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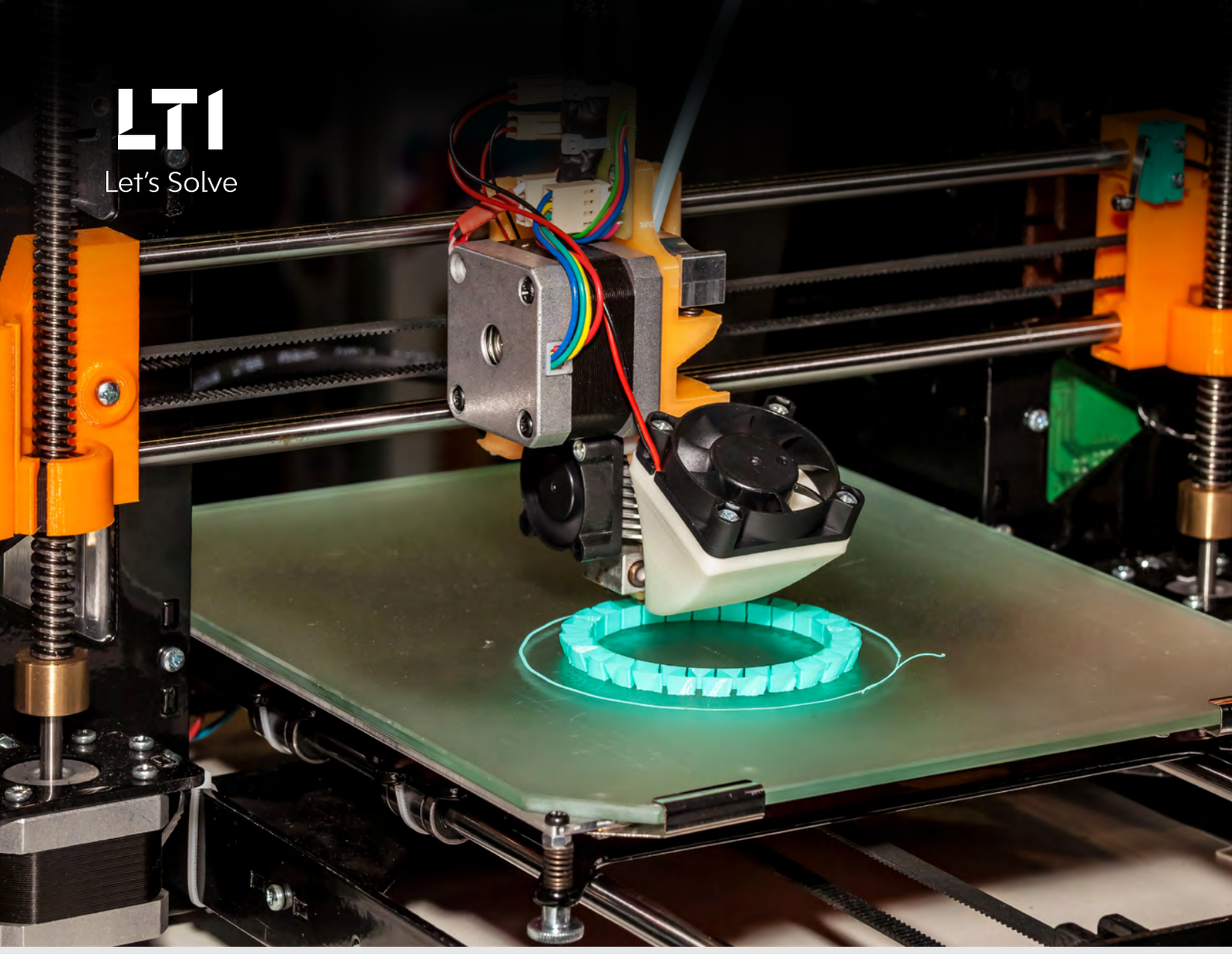


Point of view

Additive Manufacturing in Automotive – **The 3D Printing Footprint increases**

A Larsen & Toubro Group Company

Have you felt crestfallen when a Concept Car at an auto show that caught your eye wouldn't even attempt to make a production entry for years to come?

Have you wondered why every car manufacturer, large or small, high profile or budget, doesn't make bold changes to the designs each year?

If you have said yes to either, this paper is perhaps a precedent to your prayers being answered. But before that, let's take a couple of steps back to see why the automotive industry has been so hesitant to "go boldly where..."

