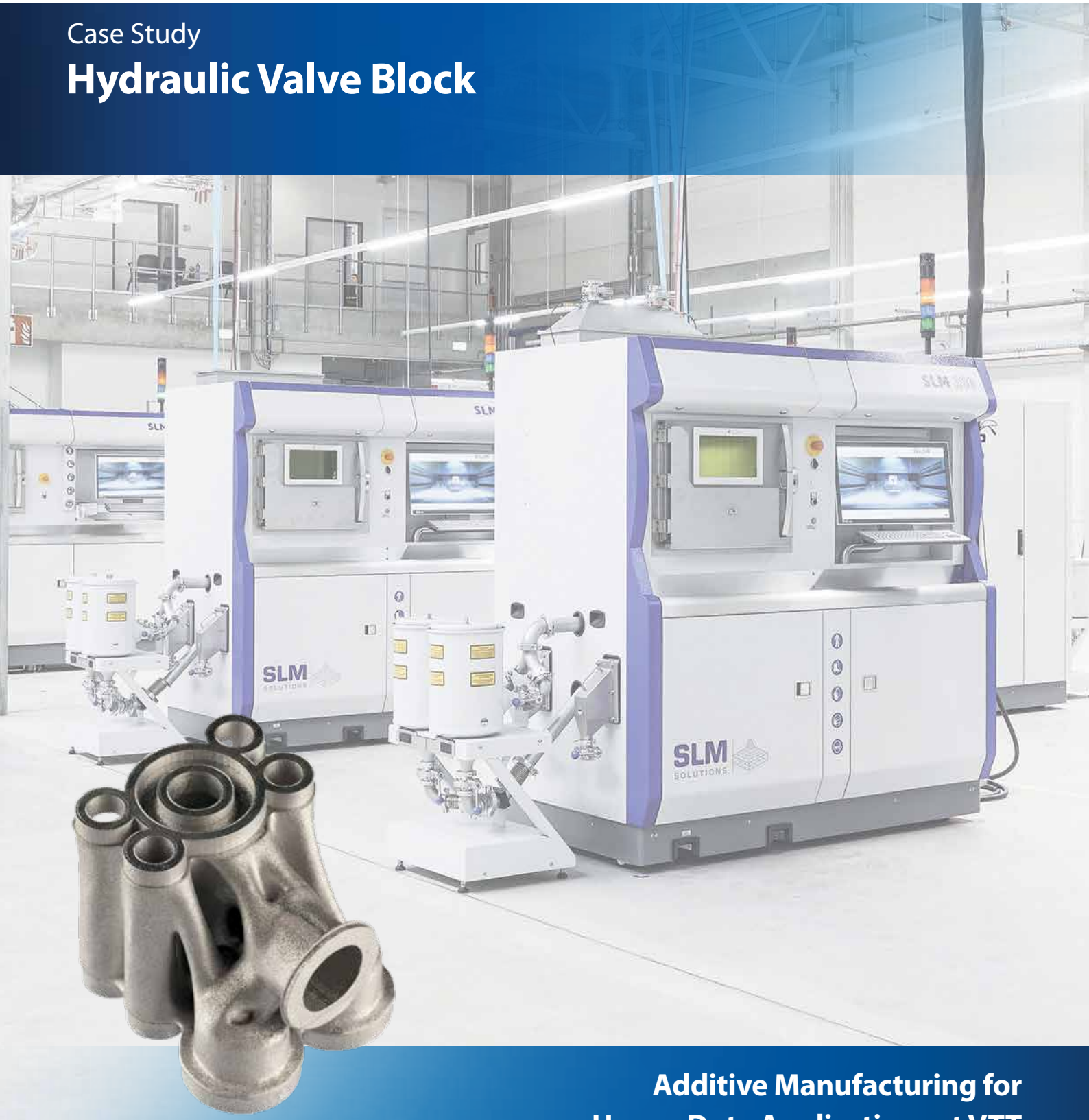
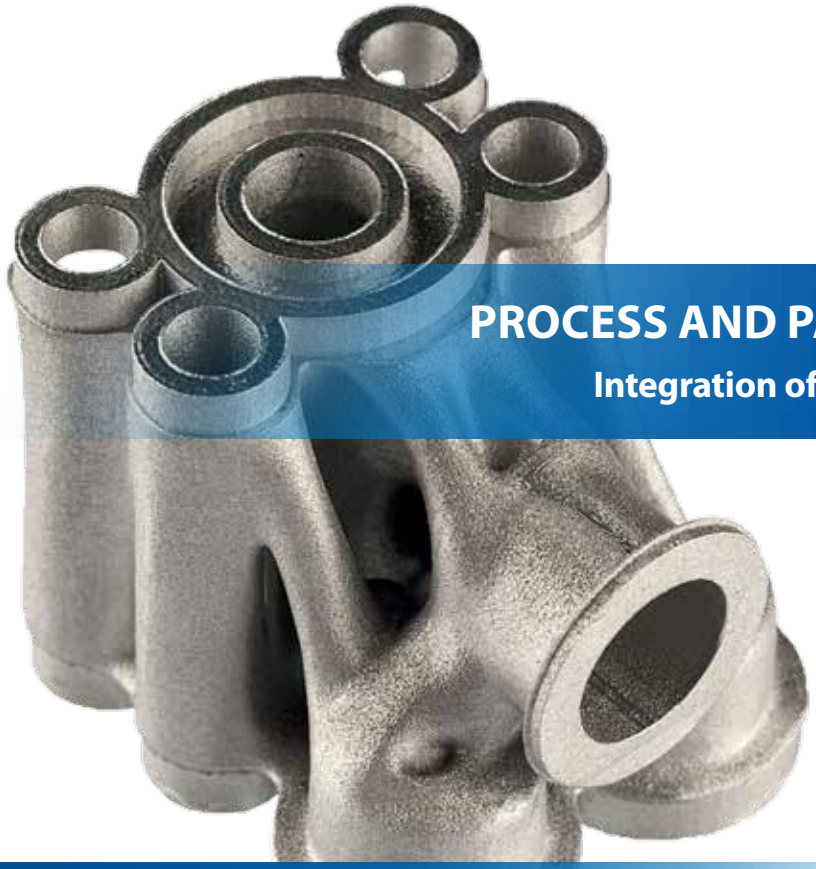
Case Study

