



CHINA & INDIA

The Leap Ahead

Biotech. Cars. Chips.
China and India look to
emerge as contenders
in some key industries



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TESTING In the lab
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Shenzhen



I-FLEX HQ Hukku aims for products that can be sold over and over

Scrambling up the Development Ladder

By leveraging software wizardry and low-cost talent, India is eyeing the next level: Tech innovation. **BY STEVE HAMM**



CONGENIA, A TWO-YEAR-OLD Italian drug company, can't match the cash of Big Pharma. So when it needed help in developing medicines to combat the diseases of aging, it turned to an unlikely source—India. Congenia in June tapped Tata Consultancy Services Ltd. for drug-discovery software and a team of programmers and life scientists in Hyderabad. The software, Bio-Suite, simulates the interactions of molecules with proteins, whittling down the universe of potential drug candidates from millions to thousands in about half the normal time. That

■ "THERE'S NO REASON INDIAN COMPANIES SHOULDN'T BE ON THE FRONT EDGE OF TECH IN EVERY FIELD," SAYS CONGENIA CEO FUNDARO

also halves research costs. With so much riding on its ability to discover new drugs, why would Congenia rely heavily on a company like TCS, which is mainly known as a low-cost supplier of computer services? Congenia Chief Executive Paolo Fundaro acknowledges he is taking a risk, but he's confident of TCS' skills. "There's no reason Indian companies

shouldn't be on the front edge of tech in every field," he says. This is a message Indian companies like TCS hope will spread far and wide. Over the past five years they've burst onto the world scene in software development, tech support, generic drugs, and back-office services. These businesses are nothing to sniff at. But in many cases they simply involve following orders from overseas clients or reverse-engineering.

Now, India is gearing up to reach the next level—technology innovation. By leveraging their software wizardry and cheap engineering and software talent, Indian companies are starting to develop their own products. Software companies such as i-flex Solutions Ltd., with its banking programs, are selling globally. "We have to build products that can be sold again and again, like Microsoft does. We have to continually go up the value chain," says Chairman Rajesh Hukku. On Aug. 2, in an affirmation of Indian software, U.S. software giant Oracle Corp. said it will pay \$900 million for a controlling interest in i-flex—but leave the current executives in charge.

Hukku isn't alone. Pharmaceutical companies such as Nicholas Piramal India, Ranbaxy Laboratories, and Biocon are making strides in drug discovery and patenting their own compounds. This creative ferment could push Indian pharma output from \$5 billion last year to \$25 billion by 2010, predicts consultant McKinsey & Co. And a Nasscom/KPMG study predicts that Indian IT industry revenues—which swelled 32% last year, to \$22 billion—could reach \$148 billion by 2012. Industry leaders figure they have the chance to design and even make advanced products of all kinds. "The big opportunity for India is when it all comes together in manufacturing," says Ravi Gopinath, TCS' vice-president for engineering and industrial services. The Indians, in fact, hope to change the global game in industries from vehicles and machine tools to medical systems.

India, a manufacturing powerhouse? Still sounds off. Last year, India exported \$1.7 billion in electronics goods. That could reach \$12.5 billion in 2010, projects Evaluateserve Inc. But India would still be a manufacturing minnow compared with China, which expects to export \$175 billion worth of electronics this year. Besides, highways, ports, air terminals, and other infrastructure aren't yet adequate to support an export boom.

Yet India produces hundreds of thousands of industrial and software engineers yearly. And as more functions for cars, consumer electronics, and complex tools are packed onto semiconductors, the need for embedded software—an Indian ex-

pertise—is expanding fast. "That means India is well positioned to be a development hub in all kinds of industries," says A. T. Kearney high-tech consultant John Ciacchella.

STILL GROWING UP

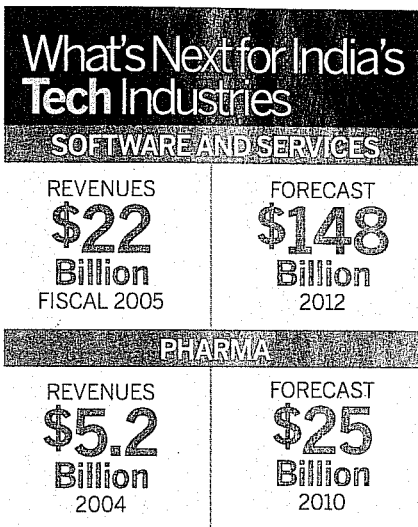
INTERNET CONNECTIONS AND advances in interactive design software, meanwhile, make it increasingly possible to design, test, and reassemble industrial prototypes of highly complex products on computers. Using 3-D computer simulations of a virtual prototype, mechanical engineers and fluid dynamics specialists at Onward Technologies Ltd. in Pune are helping to design virtually every piece of a three-cylinder tractor engine due out in 2007 from a major farm-equipment company. Says Onward Chairman Harish S. Mehta: "This industry is in its infancy, but in two years you will see this really take off." Indian product engineering revenues rose 30%, to \$2.7 billion, last year.

