

Combining the Virtual and Physical Becomes Real

CIMdata Highlight

Ten years ago, Siemens acquired UGS. At that time, the acquisition clearly set a new agenda for the entire PLM industry. Customers across manufacturing and process industries could envision the benefits of integrating the physical world, such as through Siemens AG's leading automation design and production technology, and the virtual world, through UGS's leading factory design, product design, and digital collaboration software.

Since then that vision has become a reality in many different forms (i.e., virtual commissioning, simulation, and test; IoT and simulation). Once again that vision is realized with Siemens PLM Software's Additive Manufacturing (AM) strategy. Siemens PLM Software has taken a holistic approach to AM product development by providing technologies for generative design, topology optimization, light weighting, adaptive design or convergent modeling, right through to simulation of actual downstream AM manufacturing processes. Siemens PLM Software has tapped into an ecosystem of product developers, experts, manufacturers, 3D printing machine OEMs, AM material vendors, and 3rd-party software providers.

Siemens PLM Software's software coupled with their ecosystem of partners, enables customers to choose multiple paths toward adopting AM into production. These include:

- Product transformation
 - Design for Additive Manufacturing (DfAM) methodology including lightweighting, latticing, and algorithmic design (e.g. Generative and Topology Optimization).
 - Alternate design initiation sources: Scan→modify→design
 - Functional performance optimization to achieve optimally and *adequately*, designed products. Multi-material / digital material parts, composite part printing, complexity and part reduction, HEEDS all contribute to enhancing functional performance.
- Manufacturing transformation
 - Low volume products and bridge manufacturing (e.g., lot size of one, small series)
 - Eliminate dedicated tooling (e.g. castings, injection molds, form tools)
 - Support digital inventory
- Combined product and manufacturing transformation
 - Digital twin with AM Lifecycle Management for traceability and repeatability
 - Flexible workflows: save time, stimulate more innovation cycles, faster turnaround
 - Individualization and mass customization
 - Supply chain redefinition and shrinkage. Design and print (manufacture via AM) anywhere.
 - Acceleration of innovation

Siemens PLM Software deliver their software as an end-to-end digital platform; NX and Simcenter for model-driven product development, Teamcenter providing a product lifecycle management data backbone, and SIMATIC IT for production control and MES.

The proof is in the pudding as they say; the pudding in this case being an industrial customer actually using the technology to make real parts. Hoedtke GmbH & Co. KG is one of the first manufacturing companies using an end-to-end CAD/CAE/CAM process based entirely on NX

software coupled with a Siemens AG machine tool. The SINUMERIK 840D sl CNC 5-axis milling machine integrates additive laser deposition welding (Direct Energy Deposition or DED) to complete the end-to-end process thus removing the either/or decision; leveraging advantages of both additive and subtractive manufacturing to make complex metal parts. The decade old vision is indeed real.

About CIMdata

CIMdata, an independent worldwide firm, provides strategic management consulting to maximize an enterprise's ability to design and deliver innovative products and services through the application of Product Lifecycle Management (PLM). CIMdata provides world-class knowledge, expertise, and best-practice methods on PLM. CIMdata also offers research, subscription services, publications, and education through international conferences. To learn more about CIMdata's services, visit our website at <http://www.CIMdata.com> or contact CIMdata at: 3909 Research Park Drive, Ann Arbor, MI 48108, USA. Tel: +1 734.668.9922. Fax: +1 734.668.1957; or at Oogststraat 20, 6004 CV Weert, The Netherlands. Tel: +31 (0) 495.533.666.