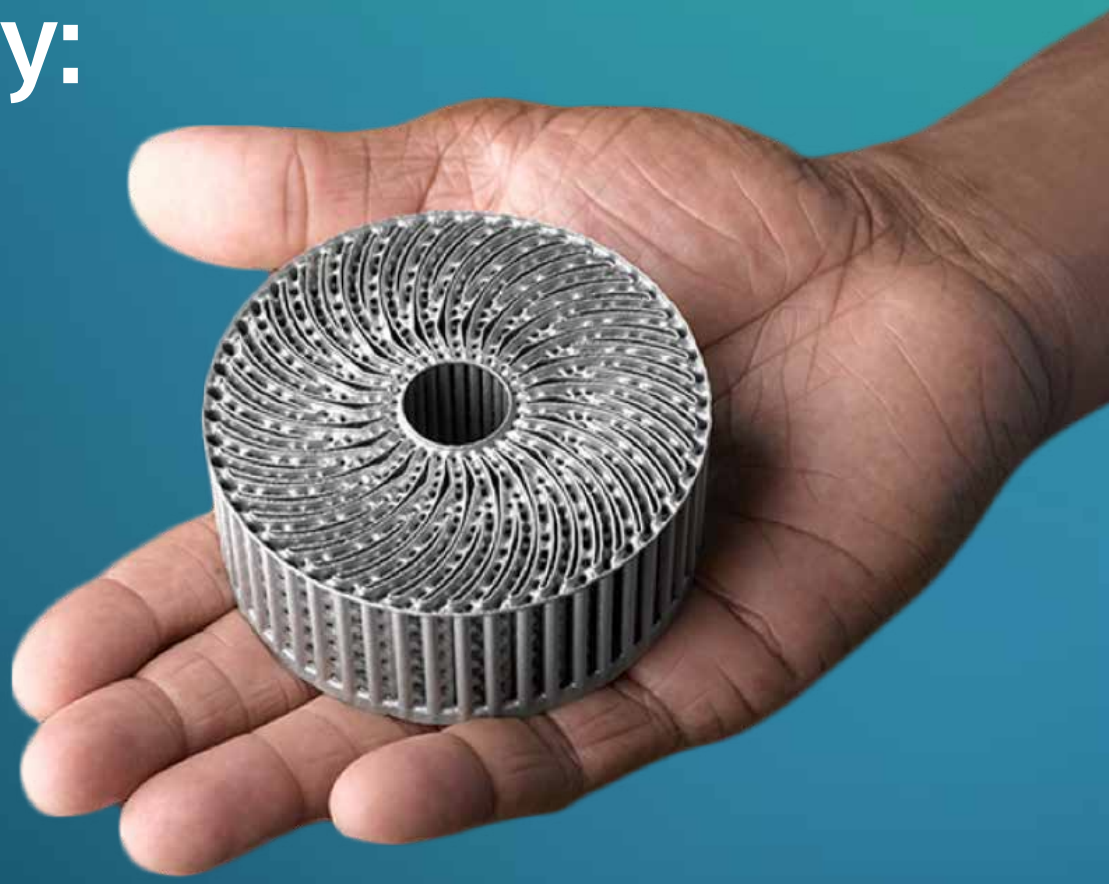
EBOOK

Lower Cost, Boost Efficiency: Reducing Part Count with Additive Manufacturing



3D SYSTEMS
Additive Manufacturing Solutions

Contents

The Impact of Reducing Total Part Count

Assembly of final parts or subcomponents is a routine part of manufacturing that requires extra time, equipment, manpower, and quality controls.

Points of assembly can create issues. They add additional weight through fasteners, which contributes to increased operating costs in applications that consume fuel. They are also common points of failure, which can introduce undesirable risk or downtime should joining points weaken. For these reasons, finding innovative and effective ways to eliminate or reduce assembly is advantageous in many areas. Not only to lower production costs and advance manufacturing timelines, but also to improve the final component or system performance and reliability.

A key benefit additive manufacturing (AM) offers to businesses and design engineers is its ability to produce complex parts. A subset of the complex parts AM is good for is consolidated assemblies and monolithic designs.

