

THE WORLD'S LARGEST COMPANIES

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STAR POWER

Despite a raging trade war and a softer economy, **China's corporate giants** are getting bigger, richer, and more competitive.

★

Here's how they're reshaping the business world.

P. 39





BROOKS KOEPKA

The world of Rolex is filled with stories of perpetual excellence. After only five years on the tour, Brooks Koepka's resolve has placed him among golf's elite. In 2014, he arrived on the PGA TOUR® after two years spent perfecting his game on the range, working out in the weight room and playing in every condition on the European Tour. Now, with back-to-back U.S. Open Championships, a PGA Championship and a world number one ranking, he's determined to outplay a field that knows he's coming for another Major. This is a story of perpetual excellence, the story of Rolex.

#Perpetual



U.S. OPEN 2018



OYSTER PERPETUAL DATEJUST 41



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The Fortune Global 500



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FORTUNE
AROUND THE WHEEL

WHAT OUR EDITORS
ARE UP TO THIS MONTH

PARDON THE INTERRUPTION
Watch Robert Hackett, Lisa Marie Segarra, and a revolving cast of characters dispute (or defend) the week's headlines on Tech Debate.
fortune.com/techdebate

ALL KILLER, NO FILLER

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INHERITING AUSPICIOUS CULTURE

Wanglaoji Communicates With the World by means of "Auspiciousness"

Wanglaoji has been ranked first in China Customer Satisfaction Index and China Net Promoter Score in China tea beverage brand for consecutive six years. Its brand vision is "Deliver Auspiciousness To The World".

Auspiciousness means fortune and harmony, which symbolizes human everlasting pursuit for happiness, beauty and peace through thousands of years.



Opening of Wanglaoji (New York) Herbal Tea Museum



New York citizens learning to write the character "Ji" in the herbal tea museum

In November, 2018, Wanglaoji Herbal Tea Museum, full of traditional culture ambience and fashion sense, was opened in Manhattan, New York, America. With multimedia and various objects in the museum, citizens of New York can keenly understand China's auspicious culture and the legend and glorious achievements of 190 years' herbal tea culture. In the meantime, they can also taste healthy freshly-made herbal tea of different aromas, so as to obtain both visual and taste experience. What is auspicious culture? You might as well drink a cup of herbal tea in Wanglaoji Herbal Tea Museum and have an insight in Chinese auspiciousness.

In Wanglaoji 190th -year Creative Development Convention, Guangzhou Pharmaceutical Holdings Limited, the trademark owner of Wanglaoji in China, proposed Wanglaoji brand vision for the next 190 years-Deliver Auspiciousness To The World.

During the First Opium War, Lin Zexu, The imperial Envoy of the Qing Dynasty, suffered from heatstroke when coming to Ghuangdong to inspect opium, but he recovered from drinking Wanglaoji herbal tea. Then, to

demonstrate gratitude, Lin Zexu granted Wang Laoji a big copper pot, on which was carved golden characters of "Wang Laoji", means the benevolence in curing patients in need. Improving the street herbal tea into the globally famous healthy plant beverage, Wanglaoji has inherited "auspicious culture" for nearly 200 years. Adhering to the original mission of health and auspiciousness, Wanglaoji spreads distinctive Chinese auspicious culture to the whole world.

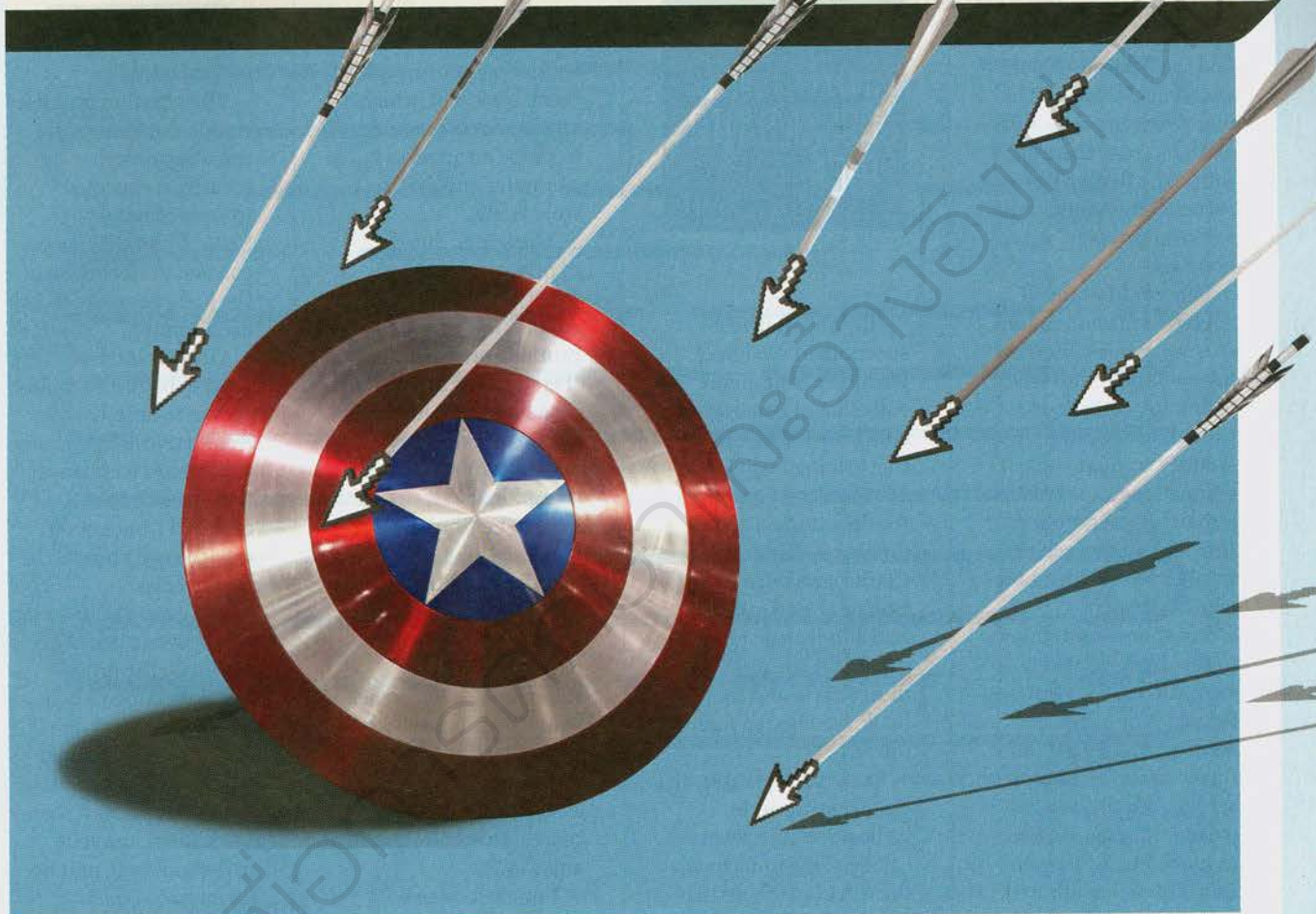
In China, the most propitious thing would be one that the whole family gather together in Spring Festival to have New Year' s Eve dinner and to drink Wanglaoji herbal tea; Wanglaoji, implicating blessing, is the first choice for the romantic wedding ceremony, housewarming and any other various celebrations. Wanglaoji, which had been the representative of auspicious culture, will open 56 museums around the whole world, so as to use auspiciousness to communicate with the world, and to have more people fall in love with China's herbal tea and feel "auspiciousness and health".

THE
WORLD IN

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PAGES

BRIEFING



The Corporate Fortress

Cyberattacks are a constant threat to American business. Is “hacking back” a viable solution? Or is picking up the telephone the secret to securing companies? **By Robert Hackett**

SECURITY

ATTEND ANY cybersecurity confab, and you’ll encounter some version of the following refrain. “There are two types of companies in this world: those that have been hacked and those that don’t yet know they’ve been hacked.”

The phrase that launched a thousand quips was coined by Dmitri Alperovitch, a Moscow-born entrepreneur and one of the world’s foremost hacker-sleuths. In 2011, as head threat researcher at antivirus pioneer McAfee, he created the classification while investigating—and publicly revealing—half a decade’s worth of (likely Chinese) cyber-

attacks on more than 70 organizations, including defense contractors, tech companies, and the United Nations.

Now the huff of resignation is due for an update. "I've since modified that phrase," Alperovitch tells *Fortune*. "The first two companies still exist, but now there's a third type that's able to successfully defend itself against intrusion." Ah, hope yet!

One could write off Alperovitch's addendum as a savvy sales pitch. As the cofounder and chief technology officer of CrowdStrike, a cybersecurity company that stunned investors with a share price-popping IPO in June, there's no wonder he's feeling a bit of good cheer.

But there's something to Alperovitch's revision. Richard A. Clarke, former White House security adviser to both Bushes and to Clinton, agrees with the new, tripartite framing. He says as much in his just-published book, coauthored with Obama cyber lead Robert K. Knake, *The Fifth Domain*—a reference to cyber as the newest theater of war, after land, sea, air, and space.

Consider NotPetya. The devastatingly global computer-wiping attack, which Russia released on the world in 2017, caused billions of dollars of damage to corporations such as FedEx, Maersk, and Merck.

"THE LAST THING WE NEED IS TO ADD WELL-INTENTIONED ROOKIES INTO THE MIX."

But not all firms succumbed. "What you don't hear about is the list of American companies that were there doing business in Ukraine"—ground zero for the attack—"that didn't get damaged," Clarke says. Firms like Boeing, DowDuPont, and Johnson & Johnson "were the dogs that didn't bark, and in our book, we tried to figure out why."

So, what separates the hacks from the hack-nots? At a technical level, the unharmed firms had patched their machines against the vulnerability exploited by NotPetya. But a more fundamental question is, Why did some companies patch, while others neglected to?

In a word: prioritization. The most resilient organizations have buy-in across the—literal—board. Any executive who blocks a chief information security officer better have a damn good

reason. The CEO will surely hear about it.

That's good defense, but what if companies could punch back? That's what some members of Congress are proposing in a piece of legislation known as the "hack back" bill, which would allow companies to probe an attacker's computer and destroy stolen data.

Mark Mao, head of privacy practice at Troutman Sanders, an Atlanta law firm, is a cautious proponent. "Personally, I don't think it's a bad idea," he says. "To me, it's like a cyber Second Amendment." (He adds that it would have to be "limited" and that "a lot of the details would have to be worked out.")

Mao draws a comparison to nuclear stalemates. "Deterrence works because nobody wants to be nuked," he says. "Most hackers get away with [it] because there's no retribution in any way."

But most cybersecurity industry insiders agree that if the hack back bill became law, the results would be a fiasco. Sandra Joyce, head of intelligence at cybersecurity firm FireEye and a U.S. Air Force reservist, disapproves. "The last thing we need is to add well-intentioned rookies into the mix," she says, noting the dangers of misidentifying attackers and the threat of tit-for-

tat escalation. It'd be "releasing a vigilantism fraught with risk."

The bill, she says, represents "the voice of the commercial sector that has felt very neglected. It's a signal of frustration."

The vexation is understandable. Worldwide spending on cybersecurity is expected to grow about 9%, to \$124 billion this year, according to Gartner. And the breaches seem to just keep coming.

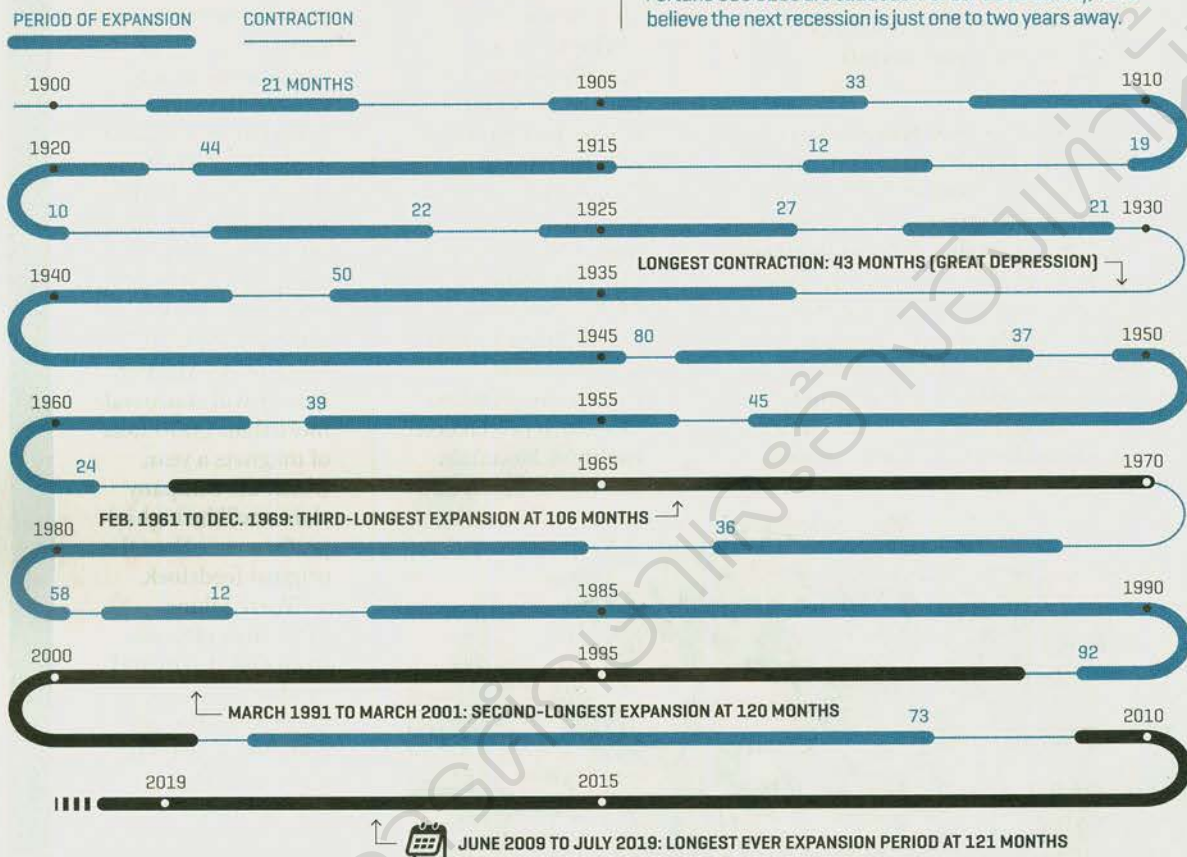
Companies don't need to bankrupt their coffers to keep hackers from bankrupting them. Clarke says companies that spend 8% to 10% of their IT budget on cybersecurity tend to be best in class.

But even this price tag is not always necessary to outrun the proverbial bear. Alperovitch says he knows of one *Fortune* 500 customer in the hospitality business that spends a mere \$11 million annually to defend itself, and he is convinced that it's among the most secure he has ever seen.

At that particular concern, the chair of the board gave his cell phone number to the company's chief information security officer and included a message: "Call me anytime, day and night, if anyone says no to you."

As Alperovitch puts it: "At that organization, no one tells him no."

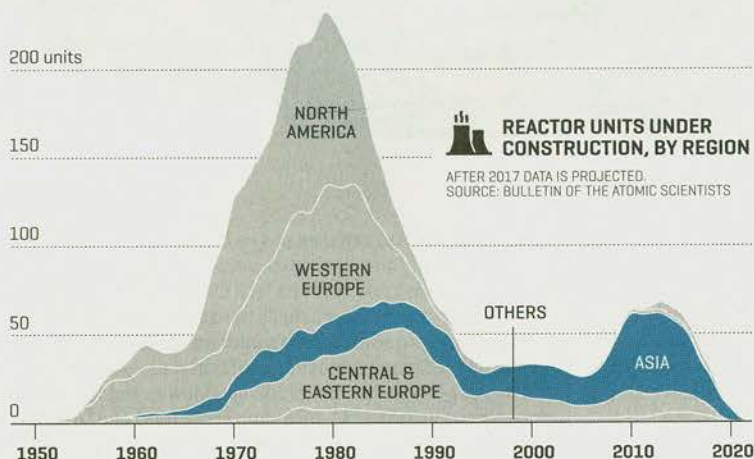
A RECORD-BREAKING ECONOMIC EXPANSION



SOURCE: NBER

OLD WORLD ABANDONS NUCLEAR ENERGY AS ASIA DOUBLES DOWN

Nuclear power—once the promise of unlimited, clean energy—has fallen out of favor in the West. America's 98 aging nuclear reactors make up just 9% of the U.S. energy supply. Disasters at Three Mile Island and Chernobyl partly explain the unpopularity; high construction costs and cheaper renewables are factors also. But in Asia, despite the calamity at Fukushima, countries are continuing to build new reactors to meet their rapidly expanding energy needs.



An Attractive Trade Tactic

Recycling the magnets found in everyday technology could be key in repelling China's rare-earth threats. **By Eamon Barrett**

RESOURCES

CHINA HAS A STRANGLEHOLD on the world's supply of rare-earth metals—elements vital to every aspect of modern technology from display screens to antimissile systems. But the U.S. has an abundance of rare-earth deposits too—stockpiled in junkyards and landfills waiting to be recycled. Texas-based startup Urban Mining Co. (UMC) is doing that job.

When trade negotiations between Washington and Beijing broke down in May, China's President, Xi Jinping, took a publicized tour of a rare-earth magnet factory, sending a veiled threat to the U.S. According to Washington-

based lobbyist Jeff Green, Xi's threat caught the attention of "literally the highest levels of the U.S. government."

The U.S. had actually been on the lookout for ways to shift its supply of rare earths from China since 2010, when Beijing last played the rare-earth card. One company, Molycorp, rose to the challenge in 2011 and attempted to reopen a mothballed rare-earth production facility at Mountain Pass, Calif. Four years

and over \$1 billion later, the mine shut down, unable to compete with China.

UMC thinks recycling is the right tack to take. At its San Marcos facility, rare-earth magnets collected from discarded tech, such as disk drives and MRI machines, are ground into a fine powder and processed into new magnets. At full capacity, UMC's "Magnet-to-Magnet" factory will churn out more than 1,000 tons of magnets a year, which the company claims will be higher-performance than the original feedstock.

"We're taking rare-earth magnets from disk drives and producing magnets for missile defense systems," says UMC CEO Scott Dunn. With rare earths vital to the security of the nation, it's no surprise that the U.S. Department of Defense has provided funding to support UMC's pilot program.



MOVIES

SHOULD DISNEY BE PREPARED FOR LIVE-ACTION FATIGUE?

THE PHOTO-REALISTIC VERSION of *The Lion King* is a surefire box-office hit for Disney. But critics have been lukewarm about the new film, praising its visual effects but docking points for its lack of "energy and heart." "People love the original so much that it's really hard to live up to what fans are looking for," says Paul Dergarabedian, a senior media analyst at Comscore. Fans are showing up for Disney's latest crop of remakes—*Aladdin* (2019) brought in more than \$1 billion despite middling reviews—but for how long? With even more updates in the works, including *Mulan* and *The Little Mermaid*, audiences may soon demand more than just flashy visuals. —MICHAL LEV-RAM



**WE WILL NOT TAKE
THIS SITTING DOWN.
UNLESS IT'S FOR TREATS.**



It's time to take a stand for homeless pets. It's time to adopt change. Every day, more than 4,100 dogs and cats are killed in shelters across the country — but **with Best Friends Animal Society leading the way, and your support, we can help our nation's shelters and Save Them All.**

save-them-all.org



**SAVE
THEM
ALL**

AUTOS

TESLA PRIME

TWO-DAY FREE delivery, it's what millions of Amazon Prime subscribers have grown accustomed to when shopping online. But it's also a little-advertised way to acquire a Tesla. Customers in certain markets are being offered the convenience of having their new Model 3 delivered to their home or office by a Tesla employee. The electric-car maker has been getting vehicles to customers in record numbers: In its second quarter, it delivered 95,200 cars, up from 63,000 in the previous quarter. The benefits of home delivery for Tesla are twofold, says George Augustaitis, director of industry analytics at CarGurus: "From a supply standpoint, it will relieve choke points and allow Tesla to deliver more vehicles. But it's also a great experience for the consumer and will elevate Tesla's status."



More than 21,000 coders and techies entered the 2018 Hajj Hackathon in Jeddah.

The Modern Pilgrim

How Saudi Arabia is looking to technology to solve the safety and logistical challenges of the world's most global pilgrimage. By Daniel Bentley

HACKING HAJJ

IT'S OFTEN SAID that Silicon Valley is a tech Mecca, but the actual Islamic holy site has technology chops of its own. More than 2 million Muslims will visit the Saudi Arabian city in August to perform the Hajj pilgrimage—a journey every one of Islam's 1.8 billion adherents must make during their lifetime, if financially and physically able. Keeping those people safe is no small task for the kingdom's government: In 2015, more than 2,000 pilgrims were killed in a stampede in Mecca's Mina neighborhood.

Since then, the Saudi government has invested billions in everything from biometrics to blockchain to keep visitors from more than 160 countries safe and comfortable during their visit. Last year, Saudi Arabia hosted its first "Hajj Hackathon"—with coders and entrepreneurs competing over a 36-hour period to build apps and services to streamline the pilgrimage. The winners were an all-female Saudi team who designed a smartphone app to help non-Arabic speakers translate signage without an Internet connection. They received \$500,000 in exchange for a 15% equity stake.

This year, the Ministry of Hajj and Umrah is

piloting a smart-card initiative with 25,000 pilgrims that will store their identity, medical information, and contact information—and track their location. By modeling this location data, it's hoped, Saudi authorities will be better able to predict crowd movements and avoid another deadly crush.

Currently, visitor numbers are restricted, and it would take more than 580 years for every living Muslim to visit Mecca for Hajj. But Saudi Arabia hopes it can allow 30 million pilgrims annually by 2030, and technology investment is vital to meeting that ambitious goal.

JAPAN GAME ON



Starting with this fall's Rugby World Cup, Japan is gearing up to host a series of major international events, sporting and otherwise, over the next several years. The public and private sectors are working to harness this positive momentum to build the nation's brand and deliver innovations with genuine social impact in areas ranging from artificial intelligence and the Internet of things to clean energy and mobility.



INSIDE:
INTERVIEW WITH
ARCHITECT **KENGO KUMA**...PAGE S9

JAPAN GAME ON

CRAFTING A WINNING LEGACY

AS THE SUMMER OLYMPICS RETURN TO JAPAN, THE COUNTRY HOPES TO LEVERAGE THE EVENTS TO GENERATE POSITIVE SOCIAL EFFECTS ONCE AGAIN. BY TIM HORNYAK



Yoshinori Sakai, born in Hiroshima Prefecture on the day of the atomic bombing, lit the cauldron at the 1964 Summer Olympic Games in Tokyo. The Games symbolized Japan's postwar return to the international stage.

JAPAN IS GEARING UP FOR ITS BIGGEST PARTY IN DECADES.

Next July and August, Tokyo will host the 2020 Olympic and Paralympic Games, a series of events that will not only be a celebration of global sports but also a pivotal moment in Japan's transformation into a more globalized society. With a new emperor ascending the throne, Japan is entering a new era, benefiting from one of its greatest economic recoveries, along with record levels of inbound tourism and foreign workers. The Tokyo Games, the 2025 Osaka Expo, and other large-scale international events are bringing these changes into sharp focus.

REMEMBRANCE OF GAMES PAST

The 1964 Summer Games were also held in Tokyo, as the first Olympics in Asia. To symbolize Japan's postwar commitment to peace, Waseda Uni-

versity freshman Yoshinori Sakai—born in Hiroshima Prefecture on the day U.S. forces dropped the atomic bomb—lit the Olympic cauldron as Emperor Hirohito looked on.

Japan's capital underwent a massive makeover. Tokyo unveiled Olympic venues such as the Nippon Budokan Hall and the Yoyogi National Gymnasium, as well as key infrastructure, including the Shuto Expressway, the Haneda Airport monorail, and the iconic Shinkansen bullet train connecting Tokyo and Osaka.

