

# Forbes

April 17, 2006

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LEADING COMPANIES IN THE WORLD

## Chips And Biryani

How one U.S. tech company builds business by arming the offshorers of India.

By Elizabeth Corcoran

**M**ICHAEL FISTER HAS COME TO INDIA NOT TO SAVE MONEY but to make money. He has seen opportunity budding at Beceem Communications, a young chip design company tucked into a few floors of a building in a bustling residential area of Bangalore. He has watched it surge at Wipro, one of India's outsourcing giants. And Fister has spotted a burst of opportunity at MindTree, an R&D and consulting firm that is building a 15-acre campus west of downtown Bangalore, a few kilometers away from streets choked with shanties.

Fister runs Cadence Design Systems, a \$1.3 billion (sales) vendor of software and systems for chip design and testing. Consumers shopping for a cell phone or a handheld video player won't encounter Cadence, but without Cadence the gadget they want might not exist. Now Cadence, in San Jose, Calif., aims to fuel the next wave of offshoring, one that takes not just the help desk but the engineering department abroad. Cadence sells its tools throughout the world. But while China is fast becoming the world's manufacturing center, India is using its expertise in software to leap into the next innovative zone: designing chips.

"We want to be part of the world as it grows and to tap the passion, intelligence and pride of people building these new markets," Fister says. Cadence got an early start in India, opening a development office in 1987, the same year it was founded. Now it employs 900 there. Revenues are still modest. Asia (excluding Japan) accounted for only 9% of Cadence's sales last year, but India's share is growing: The firm has 160 chip design clients there, up from 15 in 1998.

So far Bangalore, India's high-tech city, has been home to most of the country's chip-design companies. But another flavor of biryani,

the famed rice dish of southern India, is on the rise: In February a government-industry consortium picked Hyderabad as the spot for India's first chip-assembly-and-testing facility.

Offshoring chip design promises to turbocharge business, letting companies produce more products quicker than ever before, and at low prices. Imagine it and India's tech wizards will design it, then Chinese factories will churn out the chips for it: It's just-in-time invention.

U.S. companies can leverage this system rather than fear it. Every new chip is the basis for a score of devices; every device sparks ideas for a host of software applications. "You build a foundation around semiconductors," notes Fister. "Then you can build industries around it."

Fister, 51, has seen this multiplier effect before. A lean man with a taste for racing bikes and geeky technology, he spent 17 years at Intel. He helped Intel segment the Pentium into the troika of Xeon (high end), Celeron (low end) and Pentium classic, a move that drove up profits and held competitors at bay. He was an early advocate of starting a research lab for Intel in India. Intel committed itself to chip design in Bangalore in 2002; it has 2,500 workers there now, and they have made significant contributions, most notably to Intel's portfolio of mobile technologies.

To build business in India, Cadence has spent years working with government and industry. The company has become a big supporter of the fledgling India Semiconductor Association, which hosted its first conference in February. Last year Cadence trained more than 2,000 students and engineers in India to use its tools. The company offers payment schemes that let small outfits pay for its technology as their work brings in revenues. Fister has also pushed the idea of

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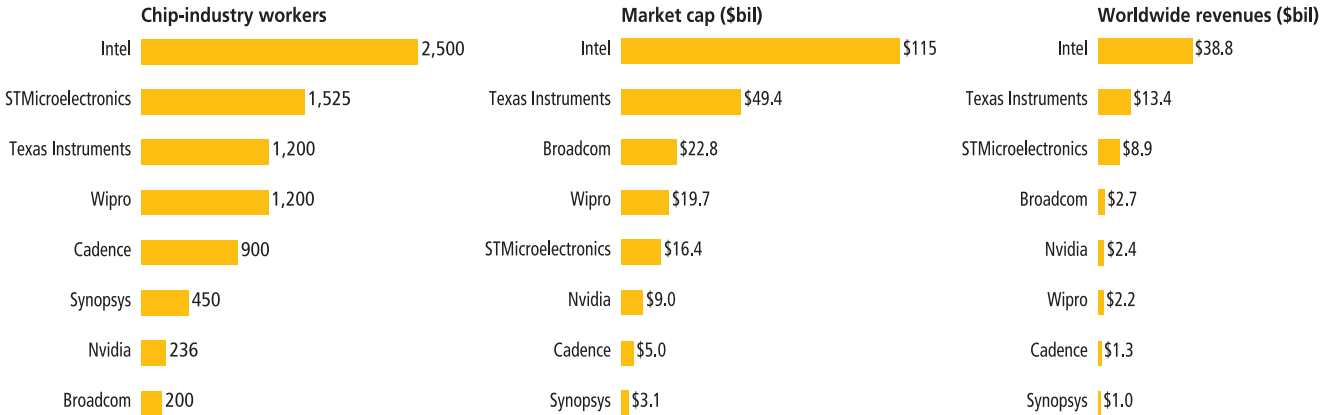
LEADING COMPANIES IN THE WORLD