The ability to create more complex designs makes it possible to think differently about the design and manufacturing process. Instead of taking a system and breaking it up into many subcomponents, each with their own manufacturing streams, additive manufacturing enables parts to be joined in the design phase and seamlessly consolidated in production. This means a reduction in the need for fasteners and a reduction in the total number of parts produced. Part consolidation opens the door to new levels of manufacturing efficiency and offers previously unheard-of freedom to design engineers.

Advantages of Additive Manufacturing

Compared with traditional metal manufacturing methods, metal additive manufacturing offers three significant benefits.

SPEED

Additive manufacturing enables both rapid prototyping and rapid manufacturing. Skipping the tooling or tooling design required for traditional manufacturing and instead using a CAD file to directly 3D print a part dramatically cuts the time from concept, to design, to manufactured part.

DESIGN FOR FUNCTION

Because there is no correlation between cost and complexity, additive manufacturing allows functionality to be the leading consideration when designing a part. In traditional manufacturing, the design is compromised throughout execution by the need to make the object compatible with traditional techniques and to comply with cost constraints.

PART COUNT REDUCTION (PCR)

The primary subject of this ebook, part count reduction, is a major selling point of additive manufacturing, allowing designers and engineers to substantially reduce the parts and processes required to create a final product. The real-world examples that follow illustrate the incredible impact this shift in capability brings to those who use it.

TRANSFORMATIONAL BENEFITS

TRADITIONAL		ADDITIVE
Design		
• Designed for manufacture • Multiple digital files • Many engineers	→	• Functional design • 1 digital file • Fewer engineers
Manufacture		
• Multiple manufacturing sources • Multiple data sources	→	• 1 manufacturing source • 1 data source • Less points of failure
Inspect		
• Multiple assembly inspections	→	• 1 inspection source • Improved tolerances and reduced tolerance stacking
Maintain		
• Multiple repair sources • Inventory requirements or on back order	→	• 1 repair source • Easier service and repair • Immediate access to parts

Automotive Exhaust

A titanium exhaust provides a practical example of the benefits of additive manufacturing for part count reduction.

Using traditional design and manufacturing methods, this exhaust was composed of 20 individual parts. By adapting the design for AM, it was possible to produce an equivalent component in a single part. Creating a monolithic design shrank design time from six weeks to six days. Using direct metal printing (DMP) by 3D Systems, the build time was a mere 23 hours. To put this in perspective, creating a similar build without additive technologies would take roughly six months, highlighting the transformational impact of additive manufacturing.

EFFICIENCY IMPROVEMENTS WITH AM

- ✓ Design reduced from 6 weeks to 6 days
- ✓ 20:1 part count reduction
- ✓ 75% reduction in production time
- ✓ Eliminated assembly time, checks, and errors

