

Thank Lynn Conway for your cell phone

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She's been called the "hidden hand" in the 1980s microchip design revolution that made today's personal computers and smartphones possible.

Now Lynn Conway's role in bringing these technologies to life is coming into sharper focus. Conway, an emerita professor of electrical engineering and computer science at Michigan Engineering, was named a fellow at the Computer History Museum in Mountain View, Calif. on April 26. She was honored for developing and spreading new ways to design

integrated circuits.

The recognition is the latest in a series that started in 2012. In the fall of that year, the IEEE Solid State Circuits magazine published a [special issue](#) dedicated to Conway's contributions to what's known as the "VLSI revolution." VLSI stands for "very large scale integration" and it's the process of making chips with more and more transistors on them.

Conway wrote a memoir for the special issue. In it, she dissects the paradigm shift and reveals for the first time how it came about step-by-step.

Why only now – more than 30 years later? Conway had her reasons. Not only was she a woman working in a field that was fiercely male-dominated at the time, she was a transgender woman who preferred to stay out of the limelight for fear that her past could cost her a future.

"I didn't mind being almost invisible in my field back then or that no one had a clue what I was really doing, much less who was doing it. I was thrilled to even have a job," Conway [wrote in the Huffington Post](#) last year.

She had undergone a gender transition in the late 1960s. Working for IBM at the time as a male, she'd been fired when she told her bosses her plan. In the early 70s, she embarked on a new life in "stealth" mode. She started working as a contract programmer and soon landed jobs at Memorex and then at high-profile Xerox Palo Alto Research Center. That's where the revolution began, led by Conway and Carver Mead, who is now the Gordon and Betty Moore Professor Emeritus of Engineering and Applied Science at the California Institute of Technology.

Intel had just released its first single-chip microprocessor. The engineers at Xerox could tell it held great promise – that it was the foundation of tomorrow's computing industry. But at the

time, chip design happened only inside semiconductor firms like Intel. Only those ideas were being prototyped. Conway and Mead had a bigger vision. So they democratized chip design. Here's how they did it:

First, Conway had to learn how to design chips herself – a task made easier by her background at IBM. Then, she distilled the chip layout process into two pages of simplified rules that a novice engineer could understand. She built the rules around ratios of dimensions rather than specific dimensions, and because of that, her rules have remained relevant over the decades as chips have shrunk.

Next, Conway and Mead wrote a textbook, *Introduction to VLSI Systems*. It included the new design rules.

“The book was a landmark,” [wrote Chuck House](#), director of InnovaScapes Institute, in the IEEE special issue. “Simplistic histories of Silicon Valley and the Personal Computer Revolution focus on the hobbyist Homebrew Computer Club, the youthful Steves (Jobs and Wozniak), with a Gary Kildall vs. Bill Gates footnote. But the paradigm shift that enabled Apple's and Microsoft's emergence had vital antecedents that have largely remained obscure. Conway's role there, while crucial, has often seemed ‘behind the scenes’ to outside observers.”

Conway taught the first course with the book at MIT in 1978, using Mead's industry connections to get each student's design prototyped. That was a major feat at the time. The following year, as the textbook grew in popularity and universities across the country offered similar classes, Conway took a gamble. She promised, on Xerox's behalf, to get a semiconductor firm to make the prototype for each student's project -- each student in every class across the country.

She made the controversial promise in an email over the Arpanet, the precursor to the Internet. She also vowed to use that network to get the design files to a semiconductor firm. It would be an early e-commerce system.

It worked. In the fall, messages and files from 12 universities “surged across the Arpanet,” Conway wrote. “We'd done the impossible, demonstrated that system designers could work directly in VLSI and quickly obtain prototypes....”

This is how the industry operates today, in large part. Conway calls it “freedom of the silicon press,” and it's made a small world big.

“These chips,” Conway said, “they're like enormously vast little cities. They're just incredible wonders invented in minds and printed in silicon. There's a whole elegant world inside our cell phones that most people don't even know exists.”

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