INDUSTRY PERSPECTIVE / 001

Machine Design

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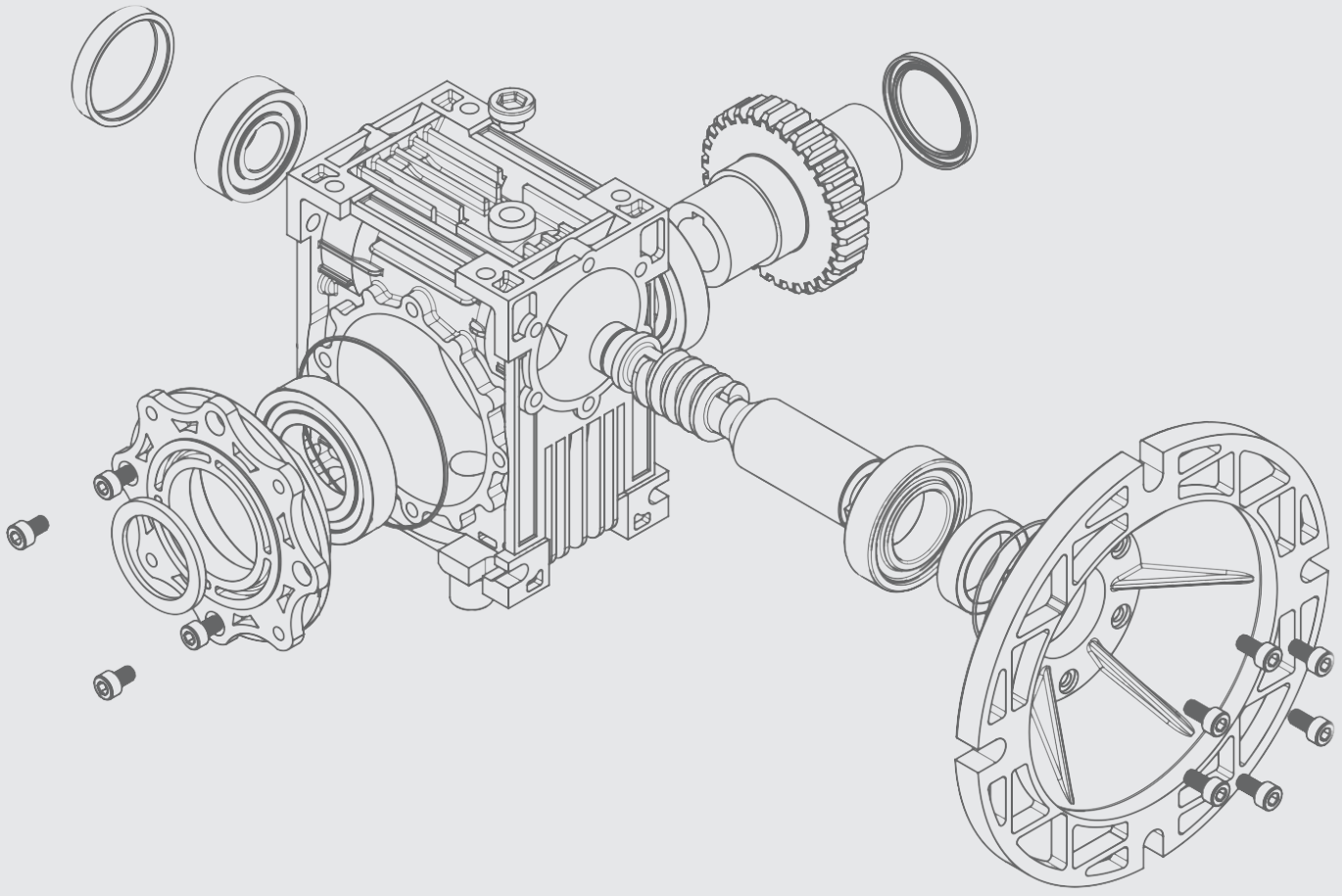
Machine design involves the development, design, and production of machines. It is key to ensure machines run efficiently, produce consistent results and can be easily repaired as components wear out or break.



