

## Top Tips

# The Prototyping Shop of the Future

In today's increasingly digital world, engineers and designers rely on data that can be displayed on a screen. But in product development, it's hard to overstate the importance of physically interacting with a design through a prototype.

Before the digital era, the creation of prototypes was a hands-on skill. Experienced workers would use a variety of hand manufacturing techniques to create a 3D model of a design. More recently, digital design data has begun to make it easier to visualize parts in 3D and has improved the way designs are translated from the screen into the physical world.

Prototyping is continuing to evolve even as the needs it fills—fit testing and aesthetic decision-making, functional and ergonomic testing, and low-rate initial production—have not changed. Read on for tips on using modern tools for prototypes now and for years to come.

# 1

### Collaborate across distances and disciplines.

In past decades, a design meeting might have included a group of engineers around a conference room table examining a physical prototype. In today's world, design teams are scattered throughout the world and involve engineers doing mechanical, electrical, and code design; marketing professionals; and vendors. Modern CAD platforms let engineers update designs concurrently and see team members' changes in real time from any location.

# 2

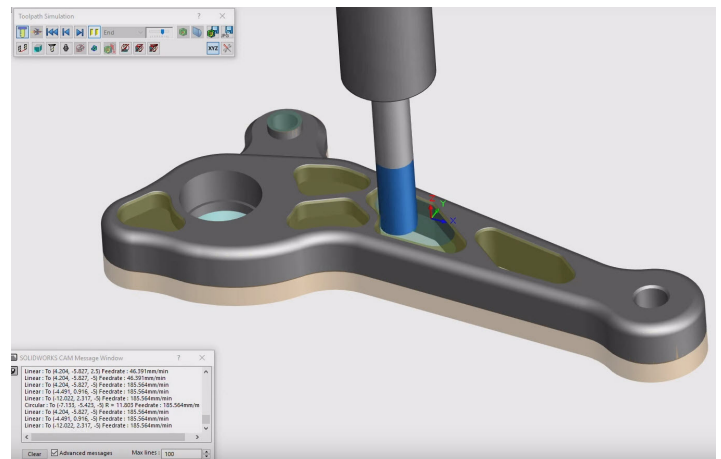
### Let the software optimize your part.

The product design process used to be based on iteration and incremental improvement. Topology generation modules included in some CAD platforms speed up the pace of change. This technique, also known as generative design, feeds key performance and manufacturing requirements into the software, which returns a series of designs optimized to perform as specified while minimizing material usage. The organic topologies help designers think differently about how a part will look and function. They also reduce material waste to improve sustainability and cut costs.

# 3

### Analyze in real time.

Engineers used to put prototypes through their paces to make sure they performed as expected. In many cases, modern CAD tools can do the same job virtually. Built-in analysis tools let engineers review responses to stress, fatigue, heating or cooling, fluid flow, and more before creating a physical part. To improve performance, they can instantly iterate the design and reanalyze it.



# 4

## **Send data right to the 3D printer.**

Additive manufacturing, or 3D printing, is one of the many ways to create physical prototypes. In certain applications, engineers like it because it can generate parts that can't be made with other manufacturing techniques, and it doesn't require additional tooling. To make it even easier to use, the file formats of some CAD platforms work seamlessly with the software that generates the 3D print path.

# 5

## **Generate CNC programs seamlessly.**

CNC machining is a subtractive manufacturing method for both metals and engineering plastics that is often used to generate physical prototypes. The code that controls the machining process used to be created by hand or with separate CAM software, but today's CAD packages have integrated modules that can create CNC manufacturing profiles. In some cases, these modules let you visualize how material will be removed before cutting begins.

# 6

## **Check parts for manufacturing challenges.**

Design for manufacturability (DFM) used to be something that manufacturing engineers learned to apply over time. Physical prototypes weren't always successful in detecting potential manufacturing snags because they were often made using a different technique than the manufacturing method to be used in full-rate production. Modern CAD packages have DFM modules that flag manufacturability problems before the product hits the production line.

# 7

## **Get quotes on the fly.**

Although physical prototypes can give you a lot of tangible and intangible experience with the part, they don't help predict how much it will cost to outsource production. Some of today's CAD packages let engineers request quotes to make the design with selected manufacturing techniques. When the CAD file format is a common one, engineers can connect instantly with suppliers to contract manufacturing or collaborate on part improvements.

# 8

## **Iterate fearlessly.**

The creation of physical prototypes can be a time-consuming process. Relying on these parts for fit, functional testing, or aesthetic decision-making; improving the design; and creating a new prototype can add weeks to your design cycle. Today's engineers are using the analysis, CAM, and DFM tools integrated into modern CAD packages and iterating designs as they find areas for improvement. Linked downstream products like manufacturing plans, inspection documents, and vendor data update automatically.

# 9

## **Augment reality.**

Augmented reality (AR) is increasingly replacing physical prototyping. Today, the design team meeting described earlier might feature a scale model of the product projected onto the conference table, or onto the desk of each attendee of a video conference. Realistic virtual models of the part can help designers make informed aesthetic decisions.

# 10

## **Do a virtual walkthrough.**

For an even more immersive experience, consider using virtual reality (VR). This technique lets designers and other stakeholders like end users and marketing professionals experience the product on a real-world scale. Some VR models let you walk through them and manipulate design features. Designers can then incorporate ergonomic and experiential feedback before committing to production.