

Additive Manufacturing

## Additive Manufactured Tools From Sandvik Coromant Help Bring One Automaker Closer to its Goal of Sustainability

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Electric vehicles (EV) are nothing new. From Nissan and Tesla to BMW, automakers the world over are getting in on the EV action. In fact, there are now more than 5 million fuel-free cars cruising the world's roadways, with many more to come.

Nor are autonomous vehicles particularly novel. Although they have yet to gain widespread acceptance, everyone knows they're coming, and self-driving cars are gradually becoming an accepted fact of automotive life. What is new, however, are autonomous electric vehicles that are produced on a massive 3D printer, then assembled by a small team of workers in a "microfactory" – a facility no larger than the nearest big-box store. These futuristic vehicles are often customized to the specific needs of the people or companies buying them.



Meet Olli, a driverless shuttle bus with a 3D-printed chassis from Arizona-based Local Motors, that promises to change the face of transportation as we know it.

Meet Olli, a shuttle bus that promises not only to change the face of transportation as we know it, but also to revolutionize the way automakers everywhere design, produce and market their wares. If you attended the 2018 International Manufacturing Technology Show (IMTS) in Chicago, Illinois, you've probably already seen Olli. In fact, you may have rested your weary feet in its air-conditioned comfort as this driverless shuttle carried you and other IMTS visitors from building to building.

The vehicle's manufacturer, Arizona-based Local Motors, has a history of similarly audacious acts. At IMTS 2014, the automaker built the world's first 3D-printed car – the Strati – on the floor of the convention center. On the show's final day, Local Motors founder Jay Rogers and Association for Manufacturing Technology president Douglas Woods took the car for a spin.

Since its inception in 2007, Local Motors has given us the Rally Fighter, the first co-created production car, as well as the XC2V (an "experimental crowd-sourced combat-support vehicle"), the Verrado electric-powered drift trike, and the "completely customizable" and co-created LM3D Swim roadster. Perhaps most exciting of all – at least to anyone hungry for pizza after a long day of work – it gave us the Domino's DXP (which stands for "delivery expert"), touted as the "ultimate delivery vehicle." All

were collaborative efforts, and all broke the mold of traditional manufacturing.

It's clear that innovation and partnerships are basic tenets of this young company, so no one was surprised when Tim Novikov, one of Local Motors' advanced manufacturing engineers, reached out to another industry pioneer, Sandvik Coromant, for help with machining a few troublesome features on Olli's 3D-printed chassis.

Ironically, the tooling provider's sales engineer, Matt Brazelton, recommended a solution that was also made with additive manufacturing. The lightweight CoroMill® 390 milling cutter is the world's first additively manufactured indexable milling cutter, and it proved to be a huge success. By mounting the ultra-lightweight cutter on one of Sandvik Coromant's Silent Tool milling adaptors equipped with a Coromant Capto® quick-change spindle interface, the two were able to reduce the Olli's machining time by an incredible 95 percent.

Yet this story isn't so much about machining as it is about vision – a vision for a cleaner, more sustainable future, investment in our communities and an entirely new paradigm for making things, all of which begins with the microfactory concept. "I grew up in East Tennessee," says Billy Hughes, Local Motors' research and development program director. "We have a culture of community here, and our microfactory in Knoxville [Tennessee] partakes in that culture. We use locally sourced components, such as batteries and aluminum substructures, whenever possible, and many of our employees are like me: they're from around here and understand the area. That's what the local in Local Motors means – to be part of the local community and help the people who live there."

Microfactories don't eat up huge tracts of land the way traditional factories do, Hughes explains, but rather they help to revitalize communities by repurposing empty buildings, often turning what was a failed business venture into a vibrant, forward-looking commerce partner and provider of high-paying technical jobs. Microfactories are also far more flexible than their large counterparts; where a typical car or truck takes years to develop and a month or more to build, Local Motors can turn around a customized vehicle in weeks.

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Billy Hughes

Local Motors' research and development program director

Hughes attributes much of this agility to direct digital manufacturing, or DDM, a technology that includes 3D printing but goes much farther. For instance, the Local Motors design and engineering teams leverage the latest in CAD simulation and other software tools and, according to Hughes, are always on the hunt for better mousetraps. They spent several years developing proprietary, carbon-fiber-reinforced materials so that the Olli is both safe and structurally sound. They also collect and analyze data – not only from the manufacturing floor but from delivered vehicles as well – and use it to continually improve their processes and products.

"We have a lot of creative brainstorming sessions with the team and make decisions based on science and available data," Hughes says. "For example, we'll use small-scale printers to create a concept car, then discuss ways to improve it. Maybe it's better to put the battery pack over there or change the wiring harness so it's easier to produce. We're constantly striving for simplicity of design, which is a big reason our vehicles contain only 40 to 50 parts, instead of several thousand."

As alluded to earlier, the hardware they use is also cutting edge. The 12-meter-long 3D printer used to produce the Olli contains a milling head, allowing the company to produce a complete chassis with

minimal handling and greatly reduced tooling expense. This approach provides significant design freedom as well. In one recent application, Local Motors engineers designed and built a one-off autonomous water tanker not unlike the behemoth vehicles seen at construction sites, but they produced it in just three weeks and at a fraction of the cost of competing manufacturing processes.

Flexibility like this means that Local Motors can place its microfactories virtually anywhere in the world and use them to serve the community and people-specific needs of the surrounding area. There are no more massive manufacturing infrastructures to support or devastating layoffs to endure after a town's largest employer moves its operations overseas. Instead, these microfactories work with townspeople and local government to solve problems.

“It’s about scale,” says Hughes. “We want to connect with and scale to the community, not build massive quantities of products to be shipped off elsewhere. That’s the whole point behind small, nimble plants – they’re able to address the needs of the few. But they’re also about the workers of the future. Manufacturers everywhere are struggling with new technology and with educating people to work in a rapidly evolving digital world. And while they’re still talking about how they might accomplish this, we’re already doing it. That’s the beauty of our concept.”

Local Motors opened its first microfactory in Phoenix, Arizona, nearly a decade ago and expanded to Knoxville, the plant where Hughes and his team work. The company recently opened a demonstration and learning facility in Maryland. Meanwhile, the automaker has its eyes set on the Pacific Northwest, Southern California, Central Europe, Australia and any city willing to embrace an all-electric, autonomous and locally built transport solution.

It might be used for public transit purposes, Hughes says, or it could be for urban shopping centers, college campuses or amusement parks, but there are clearly endless opportunities for the cleaner, greener and more sustainable future that the Olli can provide. “It’s exciting to know that we’re building the jobs, the factories and especially the vehicles of the future and that we have great companies like Sandvik Coromant with us on that journey.”

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