Japan was telegraphing to the world its new status as an emerging economic superpower. But it also set a precedent for international sporting events as a force for change that ushered in new sports and better athletic performance. The latest example of this is the 2019 Rugby World Cup, which will draw athletes from around the world to venues across Japan.



To show its commitment to the environment, Tokyo has deployed a fleet of public buses powered by hydrogen fuel cells. (Toyota)

"The Tokyo Olympics in 1964 marked Japan's recovery from World War II, and that was a tremendous legacy," says Morinari Watanabe, president of the Fédération Internationale de Gymnastique, the governing body for worldwide gymnastics. "The 1998 Winter Olympic Games in Nagano allowed winter sports to take root in Japan. With the FIFA World Cup in 2002, the level of football in Japan grew dramatically to catch up with the scale and standard of European football."

COST-BENEFIT ANALYSIS

The Olympics are rarely free from controversy, however, and they don't come cheap. Currently at \$27 billion, the projected cost of the 2020 Tokyo Games keeps climbing far above initial estimates.

"As a general matter, cities spend \$15 billion to \$20 billion in expenditures and they bring in about \$4 billion or \$5 billion in revenue," said Andrew Zimbalist, author of *Circus Maximus: The Economic Gamble Behind Hosting the Olympics and the World Cup*, on a 2018 Council on Foreign Relations podcast. "So obviously there's a substantial deficit there."

Certainly, many Japanese companies see benefits to backing the Olympics and Paralympics: Three Japanese multinationals are long-term worldwide partners, and dozens more support Tokyo 2020. Munehiko Harada, a professor in the School of Sport Sciences at Waseda University, says Japanese businesses are placing more value on sports. The old model of companies hiring star athletes for endorsements is shifting toward strategic sports marketing. Harada is coaching a growing crop of students enrolled in a nondegree curriculum called the Sports MBA Essence.

"Because of the Olympic Games and the Rugby World Cup, I think the importance of sports is now well understood among companies," says Harada, who is also chairman of the legacy committee of the 2026 Asian Games in Nagoya.

Outside the private sector, the question is whether the economic ripple effects—which the Tokyo Metropolitan Government pegs at roughly \$295 billion over 18 years—and nonmonetary benefits can justify the outlays. The national government is targeting 40 million inbound tourists next year, up sixfold from 2010. According to an online survey of 6,600 people in 20 countries and regions by Japanese ad agency Dentsu Inc., nearly 58% of respondents said they want to visit Japan, either to attend the Games or to see how the Games have changed the country. Meanwhile, the event will stimulate corporate innovation as well as interest in sports, Japanese cuisine, and


BECAUSE OF THE
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MUNEHIKO HARADA
PROFESSOR
SCHOOL OF SPORT SCIENCES
WASEDA UNIVERSITY



culture, according to the latest Japan Brand Research poll.

"I think the Olympics are the best trigger for Japan's growth, not just for 2020, but beyond," says Shusaku Kannan, executive communications director at Dentsu. "The Games can be a showcase for Japan as a leading-edge solutions provider."

A NEW KIND OF LEGACY

Featured technological advances will range from hydrogen-powered public buses to 5G phone networks and driverless taxis. These will complement the traditional "hardware" being rolled out in the form of new facilities, such as the New National Stadium, the Olympic Aquatic Centre, and the Olympic Village/Paralympic Village. Many of the laborers building these sites are from overseas—part of a more open attitude to foreign workers that has seen the government approve new visa categories for 340,000 expats.

But while the Games will add useful infrastructure, organizers are keen to bequeath a different kind of legacy this time. For one, they want to maximize participation in sports by the country's aging population. With Japan's low birth rate, and low immigration rate by international standards, the population is aging rapidly, with one in five citizens now 70 or older.

"What helps aging societies are sports and health care systems," says Watanabe, who's also a member of the International Olympic Committee. "When the proportion of the population engaged in sports increases, social security expenses decrease."

Japan's public and private sectors are also running international sports programs, like Sport For Tomorrow (SFT), a promotional effort that hopes to reach more than 10 million people in more than 100 countries by 2020. In one example of SFT outreach, physical education specialists from Peru were invited to Japan to learn about best practices. In another, SFT officials visited 10 locations in Mongolia to introduce people to radio calisthenics, a popular regimen launched in Japan in 1928.

Another legacy emphasis is accessibility and mobility. Tokyo will be the first city to host a

CONTINUED ON PAGE S8

TAKING A NEW PERSPECTIVE

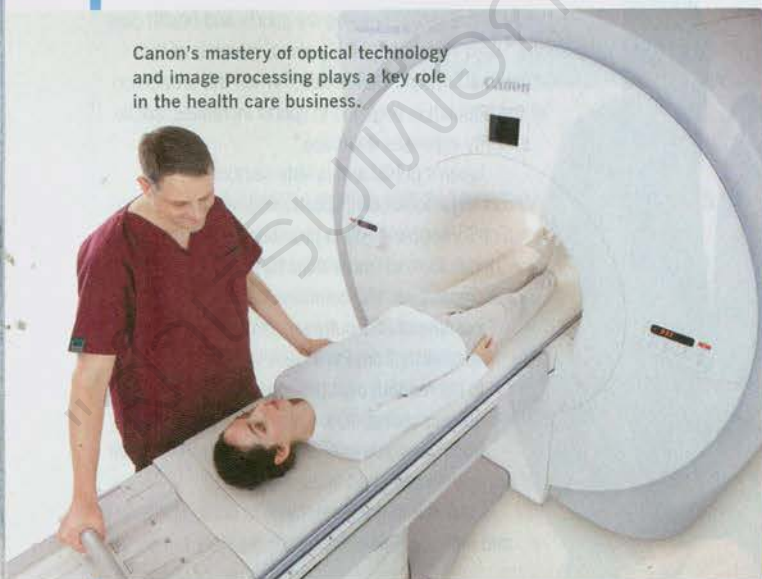
A series of transformative acquisitions over more than a decade have made **CANON** a contender in expansive new markets ranging from applied optics to health care.

FUJIO MITARAI, CANON INC. CHAIRMAN AND CEO SUMS UP

the challenges his company faces with absolute frankness. "Traditionally, Canon has had three core businesses: cameras, copy machines, and printers. Of these, copy machines are healthy; printers, flat; and cameras, in decline," he states. What is behind this upheaval? The smartphone, which has eroded both the digital compact camera market and the amount of printing people do at home.

But there's an upside to this tale. Mitarai actually began reshaping Canon's business portfolio more than a decade ago through a series of strategic acquisitions that reoriented Canon in a more B2B direction. It started with the 2007 acquisition of Tokki Corporation (now Canon Tokki Corporation), a Japanese firm specializing in the production of equipment for manufacturing organic light-emitting diode (OLED)

Canon's mastery of optical technology and image processing plays a key role in the health care business.



panels, which was followed by the 2010 acquisition of Océ, a Dutch manufacturer of high-speed digital printing presses. Sweden-based Axis Communications, the global leader in network cameras, was made into a consolidated subsidiary of Canon in 2015, while the 2016 acquisition of Toshiba Medical Systems Corporation (now Canon Medical Systems Corporation), the No. 4 company globally in diagnostic imaging, propelled Canon to major-player status in the field of health care.

Taken together, these acquisitions have compensated for any shortfall in revenues from Canon's traditional markets. (The Toshiba Medical acquisition actually bolstered revenues by 18% in a single year.) Throughout the process, Mitarai was acutely aware of what would make the most logical fit. "My basic principle was never to jettison our existing businesses but to use them as a robust foundation for lateral expansion: from consumer printers to high-speed commercial printers, from consumer cameras to network cameras, and so on," he explains. "Adapting our portfolio—rather than changing it outright—enabled us to use our existing management resources to the best advantage."

Dominating Existing Businesses

Canon's existing businesses may be maturing, but they still generate healthy profits thanks to the company's dominant market position, particularly in the camera industry. Mitarai has a two-pronged strategy for profit maximization: First, he aims to offer innovative products for which people are willing to pay a premium, such as mirrorless cameras or multifunction office devices that combine server, printer, and copy machine functions; second, he aims to manufacture those products with unbeatable cost-efficiency by automating production using Canon's in-house production-engineering capabilities. In parallel, Canon is restructuring its global sales network to make sure it can deliver its new mix of products and solutions to customers via all possible channels. "The fruits of our current cost-reduction and restructuring efforts will become fully visible from 2020," Mitarai says.

The lion's share of the profits generated by the existing businesses will be reinvested in the company's four new growth pillars: commercial printing, network cameras, health care, and industrial equipment. But Canon's deep mastery of the triad of core optics technologies—lenses, sensors, and image processing—give it the capacity to cross boundaries and break into wholly new markets. In April 2019, for example, Canon announced a tie-up with car electronics company Pioneer to codevelop 3D LIDAR sensors that collect information for autonomous cars' self-driving systems. Mass

"ADAPTING OUR PORTFOLIO—RATHER THAN CHANGING IT OUTRIGHT—ENABLED US TO USE OUR EXISTING MANAGEMENT RESOURCES TO THE BEST ADVANTAGE."

production is slated for 2020. Says Mitarai: "That's a whole new market just waiting for us."

In health care, too, further possibilities are in the offing. Canon is already leveraging its image-processing know-how to make hard-to-decipher MRI and ultrasound images easier to interpret and has developed CT scanner technology that manages to both enhance image clarity and reduce X-ray radiation through deep learning-based image reconstruction. Longer term, however, Mitarai wants Canon Medical Systems to make another sideways step and add treatment capabilities to its current diagnostic-imaging capabilities. "Health care is a very broad market made of multiple segments," he says.

Hardcore About Software

There's one thing that holds true for all of the businesses where Canon operates: the centrality of the role of software. Take the fast-growing network camera business. Here, the value resides in complete solutions that combine hardware, software, and video content analysis in a single package. Canon has people-counting software able to tally crowds at a rate of 5,000 people every three seconds, and video-synopsis software that can isolate and time-stamp specific things—vehicles of a certain color, for example—from hours of footage. Software can also assist with market research, with programs that can analyze shoppers' lines of sight to



The addition of software and video content analysis solutions is driving expansion at Canon's network camera business.

work out what products and displays are literally the most eye-catching. It is these sophisticated software-based capabilities that explain how Canon's network cameras business is growing even faster than the market, which is expanding at a sustained double-digit rate.

To ensure that it stays at the leading edge of software development, Canon opened its own software school at its global headquarters in Tokyo in August 2018. The Canon Institute of Software Technology provides a wide range of courses, from refresher training for working software engineers to entry-level retraining for factory workers superseded by job automation.

As a socially responsible employer, Canon is intensely serious about retraining. Another option for reassigned factory workers is to study production engineering and use that knowledge to help design, build, and maintain Canon's own automated production machinery. Indeed, Canon is increasingly selling the production equipment developed for use in its own factories to outside parties. One example? Its 3D Machine Vision systems that enable industrial robots to identify the position and orientation of objects quickly and accurately.

Mitarai is also eyeing entirely new fields. Through producing toner and ink, for instance, Canon has built up significant materials-technology expertise. Mitarai sees the potential to apply that know-how to other areas, including medical testing agents, plastic filaments for 3D printers, and organic LED materials—though he does emphasize that, as of now, the plan is more of a dream than a concrete strategy.

The year 2020 will mark the end of Phase V of Canon's Excellent Global Corporation Plan, a series of rolling five-year plans dating back to 1996. The goal of Phase V was to "embrace the challenge of new growth through a grand strategic transformation." Now, with the transformation done, it is time for the growth to kick in. "From 2020, we will be back on a growth trajectory and our profitability will have caught up with our revenue growth. Currently, our new growth pillars account for one-quarter of our sales, but we see that rising to 30% by 2020 and even 50% in around ten years' time," Mitarai says bullishly. ■

FUJIO
MITARAI
Chairman
and CEO
Canon



CYCLE OF LIFE

ASAHI KASEI proves that companies with a genuine commitment to environmental, social, and governance (ESG) issues outperform the competition.

HOW DOES A COMPANY FLOURISH EVEN AS THE BUSINESS

environment around it changes beyond all recognition? For diversified chemicals manufacturer Asahi Kasei, the secret lies in addressing society's specific needs at specific times. Having started out producing the basic materials essential to modernizing economies in the 1920s, the company gradually shifted into new fields like electronic materials and healthcare as consumers demanded ever-higher levels of comfort and convenience.

What society wants from companies right now is for them to be serious about their sustainability efforts, both in terms of the products they make and how they operate. "Companies have to think seriously about ESG issues and the UN's Sustainable Development Goals," says Asahi Kasei president Hideki Kobori. "We've always contributed to society in the past; we've now reaffirmed our *raison d'être* as a company by putting sustainability front and center."

The upshot is a new management initiative built on the twin pillars of "Care for People" and "Care for Earth" to be applied across the three sectors—Material, Homes, and Healthcare—in which Asahi Kasei operates. Kobori has further identified five high-growth "priority fields" where society's needs intersect with Asahi Kasei's ability to provide innovative solutions.

Solving Global Challenges

Mobility is one such priority field where rapid, disruptive change offers the opportunity for equally rapid growth. Asahi Kasei offers a range of solutions for the emerging world of CASE (Connected, Autonomous, Shared, and Electric) vehicles. In line with the company's focus on people and the earth, some of these capabilities enhance comfort and safety while others reduce environmental burden.

On the people side, for example, Asahi Kasei manufactures noise-absorbing resins and engineering plastics that help keep tire noise (an-

noyingly loud when not masked by the sound of an internal combustion engine) to a minimum, as well as special fabrics that do not retain odors (important in a world of shared vehicles). On the earth side, Asahi Kasei is the world's top producer of battery separators for the lithium-ion batteries that power ecofriendly electric vehicles. Bolstered by last year's \$700 million (¥79.1 billion) acquisition of U.S.-based Sage Automotive Interiors, Kobori sees sales of mobility-related products rising two and a half times to around \$5 billion by fiscal 2025.

Kobori expects the environment and energy, another priority field, to deliver similarly robust growth rates. Providing universal access to affordable and clean energy is one of the UN's Sustainable Development Goals. Asahi Kasei has two key technologies in this area: membranes and compound semiconductors. It is membrane technology that is behind the company's separators, which are an integral part of the large-scale storage batteries that help stabilize output from renewable energy sources. Membranes are also the basis of an innovative alkaline water electrolysis system, currently under development, that converts power from renewable sources into green hydrogen. On the people side, meanwhile, Asahi Kasei's compound-semiconductor-based CO₂ sensors monitor air quality in offices, homes, and car interiors to improve the energy efficiency of air conditioners while providing a healthy and comfortable

"WE
CONTRIBUTE
TO SOCIETY
BY OFFERING
SOLUTIONS THAT
HAVE VALUE."

HIDEKI
KOBORI
President
Asahi Kasei





CO₂ sensors monitor the atmosphere in homes, offices, and cars to maximize air-conditioner efficiency and improve air quality.

living environment.

Improved longevity is recognized as one of humanity's great recent achievements. The next challenge we face is how to ensure lives that are both long and healthy. With sales of \$2.8 billion (¥316 billion) in fiscal 2018, Asahi Kasei's healthcare business is devoted to "ensuring healthy lives and promoting well-being at all ages," in line with another of the Sustainable Development Goals. The company's pharmaceuticals and medical devices target the specific needs of aging societies, whether for acute conditions (wearable defibrillators for patients at high risk of cardiac arrest) or chronic conditions (dialyzers for patients with impaired kidney functions). Asahi Kasei is also a major presence in the biosafety area, where it manufactures filters that remove viruses from biotherapeutic drug products. Since the 2012 acquisition of Boston-based critical care specialist ZOLL Medical, the company has been looking to a combination of international markets and acquisitions for growth.

Transformation from the Inside

On the operations side, Asahi Kasei is subjecting itself to internal scrutiny. It has set an ambitious target of reducing its greenhouse gas emissions by 35% from 2013 to 2030 and is keen to tackle marine plastic waste as well. "As a chemical manufacturer, we have a responsibility to address the microplastic problem," says Kobori. "We are taking a scientific look at how marine microplastics are generated, how they accumulate, and how long they remain in the sea."

The natural environment is coming under pressure, but thanks largely to disruptive digital technologies, so is the business environment. Asahi Kasei is looking to big data and artificial intelligence to improve efficiency and create entirely new business models. Through these technologies, the company has already shortened R&D times, developed new catalysts and compounds, and cut back on prototyp-

ing. Six designated "digital model factories" are harnessing data to tackle specific challenges, from reducing energy usage to streamlining production processes. "By 2022, we will have a 150-person-strong digital-transformation team," Kobori says.

Of course, mindset matters just as much as skills do. After three large international acquisitions since 2012, Asahi Kasei is now a truly global company, with some 40% of its 39,000 employees based outside of Japan. Kobori is working to create a balanced and inclusive culture where people everywhere feel a sense of belonging to "Team Asahi Kasei" while retaining the freedom to be proactive and take initiative. Leadership development programs, more flexible working styles, and continuous human resource development represent "Care for People" at the internal HR level.

Companies that score high on ESG metrics typically perform better, and Asahi Kasei is no exception. In fiscal 2018, operating income jumped 6% to a record-breaking \$1.9 billion (¥209.6 billion) on net sales of \$19.6 billion (¥2.17 trillion), and Kobori sees both operating income and sales rising by a further 40% by 2025. A relentless focus on priority fields that combine high profitability, high market growth, and, above all, sustainability, is what drives the company's numbers higher, even in an uncertain global economy.

"We contribute to society by offering solutions that have value," says Kobori, explaining the virtuous circle that drives the company's growth. "These solutions win us the trust of customers and society at large. This results in profits we can reinvest in capital expenditure and in R&D. Those investments, in turn, lead to innovation, the creation of new solutions, and the creation of new businesses." ■

AKXY POD is a vehicle interior concept mockup featuring a range of Asahi Kasei fiber products, plastics, and sensors.



JAPAN GAME ON

"I INTEND FOR THE
TOKYO 2020 GAMES
TO LEAVE A MORE
INTANGIBLE LEGACY."

YURIKO KOIKE
TOKYO GOVERNOR



FOR 2025...WE WOULD
LIKE VISITORS TO
REFLECT AND CHANGE
THE WAY THEY LIVE
AND THINK ABOUT
WHAT THEY CAN DO TO
ACHIEVE THE SDGs."

IEAKI TAKEDA
DIRECTOR FOR INTERNATIONAL
EXHIBITIONS AT JAPAN'S MINISTRY
OF ECONOMY, TRADE
AND INDUSTRY



Tokyo Gov. Yuriko Koike accepts the Olympic flag at the closing ceremonies of the 2016 Summer Olympics in Rio de Janeiro, Brazil.

CONTINUED FROM PAGE S3

summer Paralympics twice, and it plans to make lodgings and other facilities barrier-free. Under the Open Stay Tokyo project, doors and corridors in hotels are being widened for wheelchair users.

"I intend for the Tokyo 2020 Games to leave a more intangible legacy," Gov. Yuriko Koike of Tokyo told reporters earlier this year. "I also intend for the 2020 Games to leave a cultural legacy, and for the Games themselves to be a celebration of culture."

Even though the Olympics may not have as big an impact on Japan as they did in 1964, they and other sporting events can add sparkle to the nation's brand overseas, says Harada. He points out how the U.K. benefited from hosting the Olympics in 2012, followed by the 2014 Commonwealth Games, the 2015 Rugby World Cup, and the 2017 World Championships in Athletics.

"By hosting these big events," says Harada, "Great Britain really enhanced its image as a sporting nation."

LOOKING BEYOND 2020

While 2020 is a prism, focusing light on transformation in Japan, many wonder how the momentum will continue afterward. For one, tourism is likely to keep driving growth, as the number of inbound visitors is expected to double to 60 million over the next 10 years.

Some travelers will head to another large international event on the horizon: Expo 2025 in Osaka. Focused on sustainable development, the Expo is a world fair projected to attract 28 million people and follows the city's Expo 1970. While showing

off the health care strengths of the surrounding Kansai region, the Japanese government wants to use the fair as a means to check progress on the UN Sustainable Development Goals (SDGs), which have 2030 as a target for achievement.

"At Expo '70, the legacy included hardware such as artist Taro Okamoto's Tower of the Sun," says Ieaki Takeda, director for international exhibitions at Japan's Ministry of Economy, Trade, and Industry. "For 2025, rather than focusing on a hardware legacy, we would like visitors to reflect and change the way they live and think about what they can do to achieve the SDGs. That's what we call a 'soft legacy.'"

Aside from demonstrating Japanese innovation and sustainable practices at international events, the government wants to leverage technology across the country to offset demographic woes and keep the economy growing. It aims to create what it calls Society 5.0—a new industrial revolution in which robotics, artificial intelligence, and the Internet of things innovate society.

For Watanabe, however, the key to ensuring a lasting success for Tokyo 2020 is evaluating how the Games are remembered.

"The Olympic Games are a showcase for sporting excellence," he says. "The impact will benefit a wide range of businesses, including the IT and tourism industries. Truly speaking, my dream is that the 21st century's industrial revolution will start from sports, and I believe that Tokyo 2020 will make that dream come true." ■

KENGO KUMA

THE AWARD-WINNING ARCHITECT DISCUSSES THE NEW NATIONAL STADIUM, SUSTAINABILITY, AND DESIGN INTIMACY.

The 1964 Tokyo Olympics was a watershed moment in Japanese history. What did it mean to you?

Back then, the Shinkansen bullet train had just begun service and freeways were going up around Tokyo. The city was one- or two-story wooden buildings. I remember walking with my dad from Shibuya, a totally quiet area then, to the new Yoyogi National Gymnasium. Its silhouette was impressive and monumental. Inside, natural light came down through from the high ceiling and bounced off every surface. I was amazed and asked my dad who built it. He said it was an architect named Kenzo Tange. I then formed a strong desire to be an architect too.

What do you want to convey through the New National Stadium design?

Tange understood the goal of Japan in that period: to catch up with Western civilization and industrialization. Japan's economy and population were growing, and cities were expanding. Now it's totally opposite, and the population is shrinking, but that doesn't have to be negative. It brings a different kind of happiness. The silhouette of the

new stadium I'm working on with Taisei Corporation and Azusa Sekkei Co., Ltd. is very flat. The height is only 164 feet or less. Tange's stadium has peaks reaching to heaven, but our design is more of a quiet gesture.

How are you making the stadium sustainable?

We are using certified wood from every prefecture in Japan. Cedar is the most abundant wood, and every prefecture is proud of its cedar. It's more expensive than wood from overseas, but sourcing it from Japan is more sustainable in terms of shipping's impact on global warming. Showing the diversity of Japan is also very important. Many people abroad don't realize Japan has great diversity, from Hokkaido to Okinawa.

How does the design reflect Japanese culture?

I want to show the intimate scale of Japan. We have many styles, but intimacy is the basis. Japan is mostly mountains, but the people try to find comfort and coziness in small spaces. The wooden planks on the stadium facade are four inches wide, the standard for columns and beams in Japanese houses. This intimacy and humility of Japanese buildings makes them very different from those in the West.

This image is a conceptual rendering intended to show the stadium at completion and may be subject to change. Vegetation is shown at about 10 years after completion of the stadium. Copyright © Taisei Corporation, Azusa Sekkei Co., Ltd. and Kengo Kuma and Associates Joint Venture

You're retiring from the University of Tokyo next year. What accomplishment makes you proudest?

Over the past decade, I started a digital fabrication laboratory and tried to combine computer technology with local natural materials. I worked with students to build art installations by hand. Architecture education is now all on computers, but the basis of architectural design is real materials and working with one's hands. If you forget that, your architecture will be unpopular—that happened after Japan's economic bubble burst. I think it's important to be friends with the community and return to reality. ■



100 YEARS OF FORWARD THINKING

A long history of innovation and diversification has put ceramics products maker **NGK Insulators** in pole position for the world of 5G and the Internet of things.

A GOOD COMPANY HAS THE ABILITY TO THINK BOTH big and small. Nagoya, Japan-based NGK Insulators can certainly do so. Last year, an over 11-meter-high insulator it manufactures earned a place in *Guinness World Records* as the world's "largest ceramic structure." Meanwhile, this January, EnerCera®—its series of chip-type ceramic secondary batteries, some of which are as small as postage stamps or as thin as 0.45 millimeters—won CES 2019 Innovation Awards in Smart Energy at CES, the world's largest consumer electronics show.

