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Industrial 3D printing yields success on the Formula Student circuits

Customer:
The GreenTeam

Industry:
Automotive

Challenge:
Assess the engineering performance of students, the costs of the car and a marketing strategy for the racing car of a fictitous investor.

Solution:
Renishaw's additive manufacturing (AM) technology.

Formula Student is an international student design competition that was initiated in the USA in 1981 by the Society of Automotive Engineers (SAE), and has been held in Europe since 1998. The fiercely competitive international competitions take place on race tracks in Europe, the USA and Asia, and each team decides individually in which competitions it would like to take part.

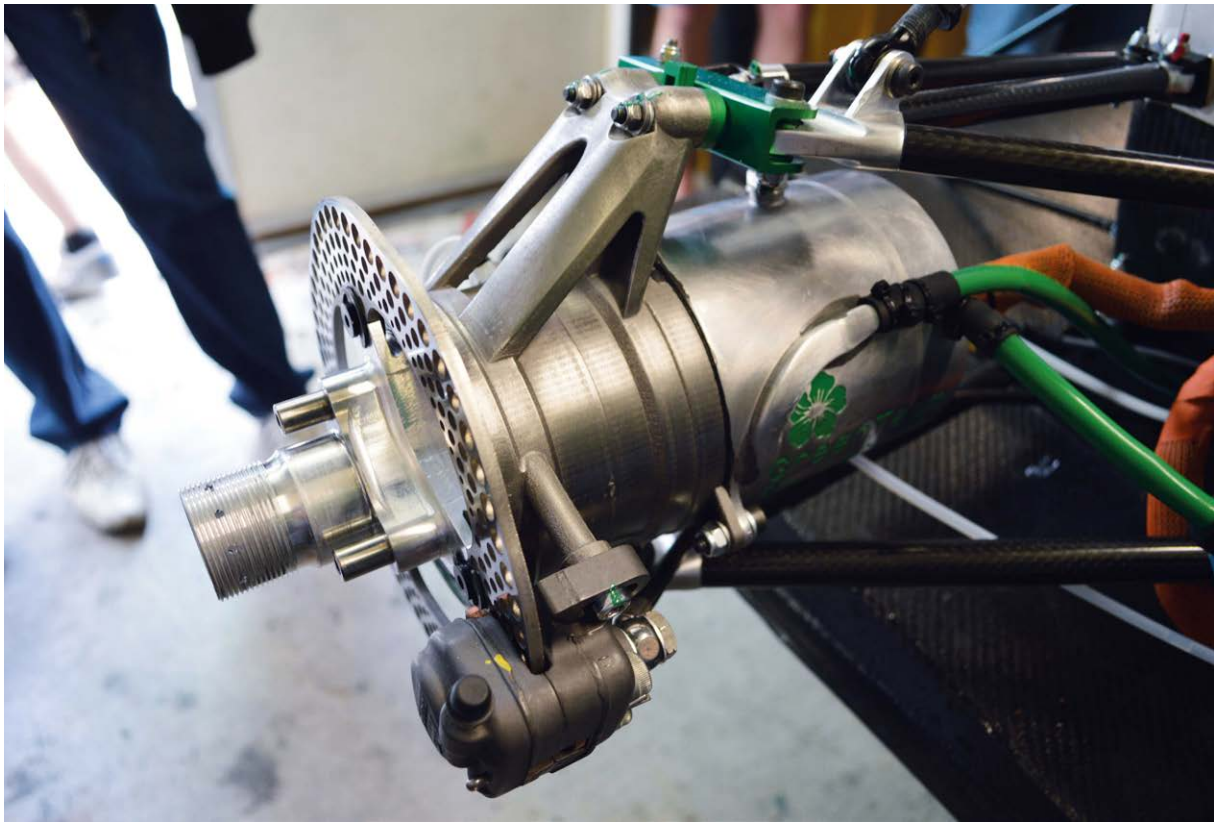
Formula Student

The best-known competition is Formula Student Germany in Hockenheim, which attracts the most successful teams from all the nations of the world. Apart from performance on the track, Formula Student is also a chance to assess the engineering performance of the students, the costs of the car and a marketing strategy for the racing car of a fictitious investor (Source: GreenTeam Stuttgart).

