Helmets for all kinds of sports

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Sector: Sports industry

Challenge: HEXR is a company located in London which manufactures customized helmets for cyclists and was looking to expand its business to other sports where helmets are also needed.

Solution: Because the customer's virtual head is already stored at HEXR, more helmets for other sports can be ordered in the future without having to do another scan.

CHALLENGE

As no two heads are the same, why should helmets be identical? At the beginning, each cyclist's head was scanned using iPads located in selected specialist stores to produce HEXR's custom bicycle helmets.

Every HEXR helmet is created to fit the exact contours of the customer's scanned head. Within seconds, the scan generates a virtual model consisting of 30,000 points. Using this data, the helmets are manufactured by 3D printing (selective laser sintering) and shipped within five weeks.

An end-to-end solution developed by HEXR, EOS, and Siemens now aims at accelerating the new process and making it more efficient and profitable – while also maintaining the same level of quality. This will allow HEXR to expand its target group.

The heart of this workflow is the design and simulation of a high-performance industrial AM factory. To derive the optimal production system for HEXR, Siemens simulated the cost per part for different production volumes and production setups.

HEXR doesn't want to stop at 3D-printed bicycle helmets. The company also wants to manufacture custom helmets for mountain bikers, canoeists, skiers, and even race-car drivers.

HEXR helmets are built on a honeycomb structure that's significantly better at controlling impact than foam (Photo: HEXR)

SOLUTION

In order to industrialize the product design and simulation, the CAE system Simcenter and CAD system NX as part of the Xcelerator portfolio by Siemens come into play. This software can generate a model of the helmet which allows the designers to perform crash and aerodynamic testing in the virtual environment.

Based on the scan made by using the HEXR app, a 30,000 point cloud is generated to perfectly match an individual helmet. Subsequently, this point cloud is automatically transferred in a 3D printable geometry and format.

The helmets are printed on EOS P 500 3D printers equipped with Simatic S7-1500 controllers. Using the additive manufacturing technology known as selective laser sintering, helmets are produced layer by layer using Polyamide-11, a plant-based material made from castor bean oil.

The process is also environmentally friendly, both because powder that's not used for printing can be recycled and because custom 3D printing means that not a single product needs to be warehoused. In addition, HEXR uses sustainable materials for its packaging.

Starting with a digital twin, Siemens is using its software and expertise to jointly design the optimal factory, beginning in the digital environment – and this even includes calculating the price of the product. Cloud-based monitoring solutions can help increase process stability and overall equipment efficiency (OEE), while automation solutions reduce lead time and cut manufacturing costs.

The optimal virtual factory is created with the aid of the Tecnomatix Plant Simulation factory planning and simulation software. Tecnomatix allows engineers to virtually simulate an unlimited number of different production scenarios. The digital twin of the factory gave the team the opportunity to arrive at the ideal manufacturing setup from more than 100 planning variants and to master their complex task. Using virtual reality (VR), planners can "walk through" a digital model of the factory to detect and correct faults. VR is also used further down the line to provide machine operators with detailed views of the machines.

Regardless of where a customer's head is scanned, the orders need to be channeled for production. This happens via the cloud-based AM Network. Orders are uploaded directly to the platform and assigned directly to specific production locations and printers. By continuously monitoring, analyzing, and optimizing the solution, MindSphere, the open, cloud-based IoT platform, makes the entire production process transparent all the way to the end customer. With the Mendix low-code development platform, programming different apps for on-site or in-cloud deployment is very easy.

With the digital twin of the factory the team mastered the complex task of finding the ideal manufacturing setup from more than 100 planning variants (Picture: Siemens)

ADVANTAGES

To achieve a balanced machine fleet utilization, the Teamcenter product lifecycle management (PLM) system and the Opcenter manufacturing operations management (MOM) solution can be used to assign orders to specific machines.

Nesting is enabled by NX and guarantees the best possible arrangement of parts in the construction volume to utilize the given space at its best. As a result, the exchangeable frame is quickly and reliably filled, the build volume is optimally utilized, and the requisite minimum distance between parts is maintained.

NX also helps compare different design options: for example, printing the entire helmet versus printing it in different segments. This has allowed HEXR to compare how many parts can be printed in one print job, which has a high impact on the cost per part.

The key outcomes of the project are convincing: The simulation based on various design and automation scenarios predicts cost per part savings of around 80%, of which about 15% are due to improved process automation. And there are more improvement strategies on the horizon.

Using TECNOMATIX the engineers were able to virtually simulate various different production scenarios (Picture: Siemens)