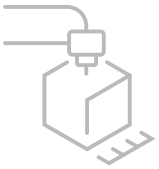
Desktop Metal

Challenge

For simplicity, speed, and most importantly cost, machine designers strive to use as many off-the-shelf components as possible. Invariably, though, some parts must be custom-made - and therein lies most of the challenge.

Due to the relatively small volumes needed, custom parts are typically CNC machined, a process that can be expensive and time-consuming, due to limited machine shop resources and nonrecurring engineering (NRE) time and costs. This NRE usually consists of the necessity to create custom workholding fixtures for machining of complex parts, even if parts are being produced in low volume, leading to significant waste and added part cost.

Machine design firms may also face challenges related to equipment that is already operating - as parts wear out or break, firms need to be able to quickly manufacture replacement parts to get the machine back up and running while keeping per-part costs low and avoid warehousing costs.



Solution

Additive manufacturing dramatically simplifies the process of creating custom parts. Because it doesn't rely on tooling or fixturing, 3D printing often allows users to print parts faster and at lower costs than machining.

The technology also opens the door to parts with greater geometric complexity, these complex parts may be better suited for the application but generally cannot be justified with traditional manufacturing methods.

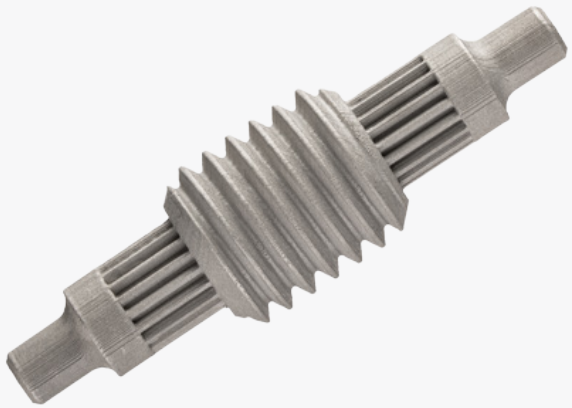
That increased complexity also enables assembly consolidation - the combining of several parts into fewer, multi-functional assemblies - which helps to simplify manufacturing and increase efficiency.

Metal 3D printing also streamlines the production of replacement parts, allowing companies to print exactly the part they need, when and where they need it, significantly reducing both machine downtime and reducing warehousing costs.

01 Assembly Consolidation

To simplify manufacturing processes, many assemblies are made up of easy-to-manufacture parts which are either held together with fasteners or welded. Additive manufacturing, however, allows users to consolidate multiple parts into a single assembly, reducing costs and increasing efficiency.

[A]



[A] Roller Screw

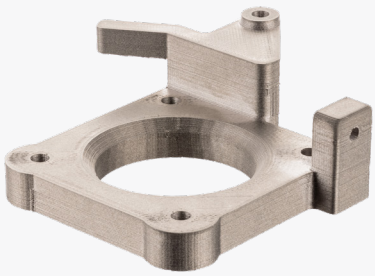
This roller screw is used in a linear actuator to open and close a pilot valve in a steam power plant. Though typically fabricated from seven components, the Studio System™ makes it possible to consolidate the assembly into one component.

02
On Demand Manufacturing

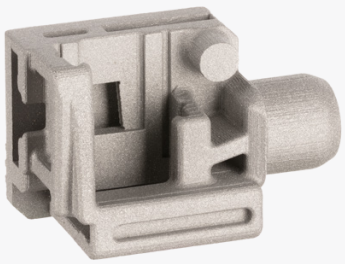
Printing brackets and mounts not only speeds up their manufacture, but gives designers more freedom to focus on optimizing their geometry for the particular application, rather than manufacturability.

[B]

[B]



[C]



[B] Brackets and Mounts

These brackets and mounts are used to hold a variety of off-the-shelf components - motors, bearings, shafts, gears, pulleys, sensors, optics and more. Printing these parts allows their geometry to be optimized for each application, while also reducing manufacturing lead time and cost.

