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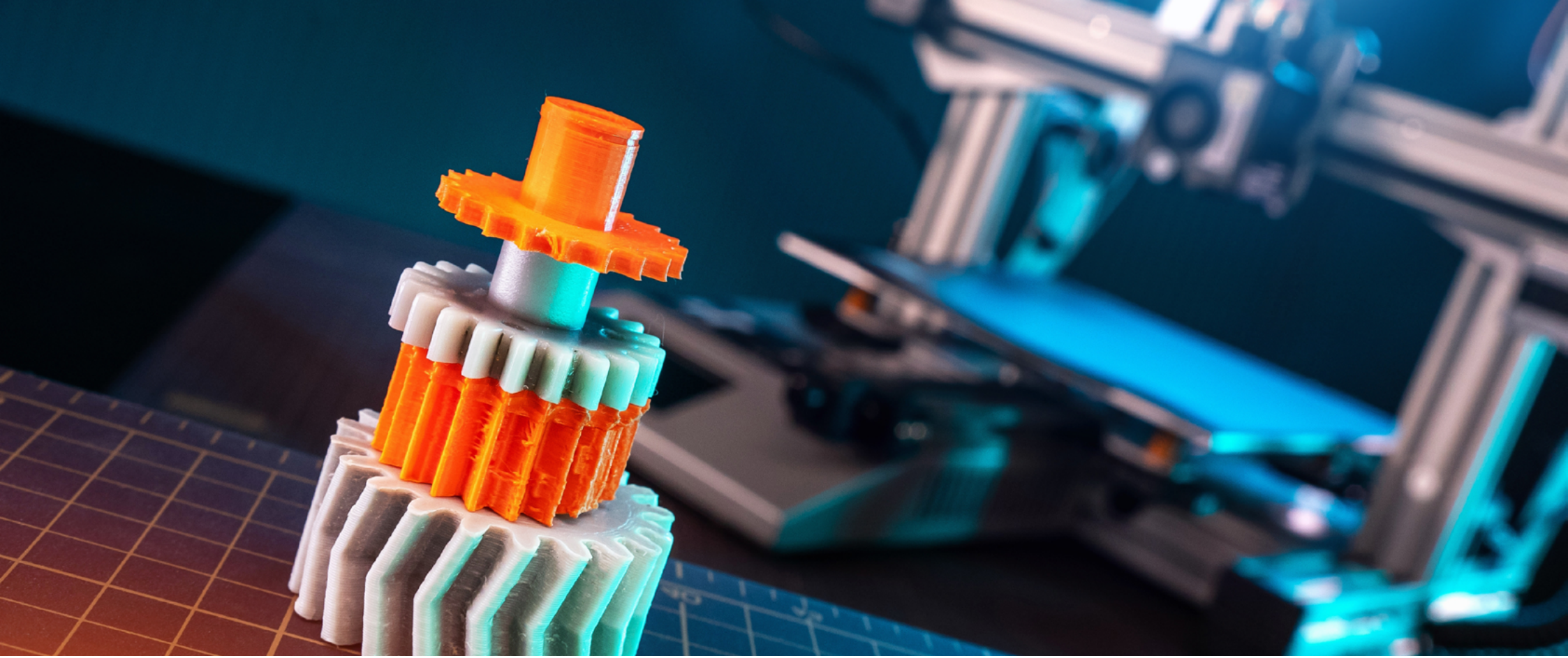
E-BOOK
AUTOMOTIVE