Mass Production – the boon and bane of automotive

When a car is designed – it is made completely from custom fabricated parts, from the fenders down to the bolts. Not necessarily the bolts and screws but most of the parts that make a vehicle unique most certainly have to be custom manufactured. Therein lies the challenge:

- They need to be designed and built from scratch
- They need to be tested for the strength, flexibility, corrosion resistance, and other parameters the production unit needs
- The slightest change in specifications would take the process back to square one
- Each iteration in the process is expensive, effort-intensive, and time-consuming
- Even if the process is complete in the very first iteration, it still needs to make it to the tooling stage

When it makes it to production, each of the new parts needs corresponding tooling to mass-produce them. That costs time, money, and event space in the assembly line.

What they don't tell you at the car dealership is that if the model took ten years to design, it is ten years' worth of R&D paychecks, failed prototypes, broken bolts, and bent metal that need to be amortized in the price tag. While it's not unfair that they do it, it's certainly inefficient.

3D Printing – The efficient way forward

Also known as Additive Manufacturing (AM), 3D printing technology has been around for a while – both since its invention and since its adoption in the automotive industry – in fact, the automotive industry is one of the earliest adopters of AM.

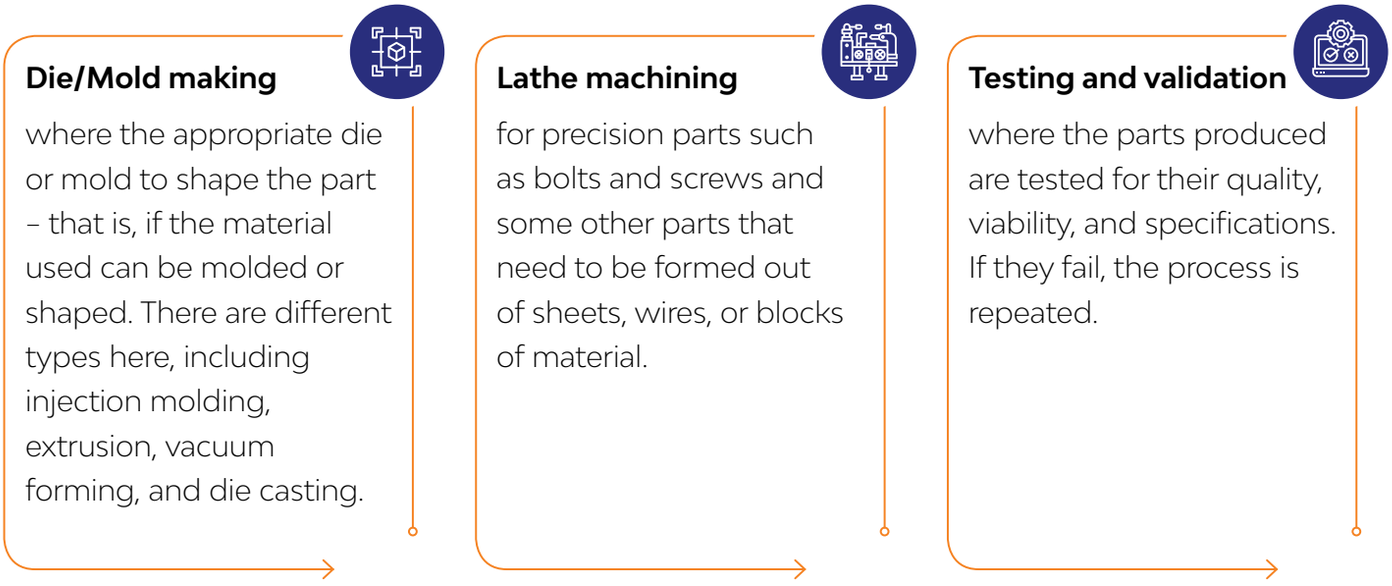
The simple case in point is Volvo Trucks – they started manufacturing tools and fixtures using AM in their Dublin plant, saving as much as $1000 on each part thus made [1].

When designing prototypes, select designs get built, each requiring its own set of tools and fixtures. With 3D Printing, there are instances where the time to manufacture these has gone down by a whopping 94% [2].

That said, there is a lot more Information and Technology in 3D printing than what meets the eye. From the tools used to design the tools, parts, and fixtures to the tools used to convey the design information to the printer, 3D printing's efficiency comes from the amalgamation of Information and Technology.

How is 3D Printing faster or better?

When a tool or fixture is designed afresh, it goes through a few stages in traditional manufacturing processes



While Original Equipment Manufacturers (OEM) may outsource these functions, the vendors still need to invest in the machinery to mass-produce the parts required.

3D Printing, on the other hand, bypasses all the intermediate steps directly to manufacturing. The 3D printer, usually available off-the-shelf, can take the design information from the CAD file and manufactures the item to the specifications in the design.