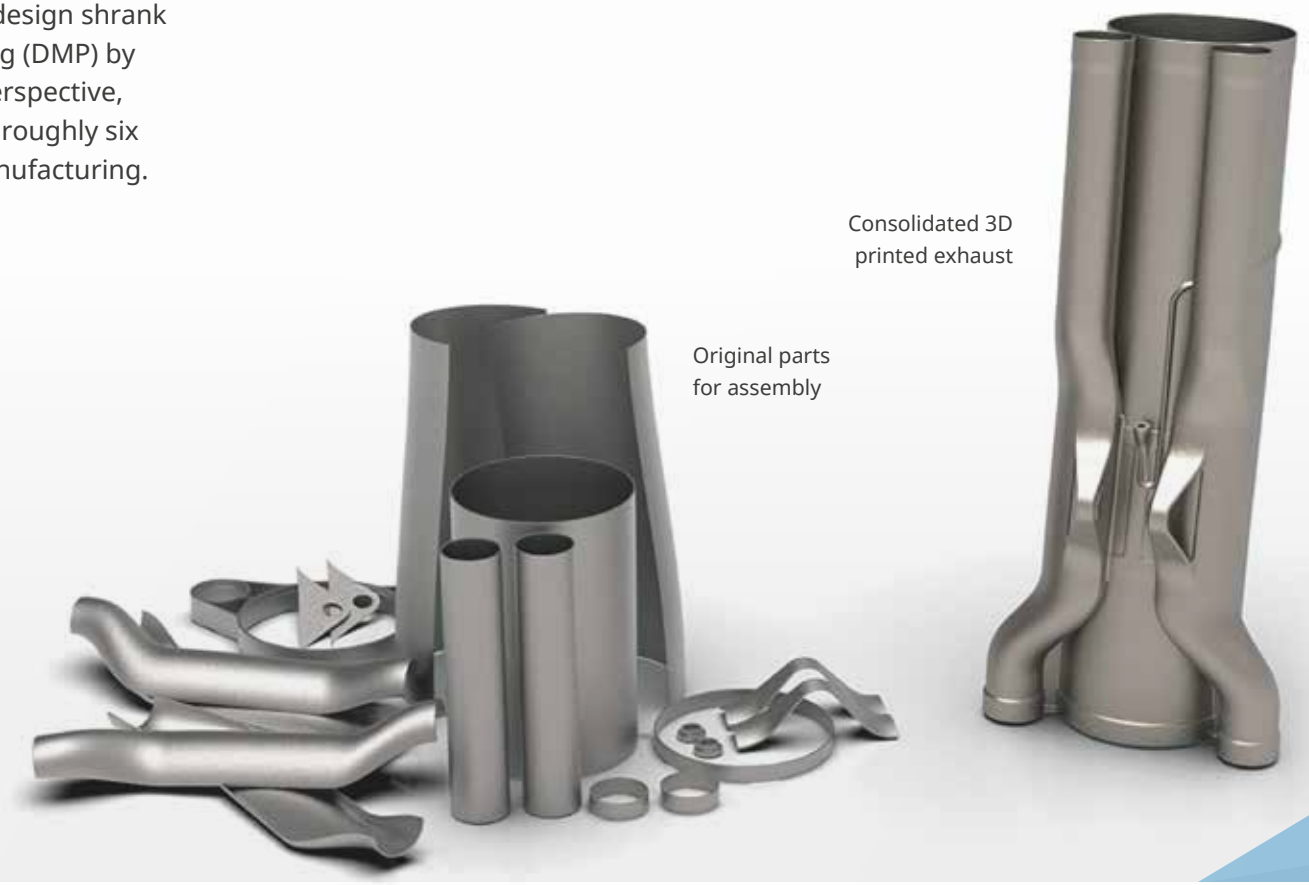
Material: LaserForm Ti Gr23(A) printed in XHP, also known as extra high productivity parameters

DESIGN IN 6 DAYS VS 6 WEEKS

20:1

PART COUNT REDUCTION

75% REDUCTION IN PRODUCTION TIME



FELIO SYLVANIA

Quartz Glass Burning Tool

The ability to consolidate metal parts has a wide range of beneficial application areas, including in the manufacturing process itself. Felio Sylvania (then Havells Sylvania) took advantage of part consolidation to optimize its quartz glass burning tool. The original manufacturing process for this tool involved multiple components and processes: sheet metal, tubes, hole drilling, welding, brazing, and assembly. Changing to a monolithic design using additive manufacturing eliminated all of these extra steps in favor of a more streamlined production process.

The benefits of reducing part count from 20 to 1 extended well beyond reducing the manufacturing time of the tool itself. Because this tool must cycle continuously between hot and cold when in use, it typically required replacing on a monthly basis, which inserted regular downtime into the production process. However, by consolidating parts, it was possible to reduce the overall material volume by 50%. With less material in the additively manufactured part, this redesign allowed the tool to run three-times longer, resulting in an extension of the tool's lifetime and a cost reduction of 60%.