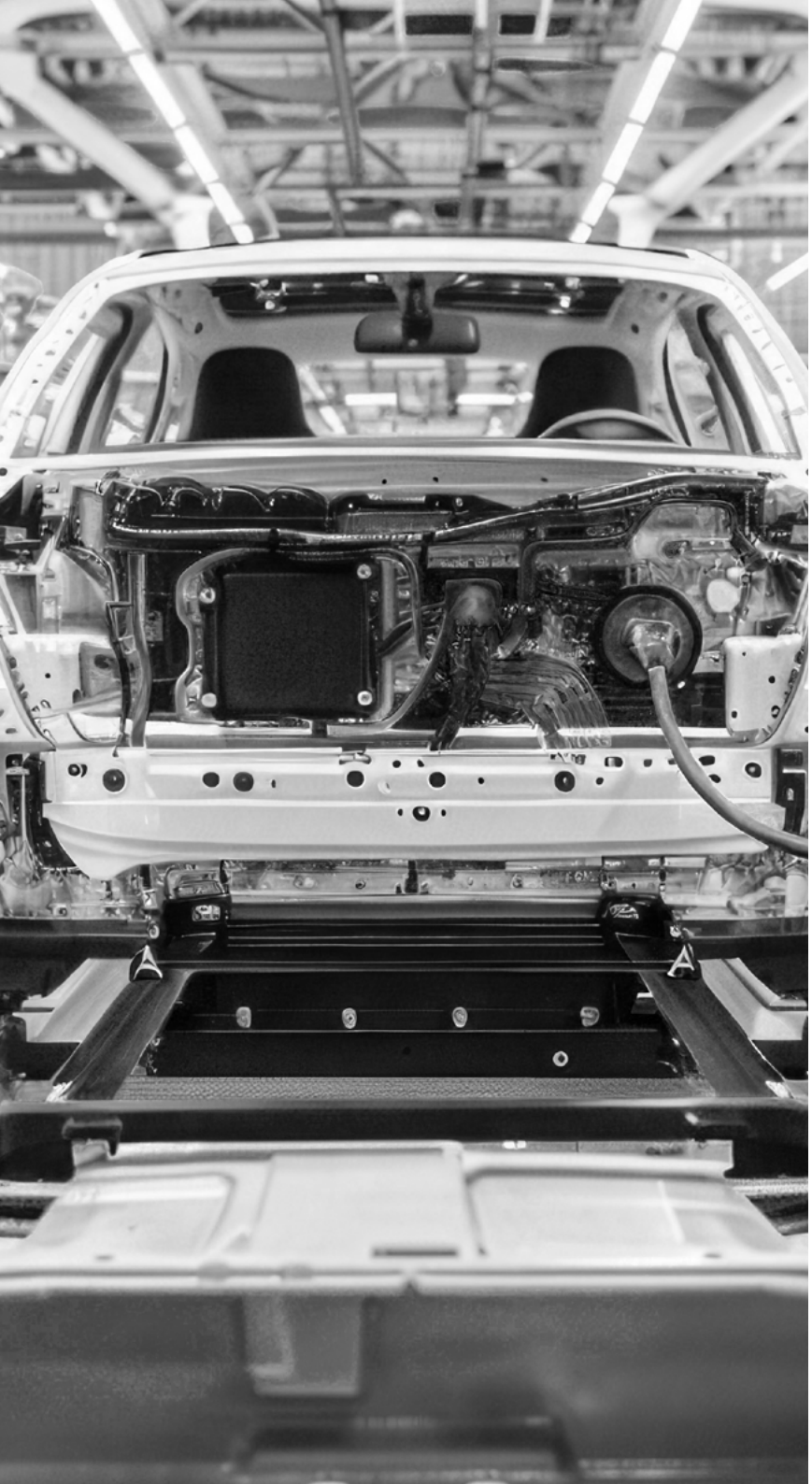
Reinventing Tooling 3D Printed Jigs & Fixtures Transform Automotive Manufacturing



Introduction

Not every innovation in the automotive industry is about the car itself. Often, it's about how it is built. Tooling, jigs, and fixtures are the unsung heroes of manufacturing, enabling assembly workers to build vehicles with repeatable quality and efficiency. Traditionally, these production aids are machined or fabricated in processes that are time-consuming, expensive, and inflexible. As vehicle models diversify and factories strive for leaner operations, relying on old methods for custom tools has become a significant pain point. Enter industrial 3D printing for tooling: an approach that allows automotive OEMs and suppliers to design and produce custom jigs, fixtures, and assembly tools rapidly and at low cost.

