

In A San Francisco Basement, An Ultrafast Electronics Factory Is Wowing Investors And The Likes Of NASA And GE

San Francisco isn't known as a manufacturing center. But in the heart of the city, not far from the highway, a venture-backed startup, [Tempo Automation](#), is manufacturing electronics for big-name clients.

Tempo, which has raised a total of \$75 million from investors that include Point72 Ventures, Lockheed Martin and Lux Capital, isn't your typical, mass-production contract manufacturer. Instead, in its tucked-away basement factory, Tempo is helping clients like Lockheed Martin, General Electric, Hitachi and NASA produce small runs and prototypes of printed circuit boards quickly and accurately thanks to its proprietary software, machine learning and automation.

On a recent visit, workers, who wore white or gray smocks and special yellow tape in their shoes to draw static electricity into the ground, moved blue trollies of electronic components that are scanned by digital QR code into position. To assemble the boards, robots will then pluck these components and feed them into giant machines that quietly do their job.

What sets Tempo apart from a typical contract manufacturer of electronics is that it uses machine learning and automation to both set up the designs for manufacturing and to test those results quickly. Firms that need mass-production scale will need to take Tempo's prototypes elsewhere, but those that need 250 or fewer can have them all produced at Tempo's 42,000-square-foot digital factory, sometimes in days.

"The goal is to make it so that every electrical engineer has a toolkit that rivals that of software engineers," says Jeff McAlvay, the company's cofounder and chief executive officer.

The result, as with other industries that have put in place data-driven software, should be not only better results for customers but also higher profit margins for Tempo's business than would have otherwise been possible. That has helped Tempo to reach a valuation that the venture-capital database PitchBook pegged at some \$100 million after a Series B funding in April 2018 and that *Forbes* estimates is closer to \$200 million after Tempo received an additional \$45 million in Series C funding this spring. (Tempo declined to discuss valuation.)

McAlvay, 33, who has a bachelor's degree in philosophy from the University of Pennsylvania, previously worked at McMaster-Carr, the large supplier of hardware, tools and materials. On the side, he fiddled around with robotics and automation. In 2013, frustrated by how painstakingly slow and error-riddled hardware development was, he launched the company. He soon brought on cofounders Jesse Koenig, a former engineer at

Sierra Nevada and Northrop Grumman, who is now the company's technology chief; [Shashank Samala, a 2016 alumnus of Forbes 30 Under 30 in Manufacturing](#), who is now the company's product chief; and Katherine Scott, who was the software lead in the early days but has since left the company.

"We said, 'What would it look like if software development came to electronics?'" says McAlvay, a bearded man who arrives at the meeting wearing tan shorts and a brown-and-white plaid shirt. "It was really about, 'How can we make hardware development as fast as software development.'"

The electronics market is enormous, cranking out hundreds of billions of dollars of stuff every year. Yet, as McAlvay says, most electronics design has been built for high-volume production (think Foxconn churning out mobile phones), not for speed or for low-volume parts runs (even though that represents roughly half of the market). Since low-volume runs are often loss leaders for large factories, requiring massive setup time in proportion to how long the line is running, the processes aren't designed to handle them, explains Ryan Saul, Tempo's vice president of manufacturing. "That's why quick-turn manufacturing work is fraught with errors," he says.

At Tempo's headquarters and factory, which was previously occupied by a company that did apparel prototyping, the 145 workers are split between software development and manufacturing. The company's software interprets its customers' designs, giving quotes in hours and doing manufacturing feasibility studies the same day—cutting a process that would typically take three days or longer to one. By automating previously manual processes and using its own quality inspection software, Tempo both speeds up its production time and improves quality.

Circuit-board assemblies may require hundreds or even thousands of components, a complex process that historically has left a lot of room for error. If a part that's supposed to be 2 millimeters is actually 2.05 millimeters, it won't work right. The result for hardware design and production has been a slow and painstaking process. "I felt the pain that Jeff described at the first meeting," says Sri Chandrasekar, a partner at Point 72 Ventures, the venture-capital arm of hedge fund investor Steven Cohen's operation, and an electrical engineer by training. "The idea that you could rapidly iterate through 10 cycles of the board in the time it would typically take to do two cycles is what got me excited about the business."

The big idea is that machine learning and software will transform manufacturing just as they have other industries, allowing not only a better product but also higher profit margins. "That's the bet we are making," says Chandrasekar, whose firm led the last two rounds of financing in Tempo, a doubling-down that isn't typical in Silicon Valley. He figures that Tempo's gross profit margins could ultimately be 50% higher than traditional contract manufacturers, allowing it to be valued like a tech company. "There's no silver bullet with this company," he says. "There's a whole bunch of changes and process improvements and pieces of software that get us another 0.2% efficiency or 0.3% efficiency."

For now, Tempo is building circuit boards that will go to Mars next year on the Rover and that will help power GE's enormous microscopes. Its electronics will also go in a variety of products for defense contractor Lockheed Martin and in capital equipment for Hitachi—and others that McAlvay won't discuss because of non-disclosure agreements. Many of Tempo's target markets, such as satellites and medical devices, require hundreds of circuit boards rather than thousands or more.

“The high-volume folks are making tens of thousands of phones. They don’t want to do this, nor are they set up to do it,” McAlvay says. “The software has to be a huge side of the story.”

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