EFFICIENCY IMPROVEMENTS WITH AM

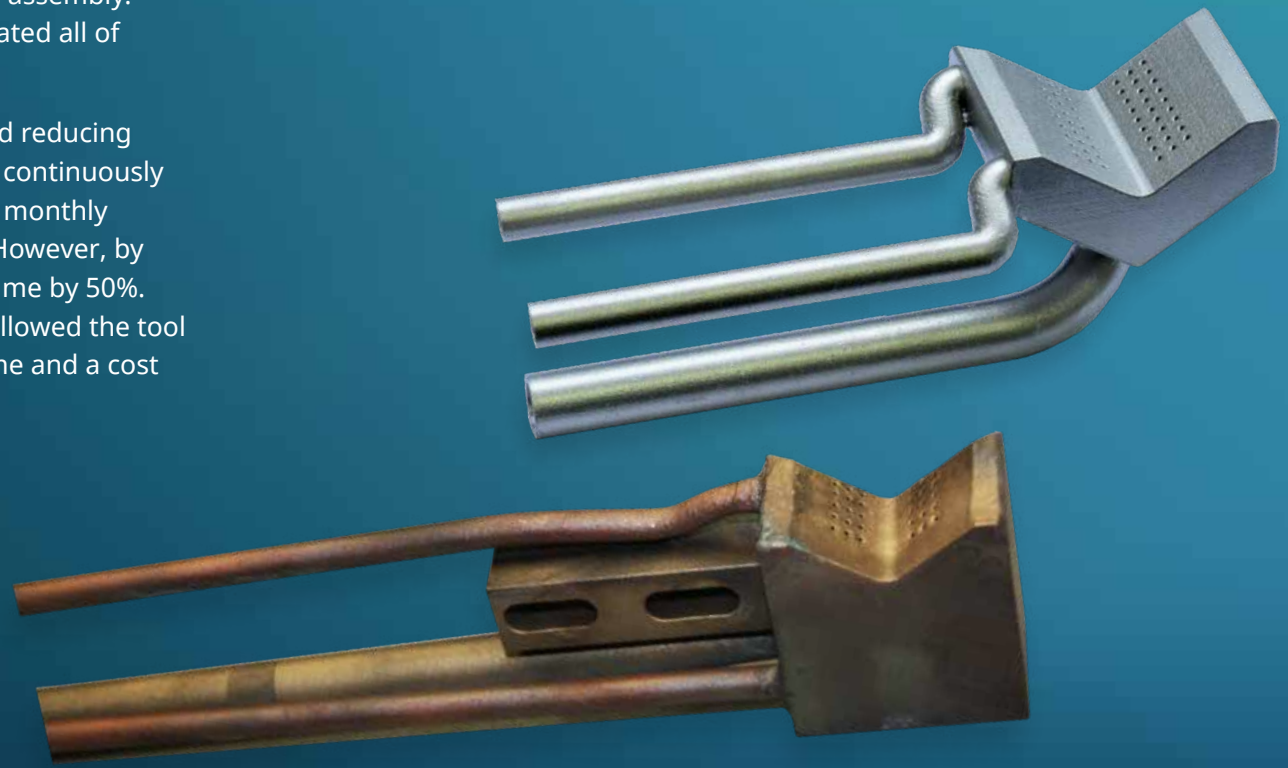
- ✓ 20:1 part count reduction
- ✓ 75% reduction in production time
- ✓ 50% reduction in material volume
- ✓ 60% more cost-effective
- ✓ Three-fold extension in tool lifetime

Material: LaserForm Ni718

75% REDUCTION IN PRODUCTION TIME

20:1
PART COUNT REDUCTION

$$$
60% MORE COST EFFECTIVE



AIRBUS DEFENSE AND SPACE

Satellite Radio Frequency Filter

With any product that spends most of its life in orbit, each gram of weight has a significant impact on costs. With this satellite radio frequency filter, applying metal AM made it possible to reduce the weight by half and reduce total parts from 39 to 1. This product has been in successful operation since 2017.

50% WEIGHT REDUCTION

39:1 PART COUNT REDUCTION

LOWER COSTS

EFFICIENCY IMPROVEMENTS WITH AM

- ✓ 39:1 part count reduction
- ✓ 50% weight reduction
- ✓ Design follows function
- ✓ Faster production times
- ✓ Lower costs

Material: LaserForm AlSi10Mg (A)

Heat Exchanger

Traditional methods of assembly for parts like heat exchangers are incredibly time-consuming. With additive manufacturing, assembly can be eliminated, cutting production times by as much as 75%.

In this case, the Center for Environmental Engineering at the University of Maryland was able to achieve an incredible part count reduction of 155 to 1. An interesting side effect was a subsequent improvement in performance. Without the roughness and interference typically caused by welding, a much smoother heat exchanger was created, enhancing performance credentials by 20%.