[C] Sensor Holder

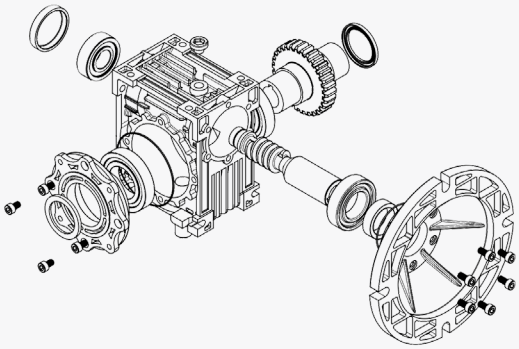
This part is used to hold multiple sensors while measurements are taken in a running machine.The intricate geometry of this sensor holder make it an ideal candidate for the Shop System. The part was printed with an extreme reduction in both manufacturing lead time and part cost. Printing on the Shop System also allows for manufacturing flexibility - when the design needs to be modified to incorporate different sensors, engineers can simply send a revised file to the printer.

03
Functional Prototyping / Pilot Runs

Manufacturing methods like casting, forging and metal injection molding are ideal for mass production, but high cost and long lead times make them a poor choice for prototyping or low-volume runs. Printed parts can often achieve the same quality as those mass-production methods without the need for tooling, saving significant time and money. Since printing eliminates the need for tooling, the part can easily be printed one day, changed and a new variation printed overnight.

[D]

[D]



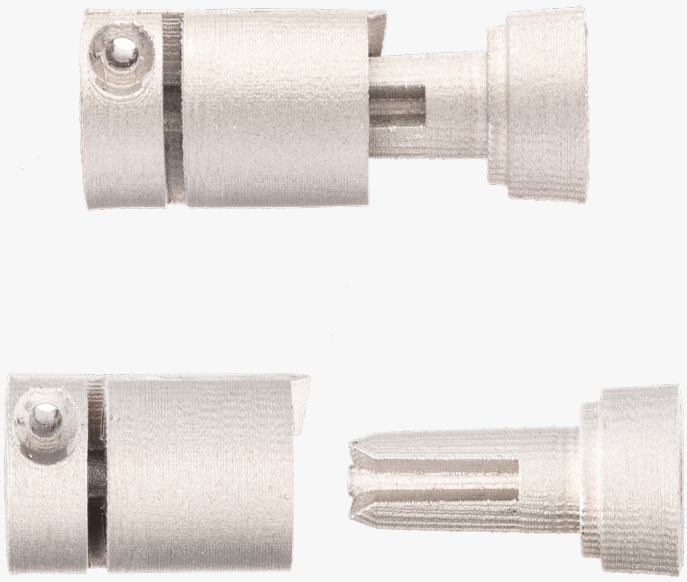
[D] Worm Gear Mounting Flange

This is the front flange of a worm gear speed reducer, allowing for the connection of different sized motors. When the speed reducer goes into mass production, this flange will be cast, followed by multiple machining operations. Using the Studio System™, this part can be quickly prototyped and iterated on without casting, greatly reducing the part cost and fabrication lead time. By prototyping in metal on the Studio System™ the flange can be functionally tested under high loading conditions to ensure that the design is optimal.

04
High-resolution Printing of Complex One-offs

Because it builds parts using extremely fine featured - layers 50 - 200 µm thick for extrusion-based systems and 15 - 20 µm voxels for binder jetting systems - 3D printing makes it easy to create fine features that may not be possible, or justifiable, with traditional manufacturing methods.

[E]



[E] Custom Coupling

This custom coupling is used to transfer power between two rotating components, and features intricate details that - though difficult to machine - are easy to print.

By printing this part, the designer was able to create multiple functional prototypes on a single print bed, allowing them to test a variety of designs in just one week and select a part with optimum geometry which can be adapted for mass production. The greatly accelerated lead time and low per-part cost enabled by the Studio System™ makes such rapid functional prototyping possible.