



© servickuz/iStock/Getty Images Plus

SEMICONDUCTORS

Ray Stata on the evolution of the semiconductor industry

The cofounder of Analog Devices looks back on his long career and assesses the state of semiconductors today.

Abhijit Mahindroo and Nick Santhanam

Ray Stata, cofounder of Analog Devices, has always charted his own course. “Early on, I decided I wanted to start my own company and be my own boss. I had a serious aversion to authority,” he says. His independent streak and willingness to challenge conventional wisdom helped make Analog into a world-wide leader in data conversion and signal-processing technology. In this edited conversation with McKinsey’s Abhijit Mahindroo and Nick Santhanam, Stata looks back on the factors that contributed to Analog’s success. He also reviews the rapidly evolving semiconductor landscape, offering advice to executives who are trying to develop their own winning strategies.

McKinsey: *The path to a start-up can be complicated. Can you tell us how Analog came to be?*

Ray Stata: After graduating from the Massachusetts Institute of Technology [MIT], I started working for Hewlett-Packard to learn about business, since I wanted to start my own company. Matt Lorber, a fellow student at MIT with whom I shared an apartment, also had the itch to start a business. We talked a lot about what to do and how to do it without any great ideas. So we took the plunge without a real business plan and little money and founded Solid State Instruments, based on our experience at MIT’s

Instrumentation Labs. The company was a failure from most perspectives, except that it was acquired by Kollmorgen's control division within a year. The sale provided a nest egg to fund Analog Devices later. More important, through our experience building instruments and controls for Kollmorgen, we learned about the emerging market for modular operational amplifiers. At Solid State, we decided to buy the op amps used in our instruments, rather than design and manufacture them. We later started Analog Devices to compete with our suppliers.

McKinsey: *New companies might benefit from hearing how Analog Devices grew from a start-up to a mature enterprise. What helped you in this journey?*

Ray Stata: First, we had a tolerance for risk and readily adapted to changes in the environment. When we founded Analog Devices in 1965, there were no linear integrated circuits [ICs]. We designed op amps using discrete transistors, resistors, and capacitors. In 1967, the first IC op amps were introduced. The performance of these devices was no match for our hand-assembled modules, but they became better each year and were an order of magnitude cheaper. So I decided in 1969 to get into the semiconductor business and to design and manufacture IC op amps, targeted at high-performance applications in the instrumentation and military markets where our modular op amps were selling well.

It was a huge risk for a small company to shift from profitable modules, where the business was growing 80 percent annually, to ICs. We had no experience in IC design and manufacture, and the large semiconductor companies had a compelling head start. We had just gone public, and the board wouldn't approve the shift, so I personally took the risk of funding a start-up and gave Analog the option of purchasing it later, if it succeeded, with no gain to myself. Well,

the start-up succeeded, and Analog bought it to enter the semiconductor business.

We also had a capacity for unconventional thinking. Take our decision to set up our own international distribution system and sales organization. Most small companies used sales representatives and distributors, especially internationally. But we directly sold and delivered products to customers in the US and abroad. This allowed us to provide superior customer service and technical support compared with competitors.

McKinsey: *Can you describe some of the most important elements of your strategy?*

Ray Stata: Our strategy has always been to focus on innovation as the driver of business success and to invest in market segments where we could achieve and sustain the best performance and largest market share. To differentiate our performance from the large semiconductor companies, we pioneered the development of wafer-level laser trimming of thin-film resistors, which were deposited on the surface of standard bipolar wafers.

Although we ventured into new technologies, we always remained focused on our traditional base—op-amps customers—when deciding what other linear functions to develop. This led us to converters, multipliers, radio-frequency [RF] circuits, voltage references, sensors, and a host of other products. Our focus gave us coherence and a sense of identity—and eventually brand recognition—as the market leader in what we labeled real-world signal processing. Today, we are able to integrate our broad range of signal-processing functions into more complete solutions for wireless communications, health-care instrumentation, and automotive safety- and entertainment-system applications. But it is still about real-world signal processing.

McKinsey: *Do you recall any mistakes you made? What could other semiconductor leaders learn from them?*

Ray Stata: In the early days, as we were struggling to build our competence as a semiconductor company, I was worried about our long-term survival and ability to compete. As a hedge, we put together a team to integrate vertically into computerized data-acquisition systems. But when the IBM PC emerged, this idea didn't get very far. The lesson for me was to stay the course and concentrate on overcoming obstacles and risks. Hedging compromises focus and actually increases the risk. You can't do it all. You have to excel at something.