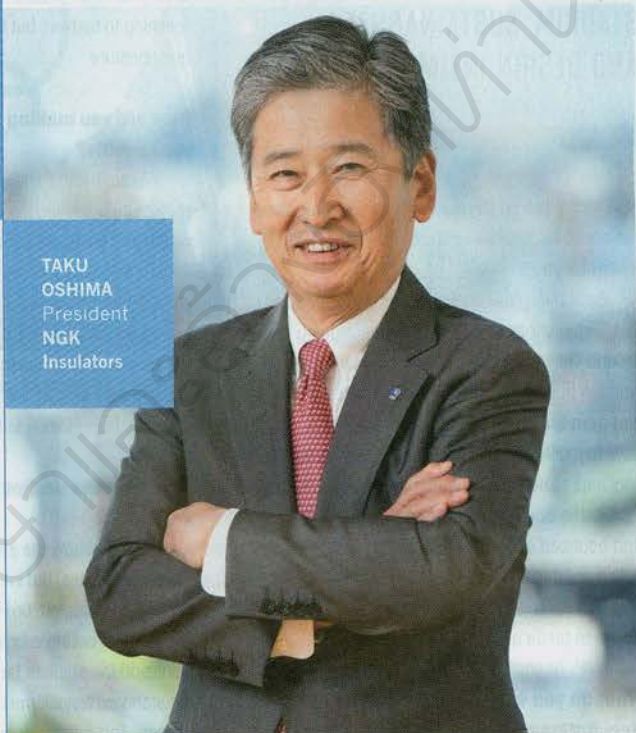
These accolades express something important about NGK in its 100th year. The company remains the global leader in its original insulator business, but it has also evolved to take leadership in multiple other categories, ranging from semiconductor production equipment to automotive ceramics. "Insulators have a long lifespan, so the market is saturation-prone. That's why NGK has always been focused on the next thing," says president Taku Oshima, pointing out that the firm started diversifying as early as the 1930s, when it began making corrosion-proof pumps and valves.

Whatever new directions NGK moves in, the underlying vector stays the same: to utilize the potential of ceramics to the full. The company has two complementary skills: know-how in controlling ceramic materials and the ability to make the production machinery needed for manufacturing them. "No one else has this combination," says Oshima. "That's our competitive edge."

That is certainly true for EnerCera. Although other manufacturers produce similarly small batteries, NGK's ceramics mastery

has equipped EnerCera with a combination of high energy density and high heat resistance, allowing it to be embedded into devices by high-temperature processes such as reflow soldering and hot lamination. That's significant because the first major market Oshima is exploring for EnerCera is smart cards. "Illegal use of cards costs the industry millions every year," Oshima explains. "Cards fitted with EnerCera can run fingerprint authentication without the need for any extra power supply equipment. Around 30 card companies have already expressed strong interest."

TAKU OSHIMA
President
NGK
Insulators



Ready for a 5G World

The incipient Internet of things (IoT) represents further opportunity. All of the everyday objects communicating and interacting with one another need a power source, and control circuit manufacturers are drawn to EnerCera's combination of small size and high power. Oshima is bullish. "Think of the smartphone," he says. "As soon as it came out, completely unforeseen new applications began springing up like mushrooms

APPLYING CERAMICS KNOW-HOW TO A CENTURY OF MEGATRENDS

1919

NATION BUILDING

As Japan evolves into a modern, industrialized nation, NGK is established to manufacture high-voltage insulators.



1950s

EXPORT CHAMPION

NGK becomes the world's top insulator producer in the 1950s; (below) it commercializes strong, lightweight beryllium copper alloy in 1958.



after rain. It'll be the same for the IoT when 5G comes along."

In fact, 5G is expected to give a powerful boost to many areas of NGK's business. A sharp rise in demand for semiconductors, for example, will drive demand for the semiconductor production equipment the company makes, which is why the company has just built a new ¥32 billion plant in Japan. But 5G's potential doesn't stop there. It will have a transformative effect on transmission speeds and data volumes, driving up data-center demand and helping enable new technological capabilities like autonomous driving.

That too is good news for NGK. The company makes ultraprecise piezoelectric actuators for the hard-disk drives used in data centers. (The actuator moves the head arm that reads and writes on the disks.) It also makes bonded wafers for surface acoustic wave (SAW) filters, which select the desired frequencies in mobile devices. Meanwhile, in the electronic vehicle (EV) space, Oshima sees gallium nitride (GaN) replacing silicon as the wafer material for next-generation high-output power semiconductors within five years. Here, too, NGK is a leader: Since 2011 it has been providing high-quality GaN wafers to Professor Hiroshi Amano, the 2014 Nobel laureate who is currently developing high-output power semiconductor devices.

Working for the Environment

NGK's relationship with the auto industry goes back a long way. The company started producing automotive exhaust gas purifiers in the mid-1970s, when air pollution was a widespread problem, and automotive-related ceramics now account for 54% of the company's approximately \$4.2 billion (¥463.5 billion) in revenues. In typical forward-thinking mode, while producing its best-selling particulate filters and sensors for diesel, gasoline, and hybrid vehicles, NGK has also been preparing for the EV future by developing not just EV components but all-solid-state batteries.

The company is being equally innovative when it comes to next-generation energy. Its large-capacity sodium-sulfur (NaS) batteries, which are used to stabilize the output from volatile renewable energy sources such as wind and solar power, have been deployed around the world since 2002 in countries including Japan, Germany, and the United Arab Emirates. On a smaller scale, NGK is developing zinc rechargeable batteries suitable for

5G IS EXPECTED TO GIVE A POWERFUL BOOST TO MANY AREAS OF NGK'S BUSINESS.



NGK's award-winning EnerCera ceramic batteries are small enough to fit into innovative IoT devices.

buildings and communication facilities. These have the advantage of being safer and more secure than their lithium-ion equivalents.

NGK's products are even helping to improve the productivity and environmental performance of the oil and gas industries. In the oil business, one emerging new technique to improve the recovery rate of crude oil is to inject CO₂ into the well. NGK has developed a DDR zeolite membrane with pores less than 1 nanometer in diameter that is capable of separating CO₂ molecules from associated gas (mainly composed of CO₂ and methane), enabling the injected CO₂ to be reused for the injection process, while a portion of it can also be stored underground, helping to reduce global warming.

All of this innovation is not the result of chance. NGK launched a policy of generating 30% of total sales from new products in 2013. Having hit that target in 2017, it is now committed to maintaining it. The company has a two-pronged method of innovation, combining a seed-side approach based on in-house R&D with a more market-driven approach based on responding to customer needs. Clearly defined companywide projects are a way of getting all departments—development, production engineering, process design, procurement, and sales and marketing—to coordinate on making the leap from research to commercialization. "We have conducted several companywide projects, for example, the Wafer Project and the Ceramic Battery Project," Oshima says. "All of our recent innovations have come from them." ■



1996

HIGH TECH

NGK begins production of semiconductor production equipment such as ceramic chucks and electrostatic heaters.



2019

BRIGHT FUTURE

GaN wafers can serve as substrates for high-power semiconductor lasers and power semiconductors.

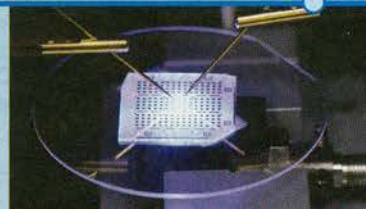
1976 CLEAN AIR

With automotive air pollution becoming a global problem, NGK moves into emissions control systems.



2002 POWER OF ONE

NGK scores a world first with the commercialization of large-capacity sodium-sulfur NaS® Batteries.



Great taste to your table



Everything we do at Kikkoman is grounded in a history of more than 300 years of brewing soy sauce to a traditional recipe, using only the finest ingredients. As we grew into a global brand, we developed an open stance and a clear awareness of our social responsibilities, a philosophy that has helped us become known for establishing standards of good taste.

Everyday we work to realize this philosophy around the world, through contributions to local communities, environmental and cultural exchanges. These include our membership in the UN Global Compact to support human rights, labor and the environment, and the World Business Council for Sustainable Development. The success of this philosophy is appreciated around the world for its original taste and contribution to the enjoyment of good food. Production facilities in Japan, the U.S.A., Europe and Asia help support sales in more than 100 countries, and spread our message to every person who appreciates the special qualities of our products.



Kikkoman Corporation

2-1-1, Nishi-Shinbashi, Minato-ku, Tokyo 105-8428, Japan

<https://www.kikkoman.com>


kikkoman[®]
seasoning your life

CHANGING THE CULTURE

After a lifetime spent promoting soy sauce around the world, **Yuzaburo Mogi** reflects on Japan's evolving role on the global stage.

EVERY YEAR, THE JAPANESE GOVERNMENT CONFERS

the Person of Cultural Merit award on a select number of people. Traditionally, the honor goes to individuals who have achieved distinction in the field of arts and letters, from *Seven Samurai* director Akira Kurosawa to Japanese literature scholar Donald Keene. Somewhat unusually, businessman Yuzaburo Mogi, honorary CEO and chairman of the board of Kikkoman, was one of last year's recipients.

The honor, it turns out, went to Mogi for his work promoting food culture domestically and internationally. "Cultural exchange is meaningful," he says. "But exchanging food culture is the most meaningful of all." In 2005, as chair of the Japanese government's food-culture task force, a group that included professors, chefs, and cooking-school principals, Mogi helped define Japanese food culture, identify problem areas, and make recommendations to the government. Meanwhile, as the driving force behind Kikkoman's long international expansion—the company now has seven overseas factories with sales in more than 100 countries—he was instrumental in introducing soy sauce, and thereby Japanese food culture, to the wider world.

As protectionism starts to rear its head, Mogi, who is one of the pioneers of globalization, is keen for Japan to hold a torch for global free trade.

"The free-market economy is better than any other system. Japan should take the lead in maintaining it," he argues, noting with approval Prime Minister Shinzo Abe's decisive role in supporting both the Trans-Pacific Partnership and a recent free-trade pact with the European Union.

Such free-trade agreements are one reason that Japan's economy is in steady growth mode after a multidecade slump. In fact, the labor market is so tight that the balance of power has shifted, meaning companies are under pressure to appeal to graduate recruits, rather than vice versa. Attitudes, however, have changed. More and more, young Japanese no longer see lifetime employment and promotion by seniority as an attractive package. They expect promotions and higher pay in return for hard work regardless of age, and they will

often move on if their expectations are not met. Companies, says Mogi, need to adapt to this change in mindset.

If young graduates expect more from their employers, employers are also starting to expect more from their employees. Since the Japanese Business Federation set aside old regulations governing hiring, companies are at liberty to recruit at any time of year and for specific jobs (rather than training all new hires from scratch in the old-fashioned way). Mogi sees these changes as delivering a double

YUZABURO MOGI
Honorary CEO
and Chairman
of the Board
Kikkoman

"THE FREE-MARKET ECONOMY IS BETTER THAN ANY OTHER SYSTEM."



benefit: Young people are motivated to choose a specialty and study hard at university, while universities are motivated to offer more specialized, practical courses. Mogi reaches to sumo

wrestling for a metaphor. "A sumo wrestler always needs a 'signature move,' or *tokuiwaza*," he explains. "Similarly, I want Kikkoman's young employees to develop at least two specialties before 40. Generalists are nothing."

At 84, Mogi himself is still going strong. His personal vision? To eat healthily, exercise, and improve Japan's productivity through his work chairing the Japan Productivity Center. Once a world leader in manufacturing productivity, Japan now languishes in 20th place among OECD countries for combined manufacturing/service productivity. "Faced with a declining population, Japan must increase efficiency and added-value to boost productivity," Mogi says. "That's important for Kikkoman—and for the Japanese economy as a whole." ■

FOCUS



FIGHTING DEEPPFAKES GETS REAL

Researchers, legislators, and Big Tech are trying to combat the growing threat of phony media created with the help of artificial intelligence. By Bernhard Warner

LIKE A ZOMBIE HORDE, they keep coming. First, there were the pixelated likenesses of actresses Gal Gadot and Scarlett Johansson brushstroked into dodgy user-generated adult films. Then a disembodied digital Barack Obama and Donald Trump appeared in clips they never agreed to, saying things the real Obama and Trump never said. And in June, a machine-learning-generated version of Facebook CEO Mark Zuckerberg making scary comments about privacy went viral.

Welcome to the age of deepfakes, an emerg-

ing threat powered by artificial intelligence that puts words in the mouths of people in video or audio clips, conjures convincing headshots from a sea of selfies, and even puts individuals in places they've never been, interacting with people they've never met. Before long, it's feared, the ranks of deepfake deceptions will include politicians behaving badly, news anchors delivering fallacious reports, and impostor executives trying to bluff their way past employees so they can commit fraud.

So far, women have been the biggest victims of deepfakes. In late June, the app Deepnudes shut down amid controversy after journalists disclosed that users could feed the app ordinary photos of women and have it spit out naked images of them.

There's concern the fallout from the technology will go beyond the creepy, especially if it falls into the hands of rogue actors looking to disrupt elections and tank the shares of public companies. The tension is boiling over. Lawmakers want to ban deepfakes. Big Tech believes its engineers will develop a fix. Meanwhile, the researchers, academics, and digital rights activists on the front lines bemoan that they're ill equipped to fight this battle.

Sam Gregory, program director at the New York City-based human rights organization Witness, points out that it's far easier to create a deepfake than it is to spot one. Soon, you won't even need to be a techie to make a deepfake.

Witness has been training media companies and activists in how to identify A.I.-generated "synthetic media," such as deepfakes and facial reenactments—the recording and transferring of facial expressions from one person to another—that could undermine trust in their work. He and others have begun to call on tech companies to do more to police these fabrications. "As companies release products that enable creation, they should release products that enable detection as well," says Gregory.

Software maker Adobe Systems has found itself on both sides of this debate. In June, computer scientists at Adobe Research demonstrated a powerful text-to-speech machine-learning algorithm that can literally put words in the mouth of a person on film. A company spokesperson notes that Adobe researchers are also working to help unmask fakes. For example, Adobe recently released a software tool that helps detect images manipulated by

Photoshop, its popular image-editing software. But as researchers and digital rights activists note, the open-source community, made up of amateur and independent programmers, is far more organized around making deepfakes persuasive and thus harder to spot.

For now, bad actors have the advantage.

This is one reason that lawmakers are stepping into the fray. The House Intelligence Committee convened a hearing in June about the national security challenges of artificial intelligence, manipulated media, and deepfakes. The same day, Rep. Yvette Clarke (D-N.Y.) introduced the DEEPFAKES Accountability Act, the first attempt by Congress to criminalize synthetic media used to deceive, defraud, or destabilize the public. State lawmakers in Virginia, Texas, and New York, meanwhile, have introduced or enacted their own legislation in what's expected to be a torrent of laws aimed at outmaneuvering the fakes.

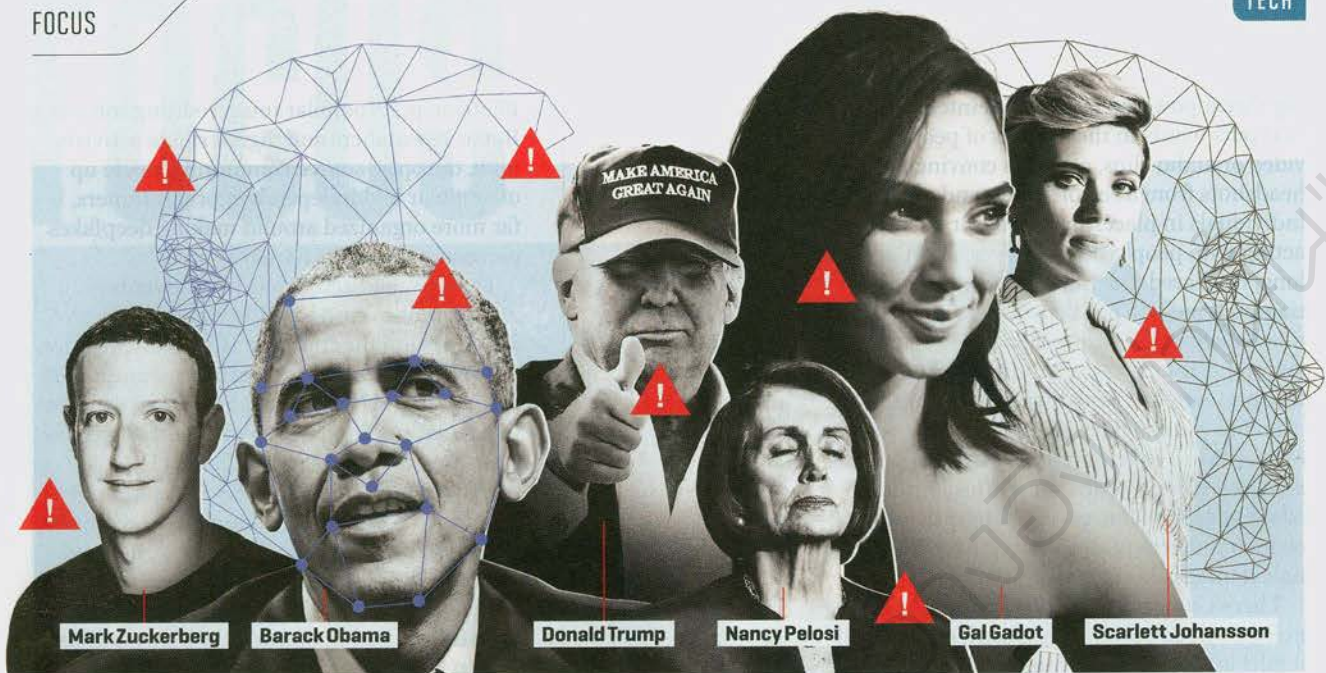
Jack Clark, policy director at OpenAI, an A.I. think tank, testified on Capitol Hill in June about the deepfakes problem. He tells *Fortune* that it's time "industry, academia, and government worked together" to find a solution. The public and private sectors, Clark notes, have joined forces in the past on developing standards for cellular networks and for regulating public utilities. "I expect A.I. is important enough we'll need similar things here," he says.

In an effort to avoid such government intervention, tech companies are trying to show that they can handle the problem without clamping down too hard on free speech. YouTube has removed a number of deepfakes from its service after users flagged them. And recently, Facebook's Zuckerberg said that he's considering a new policy for policing deepfakes on his site, enforced by a mix of human moderators and automation.

The underlying technology behind most deepfakes and A.I.-powered synthetic media is the generative adversarial network, or GAN, invented in 2014 by the Montreal-based Ph.D. student Ian Goodfellow, who later worked at Google before joining Apple this year.

Until his invention, machine-learning algorithms had been relatively good at recognizing images from vast quantities of training data—but that's about all. With the help of newer technology, like more powerful computer

**"DEEPFAKES
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Mark Zuckerberg

Barack Obama

Donald Trump

Nancy Pelosi

Gal Gadot

Scarlett Johansson

2014 GAN, the machine-learning technology powering many deepfakes, is invented by then-Ph.D. student Ian Goodfellow in an effort to improve artificial intelligence.

2017 Anonymous Reddit user “Deepfakes” posts adult videos featuring the likenesses of actresses Gal Gadot and Scarlett Johansson, giving a name to the creepy phenomenon.

2018 Barack Obama attacks Donald Trump in a deepfake video; Johansson laments that women and children have no defense against deepfakes.

2019 Doctored videos of Facebook CEO Mark Zuckerberg and Speaker Nancy Pelosi are published, giving the problem of manipulated media greater visibility; state and federal officials

start proposing and enacting laws to combat deepfakes, including a law in Virginia that bans deepfake revenge porn.

chips, GANs have become a game changer. They enable algorithms to not just classify but also create pictures. Show a GAN an image of a person standing in profile, and it can produce entirely manufactured images of that person—from the front or the back.

Researchers immediately heralded the GAN as a way for computers to fill in the gaps in our understanding of everything around us, to map, say, parts of distant galaxies that telescopes can't penetrate. Other programmers saw it as a way to make super-convincing celebrity porn videos.

In late 2017, a Reddit user named “Deepfakes” did just that, uploading to the site adult videos featuring the uncanny likenesses of famous Hollywood actresses. The deepfake phenomenon exploded from there.

Soon after, Giorgio Patrini, a machine-learning Ph.D. who became fascinated—and then concerned—with how GAN models were being exploited, left the research lab and co-founded Deeprace Labs, a Dutch startup that

says it's building “the antivirus for deepfakes.” Clients include media companies that want to give reporters tools to spot manipulations of their work or to vet the authenticity of user-generated video clips. Patrini says that in recent months, corporate brand-reputation managers have contacted his firm, as have network security specialists.

“There's particular concern about deepfakes and the potential for it to be used in fraud and social engineering attempts,” says Patrini.

Malwarebytes Labs of Santa Clara, Calif., recently warned of something similar, saying in a June report on A.I.-powered threats that “deepfakes could be used in incredibly convincing spear-phishing attacks that users would be hard-pressed to identify as false.” The report continues, “Imagine getting a video call from your boss telling you she needs you to wire cash to an account for a business trip that the company will later reimburse.”

In the world of deepfakes, you don't need to be famous to be cast in a leading role. ■

AUTONOMOUS TRAINS ARE READY TO ROLL

The race is on to create fully automated railroads. Winning over unions, regulators, and the public may be the biggest challenge. **By Aaron Pressman**

TECH IF ALL GOES AS planned this month, a freight train will chug down a track near Pueblo, Colo.—entirely controlled by computers. Humans in the locomotive will merely observe, as the latest in artificial intelligence and sensor technology puts thousands of tons of steel through its paces.

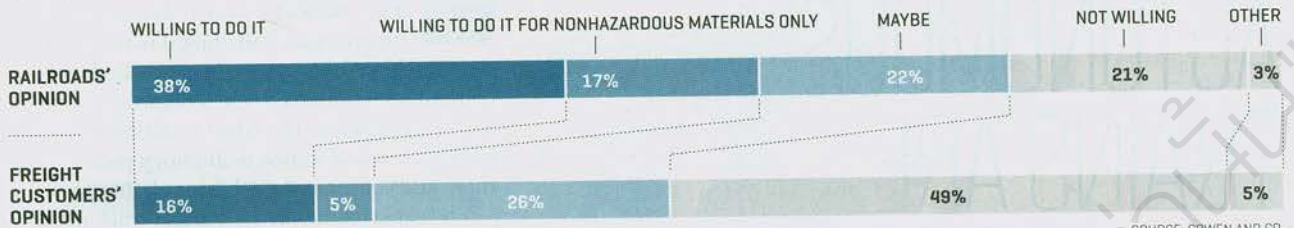
The experiment, on 48 miles of track at the railroad industry's advanced testing ground, is a big step in the push for autonomous train technology. The outcome could fundamentally alter the railroad industry.

While still a huge, highly profitable business, railroads move less freight than they did 10 years ago, and their biggest customer—the coal industry—is in long-term decline. Almost

In a possible window into the future, Rio Tinto uses autonomous trains to transport iron ore in Australia.



WILLINGNESS TO TRANSPORT FREIGHT ON AUTONOMOUS TRAINS



SOURCE: COWEN AND CO.

\$700 billion in cargo moved by train in 2017, the latest government figures show, but trucks carried far more, over \$12 trillion.

To catch up, rail companies must appeal more to faster-growing segments of the economy, like e-commerce, which require speedier and more reliable deliveries. Automation, railroads hope, is the answer because it could reduce fuel costs and increase capacity by enabling trains to run faster and closer together.

"I don't think there's much debate: This is where the railroads need to go," says Cowen and Co. analyst Matt Elkott, who forecasts extensive automation in the industry within five to seven years.

That reinvention effort is setting off a race to add A.I., machine learning, and other high-tech features to the rail system. Age-old railroad equipment makers like Siemens, Wabtec, and Knorr-Bremse are up against tech companies like Nvidia, Microsoft, and Hitachi.

Most of the tech components—including ones that reduce fuel consumption and control emergency braking systems—have already been deployed in piecemeal fashion. What's needed is A.I. to tie them together and testing to persuade all the stakeholders to go along for the ride.

