CASE STUDY

ETTEPLAN AND NIKON SLM SOLUTIONS

DESIGN UPDATE AND PARAMETER OPTIMIZATION LEAD TO SIGNIFICANT COST REDUCTION WITH ADDITIVE

Etteplan

Nikon SLM SOLUTIONS

A Nikon Company

Nikon

ETTEPLAN INNOVATION

Etteplan provides solutions for industrial equipment and plant engineering, software and embedded solutions, and technical documentation solutions to the world's leading companies in the manufacturing industry. Their services are geared to improve the competitiveness of their customers' products, services and engineering processes throughout the product life cycle. The results of Etteplan's innovative engineering can be seen in numerous industrial solutions and everyday products.

In 2018, Etteplan had a turnover of approximately EUR 236 million. The company currently has more than 3,500 professionals in Finland, Sweden, the Netherlands, Germany, Poland and China. Etteplan's shares are listed on Nasdaq Helsinki Ltd under the ETTE ticker.

NEW SOLUTIONS FOR THE INDUSTRY

For the 4-stack extraction channel design, Etteplan worked with the consulting team at Nikon SLM Solutions to optimize the process parameters for speed. While many of Nikon SLM Solutions' customers operate in critical industries where mechanical properties are of utmost importance, the dust extraction channels are not significant load-bearing structures and do not require fully dense material with the best mechanical properties achievable with the Nikon SLM® technology. Therefore, a unique process parameter approach was chosen allowing certain regions of the end component to be slightly more porous to allow a signification reduction in print time to further increase cost

savings. Particularly in the non-visible regions of the part, i.e. the threaded inlets and outlets, parameters optimizing speed were utilized. The standard,high quality process parameters were assigned to the rest of the component to ensure an optimized surface finish for the end-user.

Additionally, application engineers at Nikon SLM Solutions optimized the support structures to both minimize material usage and make powder removal easier. By teaming with the Nikon SLM Solutions consulting team, the print time of the fully stacked SLM® 280 build was reduced by an additional 25%.

Etteplan's final design of the dust extraction channel met and exceeded all their customer's initial AM design objectives. Close collaboration and good communication between the customer, Etteplan, Nikon SLM Solutions and the service bureau 3Dstep who produced the part was essential for the success of the project. It also depended on the combined expertise of the assembled project team who were able to harness the design freedoms of AM with a strong understandingof the manufacturingprocess to produce a high-quality product at low cost.

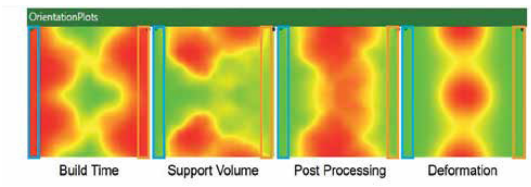

Fig. 1- 4, clockwise from top
The design evolution, starting with the traditionally manufactured component. Process simulation of the four-stack with support structures and distrortion results with increased levels of distortion shown in red and yellow. Color plots helped decide the best orientation for the part based on four criteria options.

INNOVATIONS WITH SELECTIVE LASER MELTING

Etteplan's first design for additive manufacturing (DFAM) iteration of the extraction channel smoothed the internal air channels and removed excess material from the design. At this point, process simulation software was used to conduct an orientationoptimization to analyze the effect of print orientation on build time, support volume, needed post-processing effort and predicted deformation/ distortion levels. Two orientations of the extraction channel produced comparable and preferred results in terms of support volume, post-processing and deformations. These orientations resulted in the longest print times for the manufacture of a single component, but conversely they required the minimal area footprint on the build plate, thus when the build plate was fully nested with the components, the per-part print time was actually lower than the other orientation options.
Once oriented on the plate, additional modifications were made to the design to improve printabilityand eliminate the need for support structures in regions that would be visible to the end-user after assembly in the sander. Print process simulations were used in order to determine where support structures would be required, to ensure that print-directiondistortions would not cause collision with the recoater during the printing process, and to check that the final distortion levels of the component were within the requirements.

The Etteplan AM cost estimation tool was also utilized during this stage to estimate and compare the costs of various design options with the original, traditionally manufactured part. It was found that for the amount of material and print time needed, it was too expensive to additively manufacture a single part. However, printing 11 parts at once was determined to be the threshold of where the traditionally and additively manufactured components cost approximately the same amount.

Further design changes were made to maximize the number of nested parts produced in a single build. Optimizing the design to allow components to be stacked 4-high in the print direction meant that a total of 120 pieces could be printed in one job on an SLM®280 selective laser melting machine, far exceeding the break-even price with traditional manufacturing. Process simulation was again used to estimate the support structures needed and to simulate the print process for a stack of four extraction channels.

Fig. 5:
120 stacked, nested connectors printed in one process on the SLM®280 by Finnish service bureau 3Dstep Oy.

CONFORMAL COOLING FOR HIGH VOLUME INJECTION MOLDING COMPONENTS

- **REDUCED MANUFACTURING COSTS**
  40% savings through DfAM and nested build orientation

- **OPTIMIZED PARAMETERS**
  Reduce build time 25

- **COMPONENT OPTIMIZATION**
  50% weight savings with improved performance

NIKON SLM SOLUTIONS

Nikon SLM Solutions is a global provider of integrated metal additive manufacturing solutions. Leading the industry since its inception, it continues to drive the future of metal AM in every major industry with its customers' long-term success at its core. Nikon SLM Solutions is home to the world's fastest metal additive manufacturing machines boasting up to 12 lasers and enabling build rates of <1000ccm/h.

With a portfolio of systems to suit every customer's needs, along with its team. of experts closely collaborating at every stage of the process, Nikon SLM Solutions leads the way on return on investment with maximum efficiency, productivity, and profitability. Nikon SLM Solutions: believes that additive manufacturing is the future of manufacturing and has the desire and capability to take its customers there right - now. Nikon SLM Solutions is a publicly-traded company headquartered in Germany, with offices in Canada, China, France, India, Italy, Japan, Singapore, South Korea, and the United States.

Further information is available on **www.nikon-sim-solutions.com**