In this eBook, we explore how 3D printed tooling is cutting lead times from weeks to days, slashing costs, and even improving ergonomics and quality on the factory floor, all aligned with the industry's goals of higher efficiency, safety, and cost reduction.



The Challenge of Traditional Tooling in Auto Manufacturing

Every new vehicle or component often requires unique jigs and fixtures, from alignment tools for badges to positioning jigs for welding or drilling. Creating these using conventional manufacturing can be a project in itself. Companies must outsource to machine shops or mold makers, incurring high costs for one-off tools and waiting weeks (or months) for delivery. If a design change is needed, the process repeats, causing further delays. These slow lead times conflict with the push for agile manufacturing and rapid model changeovers. Moreover, traditional tools are typically made of metal and optimized for manufacturability rather than operator comfort or versatility. This means they can be heavy, cumbersome, and not perfectly tailored to the task or the worker's needs. The consequences include strain on workers, suboptimal assembly speeds, and even quality issues if a tool is not ideal for ensuring proper alignment or fit.

Pain points also extend to the cost and inventory of tools. Custom fixtures can cost thousands of dollars each. These costs add up for a production line requiring dozens or hundreds of specialized aids. Factories sometimes avoid making a helpful jig due to cost, or they stay with a less efficient process rather than invest in a new tool. Additionally, managing an inventory of rarely used tools (for service or low-volume models) takes up space and capital. Clearly, a more nimble approach to tooling is needed, one that allows on-demand creation of precisely the right tool, when and where it's needed, at a fraction of the usual cost.

3D Printing Agile, On-Demand Tooling for the Factory Floor

Additive manufacturing provides a solution by producing tools directly from digital designs. If an engineer or technician identifies a need for a new fixture, they can model it in CAD to perfectly suit the task and then 3D print it in durable industrial materials, such as high-strength and composite thermoplastics. There's no need to machine metal or create molds, so the lead time shrinks dramatically.

For instance, Volkswagen's Autoeuropa plant used to wait several weeks for externally made tools, but after acquiring 3D printers, the company reduced that to just a few days. In one case, a wheel protection jig that cost €800 and took 56 days to procure now costs only €21 and was produced in 10 days in-house[1] - a 97% cost reduction and an 82% time savings. This kind of agility means manufacturing engineers can quickly respond to issues on the line or customize tools for new variants without derailing the production schedule.

The image shows a 3D printed wheel protection jig (in white with red trim) being used on an assembly line. This custom tool prevents a pneumatic lug nut driver from scratching the wheel during installation, and it was produced additively at a fraction of the cost and lead time of outsourcing.[1] These kinds of 3D printed jigs illustrate how additive manufacturing enables rapid, low-cost tooling solutions that directly improve factory operations. By printing tools on-demand, Volkswagen Autoeuropa now manufactures 93% of its previously outsourced tools in-house, achieving assembly tooling cost savings of up to 95% within two years. This dramatic improvement also cut average tool wait times by about eight weeks, keeping the assembly line running efficiently and avoiding delays.[2]

Image source: Ultimaker.com
https://ultimaker.com/learn/volkswagen-autoeuropa-maximizing-production-efficiency-with-3d-printed-tools-jigs-and-fixtures/

[1] *Volkswagen Autoeuropa: Maximizing Production Efficiency With 3D Printed Tools, Jigs, And Fixtures, Ultimaker.com, https://ultimaker.com/learn/volkswagen-autoeuropa-maximizing-production-efficiency-with-3d-printed-tools-jigs-and-fixtures/*

3D printing materials, such as advanced polymers (Nylon, ABS blends, and carbon-fiber composites), are strong enough for many jig and fixture applications. They also produce lighter tools than their metal counterparts. A fixture that might weigh 5 kg in steel could weigh a fraction of that if printed in thermoplastic - yet still provide the necessary strength, rigidity, and precision. Lighter tools are easier for workers to handle, reducing fatigue and the risk of injury. Moreover, additive manufacturing enables the creation of complex shapes and ergonomic designs, such as handles contoured to an operator's grip, or integrated features that eliminate the need for extra parts. This design freedom lets engineers optimize tools for function and comfort rather than just manufacturability. As a result, assembly aids can be both highly customized and user-friendly, something traditional fabrication often couldn't achieve.