But even if the tests go well, autonomous trains face several challenges. The first is powerful railroad unions, which have fought bitterly over crew sizes. Next, the industry would have to overcome public fears that autonomous technology is unsafe. And finally, sometimes-skeptical regulators would have to give their seal of approval.

"Of course we'll be able to do it," says Ulisses Camilo, CEO of New York Air Brake, the company whose technology will be tested in Colorado. "The question is how fast."

The groundwork for autonomous rails was laid as part of a 12-year, \$10 billion safety upgrade to North America's system that should be

completed by next year. The overhaul started in 2008, after 25 people died in the head-on collision of a commuter train and a Union Pacific freight train in Chatsworth, Calif. (a distracted engineer blew past a red signal light).

In response, Congress mandated that the entire system be upgraded with automatic safety overrides. Known as Positive Train Control, or PTC, the program includes sensors on tracks and switches that send information to central servers, telling trains about traffic and conditions ahead. If an engineer fails to slow or stop a train, the system can automatically intervene. Still, by itself, PTC is equipped to handle only a few types of emergencies, like a missed signal or a train traveling too fast around a sharp curve.

In some ways, the railroads should be able to adapt or borrow from many of the camera, radar, and lidar technologies used in self-driving cars and trucks. One big difference: Stopping a freight train can take a mile or more (versus 300 feet for a fast-moving car).

Already, mining giant Rio Tinto is using fully autonomous trains in Australia to deliver iron ore from 16 mines to ports hundreds of miles away. By the end of last year, the company said it had safely completed almost 3 million miles of autonomous travel.

Despite the potential benefits of automation, major freight railroads declined to comment to *Fortune* on the issue. Union negotiations in the fall make this a sensitive time, particularly because railroads will likely propose reducing train crews to just one person from two.

Railroad unions see automation as yet another effort to reduce their ranks. When the Federal Railroad Administration asked for public feedback last year about autonomous rail, it was flooded with 3,400 comments, 99% of which were in opposition.

"The technology is flashy, but it is not ready for prime time," warns Fritz Edler, special representative for the Railroad Workers United union. Reducing train crews to one person and depending on automation would be "demonstrably dangerous," he says.

The federal government hasn't moved forward with a plan for autonomous trains yet, but it may have showed its hand in June when it killed an Obama-era proposal that would have enshrined into law two-person crews.

Even as the railroad industry debates automation, the rival trucking industry is pushing ahead, with both self-driving technology and electric vehicles that may be much cheaper to operate.

Says Tony Hatch, an independent transportation industry analyst: "The railroads have to respond." ■

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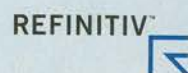
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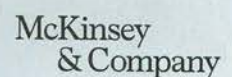
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high among all prefecture-level cities in China, and its forest coverage is 57.3%. Fuxian Lake of Yuxi is the largest deep-fresh-water lake in China, with a total water storage of 20.6 billion cubic meters, accounting for 9.16% of the total water storage of freshwater lakes in China.

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Presently, Yuxi is making every effort to build up Three Brands of green energy, green food and healthy life destination, and to promote the green industrial revolution and structural adjustment and upgrading. Following its theory of true greatness can only be accomplished by every effort as all streams eventually feed into the sea, Yuxi will release more vitality, continue to develop science and education, aviation and intelligent equipment manufacturing, biomedicine, cultural tourism, information, modern logistics etc., and strive to build a leading innovative city in China.



CRAFTING A COMEBACK AT ETSY

To survive competition from e-commerce giants, the handmade-goods retailer had to persuade its quirky community to get just a teensy bit corporate.
By Phil Wahba

TIES THAT BIND
A staffer works on a crochet project at Etsy's Brooklyn headquarters. A loyal customer base has helped Etsy fend off rivals.

WHEN YOU TYPE THE TERM “bike jersey” into the search field at Etsy.com, most of the results you get are, in fact, bike jerseys.

That may sound like “dog bites man” news. But not long ago, running such a search at this e-commerce site for handmade and crafty goods would have yielded a torrent of irrelevant results—a necktie covered with tiny embroidered bikes, a baseball jersey, a vintage New Jersey bicycle license plate. Given the high proportion of sales driven by first-page rankings from a desktop search, useless results mean lost revenue, says Etsy technology chief Mike Fisher: “I’ve got to be very narrow very quickly, or else I lose you.”



Better search results are a technological victory for Etsy—and increasingly a financial one too. The site has 60 million items for sale at any given time, from prosaic goods like oven mitts and coasters to oddities such as clothes for dogs—like the sweater CEO Josh Silverman recently bought. The company, which launched in 2005, has earned cultlike devotion from sellers and buyers alike for its “keeping commerce human” ethos and its focus on small vendors rather than big corporate conglomerates. But Etsy is enjoying a striking turnaround, thanks in part to an effort to give customers the consistent, reliable experience they’d expect

PRUNING TIME
Etsy has grown faster since CEO Silverman slashed the number of business development initiatives at the company.

from ... a big corporate conglomerate.

Much of that turnaround has happened under Silverman, a 50-year-old tech veteran. Since taking the reins in May 2017, Silverman has moved to improve search, payment and checkout, and shipping—the nuts and bolts that build customer trust. Etsy has also managed the difficult feat of increasing the share of each sale that it keeps for itself without driving sellers away. Revenue has risen 65% in two years, reaching \$604 million in 2018. The company has also been profitable for two years, and the stock is up fivefold during Silverman’s tenure, giving Etsy a market cap bigger than that of Macy’s or Nordstrom.

Retail analysts see even more upside. “There’s a lot of great merchandise in the long tail,” says Forrester principal analyst Sucharita Kodali, referring to products that aren’t bestsellers but whose consistent sales contribute a big chunk of Etsy’s revenue. Etsy is no less quirky than it was—you can still buy, say, a taxidermied mouse posed in a tiny bathtub. But as Kodali notes, it’s starting to feel less and less like a “flea market.”

SILVERMAN WAS A COFOUNDER of 1990s Internet darling Evite, which he sold for a tidy profit in 2001. He later held top roles at eBay, where he earned a reputation as a turnaround artist, and at American Express. He’s a bald, bearded man who speaks in a soothing voice that any psychotherapist would envy.

That trait came in handy amid the tumult surrounding his arrival. Though Etsy had a passionate following, it was losing money. Growth in gross merchandise sales (GMS), the aggregate value of products sold, had slowed sharply, and an activist investor, Black-and-White Capital, was pushing Etsy to fix its business or sell itself. Within weeks of Silverman’s hiring, the company had laid off nearly a quarter of its staff. The sense in the rank and file was that Silverman would either sell off Etsy or make it go corporate.

The CEO describes his mission as doling out tough love. “The core of Etsy is amazing,” he says. “It just needs the opportunity to breathe.” One of the things suffocating it, he found, was an excess of projects—there were some 800 business development initiatives underway at a company with a staff of fewer than 1,000. Silverman’s team quickly elimi-

nated half of them, including Etsy Studio, an ambitious plan to create a second online marketplace. Among those remaining, the team created “ambulances,” ideas whose paths could be cleared so they could be implemented in weeks rather than months or years.

Those ambulances included some easy fixes. Many shoppers were wary of using credit cards on Etsy, so the company added a message reassuring them: “The seller never sees your credit card information.” The website’s search box didn’t have autocorrect; now it does. The company also started moving many of its tech resources to Google Cloud, freeing up its tech team to focus on Etsy.com itself. “I don’t need people in data centers racking servers,” says Fisher. “I need them building more features.”

More controversial moves followed. Silverman required sellers to use the Etsy Payments platform. That allowed Etsy to garner processing fees from each transaction, capturing that revenue from other payment providers. It also let the company standardize checkout, improving customer service. In July 2018, Etsy increased its separate, per-transaction commission rate to 5%, from 3.5%.

Some sellers fumed, seeing the moves as cash grabs. “Jeez if another competitor ever gets the market share of Etsy, I’m jumping,” read a comment on a Reddit board last year. But that discontent didn’t dent Etsy’s growth. The ranks of sellers have risen to 2.2 million from 1.8 million since Silverman started. Growth in annual GMS, \$3.9 billion last year, is back in the 20% range, and the share of sales captured by Etsy as revenue was 15.4% in 2018, up nearly two percentage points from 2017.

Etsy’s success in cultivating loyalty stands out in online retail, where low prices often trump all other concerns. Its emphasis on small businesses and handcrafted wares, analysts say, makes it feel like a community, even as it becomes more efficient as a business. It’s telling that Etsy has so far shrugged off a challenge from the 800-ton gorilla of e-commerce. Amazon Handmade, launched in 2015 and touted as the “Etsy killer,” has had little success wooing vendors or customers, and its product assortment is a small fraction of Etsy’s.

HAVING LEARNED HOW to profit from its community, Etsy’s next challenge is to make that community bigger. Etsy has 41 million active

HANDMADE EMPIRE

Having catered to a passionate niche of buyers and sellers, Etsy now hopes to broaden its reach.

2.2

MILLION

Number of sellers on Etsy, an increase of about 18% over the past two years.

38%

Share of Etsy sales volume that involves buyers or sellers outside the U.S. (Canada, Australia, and Western Europe are big markets.)

\$7.8

BILLION

Etsy’s market capitalization in mid-July—larger than that of such Fortune 500 retailers as Macy’s (\$6.6 billion) and Gap (\$6.9 billion).

buyers, which it defines as people who bought something on at least one day in the past year. However, 60% of “actives” shop only once a year, and the average shopper spends a relatively modest \$100 annually.

The company is plowing some of its revenue into better online tools for sellers, such as a dashboard to track orders and streamline payments. To grow, “Etsy really needs to offer vendors that support,” says Oweise Khazi, research director at Gartner. And some of Etsy’s most important plans involve its search engine. Fisher, the technology chief, says improved search results added tens of millions of dollars to GMS last year, but there’s room for improvement. Etsy’s search algorithm has long favored lower-priced items, since they tend to sell more frequently. The site now intends to give higher-priced and better-quality goods more weight in search rankings—making Etsy’s brand more upscale and encouraging shoppers to also consider buying a desk when they’re searching for a desk lamp.

Search tweaks will also help Etsy attack another sore point: shipping. Sellers currently have great leeway to set shipping fees, something that the company believes can turn off buyers. Some 30% of items are eligible for free shipping; Silverman wants to push that figure toward 100%, even at the risk of upsetting sellers. In July, Etsy announced a push to make free shipping standard for orders of \$35 or more. Sellers won’t be required to waive shipping fees—but Etsy’s algorithms will give ranking priority to products and sellers that comply, effectively forcing their hand.

For all the rigor he has brought to Etsy, Silverman has been mindful not to mess with its youthful, idealistic culture. Etsy’s headquarters in Brooklyn has amenities like a bike garage and local food offerings in the cafeteria. In February the company announced a plan to offset its shipping-related carbon dioxide emissions. On a recent visit to the website, meanwhile, items on the “bestseller” list included an LGBTQ Pride-friendly wooden rainbow puzzle for kids and a box of cards featuring “date night” ideas for young couples.

The goal of all of Etsy’s improvements, Silverman says, is to make it easier to find the good stuff. The site wants to prioritize a seller “who really delights customers regularly,” he says. “You’ve got to earn your way to prominence.” ■



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MILKING OATS FOR CHINA

China wants more milk, but the planet needs fewer cows. Why oat and other plant milks could be the solution.

By Eamon Barrett

VENTURE **NICHE BARISTA JOINTS** are the preferred point of entry into foreign markets for Sweden's Oatly.

In Hong Kong, its stylized cartons are an increasingly common sight in hipster "third wave" coffee shops. Oatly, which—as its name suggests—creates a milk-like product from milled oats, claims to have partnered with 80% of such coffeehouses in the city. Having already stormed into the southern port, Oatly is beginning an expansion north into mainland China, where a much larger market awaits.

A barista in a Hong Kong coffee shop uses Oatly to craft latte foam.

"Some reports say the Chinese government wants to triple dairy consumption in China, and I think we could be very helpful in supporting that development," says Oatly CEO Toni Petersson. With an office in Shanghai and sales through more than 2,200 Chinese coffee shops and retailers, the 25-year-old company has even coined a Chinese character—the symbol for grass atop the one for milk—to help control the narrative about plant-based milk.

That's a clever move. EU regulations prevent the oat-drink manufacturer from



calling Oatly “milk” in its home market. Dairy lobbyists are pushing for similar restrictions in the U.S. However, Petersson insists Oatly won’t trademark its new Chinese character but will keep it open-source to help encourage dialogue around dairy alternatives.

Dairy is an exploding business in China. Last year the retail value of its industry passed \$61 billion, up from \$27 billion 10 years ago, according to market research provider Euromonitor International. (The U.S. dairy market is at \$65 billion but has declined in the past three years.) The increase is explained in part by Beijing’s recommendation in 2016 that citizens up their daily dairy intake from 100 grams to 300 grams. But it’s mostly a result of economic development.

One hurdle the Chinese dairy industry seems to have overcome is lactose intolerance. More than 90% of China’s population is deficient in lactase, the enzyme that breaks down the milk sugar lactose in the gut, per a 1984 study. But lactase activity increases as people add more dairy to their diet. In 1980s China, not many people were drinking milk.

“Once you see societies developing economically, the notion of lactose intolerance seems to become less of a problem,” says Hein Schumacher, CEO of Netherlands-based dairy firm FrieslandCampina, which sells a number of dairy brands in China, including Hong Kong’s most popular infant formula, Friso.

Dairy sales certainly are rising as China’s economy grows, although data from Euromonitor International shows that low-lactose

Oatly created the “plant milk” symbol as part of a Chinese marketing campaign.

dairy—cheese, butter, and cream—are the fastest-growing segments. Also, sales to the food-service industry outstrip retail sales, suggesting that a significant portion of dairy is going into processed foods or drinks.

“Cheese tea,” which is warm sugary chai capped with a thick dairy froth similar to cream cheese, is a growing craze in China. FrieslandCampina has actually repurposed a cappuccino machine from its European market to sell as a cheese-tea machine in China. Schumacher suspects the novelty beverage could even catch on in the West. Maybe, maybe not, but China’s thirst for dairy will impact the rest of the world in another way.

Last year a report by Netherlands-based Wageningen University & Research found that satisfying China’s increasing demand for cow’s milk could increase global greenhouse-gas emissions from dairy production 35% by 2050. That spike is partly because China’s domestic dairy production is so inefficient—achieving roughly half the yield of the U.S. industry.

As part of its global sustainability initiative, FrieslandCampina works with Chinese farmers to help improve their efficiency. But as admirable as that initiative is, its efforts might be moot. Wageningen report coauthor Gerard Velthof says, “Even if the efficiency of the dairy industry in China is drastically increased, global emissions of greenhouse gases and nitrogen produced by this sector will still rise by 20% to 25%. The predicted increase in China’s demand for milk will have major global consequences, whatever the scenario.”

Here’s where Oatly considers itself a savior. “The strange thing about what we do is the more we sell, the better it is for everybody,” Petersson says, claiming Oatly’s carbon footprint is 80% smaller than the equivalent of dairy. (A 2018 Oxford University study found the global average for oat-milk production was 60% less emissions than those for dairy.) That’s a message that should resonate with China’s wealthy millennials and emergent Generation Z, who value products with environmental positioning—even if they will take their eco-friendly Oatly lattes in disposable cups.

Oatly plans to open a factory in Asia—one of three new plants globally—next year to help cover the region. “In three to five years,” Petersson says, “we think China is going to be really, really important for us.” ■

PASSIONS

TIME
WELL SPENT

CYCLING



Trek's top-of-the-line Domane+ e-bike retails for \$7,000.

TOUR DE FORCE

E-bikes are putting a charge in the fortunes of America's biggest bikemakers. By Phil Wahba

EVERY FEW YEARS, a new sensation comes to the rescue of a beleaguered U.S. bicycle industry. In the 1970s, 10-speed bikes from Europe sparked a boom stateside. A decade later, mountain bikes renewed the business. A few years after that, American Tour de France champion Lance Armstrong caused a surge of interest in the sport—before his fall from grace.

Now, once again, as bikemakers find themselves confronting years of sales declines for their bread-and-butter product, a new kind of bike is fueling a renaissance in the \$6 billion industry: the e-bike.

According to the NPD Retail Tracking Service, unit sales of bikes with electric motors rose 73% last year at specialty shops, after more than doubling the year before. Across the industry, that comes to about 400,000 e-bikes. In contrast, traditional bike sales fell 8% last year.

Trek Bicycle, an iconic American bikemaker whose popularity soared in the early 2000s as Armstrong's bike of choice, got an early jump on this part of the market, and it's been a boon: Trek is now the U.S. market leader in e-bikes, ahead of Specialized and Electra, and they generate about 20% of its \$1 billion in annual sales. Trek president John Burke sees this as just the start of a new golden age for the industry.

"You have people who commute, you have people who want to bike up hills, and you have people who want to keep up with their spouse," says Burke, 57, whose father, Dick, cofounded the company in 1976 in Waterloo, Wis. (An avid cyclist who covers 5,000 miles a year, Burke himself has taken to e-bikes, choosing to ride one for nights out in nearby Madison.)

The bike industry as a whole is getting a big lift from all this. The much higher price for an e-bike—the average e-bike retails for \$3,500 at specialty shops, according to the National Bicycle Dealers Association (NBDA), roughly three times as much as a regular bike—is mitigating the pain of slipping overall sales. E-bikes can indeed get pricey: The Trek Domane+ goes for \$7,000, and the most expensive mountain e-bike from Specialized, based in Morgan Hill, Calif., retails



Trek e-bikes are powered by the latest generation of high-performance tech from Bosch.

for more than \$12,000.

In the U.S., e-bikes go way back. The first rudimentary patents were filed in 1898, according to the NBDA. And in 1996, a joint venture between Sanyo and the Electric Bicycle Co. led to the first commercially viable e-bike. A year later, Trek tried to make a go of it. But consumers were not ready.

Indeed, this latest push is Trek's third stab at the e-bike market after flops in previous decades. It was only about three years ago that e-bikes took off in the U.S., just a few years behind an explosion in Europe, particularly in Germany and the Netherlands.

The pivotal moment for the industry was the arrival of high-quality motors, such as those from German manufacturer Bosch. That has gone a long way toward easing people's "distance anxiety" about losing juice on a longer ride. And Burke's hopes for the boom to be long-lasting stem from what he sees in Europe, where bike industry trends typically begin. In 2018, sales of new e-bikes eclipsed those of regular bikes in the Netherlands for the first time.

Retailers, many of them staffed by cycling purists, have had to change their tune. "There is lots of snobbery in bike retail, that [e-bikes are] cheating, that they're not real bikes," says Noel

Kegel, co-owner of the Wheel & Sprocket chain in Wisconsin. But that's changing, he notes: "For 20 years, nothing is fueling growth, and now we have e-bikes that are generating massive growth."

The snobbery might be more widespread among the spandex-wearing weekend-warrior set. But the contingent fueling the boom sees e-bikes in a utilitarian light. For instance, about 57% of people in Amsterdam use a bike once a day, principally as a way to commute. E-bikes help them handle longer distances and not get too sweaty on their way to the office.

The e-bike boom is in sync with changing cycling habits: According to the Sports & Fitness Industry Association, the number of hard-core American cyclists (people riding at least 26 times a year) has fallen 14% since 2013, while the number of casual riders (people more apt to use an e-bike) has risen 7%.

Burke doesn't expect America's bike culture to replicate Europe's. But, he says, with more cities installing bike lanes—and with growing concerns about obesity, traffic congestion, and the environment—e-bikes will be more than a fad.

"The bicycle is a real solution for a lot of problems happening around the globe," he says. "E-bikes help on all those fronts." And another front they help on is Trek's top line. ■

ANNUAL U.S. E-BIKE UNIT SALES



NOTE: SOLD ON A WHOLESALE BASIS TO SPECIALTY RETAILERS. SOURCE: BICYCLE PRODUCT SUPPLIERS ASSOCIATION

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STAR NEARS
A MILESTONE

42

ABBVIE:
A BLOCKBUSTER
DRUG'S
SIDE EFFECT

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PING AN'S
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BOXED IN AT
THE DOCKS:
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MAKES WAVES
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THE LISTS

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CHINA'S WORLD

China has now reached parity with the U.S. on the 2019 Fortune Global 500—a signifier of the profound rivalries reshaping business today.

By GEOFF COLVIN

A S THE CHINESE CENTURY nears its third decade, *Fortune's* Global 500 shows how profoundly the world's balance of power is shifting. American companies account for 121 of the world's largest corporations by revenue. Chinese companies account for 129 (including 10 Taiwanese companies). For the first time since the debut of the Global 500 in 1990, and arguably for the first time since World War II, a nation other than the U.S. is at the top of the ranks of global big business.

That shift is transforming not just the business world but the whole world. As China seeks to succeed the U.S. as the preeminent superpower, business is playing an even larger role in international affairs than usual. Nations have always competed economically, but the U.S. and China are

engaged in direct battle over the world's economic life force: technology. As former Treasury Secretary Henry Paulson has written, "The battle is about whose economy will drive the technology of the future and set the standards for it." For an example of corporate China pushing technology's frontiers, see our story on insurance giant Ping An (page 50).

The battle is not just metaphorical; it involves life-and-death issues of national security. That's why, most prominently, the U.S. has partially banned American companies from buying products made by telecom-equipment giant Huawei (No. 61 on our list), saying the company is state-directed and could sabotage 5G infrastructure or use it to steal data. (Huawei says none of those things are true.) China has set explicit goals of dominating such fields as artificial intelligence, quantum computing, robotics, and autonomous vehicles. As these fights escalate, other nations may feel they must commit to either Chinese or U.S. technology, raising the stakes even higher.

It's true that Chinese companies' revenues account for only 25.6% of the Global 500 total, well behind America's 28.8%. But that's to be expected. China is the rising power, economically smaller but growing much faster. The No. 1 nationality among the top 50 companies in this year's

Global 500 is American; among the bottom 50, it's Chinese. Those companies near the bottom are rising quickly, and like their country, they're burning with ambition.

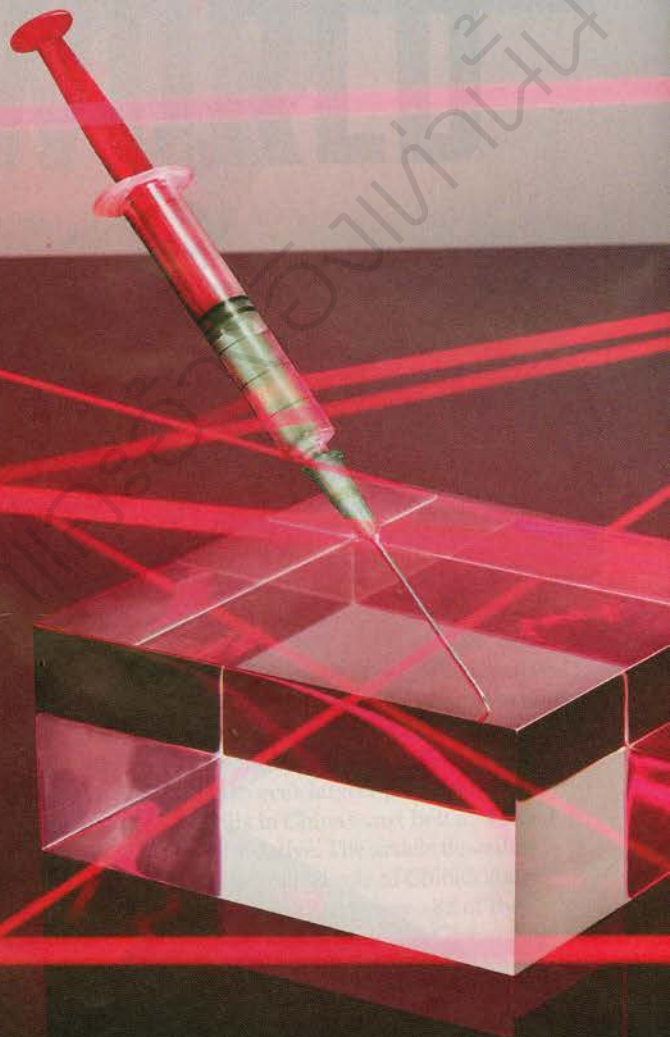
President Xi Jinping has said that by 2049, the communist revolution's centennial, China will be "fully developed, rich, and powerful," a goal that China expert Graham Allison of Harvard says includes being "unambiguously No. 1," with a military "that can take on and defeat all adversaries." With that in mind, be sure to read "Boxed In at the Docks" (page 56), which depicts China's takeover of Greece's largest port, and how it fits in China's vast Belt and Road Initiative. The article describes the crucial role of China's state-owned enterprises—82 of the Chinese firms in the Global 500 are "SOEs"—which receive generous subsidies that advantage them over the West's private sector.