A handful of Indian outfits are rapidly moving along the path to hardware innovation. Wipro, Ittiam, HCL Technologies, and others are bringing together chips, circuit boards, embedded software, and industrial design—the whole stack of skills and technology needed to create a finished product. That can shave months and even years off product development, a godsend for Western companies under great pressure to cut costs.

India's industrial engineering firms are also moving beyond limited contract jobs for clients like Ford, General Electric, and Airbus and starting to cook up original prototypes for everything from machine tools to power generators. Bangalore's HCL designed a backup navigation system for the Airbus A340 and A320 jetliners in just 18 months. HCL clients often provide a mere two- or three-sentence description of the desired product and price target, and Indian engineers do the rest. "India will be very important for the world in hardware product development," predicts HCL Chief Executive Shiv Nadar.

The model for some Indian design houses is Taiwan. Big Taiwanese electronics companies like Quanta, Compal, and BenQ design and manufacture notebook PCs, cell phones, digital cameras, and other electronics for such brands as Dell, Hewlett-Packard, and Apple. Instead of mass-produced consumer items, though, India's niche could be industrial goods involving smaller production runs but high engineering content.

The breadth of research and development at TCS evinces the new vision for Indian tech prowess. Working from digital prototypes, its 850-engineer center in Bangalore is helping a U.S. auto maker design the drive train, outer body, and interior layout of a



Data: Nasscom, McKinsey & Co., OPPI

India: A Huge Market Opening Up

IBM's Passage to India: Big Blue is making a big play in the subcontinent's tech sector, partly by hiring more locals

India: An Agent of Change: That's how Infosys CEO Nandan Nilekani sees the country's impact on the U.S. economy, through globalization and outsourcing



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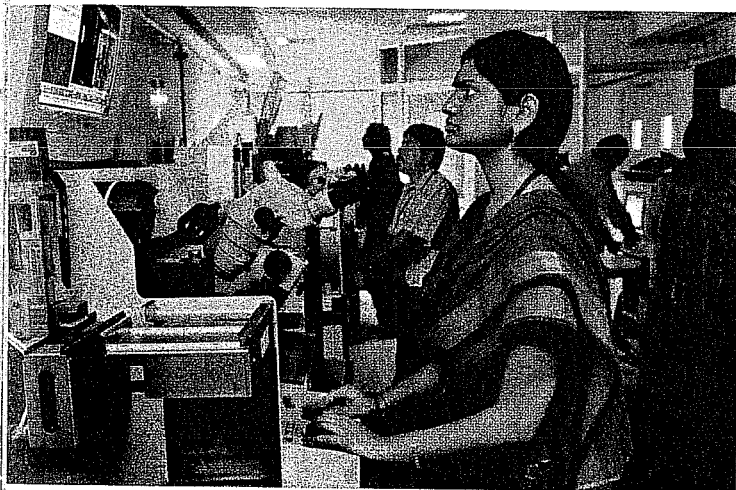
FABLO BARTHOLOMEW/NETPHOTOGRAPH.COM

future passenger car. For a leading U.S. developer of orthopedic implants, TCS engineers analyze CAT scans and custom-design replacement hips, knees, and wrist bones to fit patients awaiting surgery in American hospitals. For other U.S. clients, TCS has helped develop a forklift, a small earthmover, a golf cart, and high-security locks. For the Indian air force, it has even designed a test jet. Over the next half-decade, TCS plans to create a hybrid business model with 40% of revenues coming from licensing its technology and selling its own products, such as BioSuite.

SMATTERING OF STARTUPS

THE INDIANS ARE STARTING TO come up with original consumer electronics designs, too. Ittiam Systems Ltd. of Bangalore specializes in integrating multimedia into low-cost devices. It licenses core designs to makers of in-flight entertainment systems, digital cameras, and video cell phones. Ittiam is preparing to release designs for portable iPod-like devices to play video downloaded from the Web.

