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How Additive and Traditional Manufacturing Mix

The world of additive manufacturing is at a crucial point. There have been breakthroughs in printing larger parts. More metals are being developed for use in 3D printers. Additive is becoming part of the game plan of many different manufacturers.

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At the same time, there have been new challenges as 3D printing becomes more industrialized. Manufacturers are studying where 3D printing fits in with their factories. That includes how 3D printing should be integrated with traditional subtractive manufacturing, where parts are cut and grinded.

We asked Kevin Nerem, an applications engineer at 3D printing solutions provider, Stratasys, to analyze how additive and traditional manufacturing are being integrated on the factory floor.

In what ways does additive complement traditional subtractive manufacturing?

Additive complements traditional subtractive manufacturing by allowing parts to be built without significant tooling change costs. This is very beneficial when it comes to low-volume production parts. Additive manufacturing also enables lower cost design iterations.

What types of additive technologies go well with traditional manufacturing?

Most types of additive complement traditional manufacturing. Some types are better suited for manufacturing than others, but they all have a place. For example, fused deposition modeling (FDM®) has a wide range of production-grade thermoplastics available. This makes the FDM process and material applicable to a wide range of manufacturing applications. Thermoplastics and metals are better suited for manufacturing environments, while thermoset plastics serve a limited role in this environment.

What Stratasys 3D Printers are good to pair with traditional manufacturing?

Any printer in the Fortus® line can be paired with traditional manufacturing. On some occasions the high-end PolyJet™ 3D Printers can be paired

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with manufacturing. It all comes down to the application at hand. At Stratasys we try not to pair a printer to an industry. Rather we try to pair the printer to a particular application or solution.

There has been talk that more "hybrid" machines, which combine both additive and traditional operations, will be developed. What is Stratasys' view of hybrid machines? Is this the way to go?

Hybrid machines are a unique idea. By combining subtractive and additive techniques the best of both worlds can be achieved. Organic/custom shapes could be produced cost-effectively and could encompass highly accurate features.

Stratasys is constantly monitoring industry trends and planning future products to ensure we have the best solutions to meet our customers' changing needs.

As things stand now, traditional manufacturing machines are needed to machine parts made by additive. Will it remain that way for the foreseeable future?

Not all additive parts need to be machined. In many cases the parts right off of the machine can be used. It all comes down to the application and requirement at hand.

We often see unnecessary expectations or assumptions that all surfaces of a manufacturing fixture must be machined to a micron level of surface finish. This design strategy leads to excess cost and time with little benefit beyond improved appearance of non-critical surfaces.

A more efficient approach is to focus improved accuracy or surface tolerance on specific interface points of a given fixture while leaving the reminder of the fixture untouched directly from the additive machine.

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What is the production threshold where a user has to choose between additive and traditional? What is the production level, or how many parts per day, where additive leaves off and traditional must be used?

It's really hard to give an exact number for a threshold. There are a lot of factors that play into this decision, such as part size, complexity, and customization of the product.

Additive tends to follow a linear cost structure, meaning each part will cost the same regardless of production volume. Traditional manufacturing will typically follow an exponential cost structure, meaning, the more parts you produce the cheaper the parts will cost. At the point where these cross will be the threshold, and that production number is different for each part design.

Some types of additive systems have failure rates of one or two out of 10. What does additive need to do to improve? What is being done now to make improvements?

Quality and repeatability are of high importance when it comes to manufacturing. Additive currently has many processes in place to improve the repeatability of parts. For example, Stratasys tunes and calibrates its printing process for each of the materials that we offer.

When looking at the additive industry as a whole, many current technologies are still very young. As the industry continues to mature, the repeatability will come with it. When traditional manufacturing was first introduced to the world, it experienced the same problem.

Please describe efforts being made to produce larger pieces.