Fortune's founder, Henry Luce, famously declared in 1941 that the 20th century was the American Century. His argument was largely right and often prescient. Whether the 21st century becomes the Chinese Century in the full sense—with China dominating culture, ideals, and concepts of human rights and human nature—remains to be seen. But at least in business, the Chinese Century is growing intensely more Chinese, and faster every day. ■



LOCATION OF GLOBAL 500 COMPANIES' HEADQUARTERS

Humira, the world's bestselling drug, has turned **AbbVie** into a global powerhouse. The company has proved to be great at guarding its patents—and not so great at developing new therapies. How a blockbuster medication became a case study in what's killing drug innovation. By SY MUKHERJEE



PROTECT AT

G/
500



COMPANY

ABBVIE

COUNTRY

UNITED STATES

CEO

**RICHARD
GONZALEZ**

RANK

381

ALL COSTS

Y

YOU MAY NOT HAVE any of the conditions Humira treats. But chances are, you've heard of it.

AbbVie's flagship therapy, a medicine used to treat a slew of conditions from arthritis to psoriasis to Crohn's disease and ulcerative colitis, is the bestselling drug in the world, bringing in nearly \$20 billion in global sales last year alone. As one U.S. senator noted at a hearing on drug prices in February, that titanic sales figure would be enough to put Humira (were it a company unto itself) on the *Fortune* 500 list.

And on first glance, it's hard to conceive of a more perfect archetype for drug success. Abbott Laboratories—which spun off its branded pharmaceuticals unit as a separate company, AbbVie, in 2013—received its first FDA approval to market the medicine on Dec. 31, 2002. A little more than two years later, the injectable drug surpassed the billion-dollar mark in global sales, traditionally the threshold for “blockbuster” status in the pharmaceutical industry—a stunning feat in such a brief span. By 2006, sales had reached \$2 billion, a number that would more than double in just two years' time. By 2013, Humira was the world's bestselling drug, with \$10.7 billion in sales across more than 60 markets, and as improbable as it seems, even that colossal sales figure has nearly doubled again in the half-decade since.

Humira is also, importantly, an effective medicine—and for some people, a life-changer. Injected under the skin by way of a prefilled syringe, the drug—technically, a human antibody (more on that detail soon)—works by inhibiting a key protein that's central to inflammation, a process that's implicated in a number of pathologies. In clinical trials, patients with rheumatoid arthritis, an autoimmune disease that leads to painful and progressive swelling of the joints, have experienced rapid improvement in movement and a marked slowing of joint deterioration. In the skin condition psoriasis, which afflicts more than 8 million Americans, studies found the drug could clear up painful and itchy rashes by 75% to 90% in months. In moderate-to-severe forms of Crohn's disease, a gut disorder that can prove debilitating and require hospitalization or even surgery, the treatment has been able to cut the need for drastic medical action while boosting “mucosal healing”—a possible sign that an inflammatory bowel disease is in remission.

So, you might wonder, what's not to like about a medicine that helps millions of people suffering from serious and painful conditions and that has made its owners billions of dollars in the process? Isn't that what the pharmaceutical industry is supposed to do?

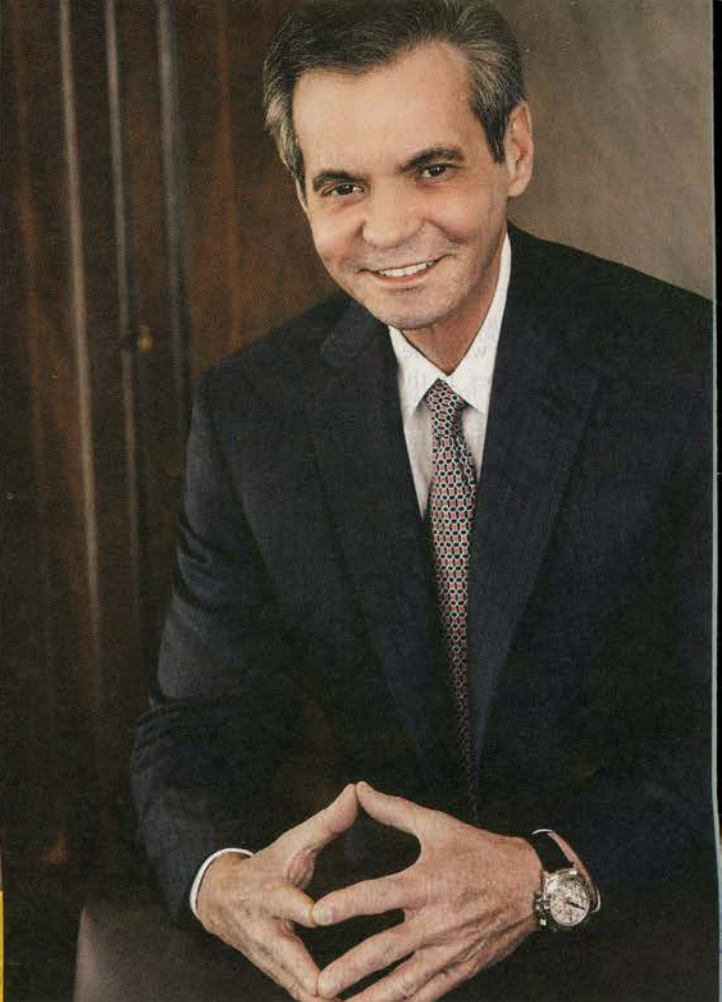
The answer, like so many aspects of the drug industry, lies in the litany of side effects that are spelled out in the fine print. For the Humira tale has a dark side too—one that's reflected in many billions of dollars in unnecessary drug costs for consumers and in stymied competition in a critical area of modern drug development. As much as it might look like the quintessential example of scientific innovation and marketing success, the story of how Humira became the world's bestselling drug is a case study of an industry in slow-motion failure—of a corporate model that is increasingly forsaking investing in research and discovery in favor of purchasing it (at a premium) from the outside. That model is driving up costs for everybody—patients, government payers, insurers, and, yes, even drug company shareholders.

Indeed, read past those striking sales figures, and AbbVie's \$20 billion-a-year drug phenom might well look like a black-box warning for Big Pharma and consumers alike.

To understand why, it helps to understand what Humira is and where it came from.

HUMIRA ISN'T A “DRUG,” technically speaking—it's a biological entity known as a monoclonal antibody, or mAb. Put simply, mAbs are proteins created by inducing a specific immune response; these lab-created antibodies then bind to specific antigens on the surface of biological adversaries and work to neutralize the offenders.

The FDA approved the first mAb, an immunosuppressive drug for organ transplant patients, in 1986. More than six dozen have been approved since then, with most targeting various cancers and immune diseases. But Humira was different in one key way from those that preceded it—it was a “fully human” antibody, as opposed to one derived from a mouse. Fully human mAbs are less likely to cause adverse side effects. Humira's name is



DESIGNED TO DELIVER Humira injection pens being packaged at a factory in Lake County, Ill. Thanks largely to Humira, AbbVie's revenue has nearly doubled since 2013; CEO Richard Gonzalez [right] has vigorously defended Humira's patents.

itself a tribute to this pioneering science—it stands for “human monoclonal antibody in rheumatoid arthritis,” the first disease it was approved to treat.

As cool as that science is, it didn't come from AbbVie—or even from its progenitor, Abbott. Abbott picked up the biologic in 2001 when it purchased the Knoll Pharmaceutical unit from German chemical company BASF. Knoll, in turn, had licensed the antibody technology from a company called (appropriately) Cambridge Antibody Technology—which, in turn, had licensed it (in large part) from Britain's Medical Research Council, where it was developed from the research of Sir Gregory Winter, who would eventually share in the 2018 Nobel Prize in Chemistry for that very same science.

It was Abbott, however, that received the

first FDA approval for Humira, in 2002. Researchers there had the good sense to try it against other manifestations of inflammatory disease—and new clinical successes and approvals kept coming: In 2005, Abbott got permission to market the antibody for the treatment of psoriatic arthritis; then ankylosing spondylitis, a form of arthritis affecting the spine, in 2006; Crohn's disease in 2007; plaque psoriasis (the most common type of the itchy skin condition) and a form of juvenile arthritis in 2008; and ulcerative colitis in 2012. After Abbott spun off AbbVie in 2013, the latter continued recruiting clinical trials in new disease settings and petitioning for regulatory approval across dozens of markets.

More indications mean a larger pool of patients to treat and, consequently, more sales—which is why drug companies do their best to increase the therapeutic reach of their drugs once they've gotten a single marketing approval from the FDA.

But in the case of Humira, its owners didn't take any chances getting the word out. Last year alone, AbbVie spent just shy of \$490 million to hawk its superstar product, topping the list of 2018 pharmaceutical ad spending, according to Kantar Media. By comparison, Pfizer's \$272 million on advertising for the pain drug Lyrica came in second. AbbVie also spent significantly on social media advertising, not included in the figure above. And television ads for Humira have aired

more than 46,000 times since Jan. 1 of this year.

Along with the über-aggressive marketing, naturally, came price hikes. In the U.S., pharma companies can charge whatever they want for their products. And the makers of Humira did just that. The U.S. list price of the standard 40 mg Humira injectable pen, used in the treatment of rheumatoid arthritis, more than tripled from 2006 to 2017, with the price for a one-year supply soaring from \$16,636 to \$58,612, according to the AARP Public Policy Institute and the University of Minnesota's PRIME Institute. That's a compound annual growth rate of over 12%.

Drug companies often argue that such list prices are misleading because they don't reflect private arrangements with benefits managers, insurance companies, and assistance programs that can significantly reduce out-of-pocket costs for patients.

But even with such factors considered, Humira's price kept soaring, as documented in a March lawsuit against AbbVie filed by UFCW Local 1500 Welfare Fund, a large New York grocery workers' union. After the rebates and discounts negotiated with various health care middlemen, the suit alleges, Humira's average price in the U.S. doubled from about \$19,000 per year per patient in 2012 to more than \$38,000 in early 2018. AbbVie declined to comment on the record about its pricing strategy.

THE COMBINED EFFECT of these efforts for a single drug has been stunning. AbbVie's revenue grew from \$18.8 billion in 2013, its first year as an independent company, to \$32.8 billion in 2018, putting the company at No. 381 on this year's Global 500, a rise of 41 spots from last year. Over that span, AbbVie has been the best in its peer group of big pharma companies in percentage revenue growth.

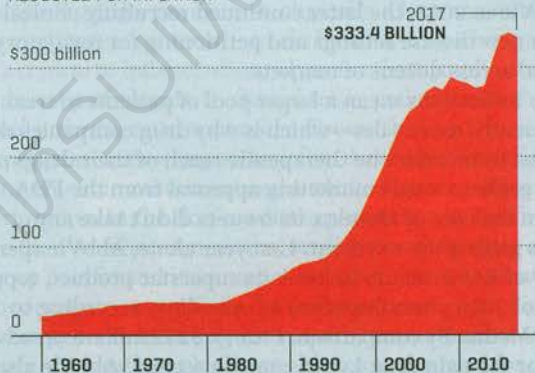
But with this cash cow has come a problem: the need to keep milking it. You see, Humira isn't just AbbVie's bestselling drug, it is its everything-drug—accounting for more than 60% of the company's 2018 revenues. And there is another catch: The initial U.S. composition patent for Humira expired in December 2016, 13 years after it first hit the American market. (A parallel patent in Europe expired this past October.)

That conundrum brings up the last, and perhaps most potent, weapon in AbbVie's campaign for market dominance with Humira: Sue anybody who comes close. "I think

THE PRICE OF SUCCESS

➤ Blockbuster drugs have been life-changers for millions. But their high prices, which manufacturers say are necessary to recoup R&D costs, are a growing burden on the health system.

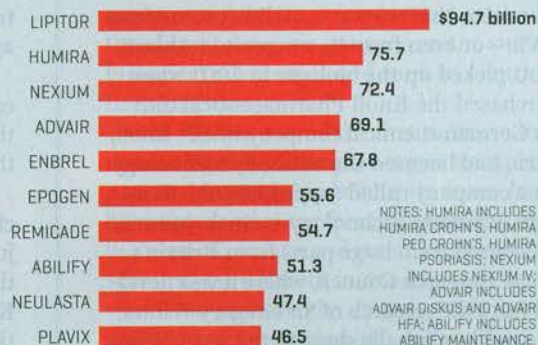
ANNUAL U.S. PRESCRIPTION DRUG EXPENDITURES
ADJUSTED FOR INFLATION



SOURCES: U.S. CENTERS FOR MEDICARE & MEDICAID SERVICES, IQVIA

U.S. BESTSELLING DRUGS

CUMULATIVE SALES, 1992-2017, EXCL. OVER-THE-COUNTER DRUGS



NOTES: HUMIRA INCLUDES HUMIRA CROHN'S, HUMIRA PED CROHN'S, HUMIRA PSORIASIS; NEXIUM INCLUDES NEXIUM IV; ADVAIR INCLUDES ADVAIR DISKUS AND ADVAIR HFA; ABILIFY INCLUDES ABILIFY MAINTENANCE.

of AbbVie as a pioneer—not just in medical treatments but also in legal protections,” Robin Feldman, a professor at the UC Hastings College of the Law and author of *Drugs, Money, and Secret Handshakes*, tells *Fortune*.

According to advocacy and drug watchdog group Association for Accessible Medicines, the company applied for and won 75 Humira patents in the three years before its initial patent expired in 2016. AbbVie CEO Richard Gonzalez has said the company now holds approximately 136 Humira patents.

How was the company able to rack up so many patents on a single product? Much of it has to do with the type of drug that Humira is—a “biologic.” Unlike chemically synthesized drugs, biologics derive from actual biological material, making them significantly more complex than standard chemical medicines. And therein lies the key to AbbVie’s IP strategy, explains Feldman. For instance, a company may be able to file patents on obscure steps in the production and manufacturing process, or adjustments in dosing.

And that’s precisely what AbbVie has done. AbbVie, in an emailed statement, says the U.S. Patent and Trademark Office (USPTO) has granted the company more than 30 patents on the ways in which the drug is administered; more than 25 patents on various formulations of the drug; more than 50 patents related to Humira’s manufacturing processes; and about 20 patents on the delivery devices that customers use to take the medicine.

To be sure, creating a monoclonal antibody isn’t easy work, explains Goodwin Procter attorney Robert Cerwinski. “The manufacture of adalimumab [Humira’s scientific name] occurs through a process called fermentation, and it involves a cell line that’s genetically engineered to secrete large amounts of adalimumab from a huge vat of cells growing in, like, a 15,000-liter bioreactor,” he tells *Fortune*.

Then things get even more complicated. Afterward, the treatment must go through purification processes to take out unnecessary by-products, modifications in dosage for different diseases, and all sorts of incremental tweaks. Amid all these procedures, Cerwinski says, “branded product sponsors like AbbVie have found many more opportunities to

conclude that little wrinkles in the manufacturing process are innovative and can be protected by patents.”

That presents a challenge for companies that want to enter the market with biosimilar copycats. (Biosimilars are generic versions of biologic medicines and are usually far cheaper than the brand-name medicines they imitate.) Those challengers “have to come up with their own process,” he says. “The process is the product.”

Cerwinski has been litigating patent infringement with a focus on the life sciences for more than two decades, including litigation concerning monoclonal antibodies like Humira. He’s also been involved in efforts to reform the U.S. patent system, which currently not only allows but also incentivizes manufacturers like AbbVie to build these so-called patent thickets.

“There’s nothing unusual about the multilayered way AbbVie has sought to patent and protect Humira,” Cerwinski says. Another patent expert, New York Law School professor Jacob Sherkow, echoes the sentiment. “They’re just taking advantage of existing law,” he says.

But Cerwinski points out that other biologic drugmakers fending off competition have employed anywhere from a handful to, perhaps, 40 patent claims in litigation. AbbVie has gone much further—using its patent thicket against rivals with vigor. In a 2017 lawsuit, AbbVie cited 74 alleged instances of patent infringement against Boehringer Ingelheim and its Humira copycat Cyltezo. At first, Boehringer fought back in court. But, in May, it became the ninth company to settle patent litigation with AbbVie over a Humira biosimilar.

“With the inherent unpredictability of litigation, the substantial costs of what would have been a long and complicated legal process and ongoing distraction to our business, we have concluded that this settlement is the best solution,” says a company spokesperson in an email.

All three companies with FDA-approved Humira biosimilars—Amgen, Boehringer, and Novartis’s Sandoz unit—have reached such deals to delay their products’ market entry until 2023. In fact, they have agreed to pay AbbVie licensing royalties in order to market their copycats.

The patent thicket and AbbVie’s arrangements with rivals is a major part of the grocers union’s lawsuit against the company and seven other firms it has struck such deals with. It was filed before Boehringer’s settlement. “Had AbbVie not engaged in anticompetitive conduct, the plaintiffs would have been able to purchase Humira biosimilars in the U.S... at significantly lower prices,” reads the March class action complaint.

While AbbVie declined to comment on the record regarding price hikes, it did defend its patent strategy. “Humira’s innovative patents have repeatedly withstood challenges in legal proceedings,” says AbbVie’s chief legal officer Laura Schumacher. “Our patent settlements, which do not include any payments by AbbVie, balance protecting our investment in innovation with

access to biosimilars 10 years before our last Humira patent expires and the allegations in the lawsuit are without merit.”

Patent thickets have recently come under fire from lawmakers as well. Sen. John Cornyn, a Texas Republican, challenged AbbVie CEO Gonzalez on the issue during a Senate Finance Committee drug-price hearing in February. “I get the idea that that’s the purpose of the patent system, which is to protect the exclusivity of that drug that you’ve sunk a lot of money into,” he says. “But at some point, that patent has to end, that exclusivity has to end, so that the patients can get access to those drugs at a much cheaper cost.”

Gonzalez, who argues that Humira shouldn’t be considered just one drug but rather multiple ones, given its approvals for various conditions, vigorously defended AbbVie’s tactics at the hearing. “That patent portfolio evolved as we discovered and learned new things about Humira,” he said.

It’s hard to tell just how much money Americans would save had Humira copycats already been on the market. In Europe, where cheaper rivals have already begun gaining on AbbVie, Humira prices have fallen in several countries. Indeed, global Humira sales dropped 5.6% in the first quarter of 2019—the first-ever worldwide slide in the drug’s earnings—thanks to “biosimilar” copycats sold abroad. But across the industry, Feldman, says, the introduction of biosimilars could produce dramatic savings for consumers and other payers. She notes one Rand Corporation study that found that biosimilars, generally, could save the U.S. \$54 billion in health spending over 10 years.

“It’s a big chunk of change coming out of your pocket and mine,” she says.

FOR ALL ITS COMMERCIAL and scientific success, Humira offers a sharply focused lens on what’s wrong with the legacy drug industry at large. AbbVie’s convoluted web of patents and other strategies will keep would-be competitors off the U.S. market until 2023. That means fewer choices—and higher costs—for consumers who might otherwise pursue cheaper options.

This is a consequence of the “blockbuster” drug model, wherein a company relies on one or two key products that ring in billions annually. Hundreds of millions go to marketing and legal-fortress building, while innovation and scientific discovery—ostensibly the beating heart of the biopharmaceutical industry—is often imported from the outside: in-licensed, for instance, from leaner biotechs that actually do place an emphasis on innovation.

The strategy can also drive aggressive dealmaking among large pharma companies when their blockbusters finally do face the inevitable “patent cliff,” the point after which cheaper generic competitors can enter the market. Case in point: AbbVie itself, which announced a proposed \$63 billion megadeal to buy Allergan in June. AbbVie’s Gonzalez cited impending Humira

competition—and Allergan’s own aggressive approach to protecting patents on bestsellers like the cosmetic drug Botox and the dry-eye treatment Restasis—as a rationale for the deal.

“This is an example of a pharma company doing a financial transaction—it has nothing to do with science; it has 100% to do with financial engineering,” says Brad Loncar, a biotechnology investor focused on cancer immunotherapy. “People have been overpaying for Humira for a long time in the United States. And what has the company done with the proceeds of that? They’ve done a major financial deal for, of all things, Botox.”

This isn’t to say AbbVie hasn’t had any recent success. In April, the FDA approved its new therapy Skyrizi, an immune system drug with blockbuster sales potential, to treat moderate-to-severe plaque psoriasis. It was a much-needed victory for the company, which believes the drug will reach \$5 billion in annual sales by 2023—the very year Humira rivals will launch in the U.S. AbbVie also won a 2018 FDA green light for Orilissa, the first drug approved to treat pain associated with the uterine disorder endometriosis.

But some industry veterans say these new therapies aren’t nearly enough to compensate for other failures in AbbVie’s pipeline. Annalisa Jenkins led major R&D divisions at drug giants like Bristol-Myers Squibb and Germany’s Merck Serono as they pumped out pioneering new treatments such as the cancer immunotherapy Yervoy, among others, in the 1990s and 2000s. But now she’s gone over to the world of biotech startups, where she feels the science is more exciting and inventive.

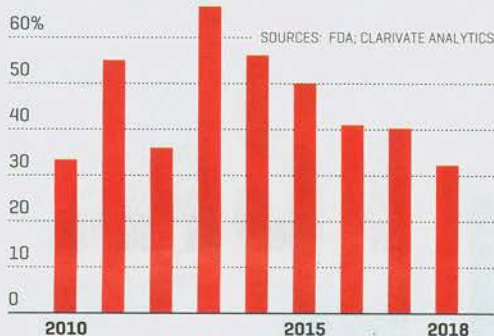
The wide-ranging experience paints Jenkins’s views on AbbVie’s and the broader industry’s innovation woes. “Part of the problem for AbbVie was just being unlucky. There were some bad picks,” she says. “They didn’t aggressively pursue the replenishment of their pipeline. They were slow.”

Those unfortunate picks include one of the more derided acquisitions in recent health care history. In 2016, AbbVie snatched up the San Francisco-based biotech Stemcentrx for \$5.8 billion in upfront cash and stock. The company was eyeing a potentially lucrative Stemcentrx lung cancer treatment called

A TRICKLE, NOT A FLOOD

➤ The share of new drugs coming from Big Pharma's research pipeline has drastically shrunk in recent years.

SHARE OF NEW DRUG APPROVALS SPONSORED BY THE LARGEST PHARMA COMPANIES



NOTE: TOP 20 PHARMA SPONSORS BY REVENUES. CO-DEVELOPMENT OF A DRUG WITH A NON-TOP-20 PHARMA COMPANY COUNTED AS HALF AN APPROVAL.

Rova-T. Three years later, Rova-T has faced multiple clinical trial setbacks, and AbbVie has nixed the program. In January, AbbVie announced it would record an estimated \$4 billion impairment charge on the Stemcentrx deal.

Another AbbVie hopeful, venetoclax, being tested for the blood cancer multiple myeloma, has also disappointed in clinical trials. Investors have noticed the struggles—AbbVie's stock has plunged more than 27% in the past 12 months, underperforming most of its peers.

"These big drug companies can't even seem to buy their way into innovation," Mike Rea, CEO of the life sciences consulting firm IDEA Pharma, tells *Fortune*. "Companies that have grown large with one drug or in one therapeutic area, such as AbbVie, have struggled... They haven't shown that new insight when it comes to a [new] market."

AbbVie's spending on R&D is on the lower end among the 12 big, global biopharma companies, according to EvaluatePharma. The company actually doubled its reported R&D spend between 2010 and 2018—but it was still just \$5.1 billion last year, compared with \$32.8 billion in global revenues.