A smattering of startups have taken the next step. They're both designing and selling their own cutting-edge hardware. Four-year-old Tejas Networks India Ltd., for instance, has become one of the leading sellers of optical networking gear in the



rapidly growing Indian market. It has also begun selling its machines globally through Western networking suppliers. "The vision is to become one of the next Ciscos or Nortels of the world," says Chief Executive Sanjay Nayak.

What could delay India as it strives to innovate and build its own global brands? "It's a capital-starved country," says Sanjay Anandaram, a partner in JumpStartUp Fund Advisors Ltd., a Bangalore venture-capital firm. Startups with one foot in Silicon Valley have the edge. HelloSoft, a leading supplier of signal-processing technology for voice-over-Internet communications, raised \$16 million from U.S. VCs on June 30. It was started by Indian entrepreneurs but its headquarters are in San Jose, Calif.

Indian startups don't have such ready access to cash. A recent scene inside the tiny conference room of JumpStartUp, located across from a crumbling Hindu temple, illustrates the problem. Wary from a red-eye flight from overseas, Sanjay Shah, CEO of three-year-old Skelta Software Ltd., a maker of corporate workflow programs, was making a presentation. JumpStartUp's partners, although sympathetic, peppered him with questions about how Skelta would gain credibility in the

EYE ON THE FUTURE An HCL engineer maps circuits

West and compete with Microsoft. Shah only wants to raise \$1.5 million but sounded discouraged after the meeting. "I don't know how many VCs will be interested in funding me, and I don't see that changing fast," he says. "Without venture capital, India won't become powerful globally in software products."

But players like Shah don't need much money to make a difference. Engineering salaries are so low in India—even now, after rising 5% to 10% per year—that Skelta can afford to employ 30 engineers even though it only expects \$2 million in revenues this year. This gives it an advantage over its main rival, SourceCode Technology Holdings Inc. of Redmond, Wash., which does much of its programming in the U.S.

Where there's hype, there's hope. Oracle's acquisition of i-flex shines a spotlight on India's nascent software products industry. And that could stimulate a flowering of new ideas and companies. "We're convinced that a good portion of the next generation of software companies will be emerging from India," says Oracle President Charles E. Phillips Jr. I-flex Chairman Hukku urges his comrades to concentrate on developing software products tailored to particular industries.

That won't be the only path to software innovation, however. Trying something brand new is another option. Ramco Systems Ltd., for instance, which stumbled in its attempt to compete against Oracle and other leading corporate software makers, is being reborn with a new business model that could knock some of the established players off balance. Instead of selling packaged applications for accounting and manufacturing, which often don't fit a particular business, it builds software components that can be mixed and matched for a more custom fit. "They have been laboring away quietly," says University of Michigan management professor C.K. Prahalad. "This is going to surprise a lot of people throughout the world."

Indians know it's now or never. The advantages of low costs will last perhaps another 15 years, and competition from the likes of China, Brazil, and Ukraine is intensifying. "We are at a point in this country where if you don't innovate, you just won't exist," says S. Sadagopan, director of the Indian Institute of Information Technology in Bangalore. The Indians don't just want to exist: They want to flourish. ■

—With Pete Engardio in Bangalore

INDIA WHAT'S COOL



Bollywood Marriott

Where the five-star rubbernecking is free

➤ It's the nightly Bollywood gawkfest. Crowds throng the doors of the Marriott Hotel on Bombay's Juhu beach road to catch a glimpse of oh-so-hot stars. There's Shilpa Shetty and Preity Zinta looking sexy. And Salman Khan—the guy with the best abs and pecs in India—is strolling out with a couple of other hunks. Like L.A.'s Spago, the Marriott offers stargazing and dealmaking. But few Bollywood fans can afford the Marriott's five-star tab, and they're too intimidated to sit in the lobby. So they come from across India to line up outside, creating massive traffic jams. If you can't crash Bollywood, at least you can eyeball it.

A New Lab Partner For the U.S.?

China's rapid rise in science could make it a valuable ally in breakthrough research. **BY BRUCE EINHORN AND JOHN CAREY**



ON A JULY AFTERNOON, CHINA'S NEWLY built Shanghai Institute for Antibodies is quiet. No researchers yet toil amid the recently installed rows of DNA analyzers, mass spectrometers, and other state-of-the-art scientific tools. But the hush is temporary, promises Guo Yajun, the center's chairman. By yearend 100 PhD researchers and 200 technicians and other staffers will be developing cancer treatments at the new \$60 million facility in Shanghai's Zhangjiang Hi-Tech Park. "Everything is brand-new here," says Guo, 50, a professor of oncology and

immunology at University of Nebraska's Eppley Institute who splits his time between the U.S. and China. "The equipment is much better than my lab in the U.S."