Mike Fister is willing to go a long way for his customers.

## More's Company

A growing number of companies are making big footprints in the Indian chip-design community.



### India's Rising Chips

India is betting on local companies to design and build more chips, plus more electronics equipment in coming years.

Company	Value of industry output (\$bil)		Employees (thou)	
	2005	2010	2005	2010
Chip design	\$3.25	\$14.4	75	286
Chip manufacturing	0	1.5	0	7.7
Electronics equipment <sup>1</sup>	11	58	445	1,500

<sup>1</sup>Like cell phones. Sources: India Semiconductor Association; Frost & Sullivan report.

packaging Cadence's tools into "kits" with such themes as wireless networking or consumer electronics, to better fit the projects its customers are tackling. Fister delivers the goods himself, visiting even tiny companies to listen to their plans and offer ideas of how Cadence can help them grow.

On a recent February morning in Bangalore Fister arrives in a hired Mercedes at the door of two-and-a-half-year-old Beceem Communications, located in a busy residential area that's fast turning into a business zone. Beceem works on chips that provide high-speed, wireless Internet access for mobile devices.

"We're always interested in the most cutting-edge work," Fister tells Beceem's managing director Rajat Gupta, while admiring the upstart's first coup: a modem that can deliver Internet data to a laptop at 15 million bits per second even in a car moving up to 60mph. Beceem and its partners lashed together the device in under a year.

"We have about 40 people here doing chip design and another 40 doing software development," Gupta tells Fister, leading him briskly through a large room with yellow walls and green trim, filled with cubicles. Beceem, which means "wireless" in Persian, is an international hybrid. Although most of its engineers work in India, senior management and 40 engineers who specialize in radio-frequency technology are in Santa Clara. Most of its more than \$30 million in venture funding has come from the U.S. (Intel and Samsung are big investors, too.) Its first customers are in Asia.

India has built up expertise in the design of analog circuits, those

that massage smoothly varying signals (like the music from a speaker). Analog happens to be a Cadence strong suit. Five years ago only a few multinational tech companies could rely on engineers in a faraway land to handle chip design, but better telecommunications and automated design tools have changed that picture.

At 10:30 a.m. in Bangalore a handful of engineers are hunkered down in their cubicles, staring at circuit diagrams on their computer screens. U.S. companies prize high-walled cubicles for privacy. Here the walls are lower, encouraging engineers to lean over the partitions and brainstorm.

Gupta reaches a series of workbenches covered with electronic test equipment and picks up a printed circuit board the size of a short stack of index cards. "Here's our first modem," he says, one for mobile WiMax. WiMax is hot: At least 350 companies have signed on to the broad technology standard. Korea and India plan to roll out the technology this year. "There's not enough copper in all the world to connect everyone in India to the Internet," Gupta says. "That's why we think this technology is so promising."

Beceem develops mobile WiMax reference designs and analog-radio chip sets for customers that piece together those components and processors to build handsets, modem cards and such. Beceem engineers were working on their designs last spring when they got a call from a Korean electronics maker that wanted to show WiMax at an Asian economic conference in Korea in November. Would Beceem's chip design be ready?