T HE LIFE SCIENCE LOBBY takes exception to the idea it's in an innovation rut. "I happen to disagree," says Andrew Powaleny, public affairs director at the Pharmaceutical Research and Manufacturers of America (PhRMA),

the industry's trade group. "From the biopharma perspective, we're at the most exciting time we've ever been." Powaleny points to some 7,000 medicines currently in development, including 4,000 in the U.S. alone.

But a deeper dive into the numbers tells a more nuanced story. Projected returns on R&D investment among the top 12 large-cap biopharmaceutical companies—measured by comparing the expected cost of bringing a drug in a company's late-stage pipeline to market versus an estimate of expected sales of those drugs—plummeted to a dismal 1.9% in 2018, according to Deloitte, compared with 10.1% in 2010. EvaluatePharma projects that the top 20 pharma companies will drop their R&D spending from 20.9% of top-line revenues in 2017 to 16.9% by 2024.

The FDA approved a record 59 novel drugs—those derived from entirely new molecular entities or biological entities—last year. But big pharma companies patented just one-quarter of those treatments, according to analytics firm IQVIA, while "emerging biopharma companies" (organizations that spend less than \$200 million per year in R&D or bring in less than \$500 million in revenue) patented nearly two-thirds. "Large-cap pharma's Food and Drug Administration approvals have been way lower than usual," says Colin Terry, a partner at Deloitte's life sciences division.

Now facing the specter of dilapidated pipelines and imminent competition, legacy firms are looking to insource the Next Big Thing from leaner, science-driven outfits (with varying degrees of success, as AbbVie's failed Rova-T gamble shows). "These companies became like great big record labels: reliant on talent spotters going out and finding new artists," says SVB Leerink analyst Geoffrey Porges. (Indeed, just before this issue went to press, AbbVie announced that it was adding another "artist" to its roster, cancer immunotherapy startup Mavupharma, for an undisclosed price.)

Jenkins, the industry R&D vet, says a long history of misaligned incentives—including many companies' failure to adopt new technologies and business models—has led to the current status quo. "What pharma did was what it's always done over the past 20 years," she says. "They're entirely short-term focused. Quarter to quarter, year to year. That's not the best way to leverage innovation."

It's also, fundamentally, not good for shareholders. The NYSE ARCA Pharmaceutical Index has delivered a total return of 5.2% annually over the past five years, compared with 10% for the S&P 500. "Without access to talent, without access to technologies, big pharma companies are just pouring more and more money into the same old R&D. All they're judged on is one big win," Jenkins adds.

Unfortunately, if big pharma companies like AbbVie keep winning like this, the cost to American patients will be immense. ■

G/500



COMPANY
PING AN

COUNTRY
CHINA

2018 REVENUE
\$169.6 BILLION

RANK
29

A TRICKLE, NOT A FLOOD

The share of new drugs coming from Big Pharma's research pipeline has drastically sunk in recent years

SHARE OF NEW DRUG APPROVALS SPONSORED BY THE LARGEST PHARMA COMPANIES



PING AN'S CASTLE MADE OF DATA

China's largest private-sector company built an empire around safe and staid products like life insurance. Now it's betting its future on inventive uses of big data—and gearing up to do battle with fast-growing tech giants like Alibaba.

By CLAY CHANDLER

TOWERING PRESENCE Ping An's headquarters in Shenzhen. The company was among the first to sell auto, life, and health insurance in China—and its "first mover" edge helped it become a giant.



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FENDER BENDERS, EVEN MINOR ONES, used to mean interminable hassle for Chinese drivers. One could wait hours by the roadside for an insurance inspector—then lose hours more filling out forms. Reimbursement took days, and often weeks.

In 2017, Ping An, China's second-largest insurer and its biggest non-state-owned company by revenue, rolled out a "Superfast Onsite Investigation" system—enabling policyholders to submit claims by simply opening a smartphone app and answering a few questions. But the app's niftiest feature offers the option to not even wait for an inspector. Instead, customers can snap photos of a damaged vehicle and send them to a Ping An computer, which can respond with a repair estimate in three minutes or less. If the customer accepts the estimate, then *wancheng!* ("Done!") Ping An can transfer funds immediately.

Last year, Ping An's customers used this feature to settle 7.3 million claims, or 62% of the total. The service saves the company more than \$750 million each year by reducing bogus

claims and human error. But its simplicity belies the extraordinary sophistication of the artificial intelligence and data-processing operations that make it possible.

To generate accurate estimates, Ping An matches photos of vehicle damage against a database of 25 million parts used in the 60,000 different auto makes and models sold in China. The system assesses whether those parts can be repaired or must be replaced, then calculates the cost of parts and labor in more than 140,000 garages. Ping An integrates all that information with face-, voice- and image-recognition tech and a complex matrix of anti-fraud rules. Ping An chief scientist Xiao Jing says it took a team of A.I. experts, data scientists, and insurance managers three years to design, develop, and integrate the new service. It is, he exults, “the only one of its kind in the world.”

But automated auto inspection is only one of myriad marvels that illustrate how Ping An is using A.I. and big data to transform everyday life in China. There's also the facial-recognition technology the Shenzhen-based conglomerate uses in its consumer lending business; Ping An claims its A.I. can read 54 distinct “micro-expressions” to determine whether loan applicants are lying. Or take Ping An Healthcare and Technology, better known as Good Doctor, which offers consultations to 265 million patients registered via a mobile app—and aids physicians in diagnosing thousands of ailments. Over the past five years, Ping An has also built its own cloud and designed a suite of A.I.-driven software services to go with it—not just to support its own work but also to market services to thousands of smaller financial institutions, hospitals, and medical clients.

These products and services have a vital feature in common: They match online data, generated by China's digitally native consumer masses, with a vast storehouse of “offline” data and insight amassed over three decades in the insurance business. Ping An believes that this offline information—which encompasses elements as disparate as business-loan default rates, symptoms of skin cancer, and the resale value of a car with sprung shocks—means that its data services are based on better data. “That's where our advantage comes in,” says Jessica Tan, the deputy CEO who oversees Ping An's technology companies. “We're able to connect to the full picture.”

Such connection is central to the vision of Ping An's hard-charging founder and CEO, Peter Ma. Ma built a massive business around an array of life, health, and property and casualty insurance. Ping An's insurance arm now reaches 184 million customers and accounted for the bulk of the company's \$164 billion in revenue in 2018. Growth in those relatively staid industries is slowing as China's economy matures. But they are generating the massive flows of cash and data Ping An needs to build its tech arsenal. Ping An's leadership foresees the day when the company's technology businesses contribute as much as half of its earnings, up from only 6% today, and compete head-to-head with pure technology plays

like Alibaba Group and Tencent Holdings.

Giant financial services companies rarely double as disruptive innovators. Ping An's very name, which means “peace and safety,” evokes warm milk and an early bedtime. Yet Ping An has already spawned a menagerie of proprietary technologies that support the group's five key “ecosystems”: finance, health care, autos, real estate, and smart cities. Meanwhile, its online financial and health care services, some sold under its own brand and some licensed to others, now boast more than 565 million registered users.

Ping An earmarks 1% of revenue for investments in innovation. Over the past 10 years, the group has plowed more than \$7 billion into research and development, and Ma has vowed to invest \$15 billion more in the decade to come. That endowment has nurtured 11 technology affiliates, of which two—Good Doctor and Autohome, a platform for car buyers—are publicly traded and three are privately held “unicorns” with multibillion-dollar valuations. For now, only two of those five are profitable. Even so, the combined value of the group's tech ventures tops \$70 billion. (See the “Star Pupils” sidebar.)

Paul Schulte, CEO of Hong Kong-based Schulte Research and an expert on how financial companies use technology, says that Ping An grasped the importance of A.I. and data analysis “from the beginning.” While other big Chinese companies seemed to sleepwalk past the new tools, he says, Ping An was “hyper-awake and constantly pushing.” These days, that push is only growing more forceful.

PING AN TOWER, the second-tallest skyscraper in China, dominates Shenzhen's skyline, looming 118 stories over the Futian financial district. From its upper floors, executives can gaze over lesser buildings to a hill upon which stands a statue of Deng Xiaoping, the leader who steered China out of isolation and rigid centralized economic control after the death of Mao Zedong. Lee Yuansiong, the deputy CEO who heads Ping An's insurance group, jokes that he bows to the statue every day—thanking Deng for setting China's economy, and his employer, on the path to rapid growth.

Ping An got its start in 1988 when Ma,



TECH TEAMMATES Deputy CEO Jessica Tan, a Singapore native, runs Ping An's technology companies; chief innovation officer Jonathan Larsen, an Australian, helms its biggest tech venture fund.

then a junior official at state-owned shipping company China Merchants Group, persuaded superiors to let him set up a property and casualty insurance unit. The concept of an insurance company was unfamiliar in China, but China Merchants was headquartered in Shenzhen, a special economic zone, where economic experimentation was not only tolerated but encouraged. Ping An later branched into life and health insurance, enjoying "first mover" status in those markets just as millions of Chinese people attained middle-class prosperity for the first time, driving demand; it eventually rolled out a profitable retail bank.

Beginning in the 1990s, Ping An took advantage of widening reforms to become the first Chinese financial institution in which foreign firms could own equity: Goldman Sachs and Morgan Stanley were early backers. The company eventually went public in 2004, listing in Hong Kong. (Current shareholders include three companies controlled by Thailand's CP Group, which together held a stake of 9.19% at the end of last year. Chatchaval Jiaravanon, son of the executive chairman of CP Group, has owned *Fortune* since December 2018.)

Even as its customer base and revenue soared, Ping An made missteps. Efforts to



expand through acquisition were particularly ill-fated. In 2008, Ping An bought a 50% stake in Brussels-based financial conglomerate Fortis, just before that company collapsed. The 2010 acquisition of Shenzhen Development Bank, a troubled commercial lender, has been slow to bear fruit.

As he grappled with those challenges, Ma marveled at the rise of Tencent and Alibaba. The rapidity with which those companies parlayed data on e-commerce and mobile payments into successful products hinted at the power inherent in Ping An's own deep data pool. (Peter Ma shares the same surname as Alibaba cofounder Jack Ma and Tencent founder Huateng "Pony" Ma, but the three are not related.) Ma's vision, says Jonathan Larsen, the company's chief innovation officer, was that Ping An could combine the best of a stable finance company and a nimble tech firm—innovating and experimenting to help keep a big company growing at a steady pace.

To implement that vision, Ma has reached outside the company's ranks and outside China itself. Jessica Tan, who joined in 2013, grew up in Singapore and earned degrees in electrical engineering and computer science from MIT. She spent 13 years at consultancy McKinsey & Co., where Ping An was a client. Her first project for Ping An also marked her first trip to mainland China. "I remember arguing with my office manager," she says, laughing. "I really didn't want to go." That assignment turned into an 18-month odyssey in which Tan helped develop a major administrative campus. Her current role puts her in constant orbit between headquarters in Shenzhen, Ping An's 32-acre tech center outside Shanghai, and Singapore to see her family.

Lee, the insurance group head, also hails from Singapore. Larsen, an Australian, held a variety of top roles at Citibank, including head of global retail banking, before joining Ping An in 2017. And Xiao, the chief scientist, is a Chinese native who joined in 2013 after stints in Silicon Valley at Seiko Epson and

PING AN'S CASTLE MADE OF DATA

Microsoft. Starting at a company with a data trove the size of Ping An's, Xiao says, was like discovering "Treasure Island."

COMPARING PING AN'S data capabilities with those of Alibaba and Tencent is a tricky proposition, given the radically different scales at which they operate. Taobao, Alibaba's main retail marketplace, has 666 million monthly active users, while Alipay, its mobile payments platform, boasts more than a billion. Tencent's WeChat platform draws more than a billion active users who generate an average of 45 billion messages—*every day*. Schulte estimates that the BAT (China's troika of Baidu, Alibaba, and Tencent) processes at least 10 times as much data every day as Ping An has acquired in its entire existence.

But Ping An executives argue that quality matters more than quantity. The data its businesses collect is richer than that gleaned by the BAT, they claim, because it involves big-ticket transactions relating to health, wealth, and property—among the most meaningful decisions in customers' lives.

As a case in point, Jessica Tan cites Autohome. When Ping An acquired a controlling stake in the New York-listed company from Telstra, the Australian telecom giant, in 2016, Autohome was seen as promising but unproven. Under Ping An, it has consolidated its position as China's largest online auto-sales platform while swinging to profitability. Tan attributes the turnaround to the firm's ability to tap into decades of Ping An data unrelated to e-commerce—millions of records about auto loans and car-insurance claims, for example. Just as important, Ping An persuaded some 14,000 auto dealers to use Autohome for sales management—generating real-time intelligence about consumer tastes. All of this information enables Autohome to target customers more precisely and offer them services like financing—and it wouldn't have been possible, Tan says, "if I were just a pure insurer who sticks to my stuff."

Those dealer partnerships point to one key to Ping An's data

expansion. By licensing big-data tech to other companies, the insurance giant creates a virtuous circle in which Ping An collects still more data through the relationships, enabling it to improve its models and thereby attract more clients. There are now 22 auto insurers using the "Superfast" accident-claim platform. Some 460 Chinese banks and over 1,800 other small- and medium-size financial services firms use Ping An's OneConnect financial platform. And Ping An's proprietary cloud lets the company scale up these offerings at relatively little expense, helping the circle grow bigger, faster.

In the same vein, Ping An has built a popular A.I.-driven model for assessing consumer credit risk. Alibaba, Tencent, and Ping An have all been granted provisional licenses to offer credit-bureau services, but Ping An's is the favorite of financial institutions; it's being used by about 200 banks. While Alibaba's and Tencent's models rely on analysis of e-commerce data to underwrite small loans for purchases by their own customers, the value of such loans rarely exceeds a few thousand yuan—a few hundred dollars. Ping An's model "can give a small-business owner a loan for a few hundred thousand completely unsecured, no problem," says Tan, "because we have been doing this for years."

TO SUPPORT his high-flying high-tech strategy, Ma has assembled a formidable talent pool. Ping An employs more than 24,000 software engineers, 800 data scientists, and 180 A.I. specialists. The company says it has filed more



STAR PUPILS

➤ Ping An's A.I. and data science have fueled products like its accident-claims service [far left]. Over the past several years, it has also acquired or launched these five data-driven companies; together, investors value them at about \$70 billion.

than 15,000 technology patent applications. Ping An also controls a gaggle of venture and private equity funds, including the Global Voyager Fund, a \$1 billion war chest launched in 2017. Larsen, who helms Voyager, says the fund focuses on early-stage ventures in fintech and health care—securing stakes in platforms or technologies Ping An has yet to develop itself.

That the stock is undervalued is a constant lament of executives, who argue that viewing Ping An solely as an insurer misses the potential of its tech ventures. Ping An shares trade at a price-to-earnings ratio of about 12—on par with mature insurers such as AXA or Allianz but a far cry from Alibaba and Tencent, which trade at 35 and 38 times earnings, respectively.

Still, some metrics are trending in the right direction. Over the past two years, a third of new customers for Ping An's financial services have already been registered users of its Internet businesses, the company says. That suggests the tech ventures are helping agents "cross-sell" more lucrative products—for example, when people who use Autohome to buy a car wind up getting insurance from Ping An.

The company also counts its technology portfolio as a hedge against a graying workforce and a slower economy. Larsen sees a huge opportunity in health care as China's population ages. "You've got higher expectation of service standards from an increasingly affluent and educated population," he says. "You have the onset of chronic diseases—54% of males smoke, 9% of long-term smokers get lung cancer—and a host of other conditions [related to]

heart disease, lack of exercise, obesity." Ping An's HealthKconnect platform aims to help the Chinese government, which covers about 55% of the country's health care costs, contain this looming wave. The company is working on features to help digitize medical records, analyze health data, pay bills, and spot fraud.

Ping An's burgeoning capacity to collect and analyze such intimate data raises complicated privacy issues. Facial recognition and "micro-expression" analysis are now standard features for companies using Ping An's cloud. Should customers be pleased that a company that sells health insurance can calculate their body fat percentage with a face scan? Does it bother consumers that the Good Driver app—which constantly relays where they go, how fast they drive, and how smoothly they change lanes—is increasingly a mandatory download for someone buying auto insurance? And what if the company selling them that policy also knows their occupation, net worth, and health history?

Tan says Ping An has developed elaborate systems to safeguard the privacy of client data, and that data is fully anonymized before being used in modeling. But decisions about insurance and loans for individuals, of course, are anything but anonymous. Chinese culture generally doesn't place the same value on privacy that Western culture does; in practice, that makes it likely that Ping An's biggest innovations will remain concentrated in China for now. "We don't have aspirations to make acquisitions overseas," Ma recently told the *Financial Times*. "The Chinese market has the best growth prospects."

Ping An is having little trouble persuading Chinese consumers to sign on. It's doing so with the help of an old-school sales force—the 1.1 million independent agents who sell its policies and other products. Automation has affected this army too. "They basically never touch a piece of paper," Larsen says. "Client relationship management, social network management—it's all automated." Still, they drive billions of dollars in sales, year after year: In emerging economies like China's, it turns out, the killer app for wooing customers remains an actual human. ■

AUTOHOME

China's largest online auto-buying platform boasts an average of 29 million daily users. Ping An acquired a controlling stake in 2016. Since then, Autohome's market cap has tripled, to \$10 billion.

GOOD DOCTOR

The app-driven venture, which helps physicians offer long-distance diagnoses [photo at left], claims 265 million users. It went public in 2018 at a valuation of \$7.5 billion; the stock has sunk 40% since the IPO.

HEALTHKCONNECT

This service uses cloud computing and data analysis to match patients' medical history with billing and insurance records. A recent round of Series A financing valued HealthKconnect at \$8.8 billion.

LUFAX

Lufax is China's biggest peer-to-peer lender, as well as an online marketplace for investment products. It is profitable and claims 40 million users; a recent venture-funding round valued it at \$39.5 billion.

ONECONNECT

This Ping An subsidiary sells cloud-computing and tech services to other banks and financial firms. Its private-market value has been estimated at \$7.4 billion; observers expect a Hong Kong IPO this year.

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COMPANY
**CHINA COSCO
SHIPPING GROUP**

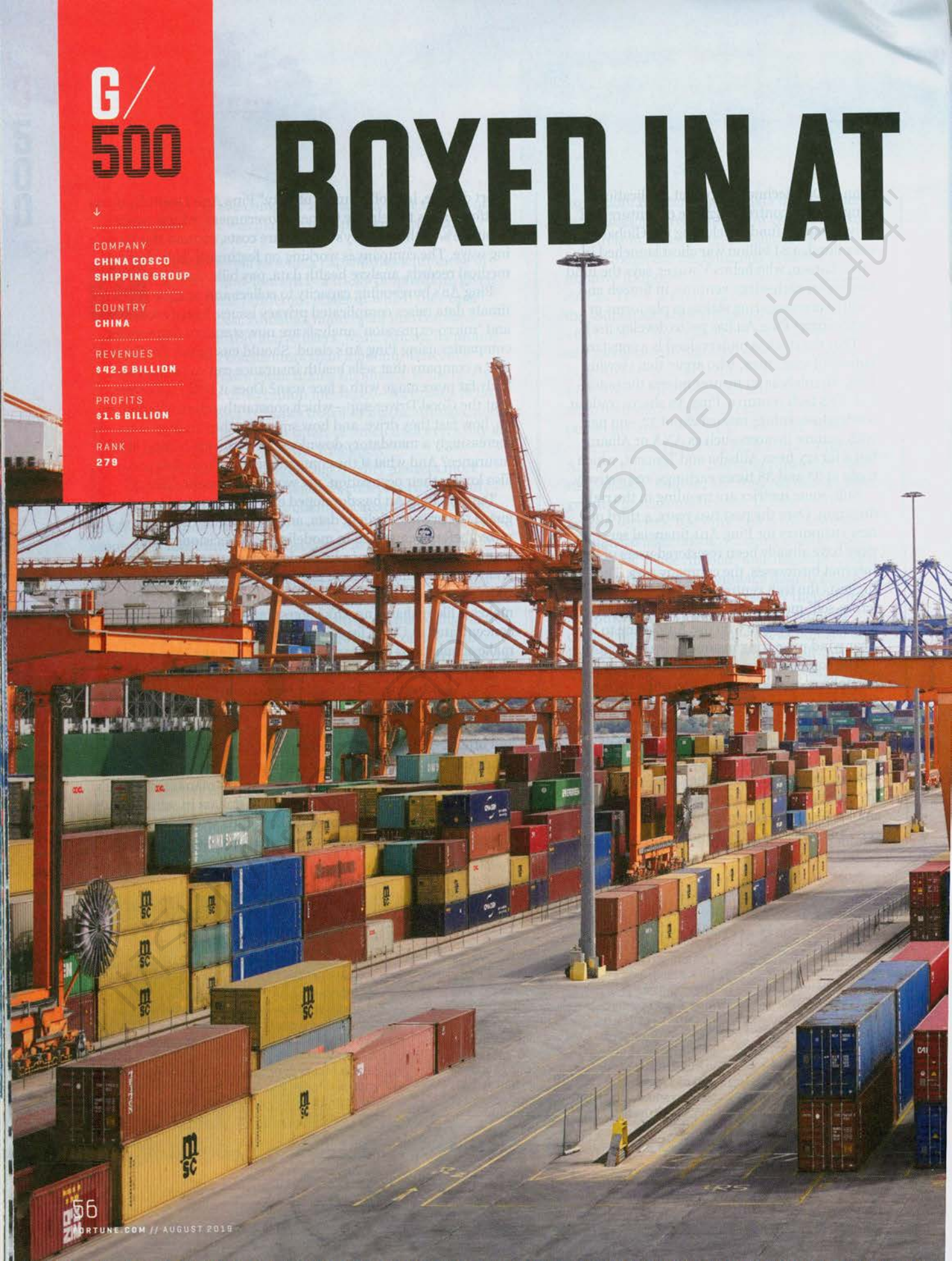
COUNTRY
CHINA

REVENUES
\$42.6 BILLION

PROFITS
\$1.6 BILLION

RANK
279

BOXED IN AT



THE DOCKS

When Chinese shipping giant Cosco snapped up the historic port of Piraeus, it threw Greece an economic lifeline. Now the port's success is reshaping the Greek political landscape—and generating choppy waters for China in Europe. By VIVIENNE WALT



ECONOMIC BOOMS
A container pier at Piraeus. Since Cosco installed state-of-the-art cranes, the port's annual cargo processing rate has increased more than fivefold.

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ON A STEAMY NIGHT EARLIER THIS SUMMER, about a thousand people poured into a public square in Athens to cheer on Greece's leading left-wing politician, Alexis Tsipras. Tsipras was in the waning weeks of his term as Prime Minister—and trailing in a race against a pro-business opponent.

Leaping onto a makeshift stage in front of a banner reading “We have the power,” Tsipras shouted over the crowd. “This is a battle between two worlds, the elites against the many!” Then he took aim at foreign companies eyeing investment prospects in Greece, one of the countries hardest hit by Europe's long financial crisis. “We have managed to get back to growth after eight straight years of recession,” Tsipras said. “Electricity, health, education, water, energy—they are not for sale!”

The promise to keep the country's state-owned assets in Greek hands elicited a deafening roar. And yet Tsipras didn't mention the most prized Greek asset of all: the port of Piraeus. Situated at the edge of Athens—a short sail from the Middle East and Africa—the port has been a strategic jewel for nearly 2,500 years, ever since the Athenians and Spartans defeated the Persian emperor in a nearby sea battle for Mediterranean supremacy. But as the crowd in the square knew, Tsipras's own government had sold off Piraeus, years earlier, to a modern-day empire intent on expanding its own power: China.

When Chinese President Xi Jinping unveiled the ambitious vision he called the Belt and Road Initiative, or BRI, in 2013, he had commerce, not conquest, in mind. Xi announced that China would build a network of highways and rail lines (the “belt”) and sea routes (the “road”) across thousands of miles, linking Asia to Europe and Africa. The idea was to re-create the old Silk Road—the trade routes between East and West that were the foundations of the world's first truly global commerce. The ultimate strategic goal: to expand and solidify a web of trading relationships that would cement China's position as a dominant economic and political power for decades to come.