20% WEIGHT REDUCTION

PART COUNT REDUCTION

75% REDUCTION IN PRODUCTION TIME

EFFICIENCY IMPROVEMENTS WITH AM

- ✓ 155: 1 part count reduction
- ✓ 75% reduction in production time
- ✓ 20% weight reduction
- ✓ 20% improvement in performance

Material: LaserForm Ni718 (A)

SMILE PROJECT

Rocket Fuel Injector: Coaxial Kerosene/Lox Injector Design

LOWER COSTS | PART COUNT REDUCTION | REDUCED PRODUCTION TIME

In addition to a significant part count reduction, the design of this rocket fuel injector enabled drastic savings in both production costs and times. Beyond these valuable savings, the fuel injector now performs better. There are far fewer join lines, and with no assembly requirements, the likelihood of defects is dramatically reduced.

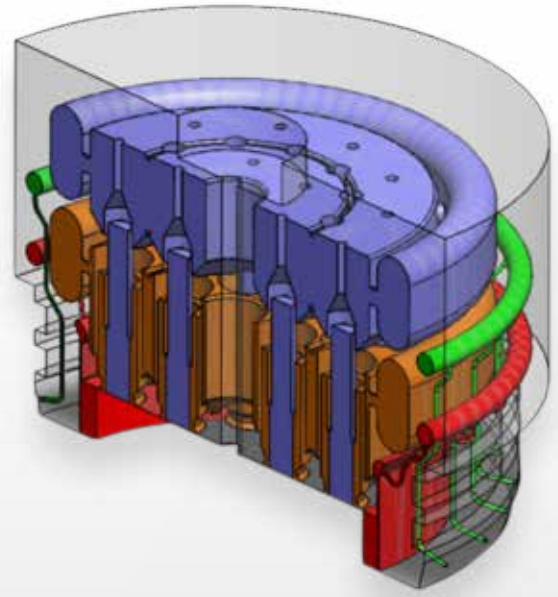
EFFICIENCY IMPROVEMENTS WITH AM

- ✓ 30:1 part count reduction
- ✓ 5 – 10% lighter at Phase 1 design
- ✓ Reduced production time
- ✓ Lower cost to produce

DESIGN & PERFORMANCE IMPROVEMENTS

- ✓ Integrated cooling solutions
- ✓ Integrated and directed flow path

Material: LaserForm Ni718 (A)



This work was performed within the 'SMall Innovative Launcher for Europe' Project (SMILE). Coordinated by DLR, the SMILE Project is supported by the EU within the 'Horizon 2020 research and innovation program,' under grant agreement 687242.

Redefining Metal Manufacturing

In metal additive manufacturing, consistent repeatable mechanical properties are key. 3D Systems is delivering cost reductions, speed, and part performance for your business with an integrated solution of high quality metal 3D printers, materials, and software for the entire workflow and access to expert consulting through our Application Innovation Group.

DMP FLEX 350

High throughput, high repeatability metal 3D printer that generates high quality parts 24/7 from the most challenging alloys.

KEY FEATURES

- ✓ Build volume: 275 x 275 x 420 mm
- ✓ Unique vacuum chamber concept
- ✓ Best in class oxygen purity (consistently below 25 ppm)
- ✓ Quick-swap build modules (RPMs-Removable Build Modules)
- ✓ Fast bi-directional powder deposition

Software Tools for Greater Productivity

Software is a major differentiator in the world of 3D printing, and 3DXpert is leading the way.