Beceem said yes, and Cadence engineers flew from Noida down to Bangalore to help Beceem work through the nuances of using the design tools (and fiddle with the tools to make them solve a knotty WiMax challenge). After a string of 18-hour days Beceem finished its design in early July. A Taiwanese chip foundry made the chips. Tessolve, another U.S.-India hybrid, which set up a testing company last year, ensured that the chips worked. The demo at the conference in Korea wowed the crowd.

Now Gupta wants even smoother ways for Beceem engineers in the U.S. and India to synch up their contributions. "It would be impossible to have our whole team in one place," he declares. His

reason is echoed by others across India: Development strictly in the U.S. is expensive; development strictly in India is hard to manage and to keep on schedule.

"When I was at Intel," Fister tells his Indian host, "I used to think that tool companies just sold you a package and then said, 'You're on your own.' We've cut out those yo-yos." He pledges to keep Cadence engineers working with Beceem to make the tools bridge the geographic distances.

On another day in Bangalore security guards halt Fister's car just outside gates that separate the Wipro campus, with its manicured lawns and quiet pond, from the dusty outside world of construction zones. The company started in 1945 as Western India Vegetable Products Ltd. A few decades later it had leaped into technology and outsourcing. A third of Wipro's \$2.2 billion in annual revenue comes from R&D services it provides to makers of high-tech gear. Of its 52,000 employees, 1,200 work on circuit designs for more than 180 customers in 25 countries. Wipro doesn't manufacture final products (one notable exception: PCs for the Indian market). But it does everything else.

"It's like we're a hundred product companies in one," A.L. Rao, Wipro's chief operating officer, tells Fister, as lieutenants from Wipro and Cadence settle into chairs at a long polished table. Waiters glide into the room with silver trays of sodas, biscuits and hot, sweet coffee.

Vasudevan Aghoramoorthy, a Wipro vice president, displays a schematic of a product development, from concept to chip design

to support for the final product. "Seventy to eighty percent of our work gets done in the middle, in the development phase," Aghoramoorthy points out. Wipro's fastest-growing area: testing everything from circuits in development to final products.

Testing is a subtle art, one that is going virtual. Engineers can create a model of how, say, a cell phone or advanced graphics processor should work and test it by simulating the systems (say, "pushing" virtual buttons) hundreds of times. But such is the complexity of these systems that even the fastest general purpose computers cannot test all the billions of possible combinations of hardware and software interactions that a cell phone or graphics chip may encounter. Put it this way: These days chips cannot keep up with their own brainpower.

Cadence's twist has been to add the elegance of inductive reasoning. Along with its specialty hardware engine, Palladium, Cadence adds mathematical techniques that prove the validity of chip designs. "I'll tell you what," Fister says, leaning on the table. "I'll let you try out the latest Palladium for a month. After you get to know how to use it, I bet you're going to realize how fantastic it is."

One drawback: The math-intensive nature of Cadence's latest tools forces engineers to relearn how to do testing. But Fister knows Indian engineers are often game to try new approaches, provided they pay off. Wipro's Rao likes Fister's overture, and a deal is set into motion.

Fister's last stop, at the end of a weeklong road trip that began in Europe, is at MindTree Consulting, a seven-year-old firm with 3,500 employees. Road fatigue is taking a toll; at lunch Fister skips an elaborate buffet of Indian delicacies in favor of a ham sandwich. The 50-

## TI SEEDS IT

**T**exas Instruments was the first international chip company to open an office in India when it set up there in 1985. Some 2,500 people applied for jobs; TI hired 16 and put them to work in Bangalore. Oxen helped haul equipment to the new office.

Twenty-one years later TI India has blossomed into a formidable 1,200-person research-and-development team and local celebrity. A leading Indian television quiz show recently asked: "What was the first digital signal processor designed in India?" Contestants vied for a chance to shout the answer: "Ankoor!"

In two decades TI India has trained dozens of engineers to be managers. Now some of them are launching their own firms, and the welter of castoffs is great news to the company they quit: They build the software and circuits that help other companies make use of TI chips.

In December TI rolled out DaVinci, a powerful new platform of digital signal processors. Developing it took a multiyear effort by TI-ers around the world. India contributed much of the software and systems technology for these chips, which, at a cost of up to \$35 apiece, can be the brains of videophones, video security systems and other devices.