Piraeus has become a showcase display of the BRI in action—a project capable of transforming not just one port but perhaps an entire economy. It's also an object lesson in the ways China's biggest companies both execute and benefit from the BRI. The port has been majority-owned since 2016 (and operated since 2009) by China Cosco Shipping—a state-



WHERE EMPIRES OVERLAP Athens is home to a community of some 10,000 Chinese expats. Cosco hopes to expand Piraeus as a tourism destination to compete with sites like the Acropolis for affluent Chinese visitors.

owned giant established nearly 60 years ago by Communist founding father Mao Zedong.

When Cosco stepped in, Piraeus “was a pretty backward container terminal that nobody took seriously,” says Olaf Merk, the ports and shipping expert at the International Transport Forum at the Organization for Economic Cooperation and Development (OECD). “China saw an opportunity that was underdeveloped.” New management has brought dizzying change: This year, the port will handle five times as much cargo volume as it did in 2010, according to the Piraeus Port Authority. And it's on track to become the biggest container port in the Mediterranean, perhaps as soon as this year, overtaking Valencia in Spain.

Cosco, meanwhile, has undergone its own



rapid growth, thanks in large part to the BRI and to substantial Chinese government support. After several mergers with other transport companies, Cosco is now the third-biggest shipping company in the world by volume, with \$43 billion in revenue—and significant stakes in other ports that ring Europe.

In recent years, China has trumpeted Piraeus as a model for what the BRI can achieve. And its impact is visible throughout Athens: in more jobs at the port, in Chinese-language advertisements for local real estate, and in plans to remake Piraeus as a tourist destination for the burgeoning Chinese upper classes.

But Piraeus's revival also coincides with growing doubts in Europe about the strings attached to Chinese investment—as leaders question whether its sheer scale is a threat to Europe's sovereignty, and perhaps even its security. Already, the political landscape in Greece has shifted in ways critics see as too friendly to China. Chinese naval vessels have docked at Piraeus—raising hackles at

NATO, of which Greece is a member. This spring, as Xi toured the continent to stump for the BRI, European Union leaders issued a tough statement that for the first time called China a “systemic rival” whose political values—a centralized government with no tolerance for dissent, run by a leader with a lifelong grip on power—clash with Europe's own.

The EU also called out Chinese state-owned enterprises like Cosco for having unfair advantages over the continent's own private-sector companies. “The balance of challenges and opportunities presented by China has shifted,” the EU statement warned. Whether that balance should still tip toward cooperation is a debate now playing out on Piraeus's docks.

WHEN WESTERNERS THINK about competition with China, the conversation often involves advanced technology—think artificial intelligence or 5G Internet. But the BRI underscores the importance of the infrastructure of trade itself: railways, roads, harbors. Ports may be the most vital link in that network. Roughly 90% of goods traded internationally makes its way around the world by sea. Control the shipping lanes and ports, and you wield great power over the global economy. “Xi thought, ‘What will my legacy be?’” says Nicolas Vernicos, a fourth-generation

Greek shipowner and vice chairman of the Silk Road Chamber of International Commerce, a trade organization headquartered in China. "He decided to be the Marco Polo of the 21st century."

If completed, the BRI will be one of history's biggest infrastructure projects. Already Chinese companies are laying highways, operating ports, and creating railway networks in as many as 60 countries as varied as Sri Lanka, Malaysia, and Kazakhstan. Chinese government spending and subsidies keep the shovels moving. The Council on Foreign Relations estimates that China has spent about \$200 billion on BRI projects so far; that investment could reach \$1.2 trillion by 2027, according to Morgan Stanley. The result, Xi said in 2015, will bring "a real chorus comprising all countries along the route, not a solo for China."

European voices make up only a small share of the chorus so far: The biggest BRI projects are underway in Asia and Africa. But outside of the BRI, Europe has seen Chinese investment rise quickly. With most EU economies still sluggish in the aftermath of the financial crisis, and heavy debt loads restraining government spending, Chinese companies have filled a void.

Indeed, as trade tensions impair China's ability to invest in the U.S., Europe now accounts for almost a quarter of China's direct foreign investment—about \$22 billion in the first half of 2018, according to law firm Baker McKenzie. State-owned ChemChina bought Swiss agribusiness giant Syngenta in 2017, for \$43.1 billion. In 2016, China's Midea spent \$5.3 billion to buy German robotics manufacturer Kuka—which, among other things, keeps Volkswagen's factories ticking. Technology player Huawei, which the Trump administration has branded as a national-security threat, maintains its largest logistics center outside China in Hungary, where it employs 2,000 people.

"Money does not like a vacuum," says Yanis Varoufakis, Greece's left-wing former finance minister, who helped negotiate the country's bailout with the International Monetary Fund and the EU in 2015. Varoufakis blames EU leaders for leaving companies vulnerable to takeovers. "European decision-makers [are] keeping investment at the slowest level in history and leaving the Chinese to come in as the only investors," he says.

Cosco has quietly become one of the busiest of those investors. Even before the BRI was unveiled, it began acquiring stakes in numerous key ports, piecing together a network of terminals around Europe. (The company signs long-term concessions with local governments; Piraeus is the only European port where it owns outright a controlling stake.) Its holdings include 47.5% of the huge Euromax terminal in the Dutch city of Rotterdam; 100% of the container port in Zeebrugge, Belgium; and stakes in terminals in Valencia and Bilbao, Spain. In Israel, on Europe's edge, it's building ports in Haifa and Ashdod.

Cosco's rise also shows how state-owned companies benefit when they subsume their strategy to the government's grand plans. Growth and profitability are virtually assured—an advantage no U.S. or European company can match. "Opera-



OLAF MERK
Shipping analyst, OECD

PIRAEUS "WAS A TERMINAL THAT NOBODY TOOK SERIOUSLY. CHINA SAW AN OPPORTUNITY."

tional losses of Cosco are compensated by state subsidies, and capital investments are made possible by generous credit lines," explains Merk, the OECD analyst.

China's government has given an astonishing \$1.3 billion worth of tax subsidies to Cosco since 2010, according to shipping-research organization Alphaliner. Alphaliner estimates that Cosco's 2018 profit of \$251 million from shipping activities was attributable almost entirely to subsidies, which Cosco reported at \$230 million. State-owned banks offer other largesse, often in the form of low-interest loans. In 2016, China's Export-Import Bank provided Cosco with \$18 billion in financing to buy ships and acquire companies. In 2017, Cosco got \$26 billion in financing from the China Development Bank for BRI projects—work that Cosco now leverages to expand globally.

Cosco's Chinese executive in Piraeus, Capt. Fu Cheng Qiu, declined multiple requests for interviews; Cosco officials elsewhere in Europe and China did not respond to interview requests. But publicly, the company's officials aren't shy about their plans for global growth. "Scale-up will still be the long-term trend for our industry," Zhang Wei, executive director of Cosco's port arm, said in April.

W

HEN YOU DRIVE into Piraeus, five miles from downtown Athens, past auto-body repair shops and small cafés, there is no sense that you're entering a flash point of controversy. Though some 450,000 people live in the town and its surrounding neighborhoods, Piraeus has the feel of a suburb that has seen better days. At lunchtime, the plastic tables at the café on the pier fill with dockworkers, smoking cigarettes and discussing their lives over \$5 plates of sardines—offering a window into the tumul-

tuous decade they have endured.

Giorgos Alevizopoulos, a burly man of 64 with a mustache and beard, says he began working in the port at 17, in 1972—when ship-building was Greece’s powerhouse industry. He ultimately became a welder, working on vessels under repair or maintenance on dry and floating docks where dozens of small companies operate on piecemeal jobs.

But by early this century, work in Piraeus had slowed to a crawl, as companies sought cheaper repairs in other nations or patronized more modern shipyards. Years of labor strife also reduced the port’s appeal. Alevizopoulos says he worked only about 50 days a year between 2005 and 2014. “My entire life changed, and my outlook on life changed. I even contemplated suicide,” he says. “Some days we just ate bread. If there was a question about what

we eat that day, the answer was always whatever is cheapest.”

For years, the Greek government seemed content to run Piraeus largely as a commuter port for the ferryboats that take millions of locals and tourists to islands in the Aegean Sea. The shipyards and cargo port, meanwhile, deteriorated year by year. Laden with debt and bogged down by political schisms and bureaucracy, the government neglected the upgrades that could have retrofitted Piraeus to serve the rapidly growing large-container shipping industry. By 2010, yearly cargo traffic had fallen to 880,000 TEUs, or twenty-foot equivalent units, the standard measurement for container throughput—a paltry fraction of the capacity of Europe’s biggest ports.

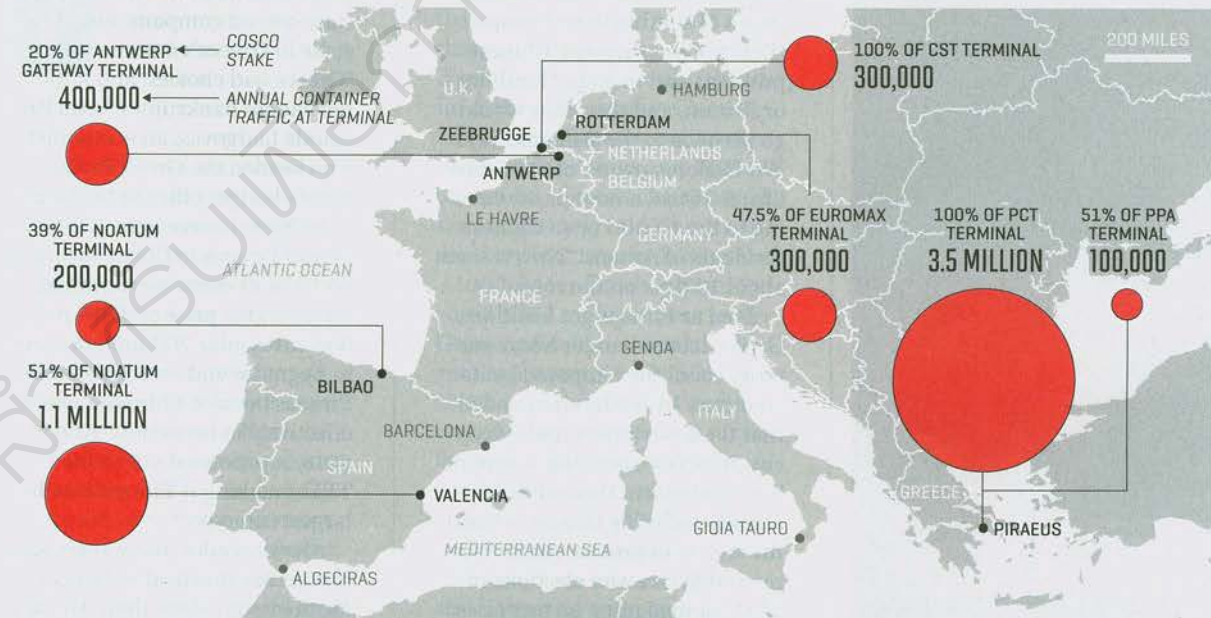
In 2008, China made its move. Cosco, then known as the China Ocean Shipping Group, signed a concession with the Greek government to operate Piraeus’s container terminal for 35 years, in a deal worth about 1.2 billion euros (\$1.4 billion) in rent and facility upgrades and another 2.7 billion euros in revenue sharing. The powerful dockworker unions, anxious at the prospect of foreign ownership, went on strike for six weeks.

SURROUNDING EUROPE BY SEA

➤ Cosco now owns stakes in four of Europe’s six biggest ports and a few smaller ones. The stakes have fueled Cosco’s growth and helped expand China’s economic and political footprint on the continent.

COSCO’S STAKES IN EUROPE’S MAJOR PORTS

NUMBER OF SHIPPING CONTAINERS PROCESSED ANNUALLY, MEASURED IN TWENTY-FOOT EQUIVALENT UNITS (TEUs)



NOTE: MANY PORTS HAVE MULTIPLE TERMINALS. SOURCE: INTERNATIONAL TRANSPORT FORUM/DECO

SHOULDN'T THE WORKPLACE BE A BETTER PLACE?

CHINA IN EUROPE'S PORTS

They hung a banner on Piraeus's waterfront on the day the Chinese company took over that read "Cosco go home!" But with the global recession at its nadir, and few other options, the strikers soon returned to work.

Cosco quickly overhauled one of Piraeus's piers and implemented a major upgrade of its loading cranes. That vastly expanded Piraeus's capacity, turning the port almost overnight into an attractive destination for container vessels. Cosco also ran the port more efficiently. "Before, the employees were public servants," says Vernicos, the shipowner. "They were working less than eight hours a day and fishing most of the time."

Most important, Cosco now directs more of its own huge container-vessel traffic to Piraeus. As the ancient Greeks understood, Piraeus's location makes it potentially invaluable. It is the closest major container terminal on the European mainland for ships emerging from the Suez Canal—and a gateway to a huge swath of southeastern Europe. "Before Cosco arrived, Chinese products had to go to Hamburg or Britain, and then they would go perhaps to the Balkans," says Wu Hailong, owner of the *Greece China Times*, a newspaper catering to the 10,000 or so Chinese residents of Athens. "Now it saves about 10 days on the route."

Even as Piraeus got healthier, Greece labored under heavy austerity conditions imposed by its creditors. Its lenders demanded that the government make deep cuts to public spending—prompting hundreds of thousands of already-suffering Greeks to flood the streets in protest. Alexis Tsipras and Syriza won elections in 2015, campaigning on promises



never to sell certain public assets. In the end, however, Greece had to do just that as a condition of a bailout by the EU and the IMF. Consider this: It sold its rail lines to Italy's state-owned railway company for a tiny 43 million euros, less than some pro athletes earn in a year. Its natural-gas holdings were sold off to a private group; China State Grid, another state-owned company, bought a stake in Greece's national utility. "Greece had choices, and it did not choose bankruptcy," says Panagiotis Liargovas, an economist who headed the Greek Parliament's budget office at the time.

In 2016, Greece agreed to sell 51% of Piraeus to Cosco, including 100% of its container terminal, for a bargain price of 368.5 million euros, plus 760 million euros in upgrades and revenue sharing. Piraeus became Chinese-owned, effectively in perpetuity. And in 2018, it processed 4.9 million TEUs, making it Europe's sixth-largest cargo port.

Alevizopoulos, the welder, says his life has drastically changed for the better since then. He says

FORTUNE

RACEAHEAD

Every company is tackling diversity and inclusion in different ways. Ellen McGirt's newsletter follows their progress and those who hold them accountable.

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SMART ROBOTS ARE NOT GOING TO STEAL OUR JOBS. YET.

he made nearly 20,000 euros last year—about four times as much as his earnings before the government sold the port. Even so, Greece's economic ordeal has left its mark. "Psychologically, we have not recovered," he says. "Like the rest of the people, we are still afraid."

I**N AUGUST 2018**, Greece finally exited the eight-year austerity program imposed by its creditors. Although the economy returned to growth in 2017, Greece's GDP had shrunk an astonishing 45% between 2008 and 2016—the largest depression ever to strike a country in peacetime. It will take years more for outside lenders to feel secure about financing projects in Greece, says Yannis Stournaras, governor of the Bank of Greece, "so we hope for equity investment." Such an influx is needed not just to boost the economy but also to literally rejuvenate Greece, the governor explains. Thousands of educated young people fled during the crash, and those who stayed have

WELDING A BOND Cosco has achieved labor peace, for now, with Piraeus's historically fractious dockworkers and shipbuilders.

been reluctant to start families. "Only by producing good jobs will young couples produce more children," Stournaras says.

Cosco says it is generating such jobs. While many Greeks worried that Chinese control would mean that imported workers would displace Athenians, only a handful of the port's staff is Chinese, and those are managers, rarely seen amid the ships and stacks of containers. Cosco's chairman, Xu Lirong, recently told Chinese media that the company has created 3,100 jobs for Greeks and added about \$337 million a year to the Greek economy—a meaningful sum in a country with GDP of about \$200 billion. The port's revenues were about \$151 million last year, up 19.2% from 2017, and Cosco says it is aiming to more than double the container volume Piraeus handles.

Boosters see Chinese money also bolstering other sectors that

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THE JOB
YOU WANT.”
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CHINA IN EUROPE'S PORTS

suffered during the dark years. Vaggelis Kteniadis, president of V2, one of Greece's biggest real estate development companies, says he has had only five Greek buyers for his properties in Athens's upscale seaside suburbs during the past 10 years. Kteniadis helped persuade Greece's government to launch a “golden visa” program in 2013, offering foreigners resident status in exchange for investing 250,000 euros in Greek property.

Kteniadis estimates that Chinese buyers since then have snapped up more than 4,000 houses and apartments in Athens, about 450 from him alone, bought as second homes or short-term rental properties. Today, V2's advertisements, in Chinese, are plastered across the baggage-claim area in Athens's airport, offering home ownership as a rapid path to EU residency—an invaluable advantage for businesspeople. “The Chinese have saved Greek real estate,” says Kteniadis, who now has offices in four Chinese cities.

Chinese money could reshape the real estate of Piraeus itself. Guiding a reporter around the port one afternoon, Nektarios Demenopoulos, spokesman for the Piraeus Port Authority, points out a large abandoned wheat silo, which Cosco wants to convert into one of five high-end hotels; the company also envisions building a luxury shopping mall. The idea is to invest some 600 million euros to transform the sleepy town into a tourist hub, catering to cruise ships (some Chinese-owned) for which Piraeus is a stop. There is little to do in town currently, and passengers, if they disembark at all, make a beeline for the Acropolis 6.5 miles away. “The Chinese

already have respect for ancient Greek culture,” Demenopoulos says. “But we still have a very small number of Chinese tourists compared to the thousands of Chinese millionaires.”

IN 2017, not long after Cosco bought Piraeus, the European Union drew up a resolution to present to the United Nations condemning China's crackdown on human-rights activists. The EU had presented such statements on multiple previous occasions. But this time, Greece blocked the resolution, and a Greek foreign ministry spokesman called it “unconstructive criticism of China.” That incident exposed a deepening divide among EU countries over how to deal with China—and stoked the fears of China hawks that countries would be willing to sacrifice principles for monetary gain.

This year, the stakes rose dramatically. In March, when President Xi landed in Rome for a state visit, Italy's presidential guards lined up on horseback to greet him, as they do for the Pope. Later, tenor Andrea Bocelli serenaded Xi at a formal dinner. Italian companies signed deals with China worth \$2.8 billion, and Italy agreed, in principle, to join the BRI, becoming the first member of the G7 group of major Western economies to sign on. Here, as in Piraeus, China's maritime ambitions play a role: Italy is courting Chinese investment in four of its ports, including Trieste, a city whose direct-rail connections to Belgium and Germany represent some of Europe's most valuable trade routes.

It was Xi's splashy Italy visit that jolted EU officials into issuing their



THODORIS DRITSAS
Former Greek
shipping minister

**“EVEN THE SCREWS
COME FROM CHINA.
THERE ARE GREEK
COMPANIES THAT
COULD DO THIS.”**

warning about China as a “systemic rival.” The EU plans to more rigorously monitor investments by state-owned companies like Cosco. It has begun rolling out guidelines to prevent countries from ceding control of strategic infrastructure or sensitive technology—an attempt to mirror the U.S. Treasury’s Committee on Foreign Investment in the U.S., or CFIUS, which examines deals involving American companies. Closer examination of security threats and unfair competition “could severely affect China’s investment footprint in Europe,” concludes a recent report by the Rhodium Group and the Mercator Institute for China Studies in Berlin. Indeed, data on Chinese investment in Europe shows that its pace is already slowing.

Within Greece itself, divisions over foreign investment—including in Piraeus—run deep. Some critics have long griped that the government sold too low, even though Cosco was the highest bidder in an open process. Local officials have, for now, blocked Cosco’s hotel and mall plans, on the grounds that they would disturb archaeological sites.

Some business leaders want the state to prevent Cosco from replacing Greek know-how with Chinese infrastructure. Piraeus’s cranes, for example, are supplied by ZPMC, a subsidiary of yet

another Chinese state-owned entity. “Even the screws come from China,” says Thodoris Dritsas, a former Greek shipping minister. “There are Greek companies that could do this.” The dockworkers suspect Cosco has designs to replace their union members with freelance labor acquired through recruitment agencies.

At the national level, events are moving in Cosco’s favor. After campaigning against foreign takeovers, Tsipras’s Syriza Party was trounced in elections in early July. Voters wrung out from years of tax increases and belt-tightening voted in the New Democracy Party. Its leader, new Prime Minister Kyriakos Mitsotakis, is a 51-year-old, Harvard-educated former venture capitalist who promises to lure big investors. In a conference about the BRI in Athens weeks before the election, the vice president of New Democracy, Adonis Georgiadis, said the party “welcomes Chinese companies to invest and grow in Greece.”

On a walk through Piraeus, worries about China’s influence seem dwarfed by the towers of containers on the dockside—bulky symbols of the port’s prosperity. Giorgos Gogos, general secretary of the local Dockworkers Union, says the era of strikes and protests is over—for now. That harmony could end if Cosco threatens union workers’ incomes. Still, after a decade of recession and pain, Piraeus’s dockworkers sense the chance for growth—or, at least, stability. “We are tired of struggling all the time,” Gogos says. “We need a period of peace.” For now, that desire for peace seems to outweigh national pride. ■

*Additional reporting by
Pavlos Kapantais*

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LOOK FAMILIAR?
We asked Stephen Bliss, the
illustrator for *Grand Theft
Auto: Vice City* and others,
to imagine the Big Three
cloud CEOs as 1980s
urban crime lords. *Bitchin'.*

BIG TECH'S NEW STREET FIGHT

G/
500



COMPANIES
AMAZON,
MICROSOFT &
GOOGLE

COUNTRY
UNITED STATES

CEOs
JEFF BEZOS,
SATYA NADELLA &
SUNDAR PICHAI

RANKINGS
AMAZON
[NO. 13];
MICROSOFT
[NO. 60];
GOOGLE/
ALPHABET
[NO. 37]

The next frontier for video games is streaming—and it promises to be an all-out brawl among companies with the Internet infrastructure to back it up. At stake? Billions of dollars and the future of a fast-growing industry. What, you thought this was a game?

By JONATHAN VANIAN



WHERE IS JOHN? THAT'S THE QUESTION hanging over you as your team of armored soldiers methodically searches this foreign vessel for a comrade—and war hero—seemingly gone rogue. It's the year 2558; humans are under attack by alien forces. The last thing you need right now is to have one of your trained killers switch sides.

You cautiously step through the cramped corridors of the spaceship. It's dark—distressingly so—but for an eerie blue light emanating from the ship's walls. Your teammates would be in complete silhouette but for the cobalt glints on their weapons. You see shadows you don't recognize and quietly extend your finger toward your rifle's trigger. A sapphire streak ripples across its scope.

But they hear you! The aliens' weapons burst with a kaleidoscope of lethal laser fire that ricochets off the ship's panels. You sidestep in an effort to get a clear shot—if only you had a little more room—but it's too late. Before you can return fire, a well-placed beam sends you to a rainbow-colored grave.

Game over. (Start again?)

For nearly two decades, scenes like this one have unfolded in living rooms across the globe, thanks to Microsoft's long-running video game franchise *Halo*, playable on the tech giant's ever-popular Xbox home console. But the rich gameplay described above, which *Fortune* witnessed during a recent visit to the company's headquarters in Redmond, Wash., needed no brawny consumer electronics to run with the speed and splendor expected of a modern first-person shooter, as such computationally intensive games are known. It required only a smartphone—in this case, paired with a conventional Xbox controller.

Have smartphones become that good? Not quite. But their tremendous proliferation—more than 5 billion people across the globe own mobile phones, according to 2019 Pew estimates, and more than half of those devices are Internet-connected smartphones—has dramatically changed the way media is consumed. Music, portable since the days of Sony's Walkman, is now streamed on the go. Movies and television, once limited to larger fixed screens, are now delivered to people's pockets over the air.

