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How to Choose the Right 3D Printing Technology for Automotive Manufacturing

Solution Guide

"The biggest benefit of 3D printing is definitely the time savings. The time for development and taking the tooling or a trial period down to a fraction of what it is with traditional methods is a huge benefit, especially when you're trying to get to market on time at product launch."

Those are the words of Luke McInnes, responsible for product development at ROUSH Performance. ROUSH is an automotive manufacturer specializing in the engineering and production of performance packages for street and racing applications.

ROUSH Performance is just one of an expanding slate of automotive suppliers and OEMs that leverage the benefits of additive manufacturing (AM). The simple reason is that AM offers time- and cost-saving solutions at each phase in the automotive production process:

- Product development
- Production support
- Part production

Despite the benefits AM offers, there's a wide variety of available AM technologies to choose from. In addition, determining which technology to use with each production phase isn't always clear or easy. But that's why we've published this Solution Guide. If you're an engineer, designer, or program manager involved in any phase of automotive production, this guide will show you how AM benefits each step of the development process and help you determine which AM technology is best suited for each.

The guide assumes you have some level of understanding of basic additive manufacturing principles. But if you don't, we suggest you start with this **3D printing FAQ blog post** to begin your familiarization journey. Also, for clarity's sake, we'll refer to "3D printing," "additive manufacturing," and "AM" synonymously throughout this document.

Let's get started.

How AM Benefits Product Development

Product development is the broad term that encompasses product ideation and design. It usually involves the creation of conceptual models and prototypes, and it's where 3D printing can play a particularly effective role.

The primary benefit of AM for this phase of automotive production is the acceleration of the design and product development process, usually at a lower cost than traditional methods. Additive manufacturing achieves this in several ways:

Tool-Less Manufacturing

AM needs no tooling to make physical parts – the 3D printer is the only requirement. No prototype tooling or manufacturing outsourcing is involved, resulting in a lower cost to produce the concept model or prototype part.

Faster Speed to Part

Because 3D printing is a toolless process, there is no tooling lead time, outsourcing, or machining queue to wait for. That means designs can be turned into physical objects much faster, usually in hours or days vs. weeks.

Multimaterial and Multicolor Printing

There are 3D printers that combine multiple materials and colors in a single print operation. They produce prototypes and concept models that replicate finished products like auto interior panels and components that would take multiple steps to make with traditional methods.

An added benefit of using AM is achieving a better final design. Because parts are made quickly, there is more time for design iteration – trial and adjustment – resulting in a more optimal design than what's possible using traditional prototyping methods.

Volkswagen

Volkswagon uses the J850™ multimaterial, multicolor printer to make highly realistic prototypes that would take multiple steps and processes to create with non-3D printing methods.

Product Development Cycle Reduced to

2 months

How AM Benefits Production Support

Production support involves anything associated with the manufacturing process on the production floor. The predominant application of 3D printing in this phase consists of the tooling used to make, assemble, paint and inspect parts that ultimately form the completed vehicle.

The key benefit of AM for manufacturing is a lower-cost, more efficient production process. This is possible for the following reasons:

Faster Tool Production

Similar to 3D printed prototypes, 3D printed tools can be produced much faster than tools made with traditional fabrication since there's no outsourcing or production lead time involved that you usually find with conventional tool production methods.

Minimal Operational Disruption

Faster, on-demand fabrication means you can deploy tooling more quickly, as needed. This avoids production delays usually associated with lead times to make or procure new tools or to replace damaged tooling.

Easier Ergonomic Designs

AM's design freedom lets you optimize tool designs tailored to the worker and the task without the inevitable compromises with tools designed for how they can be manufactured.