McKinsey: *Let us shift focus to the semiconductor industry today. How is it different from the past?*

Ray Stata: The biggest shift is that many large customers no longer want to buy components and design their own board-level systems. They want to buy more complete solutions. Thus, semiconductor companies have to become more adept at designing silicon systems. For this, you can't just focus on the performance of the separate functions. You have to design the functions to work together to achieve the best performance at the lowest cost. Although some semiconductor companies have pursued a system strategy from the outset, most have focused on specific components like op-amp converters or

Ray Stata



Vital statistics

Born in Pennsylvania
Married, with 2 children

Education

Holds a master's and a bachelor's degree in electrical engineering from the Massachusetts Institute of Technology (MIT)

Career highlights

Stata Venture Partners

(1999–present)
Founder

Analog Devices

(1965–present)
Cofounder, with MIT classmate Matt Lorber

(1973–present)
Chairman of the board

(1971–96)
CEO, president

Solid State Instruments

(1962–63)
Cofounder; company was acquired by Kollmorgen Corporation's Inland Controls division in 1963

Fast facts

Cofounder and first president of the Massachusetts High Technology Council (1977)

Member of MIT's executive committee, the American Academy of Arts and Sciences, and the National Academy of Engineering
Life trustee, Boston Symphony Orchestra

RF circuits, all with relatively low levels of functional integration. It is challenging for these companies to make the shift to systems solutions, since you have to be competent in both components and system-level ICs, which are very different businesses. It requires new competencies that go well beyond silicon-circuit design and manufacturing, such as system design, software and algorithms, and packaging technology. Another problem is that semiconductor customers are accustomed to buying silicon by the square millimeter and have trouble seeing the value in less tangible features, like embedded software.

But there are many advantages to a systems strategy. As a component company selling into board-level designs, you have to compete for every socket on the board. In the systems business, the winner takes all. There's an opportunity to capture more of the value.

McKinsey: *What role do you see China playing in the global semiconductor industry? Will the entry of Chinese players alter the current industry structure?*

Ray Stata: China is already the largest consumer of semiconductors, and its market is growing most rapidly, so the country has a positive impact on global demand. There's no doubt that China will capture a larger share of the semiconductor market over time, but the country has far to go in terms of creating innovative, state-of-the-art semiconductor products. It takes decades to develop the depth and breadth of talent in research, design, process technology, and entrepreneurship that you see in the United States and other developed countries. Even as China makes strides in the right direction, industry leaders will be developing more innovative technologies, and the leading edge will keep moving forward at a blistering pace. It is important for China to emphasize technology and innovation as the means to improve the quality of life and solve social problems, and the

country is doing just that. Through acquisitions, China may be able to accelerate domestic innovation and technology capabilities, but it will take a very long time to catch up in this fast-paced industry.

McKinsey: *Some people believe the semiconductor sector is not as attractive to young engineers as other disciplines, such as computer science. What is your view of the talent entering the industry today?*

Ray Stata: It is true that interest in electrical engineering, not just semiconductors, has declined relative to computer science. In the United States, however, we benefit from foreign students who come here to pursue an engineering education and then stay after graduation. It would certainly make it easier to retain foreign students after graduation if we reform immigration laws. Most US semiconductor companies also benefit by setting up design centers overseas to capture the great abundance of engineering talent in other locations.

From an academic perspective, engineering education and research are increasingly interdisciplinary. Thus, more engineering students will pursue joint degrees and new interdisciplinary degree programs like bioengineering. This will help to create interest and allow more students to see the exciting developments in electrical engineering and semiconductors.

McKinsey: *How do you see the semiconductor industry evolving?*

Ray Stata: As I mentioned, the shift toward complex systems solutions is changing the profile of the semiconductor industry and what it takes to be successful. These factors will drive further consolidation because companies need a breadth of products and capabilities to provide more complete solutions. There will be less investment in the component business.

You hear it said that the semiconductor industry is maturing. It's true that industry growth has slowed, but this has occurred because technology and innovation have decreased prices so rapidly, not because there are fewer opportunities. With lower costs, increased performance, and more capabilities, semiconductors may now, more than ever, provide the solution to society's greatest challenges in energy, healthcare, transportation, communications, automation, and defense. They may also be the greatest enabler of new opportunities and new markets. Who would have thought of drones as a multibillion-dollar market just a few years ago?

We can't imagine where the industry's new capabilities will take us. But the opportunities that are already visible are truly exciting—the potential for a thousand-fold increase in wireless-communications capacity at one-tenth the cost, the potential of the ubiquitous Internet of Things, or the mastery of speech recognition to reliably enable voice commands for smartphones and to accurately translate speech to text.

McKinsey: *What advice would you give to CEOs about succeeding in the future semiconductor market?*

Ray Stata: You should rethink your views on what it takes to be successful. You'll need a deeper and more comprehensive understanding of your customer's business to excel at solutions. You'll also have to make bigger bets and assume higher risks. You can't afford many losers.

I'd also say that semiconductor companies have to become much better at forming true partnerships with customers—long-term alliances in which both parties develop the trust to share ideas and possibilities. These partnerships will help semiconductor companies reduce risks and capture more opportunities. ■

Abhijit Mahindroo is a principal in McKinsey's Southern California office, and **Nick Santhanam** is a director in the Silicon Valley office.

Copyright © 2016 McKinsey & Company.
All rights reserved.