Researchers with U.S. experience like Guo are helping to power a remarkable surge in Chinese science. Zhangjiang Hi-Tech Park has become a hotbed of new biotechnology research facilities. Eight government-run labs, including the Shanghai Transgenic Research Center, are located in the park, which is also home to 34 local and multinational drugmakers. Roche Holding Ltd. opened a research and development center nearby last year. And Chinese government spending on R&D is on the rise. It has more than tripled since 1998, and the number of scientific papers from Chinese researchers has more than doubled in that time. If current trends continue, says Richard B. Freeman, economics professor at Harvard University and director of labor studies at the National Bureau of Economic Research, "by 2010, China will produce more science and engineering PhDs than the U.S."

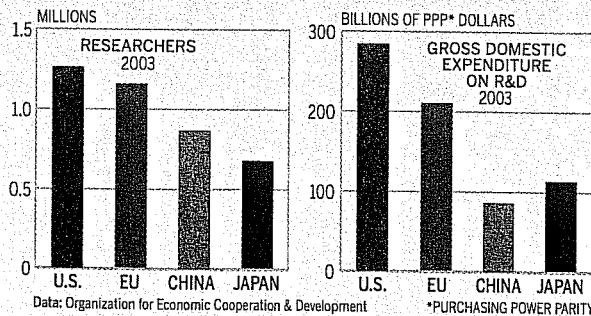
Such dramatic statistics are setting off alarms in the U.S., where Cassandras are quick to warn of a possible end to American preeminence in science. "There is a good chance that U.S. competitiveness in vitally important high-tech areas will fall behind that of China" and other countries, Johns Hopkins University President William R. Brody told a congressional panel on July 21. Experts worry that China is in-

vesting heavily in key areas like biotech and nanotech while U.S. funding for the National Institutes of Health has leveled off after a five-year doubling. Spending in some areas of the physical sciences has actually declined in real dollars.

But that doesn't mean China will ever beat—or even seriously challenge—the U.S. in research and high tech. For one thing, China's advantages—low costs, government support, and skilled researchers—are still outweighed by shortcomings. These include an immature financial system that makes it hard for science-based startup companies to raise money, a copycat culture wherein intellectual-property pirates regularly rip off patents and copyrights, and weak links between China's universities and its top businesses. "There's still a lot that needs to be done before China can be an innovative economy," says Lu Xianping, a 42-year-old native of western China's Sichuan province who did postdoctoral research at the University of California at San Diego and worked in the U.S. for a dozen years. He is now president and chief scientific officer of Shenzhen Chipscreen Biosciences Ltd., a drug-discovery startup he founded with six other Western-educated PhDs.

More important, China's rise doesn't have to be America's loss. Besides leading to benefits at home, Chinese R&D will add to the world's pool of knowledge. "Science really doesn't have boundaries," explains Shu Chien, the China-born director of the Institute for Biomedical

How Chinese Science Stacks Up





SHARING KNOWHOW
Chipscreen was founded by Western-educated PhDs

Engineering at the University of California at San Diego and a frequent visitor to the mainland. "Whatever the Chinese publish, we will see here in the U.S., and we can step on each other's shoulders to move ahead faster. If we look at it as a friendly competition, everyone gets better."

Experts increasingly see the chance of a win-win result from the combination of Chinese and American research might. That was one of the motivations for Wise Young, director of the W.M. Keck Center for Collaborative Neuroscience at Rutgers University, when he decided to set up a network of 17 clinical centers in China and train researchers to test new therapies. Born in Hong Kong, Young is a leader in the search for spinal-cord injury cures.

■ CHINESE CLINICAL CENTERS COULD HELP WESTERN COMPANIES GET THEIR OWN TREATMENTS TO MARKET MORE QUICKLY

Störmer is convinced the Chinese will become major players. "We talked at the same level," he says, adding that the Chinese were doing "top-notch research."