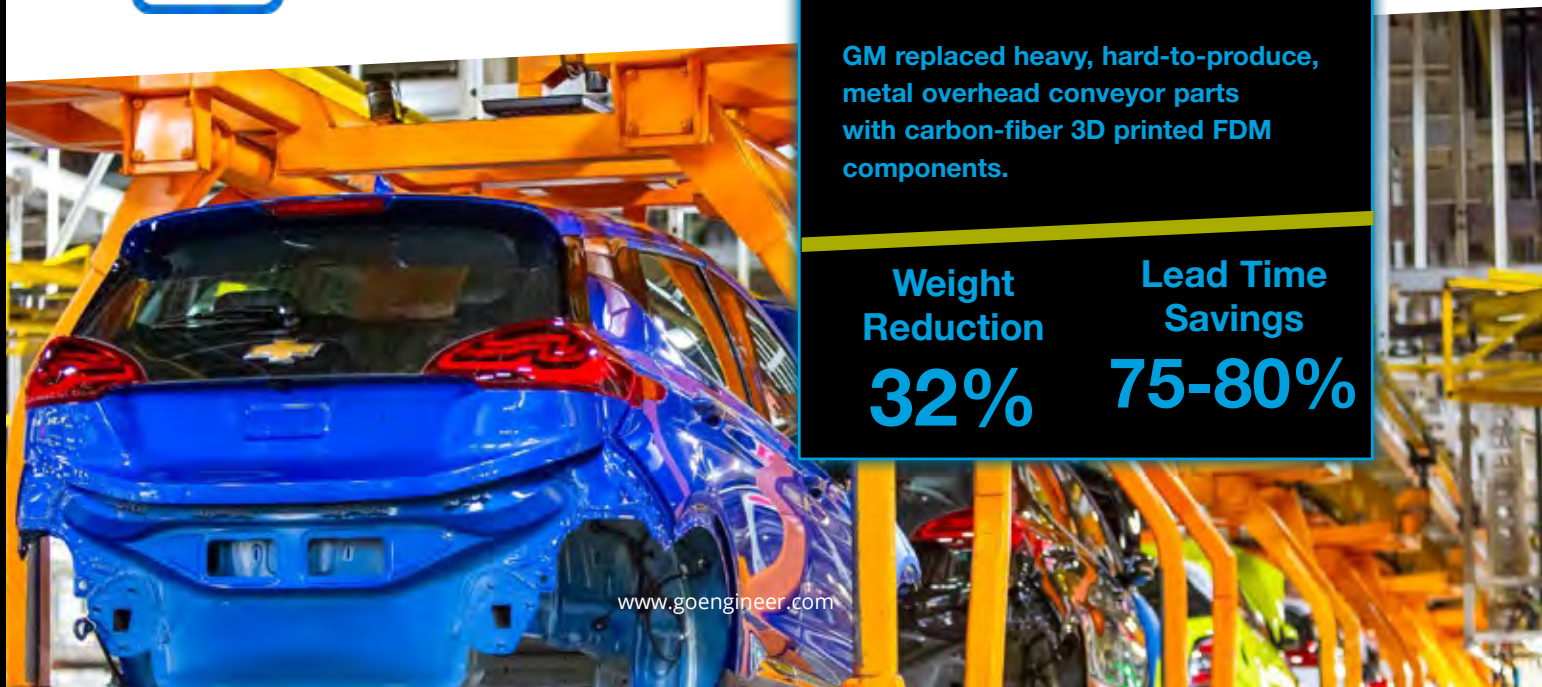
Increased Task Efficiency

Optimized tools that streamline operational tasks result in a more efficient process. Reducing repetitive tasks by even seconds adds up to significant time savings over weeks and months.

High-Performance Polymers

Polymers can replace metal in many tooling applications due to their outstanding mechanical performance, resulting in lighter tools. This reduces worker fatigue and repetitive motion injury for hand-held tools. In addition, lighter end effectors mean smaller, lower-cost (and usually less expensive) robots to move them.

general motors



GM replaced heavy, hard-to-produce, metal overhead conveyor parts with carbon-fiber 3D printed FDM components.

Weight Reduction	Lead Time Savings
32%	75-80%

How AM Benefits End-Use Part Production

Additive manufacturing is traditionally viewed as a prototyping and tooling technology. However, the reality is that AM can beat traditional manufacturing for making end-use parts in specific scenarios. These scenarios are becoming more prevalent as car manufacturers increase customization and search for more economical ways to support spare, replacement, and obsolete parts. These situations involve reduced part quantity demand, which opens the door to economically viable low-to-mid-level production quantities using additive manufacturing.