Impact on Cost, Lead Time, and Quality

The business case for 3D printed tooling is compelling: it drastically lowers cost per tool and speeds up availability, which in turn boosts manufacturing efficiency. BMW reported a 57% cost savings by using 3D printing for jigs and fixtures.[3] General Motors likewise expects substantial savings; at one GM assembly plant, a single 3D printer has yielded over $300,000 in tooling cost savings in three years.[4] GM gave a striking example: a particular alignment tool used for engine and transmission assembly cost only $3 to print, whereas outsourcing it would have been about $3,000.[4] That's a 1000x cost reduction for that item - and new tools can be made as soon as they're needed, sometimes in hours, minimizing downtime if a tool breaks or a new step is added.[4] Scaling this across a factory (GM now has printers in most of its plants[4]) translates to multi-million dollar savings and far greater flexibility on the production line.

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[2]*Applications of Additive Manufacturing in the Shopfloor: The case of the Wire Harness Industry,* José Maria Monteiro da Silva Inglês Dissertation, https://fenix.tecnico.ulisboa.pt/downloadFile/1126295043840470/87597_Jose%20Maria%20Ingles_Dissertation.pdf

[3]*Top Reasons To Use 3D Printing For Jigs And Fixtures*, TCT Magazine, https://www.tctmagazine.com/additive-manufacturing-3d-printing-industry-insights/top-reasons-to-use-3d-printing-for-jigs-and-fixtures/

[4]*General Motors Saves $300,000 By Switching To 3D Printed Tooling,* 3D Printing Industry, https://3dprintingindustry.com/news/general-motors-saves-300000-by-switching-to-3d-printed-tooling-134991/

Lead time reduction is equally important. When engineers can get a jig in a day or two, they can implement process improvements much faster. Nissan, for example, found that by 3D printing their assembly jigs on-site, they could continuously refine and adjust tools to improve workflows, something previously hindered by long waits from external suppliers. Volkswagen's experience in Portugal, as noted, showed nearly two months shaved off the development time for some tools.[2] This agility means that vehicle launch preparations can stay on schedule even if last-minute design tweaks require new or modified tooling. It also supports continuous improvement in manufacturing. Line workers can suggest a tool to solve a problem, and within days, a printed solution is in their hands to test.

The assembly process also benefits from improved quality and consistency. Precise, custom jigs ensure that components are placed or installed correctly every time, reducing human error. For instance, a simple 3D-printed badge alignment jig at Volkswagen ensures each model's emblem is positioned perfectly. Without a jig, these tasks rely on manual measurement or adjustment by eye, which is slower and prone to variation. By deploying more jigs that are made affordable by 3D printing, manufacturers can increase assembly accuracy and repeatability, leading to higher built-in quality for the vehicle. Additionally, when tools are tailored to the task as well as the operator, workers perform their jobs more comfortably and confidently. According to a Stratasys study, incorporating ergonomic design into 3D-printed aids – such as contoured grips or weight reduction – can directly improve worker safety and reduce fatigue.[3] This translates to fewer mistakes and less downtime, enhancing productivity.

> "Industrial 3D printing for tooling allows automotive OEMs and suppliers to design and produce custom jigs, fixtures, and assembly tools rapidly and at low cost."