3DXpert

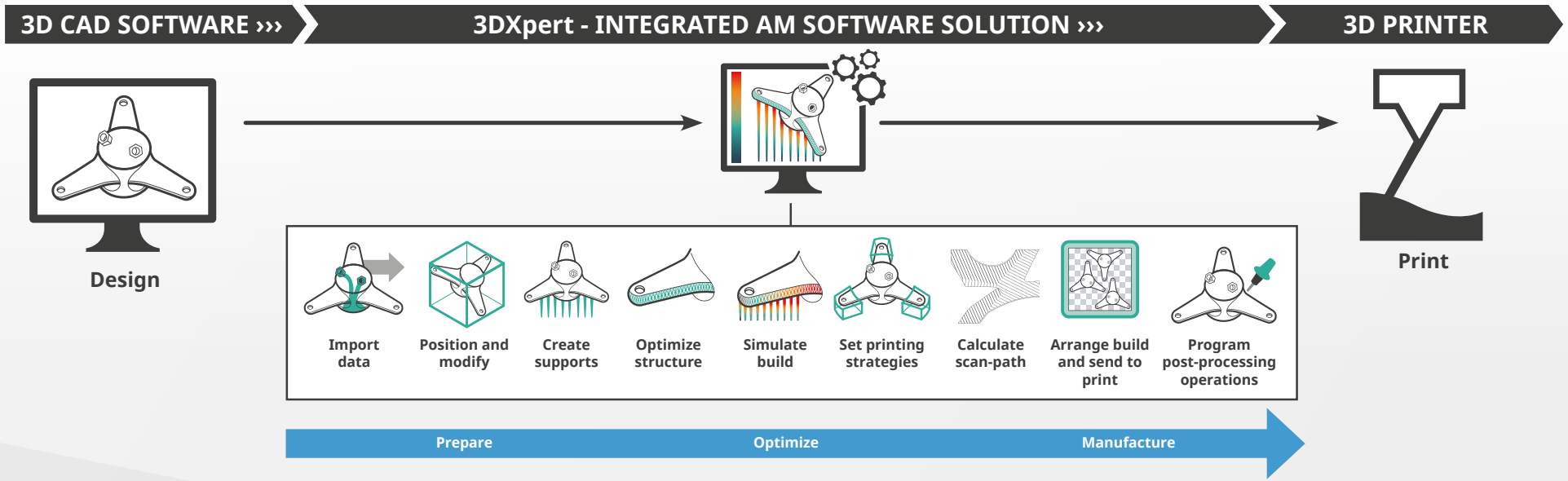
3DXpert® is an all-in-one, integrated software solution for industrial AM for preparing, optimizing, and 3D printing high-quality parts in record time. It enables designers and engineers to streamline their workflows, from design to post-processing, by easily implementing unique 3D printing design features and maximizing 3D printing advantages including part count and weight reduction and functional design. 3DXpert is optimized to work with all metal 3D printers from 3D Systems and supports those from other manufacturers as well.

3DXpert

1 SINGLE SOFTWARE SOLUTION REPLACES MULTIPLE

40% PRODUCTIVITY INCREASE

75% FASTER FILE-PROCESSING TIME



We're Here to Help

Whether you're just starting out or need ongoing support, we are available at every stage to apply our professional expertise toward your unique goals.