The bottom line is that high-production 3D printers enable faster time to market, optimal supply chain efficiency, and cost-effective customization.

This is made possible by two key AM technologies:

DLP (Digital Light Processing) AM

DLP is a faster AM technology compared to stereolithography and extrusion 3D print technologies. It achieves this by simultaneously fusing the entire part layer at one time, vs. the slower point-to-point process used by the other AM methods.

Powder Bed Fusion Printers

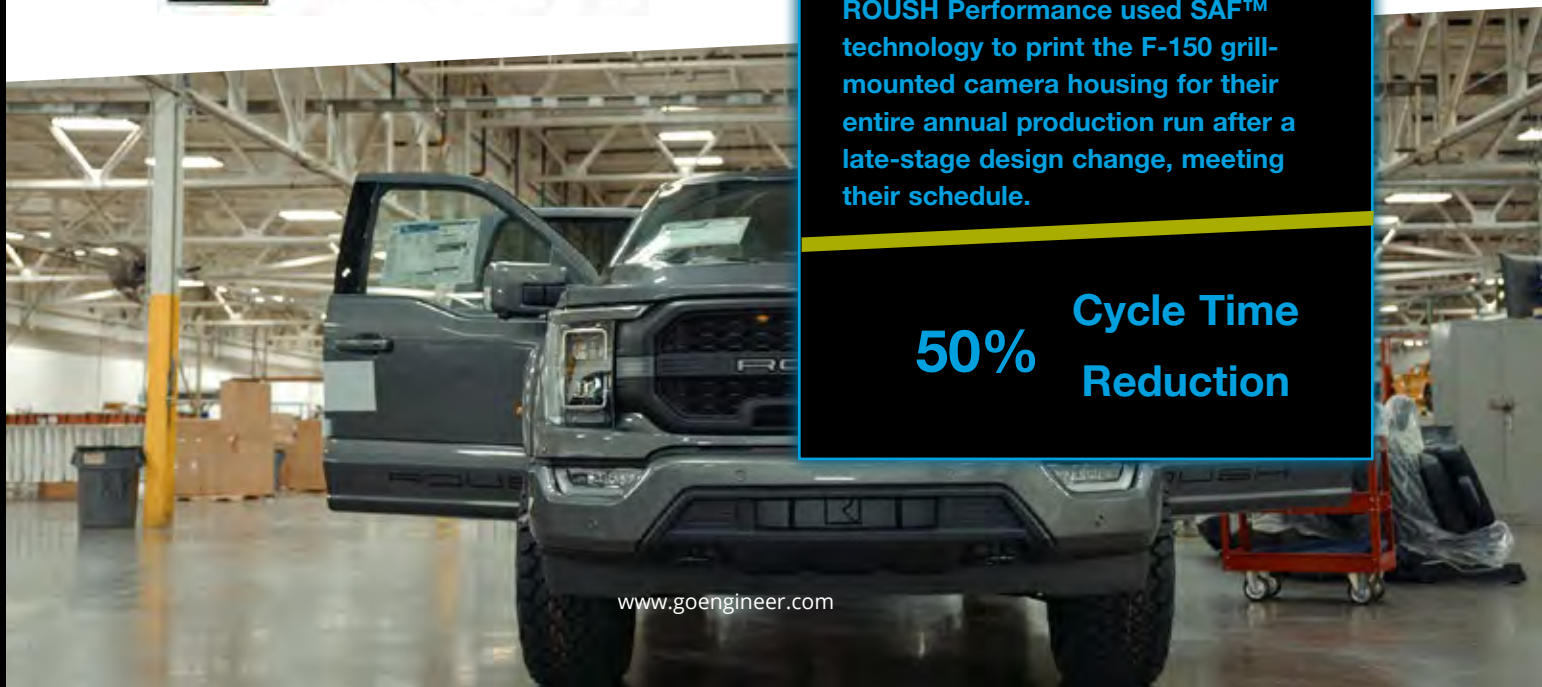
Powder bed fusion technology uses the printer's entire print volume, allowing parts to be stacked closely together. As a result, printers can produce hundreds of pieces in a single build, depending on part size. Using multiple printers with this capability allows manufacturers to produce at scale.