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[5]*When the Success of the Job Requires It: 3D Printing for Prototyping, Tooling and Jig Design in the Automotive Sector,* GrabCAD Blog, https://blog.grabcad.com/blog/2018/10/01/3d-printing-for-prototyping-tooling-and-jig-design-in-the-automotive-sector/

Ergonomics and Innovation on the Shop Floor

One often-overlooked benefit of additive tooling is how it fosters an innovative culture on the shop floor. When production staff know that a proposed tool improvement can be tried quickly and cheaply, they are more likely to suggest ideas. The barrier to experimentation is low – if a new fixture design doesn't work as hoped, the CAD file can be adjusted and another version printed by the next shift. This encourages a mindset of continuous problem-solving. At BMW, for instance, assembly workers collaborated with engineers to design 3D-printed hand tools that relieve strain on certain assembly tasks. These tools, which were previously impossible or too costly to produce before, now improve daily operations in the plant. By freeing tooling design from the constraints of machining, any organic shape or multi-part assembly can be reimagined as a single 3D print.[3] Complex geometries such as curved surfaces that fit exactly against a car body and component consolidation are readily achieved.[3] The result: simpler, smarter tools that do the job better.

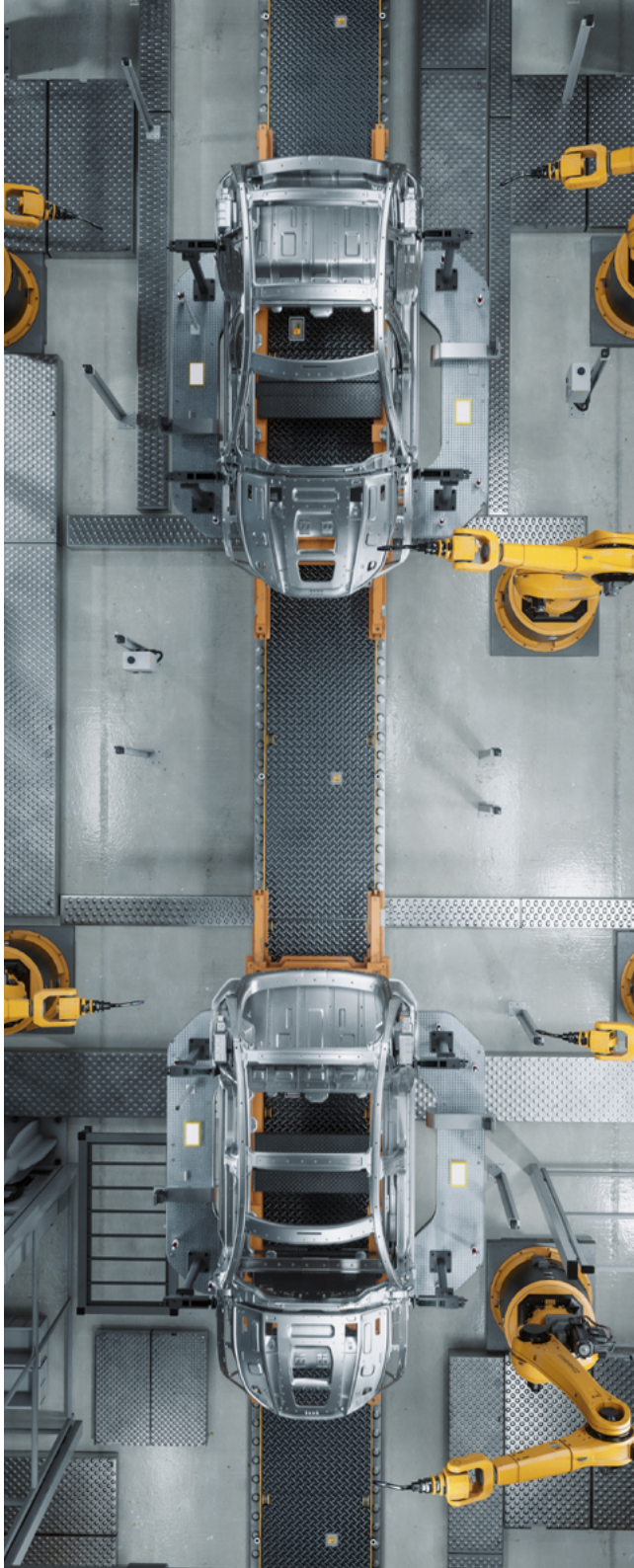
From an ergonomic perspective, 3D printed jigs and fixtures have been a revelation. Lighter, well-shaped tools reduce the physical load on workers. A study in an automotive setting found that a traditionally machined fixture might require two people to carry and position. In contrast, a 3D printed redesign could be handled safely by one person, thanks to weight reduction and added handles. Stratasys Direct Manufacturing notes that companies have delivered significantly lighter tools to production workers via additive manufacturing, increasing productivity because cumbersome metal tools are less likely to be used, whereas lightweight optimized aids are readily adopted on the line.[3] Better ergonomics also means workers can perform tasks faster and with fewer pauses, which saves time in high-volume production. It can also decrease injury rates over the long term, addressing a safety and workforce well-being goal that many manufacturing directors now prioritize.