Hydraulic Valve Block



Additive Manufacturing for Heavy-Duty Applications at VTT

3D-Printing Success Story



PROCESS AND PART OPTIMIZATION

Integration of internal cooling channels

WEIGHT- AND MATERIAL SAVINGS

Manufactured in one piece

Part Data

Designation:	Hydraulic Valve Block
Industry:	Aviation and Aeronautics
Material:	316L
Layer Thickness:	50 µm
Build Time:	2d 7h 26min (full load, 12 pieces)
Machine	SLM®280 Twin

SLM®280

Current Situation

Production of customized objects of nearly any shape

Additive manufacturing (AM) is opening up new business opportunities by freeing design from the restrictions of traditional manufacturing processes, enabling customization and speeding up product time-to-market. Together, VTT Technical Research Centre of Finland Ltd. and Nurmi Cylinders Oy developed a cost-efficient, 3D-printed, reliable hydraulic valve block that is 66% lighter than the original part.

AM technology enables the production of objects of nearly any shape without the limitations associated with traditional manufacturing methods. Combined with advanced design and optimizated techniques, the potential cost-savings of selective laser melting extends to the design phase, where simulation can reduce the number of necessary design iterations. This technology also enables small, one-off production runs, which remove the additional costs typically associated with customization.

Innovations with Selective Laser Melting

Additively manufactured valve block leads to savings in weight, space and material

The hydraulic valve block was developed by VTT and Nurmi Cylinders, with a design optimized to take full advantage of the benefits of 3D printing. The resulting product is 66% smaller than the original model design space and a 76% reduction compared with a traditionally manufactured valve block – leading to savings in weight, space and material. The valve block, used to control hydraulic cylinders that move under loads applied via the hydraulic fluid, can be found in cranes, for example.