An additional benefit of higher volume printing is a lower cost-per-part. As automakers move to more high-value/lower-volume production, AM technologies that meet the required production levels without hard tooling lowers the production cost. This can make a scenario financially unfeasible with traditional manufacturing doable, thanks to higher-producing AM technologies.

ROUSH PERFORMANCE

ROUSH Performance used SAF™ technology to print the F-150 grill-mounted camera housing for their entire annual production run after a late-stage design change, meeting their schedule.

50% Cycle Time Reduction



Choosing the Right AM Technology

Now that you know how additive manufacturing benefits the auto industry, it's time to take a closer look at how you can make that happen in your operation. The key lies in using the right technology for the distinct phases of auto production. That starts with knowing what technology exists and where it fits.

Stratasys makes five different polymer-based AM technologies. Bundled with them are a diverse array of materials and the software needed to manage everything from printing your part to communicating with your connected shop floor.

Stratasys 3D Printing Technologies

PolyJet™

PolyJet is a photopolymer technology where droplets of material are deposited in successive layers and exposed to UV light to build a part. PolyJet's advantage is its ability to use multiple colors and materials in the same build. As a result, it can mimic wood, leather, and virtually any other type of material, resulting in parts that exhibit incredible realism.

Optimal Automotive Industry Applications – Product Development

- Prototyping
- Concept models
- Design validation

Stereolithography

Stereolithography (SL) produces parts by fusing layers of material within a vat of liquid photopolymer, creating parts with excellent detail and exceptional surface finish. This makes it another optimal technology for high-fidelity prototypes and concept models, including clear parts like light lenses.

Optimal Automotive Industry Applications – Product Development

- Prototyping
- Concept models
- Design validation

Stratasys 3D Printing Technologies

Industrial FDM®

FDM (fused deposition modeling) is a filament extrusion process. Its advantages include a broad material range, ease of use, and consistent, reliable output. FDM technology is a mainstay for functional prototypes and manufacturing tooling.

Optimal Automotive Industry Applications – Production Support

- Functional prototypes
- Part testing
- Manufacturing tooling
- Surrogate parts

Origin® P3™

Stratasys P3 (Programmable PhotoPolymerization) technology is the next level of DLP AM. It is an open system that allows you to use a broad range of materials developed by leading polymer material producers. Its primary benefits include fast print speed and surface finishes that rival injection-molded quality.

Optimal Automotive Industry Applications – Part Production

- Smaller end-use parts
- Production parts with unique material capabilities (flexible, FST-rated)

SAF™

SAF (Selective Absorption Fusion™) is a powder bed fusion technology developed by Stratasys specifically for higher-volume production. Its advantage over competing powder bed systems is the uniformity of part properties across all parts in a build due to tight thermal control. The ability to nest parts within the build envelope enables higher-volume production.

Optimal Automotive Industry Applications – Part Production

- End-use parts
- Volume production (thousands to tens of thousands depending on part geometry and printer quantity)

Materials Make the Difference

It's no secret that material technology is vital in achieving any level of success with AM. The Stratasys AM material portfolio is dynamic, with new materials and suppliers added regularly. It's also an open ecosystem whereby certain printer technologies can use third-party materials, and printer parameters can be adjusted to optimize a material's output. Leveraging third-party material sources makes sense because their primary goal is to push the boundaries of material science. A broader material portfolio enables new 3D printing applications.

The form factor of polymer AM materials – liquid photopolymers, powders, and filaments – depends on your specific technology. Therefore, choose the appropriate technology for your application first, followed by the suitable material for your particular use case. The following chart lays out the key material attributes of Stratasys print technologies.

If you don't have 3D printers or would like to test a certain technology for an automotive project, **Stratasys Direct manufacturing** can help. With a fleet of 3D printers, including five AM technologies, Stratasys Direct Manufacturing can fulfill your capacity constraints.