Five weeks after DaVinci appeared, a company called Ittiam

Systems was showing off a working Internet phone based on DaVinci at the Consumer Electronics Show in Las Vegas.

Ittiam's inside track? It's a five-year-old Bangalore software firm, founded by five TI India alumni, including Sridhar Rajam, who in 1995 became the first Indian managing director of TI India.

Rajam was among TI India's original team of 16. By 2001 the itch to run his own show was too great. The name "Ittiam" is an amalgam of the first letters from the René Descartes statement: "I think, therefore I am." "It tells our message," Rajam says. "Our thoughts will lead to our destiny."

Ittiam builds working prototypes based on digital signal processors such as those from TI. Ittiam doesn't worry about design niceties such as color or styling. It simply shows off every muscle of a new chip—how well it supports three- or four-way videoconferencing and how it can capture and play back speech. Customers such as Sony and Microsoft can cherry-pick the features they want in their products. What goes into their shopping carts: TI's chips and Ittiam's software for gluing system elements together.

By late March Ittiam was already in discussions with an equipment maker keen to license the technology. But it offers a payoff for TI, as well. "No one wants to see employees leave," says R. Gregory Delagi, a TI vice president, "but we're doing more than R&D. We're building a big ecosystem in India."

—E.C.

## By the Numbers

India's taste for luxuries is growing as is its ability to pay.

**4.7**  
million  
mobile  
phone users  
signed up in  
January

**\$360**  
billion in  
purchases of  
electronics  
goods ex-  
pected in 2015

**\$100**  
thousand  
for a luxury  
two-bedroom  
flat in  
Bangalore

**9.8%**  
growth in  
per capita  
income last  
year

**2.5**  
million  
university  
graduates  
every year

**14**  
varieties of  
French vines  
imported for  
cultivation in  
Bangalore

Sources: Telecom Regulatory Authority of India; ISA-Frost & Sullivan; Puravankara Projects; Government of India; McKinsey Global Institute; Indian Institute for Horticulture Research.

minute drive to MindTree from downtown Bangalore shows India's many facets, from a smooth modern highway flyover to side streets jammed with blacksmiths, sweetshops, street vendors hawking bright flower garlands, people waiting for dusty buses and cattle.

MindTree was founded by ten people who had already had successful careers elsewhere. (Half are former Wipro executives.) MindTree wants to be an "aspirational company," Subroto Bagchi, the chief operating officer, tells Fister.

Every employee holds equity in the privately held company, which raised \$24 million in funding, mostly from U.S. venture capitalists. MindTree's logo was designed by a child afflicted with cerebral palsy. ("It shows we believe there is much we can learn from everyone," Bagchi says.) The company hosts lectures by people from diverse backgrounds—dancers, astronauts and authors—aiming to "break the engineering mindset," he says.

"Ten years ago clients would just ask: 'How many C++ programmers do you have?'" Bagchi says. "Today we're getting asked to help design a concept. We're not just saving money for customers—we're creating value."

Fister gets recharged by hearing this. Like MindTree, Cadence wants to help its customers not just build products but deepen their expertise in new areas, he asserts. MindTree executives nod. In 2004 a Korean customer asked MindTree to develop a lithium-ion battery charger for cell phones, a device that required expertise in mixed-signal and analog design that MindTree lacked. Cadence helped out, Bagchi says, both by helping MindTree engineers learn to use the right design tools and by making the wares available in a pay-as-you-go program. Eight months later MindTree delivered the battery charger—and had built a new set of skills in a booming area. "We couldn't have made it without Cadence," Bagchi says.

Now, as Fister tours the MindTree labs, he suggests that Cadence's tool kits can help MindTree sharpen its skills and add to its intellectual property in radio frequency design. MindTree's executives are intrigued. The kits could speed up their development time. A month later, they decide to try out one of the Cadence kits.

As Fister sees it, the deal is another brick in the emerging Indian semiconductor economy. "It's about building a foundation," Fister says. "You don't have to reinvent everything." **F**