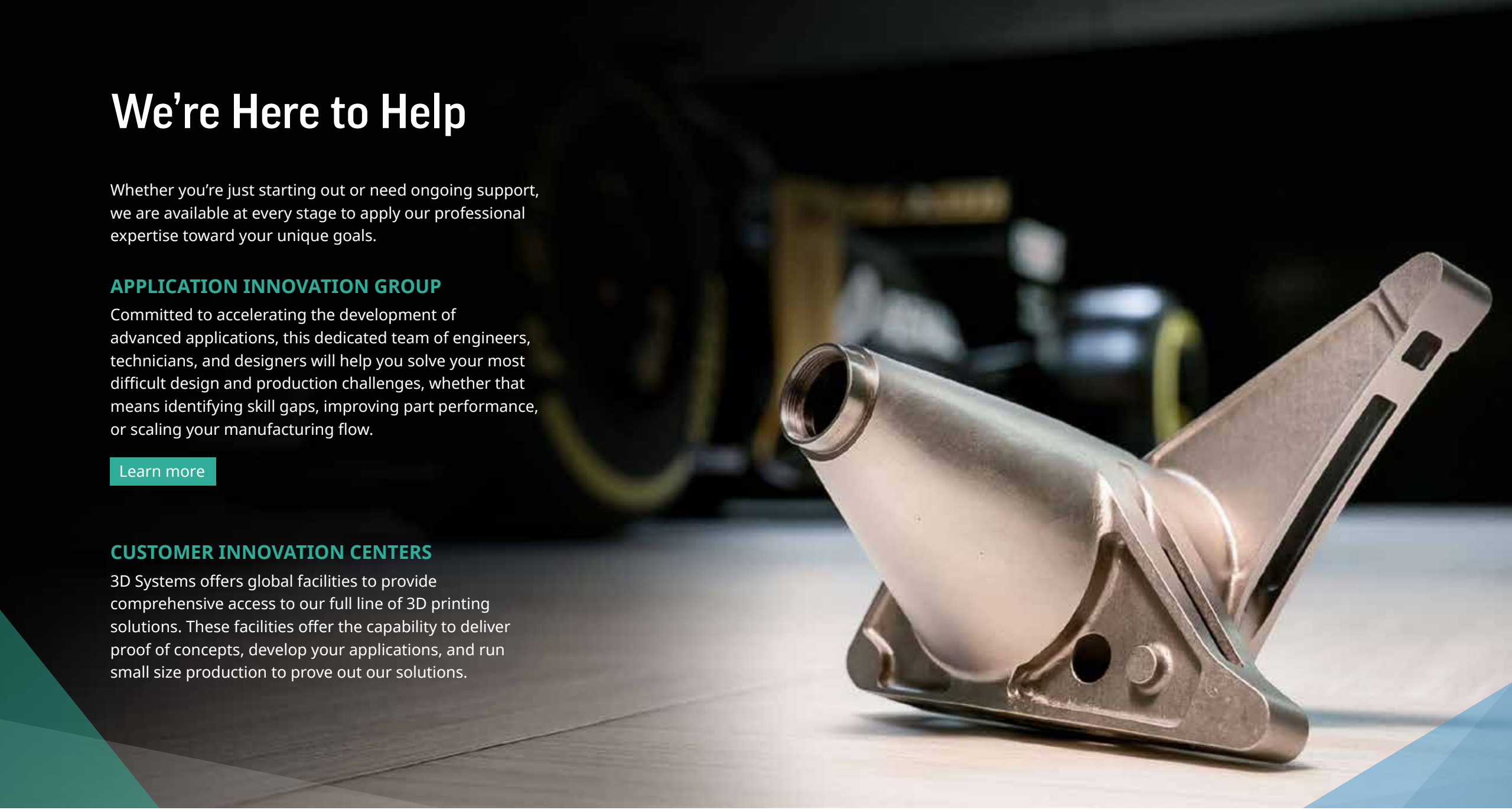
APPLICATION INNOVATION GROUP

Committed to accelerating the development of advanced applications, this dedicated team of engineers, technicians, and designers will help you solve your most difficult design and production challenges, whether that means identifying skill gaps, improving part performance, or scaling your manufacturing flow.

Learn more

CUSTOMER INNOVATION CENTERS

3D Systems offers global facilities to provide comprehensive access to our full line of 3D printing solutions. These facilities offer the capability to deliver proof of concepts, develop your applications, and run small size production to prove out our solutions.



What the Future Holds

Additive manufacturing provides a pathway to new efficiencies and completely new approaches to design and manufacturing.

