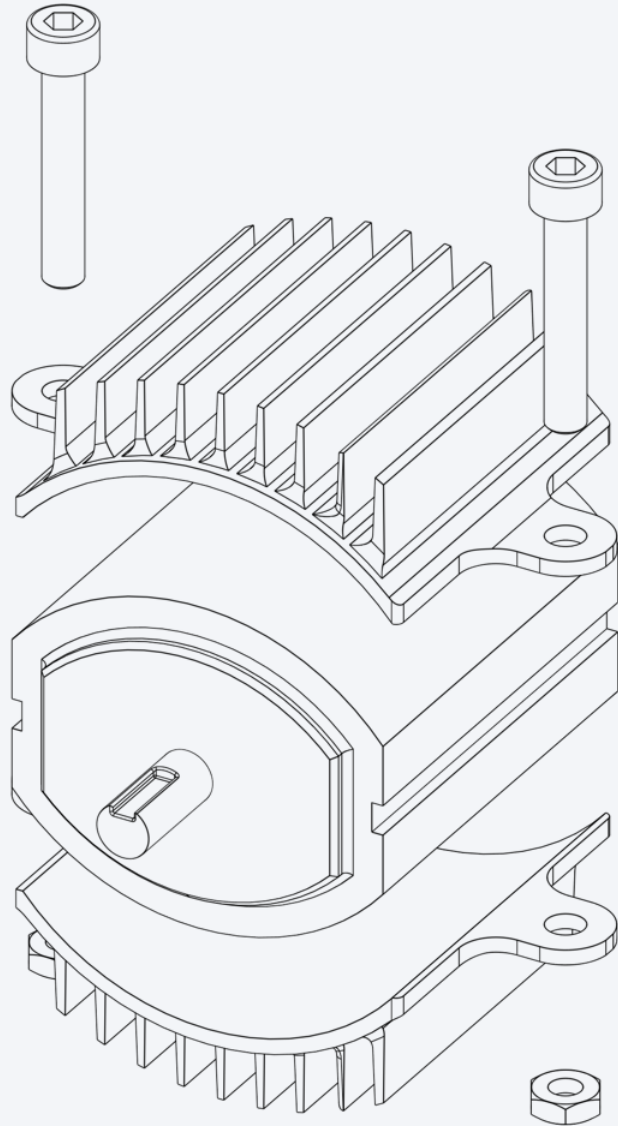


Education and Metal 3D Printing

—
As metal 3D printing continues to emerge as a key manufacturing technology, it is critical educational institutions include the disruptive technology in their curricula to avoid leaving students at a disadvantage as they enter the workforce.

In addition to ensuring students have experience with digital tools used in additive manufacturing like CAD, FEA, and generative design, investing in metal 3D printing systems allows students to gain invaluable hands-on experience by actually producing the parts they design.





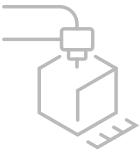
Challenge

Most student-designed parts are produced in extremely small quantities.

Traditional manufacturing methods that require hard tooling, such as casting, forging, stamping, or injection molding, become impractical because of the long lead times and high costs needed to produce conventional tooling.

If a part can be machined, often the limiting factor to production may be the on-campus shop itself. Highly complex designs requiring multiple setups or five-axis mills may exceed the capabilities of both students and the shop machinery, forcing students to either redesign a part or manufacture it as separate component to be assembled in a separate operation.

Because on-campus shops have a limited number of machines, bottlenecks for machine set-up can create long delays in manufacturing parts, which also limits students' ability to iterate and test multiple designs.