PolyJet	• **Thermoset resins** • **Many color options and combinations** • **Capable of many characteristics – transparent, opaque, rigid, pliable**
Stereolithography	• **Assorted range of Somos®-brand polymers offering suitability for diverse set of applications** • **Polymers with superior clarity, structural integrity, thermal resistance, and capability for use as casting patterns**
FDM	• **Wide range of available thermoplastics – engineering grade to high-performance** • **Includes Stratasys Validated Materials – developed for specific applications by industry-leading material suppliers** • **Includes carbon and glass-filled materials for high-strength applications**
Origin P3	• **A portfolio of materials developed by industry leaders in polymer technology** • **Includes materials highly suitable for automotive applications – flexible materials (seals/gaskets) and FST-rated materials (electrical connectors)**
SAF	• **PA11 and PA12 nylon powders suitable for a wide range of industrial applications**

A Complete Software Suite Ties It All Together

Innovative printer hardware and capable materials are great, but the solution isn't complete without powerful software. It's the software that lets you easily go from CAD model to printed part at the push of a button. It's the software that seamlessly ties your printer together with the rest of your connected factory. And it's the software that provides the information security you may need to prevent breaches of your AM-related data.

Stratasys AM technologies employ software applications that get your parts in hand more efficiently, reliably, and securely, anchored by the following applications.

GrabCAD Print™

The cornerstone of Stratasys AM software is GrabCAD Print. It enables you to import your 3D model and, with an intuitive menu, achieve the print results you need.

GrabCAD Shop™

Designed for engineers and 3D printing shops with higher AM project loads, GrabCAD Shop software simplifies the workflow and project tracking in busy 3D printing operations.

GrabCAD Software Partners

Stratasys also has a network of software partners specializing in productivity and connectivity enhancements for your AM operation, including MES, DRM, PLM, and analytics software.

GrabCAD Develop

GrabCAD Software Development Kits (SDKs) let independent software developers and customers use APIs to connect and integrate Stratasys printers with their existing software infrastructure.

OpenAM™

OpenAM™ software lets users alter print parameters on select Stratasys printers to optimize material capabilities and print results. This lets you tailor a material's performance to meet specific application needs or part properties.

As you can see, additive manufacturing covers a lot of ground. But it's no different than any other tool designed to solve a particular problem. AM doesn't replace other manufacturing technologies. Instead, its value is that it offers a better alternative to some of the traditional tools you currently use. And in some cases, it provides a solution where none previously existed.

A Complete Software Suite Ties It All Together (cont.)

As someone responsible for automotive design or manufacture, the key to benefitting from AM is matching the right technology to the intended use case. The following chart is a good starting point for initial guidance.

Production Phase	Product Development		Manufacturing or (Production Support)		Part Production	
Application	Concept models, visually distinct, mimic textures	Transparent prototypes, low-volume clear parts	Functional prototypes	Manufacturing aids, EOAT, fixtures	End-use parts in mid-to-high volumes, unique materials like FST, mold-like surface finish	High-volume end-use parts
3DP Technology	PolyJet	SL	FDM	FDM	P3 DLP	SAF

Take the Next Step

"We have printers on the shop floor, which is, I mean, that's the dream, right? I can create something in 3D, send it to the printer here, pull it off later that day, and we can just drop them on the car straight away."

Mark Stubbs – Automotive Designer, Radford Motors

3D printing is not the answer to all automotive production problems. At its core, it's simply another tool in your toolbox. But it's a powerful one. When you can design and make prototypes, manufacturing tools, or end-use production parts in a matter of days, sometimes hours, it's a significant benefit at the least, transformational at best.

The automotive industry is undergoing tremendous change – the drive for sustainability, electrification, and greater customization. The manufacturers and suppliers that are first to market with these deliverables will reap significant success. Additive manufacturing is vital in accelerating how cars are designed and made, helping you achieve that first-to-market goal. That's why it is a tool you can't ignore.

So, where does AM fit in your toolbox? How would your job, your operation, change with the adoption of 3D printing technology? It's a question worth asking yourself because your competitors are making the most of it.

This guide showed you how AM provides tangible benefits in the automotive production cycle where each best applies. But it can only go so far. The next step is up to you. **Contact a Stratasys representative** today to learn more about how Stratasys AM technology can help your automotive business.

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