No doubt, some Chinese scientists will wind up becoming world-beaters, challenging their counterparts in the U.S. What's important is that researchers from both countries also expand their efforts at collaboration. That will pay off for all. ■

—With Neil Gross in New York

'China Shouldn't Follow the American Way'

Tiny Tech, Big Ambitions: China must be innovative in using nanotechnology to solve its energy problems, says NASA and IBM alum Han Jie

BusinessWeek **online**

www.businessweek.com/go/china-india/

A few years ago he had a visit from Chinese gymnast Sang Lan, who broke her neck practicing for the Goodwill Games in 1998. "She asked, if I discover the cure, how will it get back to China?" Young recalls. "I said that the only way China would get the therapy was if it actually did the clinical trials."

Young's clinical centers could help China become a leader in important new areas such as stem cells and nerve regeneration. They could also offer a way for Western companies to get their own treatments to market more quickly, Young says. Costs for conducting clinical trials in China are about one-fourth of those in the U.S. And while China was previously known for poorly regulating clinical trials, the government is beefing up standards in a bid to attract more Western companies to test drugs there.

TECH FOR TODAY

BEIJING IS ALSO WORKING hard to lure American-educated Chinese scientists back to the mainland. One way to do that is by hiring returnees such as Han Jie, 48, a University of Utah PhD in materials science and engineering, to run government institutes. Han worked for IBM and for NASA's Ames Center for Nanotechnology before becoming director of a premier Chinese nanotech lab, the National Engineering Research Center for Nanotechnology in Shanghai, last spring. Next year, Han and his team will move to a new \$15 million complex equipped with top-of-the-line facilities. Among other projects, the center is working on energy-efficient streetlights made from nanomaterials. "In the U.S., we try to build up technology for the future, but in China, I try to build technology that can be used today," Han says.

It's too early to tell what results labs like Han's will achieve. But experts such as Horst L. Störmer, a Nobel prize laureate and director of Columbia University's nanotech center, have returned from visiting China's top nanotech institutes impressed by the science.

China Ramps Up

It's adding massive factory capacity in tech-intensive industries such as autos and electronics. **BY BRIAN BREMNER AND PETE ENGARDIO**



THE AUTOMOTIVE WORLD BARELY NOTICED, but a little bit of Chinese economic history transpired in late June at the Xinsha Port in Guangzhou. In a dockside ceremony replete with costumed dragon dancers, Honda Motor Corp. executives and Chinese officials celebrated the country's first full-scale export of cars made in China: 150 Jazz compacts bound for Europe. Guangzhou officials, who believe their booming city of 6.7 million is destined to become the nation's top auto hub, were thrilled. "From now

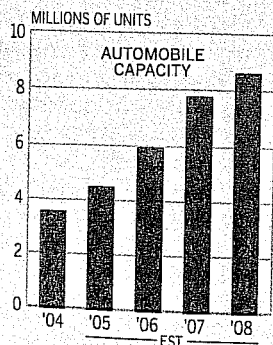
on, high-quality autos made in Guangzhou will be shipped to more and more markets around the world," says Lin Yuanhe, the city's executive vice-mayor.

Officials in Changchun, Tianjin, Wuhan, and Shanghai are just as car-crazy. The mainland is in the grip of a massive capacity ramp-up by both global auto makers and rising domestic outfits, from Chery Automobile to Shanghai Automotive Industry Corp. Plenty have plans to export China-made vehicles some day. "Where will these cars go but to international mar-

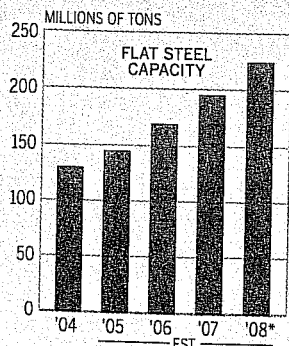
kets?" asks Hai Wen, deputy director of the China Center for Economic Research in Beijing.

Get ready for the next industrial leap. For years, China has been the cheap assembly shop for the world's shoes, clothing, and microwave ovens. Now, it is laying the groundwork to become a global power in much more sophisticated, technology-intensive industries that also demand tons of capital. Billions of dollars are flowing into auto, steel, chemical, and high-tech electronics plants. Driving this massive spending push is vor-

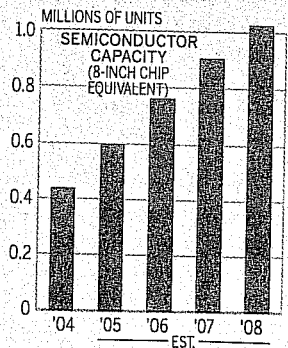
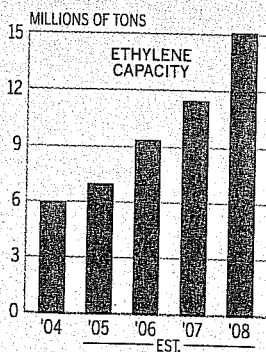
China's Growing Industrial Might



Data: Credit Suisse First Boston, iSuppli Corp.