Engineering and design process

The GreenTeam's electric racing car was designed and built by students studying mechanical engineering, automotive and motor engineering, and electrical engineering at the university of Stuttgart. Today, more than 110 teams with electric motors and more than 600 teams with internal combustion engines from all over the world compete in Formula Student, which launched in the early Eighties, making it an international event to be taken seriously. With motor powers of up to 100 kW (130 bhp) and maximum speeds of up to 80 mph (130 km/h), this student version of Formula 1 demands the very best that modern engineering can offer. In addition to engine power or traction control, the weight of the vehicle also makes a significant contribution to performance on the track. In spite of relatively heavy batteries, the GreenTeam single-seater, equipped with four independently controllable electric motors, is lightweight at 178 kg in total.

> "Compared with previous aluminium wheel carriers, Renishaw was able to save a total of 1.5 kg in vehicle weight, enabling the lightest vehicle so far."
>
> **Renishaw GmbH (Germany)**

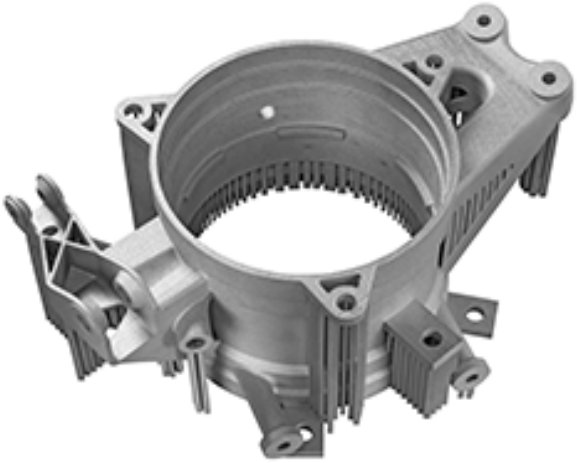


Optimised wheel carriers in a titanium alloy made via Renishaw's additive manufacturing process saved a total of 1.5 kg in vehicle weight.

Apart from the use of composite materials for the body, weight reduction has also been made possible through intelligent lightweight construction of the chassis. "Lightweight construction with metal components is not all that simple", explained Benedikt Bauersachs, the GreenTeam's complete vehicle engineering manager, "because these components are exposed to high stresses and forces on the racing track, which means that detailed FEA calculations and simulations are necessary." The GreenTeam initially opted for aluminium wheel carriers, but it soon became clear that only a combination of a force-optimised design with less material, and a light material with a very high tensile strength, such as titanium, could further reduce the weight of the wheel carrier.

A solution in additive manufacturing

Titanium alloy is a wise material choice when you need lightweight, high strength and corrosion resistant components, however titanium is notoriously difficult to machine and cast. The GreenTeam found it hard to find a sponsor able to manufacture the optimised wheel carrier design using conventional methods. With its metal powder-based additive manufacturing system, capable of producing complex component geometries, Renishaw became the new premium GreenTeam sponsor.



Green Team wheel housing

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The University of Stuttgart's Formula Student race car with additively manufactured wheel carriers.

Support structures

Support structures are necessary for the majority of additive manufacturing builds. They anchor the build and dissipate heat, allowing overhanging parts of the structure to be built up layer-by-layer. The wheel carriers were additively built using Renishaw's AM250 additive manufacturing system using minimal supports, which are easily removed post build. The need for support structures may seem wasteful, however in traditional subtractive machining the ratio of material needed to produce a finished part such as this can be as high as 19:1. With additive manufacturing that ratio is closer to 1:1, in this case 1.12:1.

Solution partner

Renishaw provides a design review service to anyone considering Renishaw's laser melting systems as a production solution. Your component or assembly will be reviewed by Renishaw's applications engineers who can make recommendations on DfM (Design for Manufacture), digitally process the model, and build a sample component using one of its on-site AM systems. A pre-build report, inspection report, and component price estimate can also be provided on request.

For more information visit, **www.renishaw.com/greenteam**

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H-5800-1082-02

Part no.: H-5800-1082-02-A
Issued: 04.2015