NEW THINKING

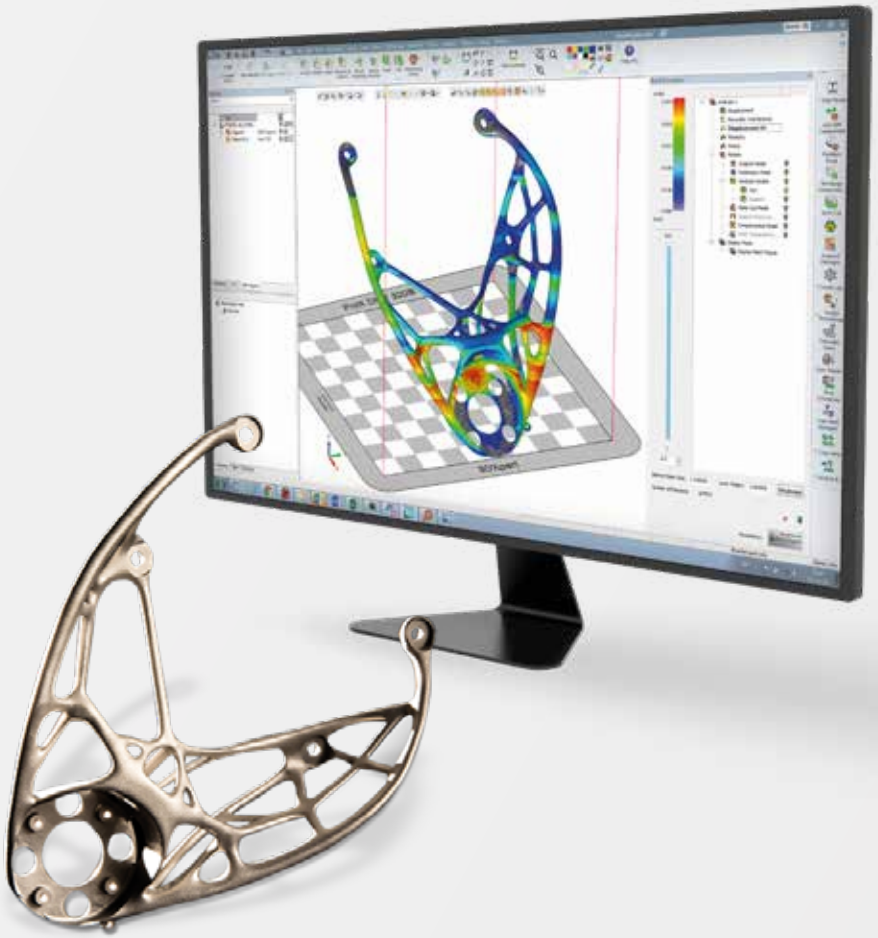
Additive manufacturing offers incredible freedom to design engineers and requires new ways of thinking. It is not enough to take an existing CAD file designed for traditional manufacturing and produce it with a 3D printer as this approach does not tap into the values this new way of manufacturing brings. By reconsidering parts at the initial design stage, significant benefits can be realized.

BETTER PRODUCTS

The opportunities available with additive manufacturing are numerous and significant. Beyond revolutionary new part designs and shortened time-frames are significant bottom-line returns.

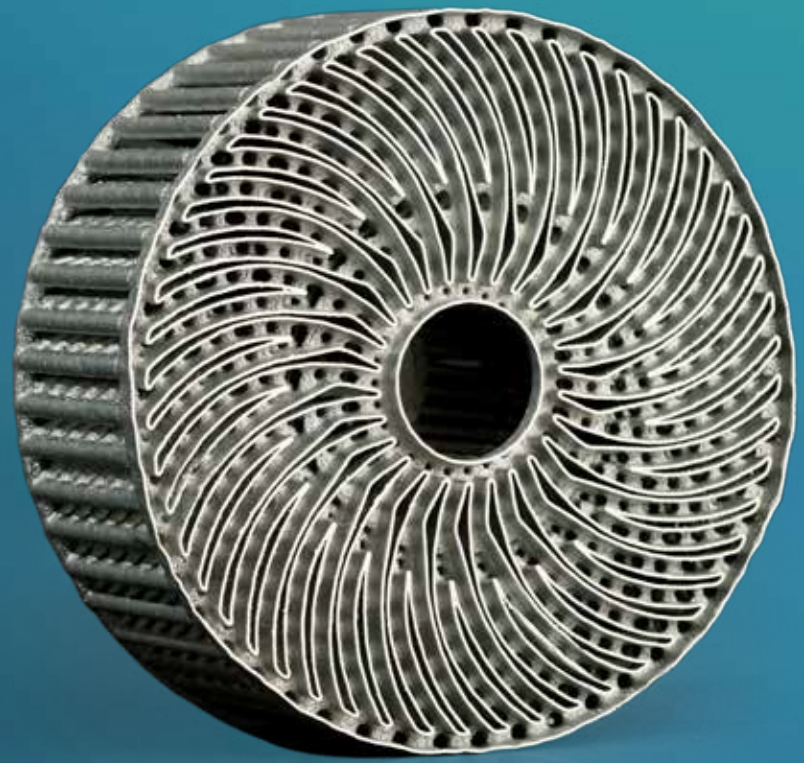
GUIDANCE FROM 3D PRINTING EXPERTS

Ease your transition to more effective and higher performing designs by consulting with the experts in 3D Systems' Application Innovation Group. We support you in each phase of technology adoption, from identifying the potential of additive technology for your company, through developing and qualifying your application, and finally transferring this knowledge to your own manufacturing team.



Contact Us

If you want a better understanding of how part consolidation with metal AM could benefit your business, talk to our experts today.



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