What's more, 3D Printing uses thermoplastics such as ABS and new carbon fiber-infused ABS variants as strong as steel and light as plastic.

How does 3D printing work?

There are many types of 3D printing techniques, including fused deposition modeling, Selective Light Sintering (SLS), Direct Metal Laser Sintering, Digital Light Processing (DLP), Multi Jet Fusion (MJF), and Electron Beam Melting (EBM). Some of the instances where 3D Printing is used in the automotive sector include:

- Porsche has begun personalizing seats to the contours of the owner's body using polyurethane 3D printing [3]
- Ford 3D printed brake components in the 2020 Shelby GT 500 [4]
- Volkswagen and Volvo have both used 3D Printing for tools and fixtures
- The Alfa Romeo Sauber Formula 1 Team has used Stereolithography and Selective Laser Sintering (SLS) for testing out parts [5]

Beyond cost and time

The benefits of 3D Printing, while standard, in terms of their cost, time, and labor efficiency, have far greater benefits than the obvious. For example:

1. 3D Printing can be used to customize tools for specific body types and sizes. For example, they can prevent Repetitive Stress Injuries (RSI) by taking a leaf out of Porsche's book and creating personalized tools for the workforce.
2. 3D Printing allows for multiple materials, thus increasing durability, resistance to wear and tear, and even longevity of the part. For example, Daihatsu created 15 different skins for its cars made from Acrylonitrile Styrene Acrylate (ASA) – a UV-resistant thermoplastic most suited for exterior panels of automobiles [8].
3. The personalization potential allows each 3D printed object to be unique and can have some pretty interesting advantages. For example, Ford started making sound-wave-based unique designs for tire lug bolt keys, unique to the owner's voice. Likewise, Rolls Royce has started making 3D printed parts with its unique serial number and QR code.

3D printing is a silver lining – to a dark cloud

The transition from the ENIAC and Mainframe of the yesteryears to the servers, virtual machines, and ultimately to the cloud was not a simple or easy journey. Neither will the transition from traditional manufacturing to additive manufacturing among the automotive OEMs. For starters, the technology is still new, despite being around for over half a century.

Secondly, while small parts are still viable, it is still a while away, the day we would see a 100% 3D printed car. From standardized materials to the printing speed and the even bigger challenge of managing Intellectual Property, there are a fair few stumbling blocks preventing adoption in mass production.

Adding to OEMs' woes are the billions of dollars they have invested in traditional manufacturing facilities. It may be quite a while before the cost-efficiencies of 3D printing begin to outweigh the erstwhile technology investments of automotive OEMs.

How will the future assembly line look? How will 3D printing fit into the OEMs' strategy? These are significant questions that require both deliberations, and in a manner of speaking, deliverance.

In a Nut Shell

Despite the challenges, Additive Manufacturing offers a multitude of benefits – but in essence, it boils down to the basics.

- Faster design-to-manufacture allows for extremely rapid prototyping, reducing time, effort, and money spent on design and development, spurring innovation, and refines the competitive edge.
- Tools and Fixtures being 3D printed allow for refinements in design on every iteration, reduce time to 11%, and cost to 2.5% of the traditional approach [5].
- Complex Fabrication is made simple with 3D printing technologies such as DMLS and EBM, making the future of even the engine personalized to the customer, not a distant dream.
- Lighter doesn't only mean cost-efficient. It also means better performance and increased environmental friendliness. Bugatti started with brake components. But with each additional part they 3D print, the Chiron is bound to add a few more brake horsepower (BHP) per ton [7].
- Customer Delight in better service is now possible with 3D Printing for parts that aren't typically in stock.

Conclusion

The 3D printing industry is forecasted to grow to approximately $7 billion by 2025 [6]. The factors that will drive this growth are essentially the flexibility that 3D Printing will continue to offer the automotive industry, and improve upon, the speed of delivery, the ease of manufacture, and of course, the entry barrier, which is pretty significant now.

To bridge the gap, automotive OEMs will need to weigh their options carefully. They will need unbiased assessments of their maturity and their processes. If the transition isn't smooth, efficient, and effective, 3D printing can become a very expensive mistake.

This is where consulting service providers will play a crucial role. From the preliminary due diligence to feasibility studies and establishing industry-leading processes, technology consulting will play a critical role in the adoption and, ultimately, the success of 3D printing in the Automotive industry.

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Aditya has 5+ years of delivery and consulting experience in the Real Estate & Manufacturing sectors. He is currently responsible for delivering data driven business outcomes for an American Elevator company. He holds an MBA from IIM Calcutta. His areas of expertise include project management, driving process improvements, data analysis and reporting.