shoe. Alan Guyan, the brains behind the latticed heel that was designed generatively using Autodesk Within, needed to finish his Luvosint TPU SLS prints throughout.

"SLS parts naturally have a gritty surface finish that is not acceptable for finished footwear products," Guyan told TCT. " The PUSh process added a new-level of finish to our 3D printed components."

As great as PUSh proved for individual projects, as a lab-based process, it wasn't scalable and it was still analogue. Joseph, a material scientist and mechanical engineer working in the aerospace industry until carving his own path by launching AMT, set about building upon the PUSh process to simplify and digitise it, the result is PostPro3D.

"Our solution is a repeatable and reproducible process that allows a user to have a digital post-production method," explains Joseph. "In a nutshell, you put your parts into our machine, select the surface roughness you require either in microns or via a pictorial representation, press go and a number of minutes later your parts come out as required

THE FUNDING

SLS parts have a surface roughness of around 15 microns, the ability of PostPro3D to select anywhere below that value and ensure that you are getting the same result each time will be invaluable to service bureaux and manufacturers alike. Currently, the process is not automated and this is where the Innovate UK funding competition comes in.

Together with the inventors of the PUSh process, now of Xaarjet and Atomjet, who helped build the first High-Speed Sintering machine, AMT led a pitch for funding to create a saleable automated post-processing machine, develop intelligent algorithms and develop a machine that is fully integrated into the digital manufacturing chain. The pitch won the consortium £624,000 of the £4.5 million on offer from Innovate UK. This sort of funding allows AMT and co. two years to create a fully smart version of PostPro3D technology that brings the post-process step of additive manufacturing inline with Industry 4.0 initiatives.

"We've done a lot of work on our base technology, this combined with the specific end-use applications we've been involved in gives us a grounding both in terms of the types of materials processed and the types of complexity and certain finish of the parts. We've got a very good dataset and technical know-how of how we can take that forward to automate the process."

Joseph believes that automating the post-process will take away significant roadblocks that stop OEMs like Airbus and Rolls Royce bringing their entire 3D printing operations in-house. But the burning question as with any ground-breaking technology is cost?

"If you look at a traditional tumbling system for example plus the ancillary equipment it is fairly expensive and then you have labour on top of that," explains Joseph. "What we want to do is price it at the point where the business case remains comparable with that."

Although initially AMT's technology will be targeted industrial markets that use polymeric materials like Nylon 11, 12, TPUs and TPEs the team are looking at post-processing of FDM materials and because of the scalability of PostPro3D do foresee a desktop version for smoothing of ABS parts in the future. ■

BELOW: Lattice structure of Under Armour Architech shoe was finished using PUSh