*BusinessWeek estimate



CHARTS BY ALBERTO MENA/BW



STEEL TOWN Shanghai Baosteel Group is ranked No. 6 globally

ing, China's needs for steel remain high. But even if China simply manages to satisfy its own steel needs, that has

big implications. In stainless steel, for example, China has quadrupled its capacity since 2000. That has allowed the country to shrink its imports from 65% five years ago to 40% last year—a worrying sign for big global steelmakers.

CHEMICALS The same thing is going on in petrochemicals. China has 50 projects under way involving at least \$1 billion in investment—compared with just one in the U.S. today. Outside Shanghai, 5,600 workers are building a chemical complex a half-mile long for Germany's BASF and its Chinese partners in record time. Six other so-called crackers, built by Sinopec and other chemical companies, are expected to come on stream by 2010—an expansion that would push up China's annual ethylene capacity by 25% annually. China will still need to import the stuff, but it will be able to supply half of its needs in 2008, compared to one-third now.

SEMICONDUCTORS China's chip industry is still in its infancy, but it is expanding rapidly. Consumer-electronics and telecom-equipment manufacturers are major buyers. Some 22 new silicon wafer fabrication plants are expected to be built by 2008. Fueled by this expansion, China's chip-design industry has grown nearly fivefold, to 450 companies, during the past five years. While China's fabs are still a generation or two behind those in the U.S., Taiwan, Japan, and Europe, they're good enough for chips in appliances and other consumer gear.

acious domestic demand for all manner of goods as well as a big shift by multinationals to manufacture in China. As a result, China is rapidly becoming more self-sufficient in key materials and components, and setting the stage to be a major exporter of high-end products. Here's where:

AUTOS By 2008, Chinese passenger car capacity could reach 8.7 million vehicles annually—double the number of expected buyers. Quality is increasing. At Honda's new \$82 million export plant in Guangzhou, you'll see the same efficiency as at plants in Nagoya, Japan, or East Liberty, Ohio. Honda can crank out 50,000 1.2- and 1.4-liter versions of the Jazz compact, and there's plenty of unused land for expansion. At another jointly managed plant, where the Accord is produced, Honda officials were surprised to learn from in-house quality tests that the China-made version of the car is superior to the U.S.-manufactured model. The day is coming, declares Honda Senior Managing Director for China, Atsuyoshi Hyogo, when the Japanese auto maker “will use China as one of our export production bases” for global markets.

STEEL For the first time ever, the Chinese steel industry became a net exporter in 2004, and shipments of rolled steel vaulted 54% during the first half of this year. Asian steelmakers such as South Korea's INI Steel Co. and Tokyo Steel Manufacturing Co. have announced price cuts in response.

It's too early to tell whether China will become a major exporter. With investment in construction and highways soar-

DIGITAL ELECTRONICS By any measure, China is a consumer-electronics giant. It's the leading producer of color TVs, cell phones, desktop PCs, and DVD players. Now the industry also is poised to dominate in high-end products. That means China also may emerge as a global innovator. The country boasts more than 350 million mobile-phone users—the most in the world—and will likely overtake the U.S. in broadband households this year. Beijing also aims to convert to digital TV faster than in the U.S. and Europe. This makes China a crucial test market for new electronics technologies and products of the future, and it means China will help shape global standards as well.

The impact on world prices? “Chinese factories will drag down the profitability of global industries,” predicts UBS Securities Asia Ltd. analyst Joe Zhang. If history is a guide, China's exports also will surge. UBS predicts China's global trade surplus will quadruple this year, to \$126 billion. That's on par with Japan, an economy almost three times as big. The Washington (D.C.)-based National Association of Manufacturers forecasts China's sensitive surplus with the U.S. will leap 35%, to \$220 billion, this year.

That means as China charges into these more sophisticated industries, a whole new strata of Western industries will likely face a crossroads. They will have to move even more forcefully into higher-tech, higher-value materials and products—or buy from China like everyone else. ■

—With Michael Arndt in Chicago