Efforts are always being made to improve additive manufacturing technologies. As customers' demands for larger parts become more prevalent, the industry will adapt. There are currently a few

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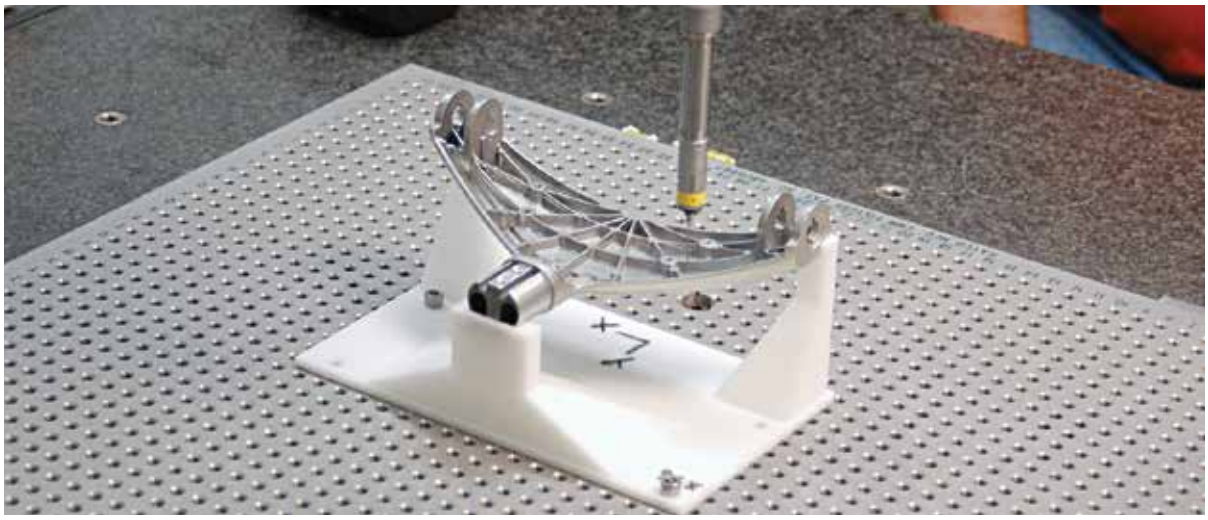

companies that can produce larger parts such as cars. Other companies use the method of bonding parts together to produce a large piece.

We see this trend following the CNC industry, as it began with smaller mills and lathes, then expanded to include very large format systems.

Please describe efforts to increase the number of materials, especially metal materials that can be printed.

New materials are always being developed for use in additive systems. This will be one of the major factors enabling the growth of the additive manufacturing industry.

Stratasys devotes a large percentage of its development budget to materials research. Our extensive list of materials is what helps set us apart from our competition.

Please describe where things stand now to make additive practical – where it's a key part of the mix (additive and subtractive) in manufacturing.

Additive is very practical for low volume and/or highly complex parts. As the number of parts needed increases, traditional methods become more cost effective.

Additive is practical for production assembly fixtures across all industries. The benefits of applying additive for production fixtures include improved ergonomics, reduced tooling time and reduced tooling cost.

Stratasys is Shaping Our World

Every day, our customers find simpler, smarter approaches to stubborn design problems – and greater confidence to confront towering human and technological challenges. Less hindered by the usual constraints, they can imagine, design, iterate and replicate more freely than ever before. By providing the shortest possible path from idea to solid object, Stratasys empowers them to untangle complexity, tackle tough problems, uncover new solutions – and to do it all with the urgency our accelerating world demands.

We've been at the forefront of 3D printing innovation for more than 25 years. We're shaping lives by helping researchers and health experts expand human knowledge and advance health care delivery. We are fueling the next generation of innovation through our work in aerospace, automotive and education. We're trusted worldwide by leading manufacturers and groundbreaking designers, makers, thinkers and doers. As a proud innovation partner, we offer the best mix of technologies, deep industry expertise – and the most flexible implementation options to meet our customers' needs – whatever shape they may take.

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