

3D printing of plastic and titanium parts for racing bicycles

Read how RaceWare Direct, a start-up company, leveraged additive manufacturing technology to literally build a business.

Martyn Harris called on two personal skills last year when starting his new business, RaceWare Direct, to manufacture bespoke plastic brackets for mounting instruments onto racing bikes and to produce titanium components such as chain catchers and handlebar stems.

First, he has been a keen cyclist since he was 14 and represented Team GB in 2011, when he won the Track Cycling Masters World Championship in the scratch race for the age category 35–39. Second, he is an expert in additive manufacturing, also known as industrial 3D printing, having been employed at 3T RPD in Newbury since 2000. Note: At 3T

RPD, EOS machines are used to build prototypes and fully functional components from plastic and metal powders, directly from CAD models.

Harris now splits his time between 3T RPD and RaceWare, which is located next door. The new venture came into being in early 2012, after he tried to buy a mount to secure a computerised power meter safely and neatly to his aero extension TT bars (forward facing extensions to a bike's handlebars that improve aerodynamics in time trials).

"All I could find was a horrible adaptor kit, which included cable ties to lash up the instrument to the bars, so I thought I would make my own mount using the EOS additive manufacturing machines at work," Harris recalled.

The CEO at 3T RPD, Ian Halliday, was very supportive of Harris' venture — and still is.

"I quickly discovered via the Internet that a lot of other people were looking for ways to mount power meters, global positioning systems (GPS), cameras and other instruments to their bikes, without using the manufacturers' clunky bracketry," Harris stated. "The interest came not just from the TT racing community, but also from road bikers and leisure cyclists."

One of the contacts was cycling enthusiast Jason Swann, who sent through a CAD file of his ideal mount for a Garmin Edge GPS. It took just four months for



Martyn Harris (left), who is also IT Manager at additive manufacturing specialists, 3T RPD, with its chief executive officer, Ian Halliday.



A Garmin GPS computer attached to a road drop bar using a RaceWare mount. The instrument allows a cyclist and his or her team to navigate a route and monitor performance, distance travelled and speed.

Harris to progress from the first iteration to the wide range of products that RaceWare now sells online for mounting Garmin equipment onto road drop bars and aero extensions. They cater to every possible bar size and stem width combination, to allow perfect central positioning of the GPS device. The mounts can be painted after vibro-finishing, if the customer prefers a neon colour to the white of the EOS PA2200 nylon material from which the products are 3D printed.

Harris rides for the Banjo Cycles Racing Team, which undertook a six-hour mountain bike endurance challenge using the Garmin mounts to test them under extreme conditions. They were found to be very stiff, with minimal vibration and movement throughout the challenge.

The variety of Garmin mounts manufactured means that batch sizes are small, from 10-off to the low thousands. It would not be cost-effective to produce them by injection moulding, as the tooling would be prohibitively expensive. Building 3D parts directly, layer by layer, not only involves much lower initial outlay, but it also speeds progress from the drawing stage, through honing the design in CAD and 3D printing prototypes, to production of the finished articles. (Even his CAD expertise is bought in, as RaceWare uses the services of Rob Weighill Design, one of four finalists in

the Young Designer of the Year category in The Plastics Industry Awards 2013.)

“People find it difficult to understand how we produce new parts so rapidly,” Harris stated. “They ask about lead-time and I reply ‘two to three weeks’, whereas they are used to hearing six months to a year.”

According to Harris, RaceWare produced in a matter of days two bespoke Garmin 500 mounts with lettering down the side, saying: ‘Reading GP 2013’, one each for the winner of the men’s and ladies’ races at a meeting in July.

RaceWare also markets lightweight metal bike parts, which are manufactured



Garmin GPS navigation systems secured to RaceWare mounts for attaching to racing bicycle handlebars. The stiff nylon mounts are made in EOS laser sintering machines and subsequently painted.

additively in EOS machines designed for producing a nest of components, layer by layer, from metal powder rather than plastic. In addition to the hollow titanium chain catcher, which is now a commercial product, and the very stiff handlebar stem, which is still at prototype stage, Harris has just started offering a titanium race number holder and will be looking to introduce more metal parts next year. The powder material used for these applications is EOS Titanium Ti64.

An example of how additive manufacturing can be the enabling technology for starting a business.

Although RaceWare has been in existence for only 18 months, nearly 6,000 products have already been produced in EOS systems at 3T RPD, which runs six machines for plastic and five for metal. (Martyn subcontracts his manufacturing to a bureau, so he does not bear the costs of investing in EOS' laser sintering machines.) Harris likes their reliable and consistent performance, which allows high-quality parts to be produced during every build. This is important for RaceWare, as in addition to selling its products in almost every country, it supplies numerous elite UK and overseas cycling teams — all of which demand top quality. Many of the most famous cyclists in the world, including those competing in this year's Tour de France, have RaceWare products on their bikes.

Stuart Jackson, regional manager at EOS Ltd, the UK & Ireland subsidiary based in Warwick, commented, "This is an outstanding example of how additive manufacturing can be the ideal enabling technology for starting a new business. With no up-front tooling costs and the ability to tweak designs along the way, it supports a low-cost, innovative culture that brings products to market very quickly."

The business model is perfect for a high technology company start-up, as it can leverage an entrepreneur's specialist knowledge, expertise and passion with hardly any financial risk. ■



A 24 ct gold-plated plastic mount for a Garmin Edge 500 was presented to RaceWare's 1,000th customer.



RaceWare's 3D-printed titanium chain catcher has weight-reduction features that would be almost impossible to produce using conventional subtractive machining methods.

About EOS

Founded in 1989 and headquartered in Germany, EOS is the technology and market leader for design-driven, integrated e-Manufacturing solutions for additive manufacturing (AM, or "Industrial 3D Printing"). EOS offers a modular solution portfolio, including systems, software, materials and material development as well as services (maintenance, training, specific application consulting and support).

As an industrial manufacturing process, it allows the fast and flexible production of high-end parts based on 3D CAD data at a repeatable industry level of quality. As a disruptive technology, it paves the way for a paradigm shift in product design and manufacturing. It accelerates product development, offers freedom of design, optimizes part structures, and enables lattice structures as well as functional integration. As such, it creates significant competitive advantages for its customers.

For more information please visit www.eos.info.