Case in Point How Automotive Leaders Embrace 3D-Printed Tooling

The industry is full of real-world success stories that demonstrate these benefits. Volkswagen's Autoeuropa facility became a poster child for 3D printed tooling: they invested in a cluster of UltiMaker 3D printers and, within two years, were producing the vast majority of their assembly aids on-site.[2] The plant reported that every tool they printed saved them between 70% and 95% in cost compared to outsourcing[2] - an enormous boost to their efficiency. They printed tools such as custom gauge holders, drill guides, and devices for holding wheels in place, all adapted perfectly to their assembly line.

Similarly, General Motors has rolled out a "3D printing as standard" program in its plants.[4] The Lansing Delta Township plant alone expects to eventually save millions of dollars annually by 3D printing tooling and fixturing across the board.[4] A GM engineer was quoted as saying that if they need a new device or fixture, they can have it the next day, avoiding situations where a broken tool would halt a line for days while waiting for a replacement.[4]

BMW has also integrated additive manufacturing in tooling for many years. They use SLS 3D printers to create assembly jigs with complex shapes that perfectly fit the components they're used with. One famous example is a flexible hand tool for fitting door seals on the BMW 3 Series – 3D printing enabled a design that snaps onto the door frame contours exactly, speeding up the seal installation and reducing strain on the worker's wrist. This contributed to BMW's report of double-digit percentage improvements in some assembly steps. Nissan and Ford have similar initiatives: Nissan's Barcelona plant printed over 100 different tools and devices to optimize production, focusing on ergonomic improvements and even creating a digital library of printable tools for various tasks. Ford's use of printed hand tools in its 3D printing lab was mentioned in a corporate article, noting that 3D-printed hand tools that engineers have invented to help them build new parts are prevalent throughout the shop[6] - evidence that once the capability is there, engineers will find countless ways to use it.



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[6]*Building in the Automotive Sandbox,* Ford Motor Company, https://corporate.ford.com/articles/products/building-in-the-automotive-sandbox.html

Conclusion: Leaner, Safer, and More Efficient Production

For automotive manufacturing leaders, 3D printed tooling, jigs, and fixtures represent a strategic advantage. By dramatically shrinking the cost and time to create custom tools, additive manufacturing directly addresses pain points like slow changeovers, high tooling expenditures, and ergonomics. The examples from VW, GM, BMW, and others show that this isn't theoretical - it's happening now, with clear ROI. Factories that embrace on-demand printed tools become more agile and resilient. They can adapt to design changes or tackle assembly challenges in days instead of weeks, keeping production on track. They also empower their workforce with better tools, which improves morale and safety and leads to higher-quality output.

In an era where efficiency and continuous improvement are paramount, 3D printed jigs and fixtures offer a way to do more with less - less time, less money, and less physical strain. The overt promotion of any one brand isn't needed because the value speaks for itself: adopting industrial 3D printing for tooling is a practical, data-supported way to reduce costs and boost performance in automotive manufacturing. Decision-makers who invest in this capability will see payback through leaner operations and a future-ready production process that can handle the ever-increasing complexity of building the cars of tomorrow.

The Main Takeaway: 3D printed tooling empowers automotive manufacturers to build smarter, safer, and more flexible production environments-reducing lead times, cutting costs, and improving ergonomics while supporting rapid change and continuous improvement on the factory floor.

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