Solution

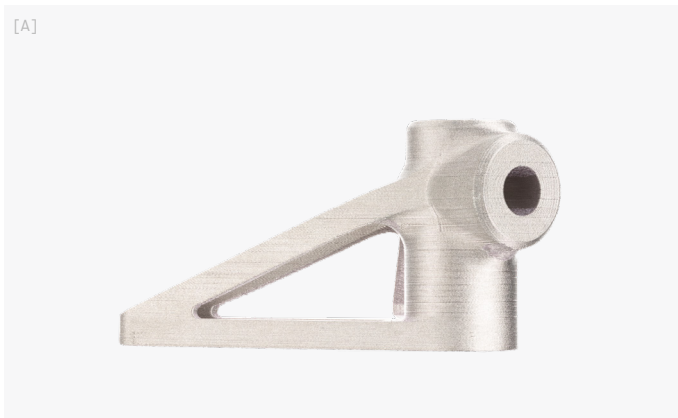
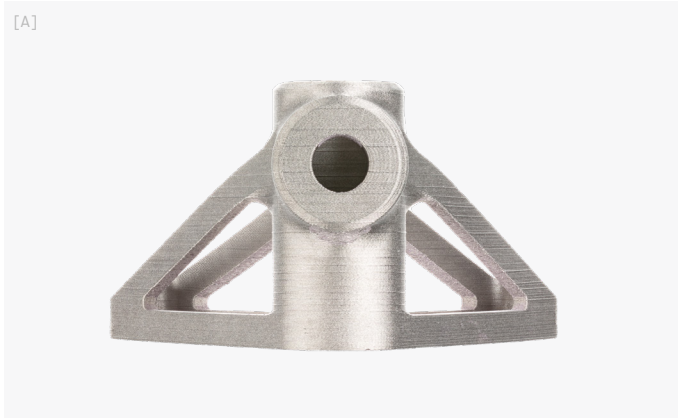
Desktop Metal 3D printing systems are designed for accessibility, making it easy and affordable for colleges and universities to invest in disruptive technologies and ensure students gain the experiences that make them competitive in the workforce.

With no need for a dedicated operator or extensive training, Bound Metal Deposition (BMD) 3D printers like the Desktop Metal Studio System™ are easy for students to learn. Without loose powder, lasers, or other elements that cause environmental concerns, the Studio System can be installed in any classroom, office, or workshop environment. With an intuitive, software-guided workflow, students can begin printing complex metal parts in just minutes.

Because metal 3D printing eliminates the need for tooling, or can be used to directly print tooling for other processes without long lead times, investing can help on-campus shops optimize processes and costs. Whether making a single part or hundreds, the production flexibility of metal 3D printing enables easy production of complex components that would otherwise require master machinist knowledge and helps ease machine shop bottlenecks.

Easy-to-use metal 3D printing technology enables students to unleash their creative designs with ease. Systems capable of running 24/7 with little intervention from operators allows designs to be printed, tested, and redesigned with quick turnarounds.

Metal 3D Printing Examples



[A] BattleBots Backstop

This part is a structural component used to hold a rotating saw blade on a fighting BattleBots robot.

As part of the Discovery Channel program, students were given less than a month to design and build a fighting robot. Using the Studio System™, the team was able to print a bracket capable of resisting the intense bending and lateral motion experienced during battle while providing the stiffness, strength, weldability, and fire resistance required.

The Studio System allowed the team to quickly 3D print this complex part in stainless steel with a greatly simplified manufacturing process - they simply loaded the design file into the printer and had a part ready to be installed after just a few days turnaround time.



[B] Exhaust Manifold

This part was developed by Clarkson University's SAE International Clean Snowmobile Challenge (CSC) team. The competition allows students to apply engineering and project management skills to reduce snowmobile emissions and noise.

Students are encouraged to reuse parts from previous competitions, and the complex series of runners designed to optimize exhaust gas collection also needed to fit to an existing turbocharger flange. Limited space within the chassis also dictated that the design be compact.

The design freedom of 3D printing allowed the redesigned exhaust manifold to be optimized to the performance requirements and produced without the manufacturability constraints of traditional methods. A feasibility prototype was built on the Studio System before production for the final race-use component with binder jetting on the Shop System.

Metal 3D Printing Examples

[C]



[C] Custom Heat Exchanger

This custom heat exchanger attaches to the outside of an electric motor to help dissipate heat while in operation. 3D printing allows for the heat sink to perfectly conform to the motor's shape, allowing heat to be more efficiently pulled from the motor.

Machining the tall, thin fins is challenging due to chattering as the fins are being cut. This would be beyond the manufacturing capabilities of most students, but a feature that can easily be 3D printed. The Desktop Metal Studio System™ allows students to produce complex parts, even with materials like copper and even in low-volumes, that would normally not be possible or economical.

[D]



[D] Skateboard Truck

This part is used to attach wheels to a skateboard deck. It was optimized using generative design tools.

Generative design compared with 3D printing allows for the easy fabrication of innovative designs that are impossible with conventional methods. Traditionally cast, these 64 x 43 x 60 mm (6.46 x 1.69 x 2.36 in) skateboard trucks are optimized for strength while reducing weight and enabling design impossible or uneconomical to cast with traditional core and mold tooling.

The Studio System allowed the complex design to be 3D printed in 17-4 PH stainless steel without the high cost and long lead time of hard tooling.