Traditionally, the internal channels of the valve block are created with straight, circular drillings in a solid block of material. Several auxiliary drillings are required to complete the channels, which are then plugged yet create the potential for leakages. With AM, the internal channels of the valve block can be optimized for improved flow and space savings, while the potential

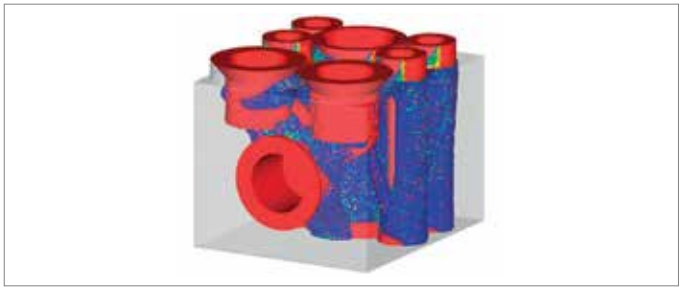


Fig. 1:
Topology optimization result (element density color contour plot)

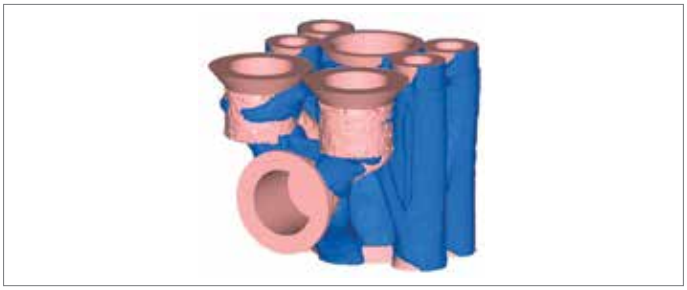


Fig. 2:
Interpretation and remesh of topology optimization result

for leakage is removed because auxiliary drillings are no longer necessary.

„Using a laser for metal 3D printing is fairly new in Finland. Metal powder is spread one layer at a time and laser-melted at the desired areas. Unique, new materials are under development which will lead to new features and designs not yet commercially available. We have analyzed the manufacturing costs and identified cost savings. In the future, this technique will give free hands for a designer because manufacturing is not limiting geometries anymore," says Senior Scientist Petri Laakso of VTT.

Together with the private sector, VTT engaged in a two-year project aiming to create new business within Finland with the use of AM technology. The overall project consisted of the companies' own projects and a research project by VTT, in which the companies are also participating. Tekes, the participating companies and VTT are provided three million euros of funding to the project as part of VTT's For Industry spearhead program and its SME project startups.

Fig. 3:
Analysis of smoothed optimization design

Fig. 4:
Final smooth CAD file, ready for printing

VTT Technical Research Centre of Finland Ltd.

VTT Technical Research Centre of Finland Ltd. is the largest multidisciplinary research organisation in Northern Europe. It provides high-end technology solutions and innovation services. VTT is a non-profit research organisation and it was founded in 1942 for scientific and public utility. VTT has its headquarters in Otaniemi. VTT is originally an abbreviation of Finnish words „Valtion Teknillinen Tutkimuskeskus" (State Technical Research Center).

Summary

Hydraulic Valve Block

- 66% smaller than the original model design and 76% reduction compared to traditional manufacturing methods
- Savings in weight and material through reduced part size
- Single process production with SLM® machines
- Improved function by removing leakage possibility from plugged drilling holes since internal channels are built directly into the part
- New potential from metal based additive manufacturing technology that enables customization and speeds up product time-to-market

VTT offers R&D services to a number of industry sectors using these technologies. Through its international scientific and technology network, VTT aims to produce information, upgrade technology knowledge, create business intelligence and value added to its stakeholders. VTT has 2,834 employees, of which 81% have a university degree and 26% a postgraduate degree. There are 1,510 customers, of which 865 are domestic companies, 385 foreign companies and 220 public bodies. VTT has a patent portfolio of over 1,200 patents and 605 peer-reviewed scientific articles.

SLM Solutions - Technology Pioneers, Innovation Leaders

SLM Solutions helped invent the laser powder bed fusion process, was the first to offer multi-laser systems and all selective laser melting machines offer patented quality, safety and productivity features. Taking a vested interest in customers' long-term success in metal additive manufacturing, SLM Solutions' experts work with customers at each stage of the process to provide support and knowledge-sharing that elevate use of the technology and ensure customers' return on investment is maximized. Optimal paired with SLM Solutions' software, powder and quality assurance products, the SLM® technology opens new geometric freedoms that can enable lightweight construction, integrate internal cooling channels or decrease time to market.

A publicly traded company, SLM Solutions Group AG focuses exclusively on metal additive manufacturing and is headquartered in Germany with offices in China, France, India, Italy, Russia, Singapore and the United States and a network of global sales partners.





SLM Solutions Group AG | Estlandring 4 | 23560 Lübeck | Germany
+49 451 4060 - 3000 | info@slm-solutions.com | slm-solutions.com