Now video games are preparing to take their turn. If you're not a gamer, you may not realize just how monumental a metamorphosis streaming promises to be. Today's video game industry is a behemoth expected to generate \$152 billion worldwide this year, according to market researcher Newzoo. That's 57% more than the \$97 billion generated by the global theatrical and home-movie market last year, and eight times the \$19.1 billion generated by the global recorded music market. Like those industries, video game makers are grappling with the seemingly boundless potential of streaming, and the race is on to see who gets it right first.

The secret sauce powering all of this media streaming is a technology concept every executive is now familiar with: cloud computing. The off-loading of “compute” to staggeringly large server farms in remote locations, linked to our personal devices with persistent Internet connections, affords each of us on-demand access to supercomputer-level number-crunching power. This capability—plus forecasts that the global gaming industry could reach \$196 billion in annual sales by 2022, per Newzoo—is why Microsoft, a gaming-industry stalwart that also happens to be a leading provider of cloud services, is so intrigued by so-called cloud gaming.

It's also why *Halo 5* on a Samsung Galaxy smartphone can still manage such impressive visual pyrotechnics. The demonstration on view in Redmond is really running on the “racks” in a Microsoft data center in Quincy, Wash., 160 miles away. The Quincy facility is one of 13 the company plans to use to host its ambitious Project Xcloud game-streaming service when it begins a public trial this fall.

The last big breakthrough in gaming came a decade ago, when the birth of the smartphone gave rise to rudimentary but wildly popular mobile-first titles like *Candy Crush* and *Angry Birds*. “Ultimately the appeal of cloud gaming is the same thing,” says Newzoo analyst Tom Wijman. “You can reach all of this audience without them needing to have a high-end gaming PC or expensive console.”

The folks in Redmond are not alone in their interest. Google, which has fervently expanded its cloud division, announced a cloud-



TOM WIJMAN
Senior market analyst, Newzoo

"YOU CAN REACH AN AUDIENCE WITHOUT THEM NEEDING TO HAVE A GAMING PC OR EXPENSIVE CONSOLE."

gaming platform called Stadia that it promises to launch by year's end. Meanwhile, crosstown rival Amazon, the leading cloud-services company by a country mile, is evaluating how to take its viewing platform Twitch, a top destination for people who watch other people play games, to even greater heights. Behind the big boys, a motley crew of lesser challengers—from *Fortune* 500 peers like Apple,

Nvidia, Walmart, and Verizon to gamemakers like Electronic Arts and Valve to startups like Blade and Parsec—are developing or said to be investigating game-streaming subscription services of their own.

But none of them have cloud-computing muscle like the Big Three, which otherwise use their infrastructure to power the software and services they're best known for. Whether Amazon, Google, or Microsoft succeeds in crafting the next great console in the sky is almost immaterial. In any case, they'll all stand to benefit.

S **ATYA NADELLA HAS GROWN USED** to the naysayers. For years, Wall Street analysts questioned why Microsoft, the company famous for its Windows operating system and Office business suite, would waste money on something so seemingly trivial as video games. The calls grew louder when Nadella took the company's helm in July 2014. Still smarting from his predecessor's missteps in mobile devices, Nadella promised to steer Microsoft away

A BATTLE ROYALE TO BELIEVE IN

Analysts agree that the major consumer cloud-computing providers—Amazon, Google, and Microsoft—will become the heavyweights of the nascent cloud-gaming market, thanks to their global data-center footprints. Yet many more companies, including two of the world's biggest, are developing their own game-streaming services. Here's a look at some of the players.

ACTIVISION

The Santa Monica game publisher has yet to sign on to any cloud-gaming services, but it doesn't appear to be far off. "When you own 30 years of IP like we do," CEO Bobby Kotick said on a recent earnings call, "there's probably never been a better time to be in the games business."

APPLE

The tech giant (No. 11 on the Global 500) plans to debut its Apple Arcade in the fall, promising access to 100 games that can be streamed to Apple devices. The company has not revealed how much the service will cost, but it has teased two legendary names in gaming as partners: Sega and Konami.

EA

With much fanfare and minimal detail, Electronic Arts revealed in October that it had assigned more than 1,000 employees to Project Atlas, a forthcoming cloud-gaming platform that promises to marry its Frostbite game engine with artificial intelligence and other cloud services.

NINTENDO

The Japanese gaming legend has toyed with streaming on its Switch device, but that's about it. "We see a future where cloud and streaming technologies will develop more and more as a means of delivering games to consumers," Nintendo president Shuntaro Furukawa said in July.

SONY

The entertainment and electronics conglomerate (No. 116 on the Global 500) offers a streaming service that works for its PlayStation 4 console and PCs, but includes only older video games. A subscription costs \$19.99 a month. It has signed a partnership with Microsoft for cloud gaming.

UBISOFT

The French game developer behind hit franchises like *Assassin's Creed* and *Far Cry* will debut in September its Uplay+ game-streaming service, which will cost \$14.99 a month. The service will work only with Windows PCs, but in 2020, it will be available via Google's Stadia service.

from consumer distractions and toward its highly lucrative business services. Some even urged Microsoft to exit the gaming business altogether. "Four to five years ago, we and others were calling for them to divest that piece of the business," says Daniel Ives, managing director of Wedbush Securities and a longtime Microsoft observer. That tune has changed: Last year, Microsoft's gaming revenue—which includes Xbox, Windows games, and a cut of third-party gaming sales—topped \$10 billion for the first time.

When I ask Nadella why the company didn't drop gaming, he chuckles. "There were a lot of things that a lot of people said Microsoft should be doing," he says. "If I listened to everything that everybody else on the outside asks me to do, there would be very little innovation in this company."

To be fair, in years past, Nadella had been hesitant to call gaming business core to Microsoft's overall strategy. Despite its success, gaming represents about a tenth of Microsoft's annual revenue. Cloud-computing growth is a big reason that the company's market capitalization topped \$1 trillion this year; its "intelligent cloud" unit, which includes its Azure cloud-computing service, generates as much revenue in a quarter as the gaming group generates in a year. (Hasta la vista, *Halo!*)

But what if you could hitch gaming's fortunes to Microsoft's potent cloud engine? Well, now you're talking. Nadella's blockbuster \$2.5 billion acquisition of the enormously popular world-building game *Minecraft* in 2014 was a "bit of a head-scratcher" when it was first announced, says analyst Ives, but it's now clear that the CEO was "planting the seed of how he viewed gaming as part of the broader business." Microsoft wouldn't just retain video games. Much as the company managed with Windows and Office, it would use the flywheel of its cloud-computing infrastructure to dramatically boost the scale of its gaming business—and the fortunes of every video game publisher it works with—far beyond what was previously possible.

Today, gaming is unquestionably "core"; in late 2017, Nadella elevated gaming lead Phil Spencer to the company's executive leadership team to underscore the point. And executives are bullish on the prospects of cloud-driven gameplay. Julia White, who leads product management for Microsoft's cloud platform, estimates that the business of selling Azure services to video



JULIA WHITE
Corporate VP, Microsoft

"GAME DEVELOPERS FACE THE SAME TRIALS AND TRIBULATIONS OF A COMMERCIAL BANK OR A RETAIL COMPANY GOING TO THE CLOUD."

game publishers is worth \$70 billion—about as much as publicly traded transportation darling Uber. Most of today's Internet-connected video games are developed in, and operated from, private data centers run by game publishers, she says. Technology trends in other industries suggest that won't last. "Even though game developers are in a very different business," she says, "they face the same trials and tribulations of a commercial bank or a retail company going to the cloud."

To the cloudmaster go the spoils: In January, the Xbox maker shocked the gaming world by landing longtime console adversary Sony (of PlayStation fame) as an Azure customer with a promise to collaborate on future unspecified gaming projects. It was as if General Motors and Ford had announced a partnership to take on Tesla—an unmistakable sign that the competitive landscape would rapidly and dramatically change.

It was also an indication that Nadella's mission for Microsoft would be more expansive than it originally appeared. When I ask him why Microsoft is working so hard to build a consumer entertainment service

KING OF CONTENT

► Think music and movies are bigger than video games? Think again. Here's a look at how they add up around the globe.

VIDEO GAMES

**\$152.1
BILLION**

The estimated total for global video game sales this year, according to Newzoo, up 9.6% from 2018. [With more than 2.5 billion gamers worldwide, it's no wonder.] Though the home console category is growing the fastest, mobile gaming remains the largest, representing almost half of all global game sales.



MASTER AND CHIEF
Bonnie Ross, head of Microsoft-owned game studio 343 Industries, mugs with a statue of Master Chief, the protagonist of its *Halo* series, at the studio's headquarters in Redmond, Wash.

view that what we can do is unique.”

The problem: so does every other player in this game.

FOR 39,000 VIEWERS tuned into Twitch, Elvis might as well have entered the building. Richard Tyler Blevins, the 28-year-old celebrity “streamer” known to fans by his moniker Ninja, has logged on to the service to play a few public rounds of the popular “battle royale” game *Fortnite* with his buddy. As his avatar runs and leaps through the game’s virtual environment, weapon in hand, Blevins barks commands like an NFL quarterback at the snap—and his Twitch viewers hang on every mundanity. Their comments rush by in the chat window accompanying Ninja’s feed. Some viewers respond to every move Blevins’s character makes (“get that delay ninja”); others practically ignore the show to talk among themselves. (One thread of conversation among many: Why *Finding Nemo* was a “pretty good” Pixar movie.)

In other words, just another day on Twitch. Viewers—overwhelmingly male and mostly 34 or younger—watched a breathtaking 9.36 billion hours of gameplay on the platform last year, according to estimates by production company StreamElements. Twitch launched in 2011 as a spinoff of streaming video site Justin.tv, a pioneer in user-generated content. In 2014, Amazon reportedly spent \$970 million to acquire the site, besting YouTube-owner

Google in a bidding war. Wedbush analyst Michael Pachter estimates that Twitch brought in \$400 million in revenue last year.

Twitch, which is housed in Amazon Web Services, the online retailer’s cloud-computing unit, has rapidly become a cornerstone of the company’s broader video gaming strategy. AWS, as Amazon Web Services is known, is already selling computing

when it has positioned itself as an enterprise software company, he replies, “It’s a bigger business, right? It’s bigger than any other segment. Why would I not do gaming? It fits with what we do. It has connective tissue to the common platform. We have a point of

MOVIES

\$96.8
BILLION

The 2018 total for the combined global theatrical and home entertainment market, according to the Motion Picture Association of America. Revenues are up 9% from the year prior, driven in part by increased digital spending.

MUSIC

\$19.1
BILLION

Total global sales for the recorded music industry in 2018, according to the International Federation of the Phonographic Industry. At 37%, subscription audio streams represent the largest slice of the pie; digital music is now 59% of all sales.

OUTFOX THE WOLVES OF WALL STREET.

BIG TECH'S NEW STREET FIGHT

resources and developer tools to video game publishers. It's also rumored to be working on a service that would allow it to stream video games themselves rather than merely video of people playing them. (The company declined to comment, though recent job listings for technical roles for "an unannounced AAA games business" suggest its intentions. Like minor league baseball, "AAA" denotes the highest level of play in terms of budget and production.)

Two major milestones in the gaming industry set the stage for a cloudy future. The first: The massive success of Epic Games' *Fortnite*, which brought in an estimated \$2.4 billion in sales last year and now claims 250 million registered players. *Fortnite* demonstrated that "cross-platform" games, playable across competing devices from Microsoft, Sony, Apple, and others, could amass audiences far larger than those of the previous era, when titles were limited to specific ecosystems. "*Fortnite* was critical in getting the message across to all platforms that they have to lower the barrier of entry to their respective walled gardens," says Joost van Dreunen, head of games for market researcher SuperData.

The second? Twitch. The service demonstrated that people were just as happy to watch and cheer people playing games—call it the kid-sibling phenomenon—as they were to play the games themselves. That kind of interactivity proved that engagement and gameplay were not one and the same. The dynamic expands the addressable viewership for a given title. "Viewing is eclipsing gaming, and a lot of youth of today would say they played the game when they really viewed the

game," says Bonnie Ross, head of 343 Industries, the Microsoft studio that develops *Halo*.

For Microsoft's part, the company never saw the spectatorship aspect coming. "Amazon has Microsoft on a treadmill," a former executive says. Two years after Amazon bought Twitch, Microsoft acquired competing service Beam for an undisclosed amount. Rechristened Mixer, it has become the means by which Xbox customers can watch one another play games, logging 39.6 million hours of viewing in 2018, per StreamElements—a whopping 179% more than the previous year but still a distant third to Amazon's Twitch and Google's YouTube Live.

T HE SUMMER SUN blazes above the thousands of coders assembled for Google's annual I/O developer conference in Mountain View, Calif., but the anxiety on display in the long line has little to do with the weather. The event's attendees, who base their livelihoods on building software for as many users as possible, are keen to hear Google's sales pitch for why they should create games for Stadia, an experimental cloud-gaming service that the search giant promises to debut in November.

Like most Silicon Valley presentations, the executives onstage overwhelm with ambitious assurances of technical prowess. Stadia's complex cloud architecture will prevent the nasty networking hiccups that cause online gamers to throw down their controllers in frustration, Google's representatives say. All gamers will need to do is open a tab in the Chrome web browser; with just a few

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ROCK AND ROLL

Frames from *Halo Infinite*, the forthcoming edition of the sci-fi game series, and *Forza Horizon 4*, a popular car-racing series. Both are published by Microsoft.

clicks, they can play a high-speed, high-resolution title such as *Assassin's Creed Odyssey*.

Like their counterparts at Microsoft and Amazon, Google brass believe their vast data center empire gives them an edge on the technical demands of streaming high-end video game titles without interruption. Like its peers, Google has encouraged its consumer gaming and enterprise cloud groups to work together to ensure Stadia launches without the problems that have traditionally plagued online games.

Thomas Kurian, a longtime Oracle executive who is now chief executive of Google's cloud business, says the company's enterprise engineers built the networking technology that powers Stadia. Cloud gaming is a way for Google to penetrate a multibillion-dollar industry,

Kurian says. "Our hope is that it's expanding the market, not just being a replacement market," he says. "For every person in the world that games on a professional desktop, there are probably three who can't afford one."

In other words: Why fight over a quarter of the market when the rest is greenfield? John Justice, a Microsoft veteran who now leads product development for Google Stadia, agrees. Gamers no longer want to "buy an expensive box every few years," he says. Stadia, and services like it, are more accessible destinations to engage with games without the high barriers of entry found in the traditional console market.

Even the pricing plays a part: Though Stadia's \$129 bundle plus \$9.99 monthly subscription has already been announced, Google says it is also evaluating

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BIG TECH'S NEW STREET FIGHT

a free version, with lower-quality graphics, that would debut later. Though the technological trajectory is clear, it's still "early days" for the business model behind cloud gaming, Justice says. "Some people really do want transaction models, and some people want subscription models," he says. "I don't think we will say we will only go with one."

It could take years to iron out the details. Though consumers would love a gaming model akin to Netflix or Spotify—pay a monthly fee, play titles to your heart's content—it's not yet clear that cloud providers have the leverage over game publishers to make that happen. Publishers have seen how platform pressures have changed the business of movies, music, magazines, and more. They don't want to give up a share of their sales unless they're certain that there are many more to be had in the long run.

Ubisoft, the French publisher best known for the *Assassin's Creed* series, isn't terribly concerned. "That's less interesting to us," says Chris Early, an Ubisoft executive who manages partnerships and revenue. The company in June revealed its own subscription service, called Uplay+, that is playable on personal computers and spans more than 100 titles in its own catalog, including *Far Cry* and *Prince of Persia*. It costs \$14.99 a month and will also be available on Stadia next year. At this moment, "it makes less sense for a publisher to be part of an aggregated subscription model," says Early. There are many proposals for how to sustainably monetize cloud gaming, he adds, but it remains unclear "who is going to pay whom."

For now, publishers are fo-

cused on figuring out whether today's successful titles make sense in the cloud—or whether all-new titles, native to the format, will replace familiar franchises. The interactivity of Twitch and the novelty of so-called freemium mobile games, like *Candy Crush*, showed that technological leaps could open new paths to gaming engagement. The possibilities that could emerge from running games on the same infrastructure that supports today's artificial intelligence are something that technologists can only fathom.

"There will probably be evolutions of game design that we can't even imagine yet," says Early, "and they're going to take advantage of the increase of cloud compute."

BACK IN Redmond, I stop by Microsoft's 343 Industries game studio, where employees welcome me to a visitor center—a shrine, really—celebrating the company's *Halo* franchise, which has racked up \$6 billion in sales since its debut. Statues depicting its heroes and villains tower over my head—a gallery of Greek gods, so to speak, for the gaming set. There are glass museum cases everywhere packed with memorabilia. On one wall is a rack of replicas of the virtual weaponry from the game, as intimidating in person as they appear on the screen. Bright orange tags with the word "prop" hang from their triggers in case someone takes the "incineration cannon" a little too seriously.

Founded in 2007 and named after a *Halo* character, 343 Industries is one of the older members of the Microsoft game portfolio. Last year alone, Microsoft

acquired six game studios; at this year's E3 industry confab, the company announced that it had picked up one more. Today, its Xbox Game Studios division is a federation of 15 semiautonomous studios that the company believes will be a key asset in the cloud-gaming wars—particularly against Amazon and Google, which lack strong titles of their own.

Not everyone sees it that way. Though Microsoft has won plaudits for successive editions of *Halo* and the *Forza* car-racing series, analysts have pointed to the titles' relative age—*Halo* debuted in 2001; *Forza* first appeared four years later—as evidence that Microsoft's homegrown studios have run out of ideas. "We have work to do there," acknowledged Spencer, the Microsoft gaming chief. "We haven't done our best work over the last few years with our first-party output."

That must change if Microsoft, the only video game veteran among the Big Three consumer cloud companies, hopes to maintain its natural advantage against Amazon and Google. After all, in video games, as in other parts of the media industry, content is king—which is why Microsoft's rivals have moved to hire gaming veterans from top shops such as Electronic Arts (*Madden NFL*, *Need for Speed*) and 2K Games (*Civilization*, *NBA 2K20*) in an effort to build their own franchises. It is an uncanny echo of the moves by Amazon and Google to build their own premium programming, for Prime and YouTube, respectively, to compete with Netflix.

But Rome wasn't built in a day. Seven years after establishing a gaming group in 2012, Amazon laid off dozens of game developers as it reorganized itself for a

cloud-based future. (Amazon downplayed the news. "Amazon is deeply committed to games and continues to invest heavily in Amazon Game Studios, Twitch, Twitch Prime, AWS, our retail businesses, and other areas within Amazon," a spokesperson tells *Fortune*.)

Van Dreunen, the SuperData analyst, believes it will take up to five years before cloud-driven efforts by the Big Three will significantly affect the traditional gaming industry. Until then, look for cloud computing's leaders to continue investing in their data center infrastructure to support the "gradual rollout" of cloud-gaming services, he says.

Why would Amazon, Google, and Microsoft make so much noise about a future that's so far away? It's all a part of the "land and expand" business model familiar to the technology industry, says analyst Pachter: Give a speech, plant a flag, hope that early momentum snowballs into an insurmountable competitive advantage. After all, "Facebook wasn't a billion-dollar idea until it was," he says. "Uber wasn't a billion-dollar idea until it was."

Microsoft, in particular, has no intention of missing out. The company still regrets losing the mobile war to Google and its Android operating system. (Microsoft "missed being the dominant mobile operating system by a very tiny amount," cofounder Bill Gates lamented earlier this year.) To underperform in an area where it has a head start of almost two decades would be, in a word, unconscionable.

Time to suit up, then. "We're in gaming for gaming's sake," Nadella says. "It's not a means to some other end." ■

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THE LIST

For the sixth consecutive year, mega-retailer **Walmart** topped *Fortune's* annual list of the world's biggest companies ranked by revenue. [See page F12 for the full methodology.] While the top 20 was relatively stable, there was plenty of motion elsewhere. Chinese Internet giants **Alibaba** [up 118 spots to

RANK 2018	2017	Company	Country	REVENUES		PROFITS		ASSETS		EMPLOYEES		
				\$ millions	% change from 2017	\$ millions	Rank	% change from 2017	\$ millions	Rank	Number	Rank
1	1	WALMART ¹	U.S.	514,405.0	-2.8	6,670.0	92	[32.4]	219,295.0	124	2,200,000	1
2	3	SINOPEC GROUP ²	CHINA	414,649.9 ²	26.8	5,845.0	102	280.1	329,186.3	87	619,151	8
3	5	ROYAL DUTCH SHELL ^{1,2}	NETHERLANDS	396,556.0 ²	27.2	23,352.0	11	79.9	399,194.0	76	81,000	292
4	4	CHINA NATIONAL PETROLEUM ²	CHINA	392,976.6 ^{2*}	20.5	2,270.5	252	-	601,899.9	56	1,382,401	2
5	2	STATE GRID ²	CHINA	387,056.0	10.9	8,174.8	75	[14.3]	572,309.5	62	917,717	4
6	•	SAUDI ARAMCO ^{2,3}	SAUDI ARABIA	355,905.0	35.3	110,974.5	1	46.9	358,872.9	82	76,418	301
7	8	BP ¹	BRITAIN	303,738.0 ²	24.2	9,383.0	58	176.9	282,176.0	98	73,000	310
8	9	EXXON MOBIL	U.S.	290,212.0 ²	18.8	20,840.0	16	5.7	346,196.0	83	71,000	313
9	7	VOLKSWAGEN ¹	GERMANY	278,341.5	7.0	14,322.5	27	9.3	523,672.3	67	664,496	6
10	6	TOYOTA MOTOR ^{2,3}	JAPAN	272,612.0	2.8	16,982.0	19	[24.6]	469,295.6	71	370,870	31
11	11	APPLE ⁴	U.S.	265,595.0	15.9	59,531.0	2	23.1	365,725.0	80	132,000	171
12	10	BERKSHIRE HATHAWAY	U.S.	247,837.0	2.4	4,021.0	156	[91.1]	707,794.0	49	389,000	25
13	18	AMAZON.COM	U.S.	232,887.0	30.9	10,073.0	54	232.1	162,648.0	151	647,500	7
14	15	UNITEDHEALTH GROUP	U.S.	226,247.0	12.5	11,986.0	40	13.5	152,221.0	164	300,000	50
15	12	SAMSUNG ELECTRONICS ¹	SOUTH KOREA	221,579.4	4.5	39,895.2	4	9.1	304,165.3	95	309,630	44
16	14	GLENCORE ^{1,5}	SWITZERLAND	219,754.0	6.9	3,408.0	185	[41.0]	128,672.0	186	85,504	278
17	13	MCKESSON ³	U.S.	214,319.0	2.9	34.0	465	[49.3]	59,672.0	298	70,000	316
18	16	DAIMLER ¹	GERMANY	197,515.3	6.6	8,555.0	71	[27.9]	321,890.5	91	298,683	53
19	17	CVS HEALTH ²	U.S.	194,579.0	5.3	[594.0]	486	[109.0]	196,456.0	134	295,000	56
20	28	TOTAL ¹	FRANCE	184,106.0 ²	23.5	11,446.0	45	32.6	256,762.0	108	104,460	226
21	23	CHINA STATE CONSTRUCTION ENGINEERING ²	CHINA	181,524.5	16.3	3,159.5	193	18.1	272,768.8	100	302,827	49
22	32	TRAFIGURA GROUP ^{1,4}	SINGAPORE	180,744.1	32.5	849.2	371	0.2	53,801.0	318	4,316	496
23	24	HON HAI PRECISION INDUSTRY ¹	TAIWAN	175,617.0	13.5	4,281.6	148	[6.1]	110,012.9	209	667,680	5
24	19	EXOR GROUP ¹	NETHERLANDS	175,009.5 ⁴	8.2	1,589.7	308	1.3	190,052.3	136	314,790	42
25	20	AT&T ⁷	U.S.	170,756.0	6.4	19,370.0	17	[34.2]	531,864.0	66	268,220	66
26	26	INDUSTRIAL & COMMERCIAL BANK OF CHINA ^{1,2}	CHINA	168,979.0	10.4	45,002.3	3	6.3	4,034,481.6	1	449,296	19
27	25	AMERISOURCEBERGEN ⁴	U.S.	167,939.6	9.7	1,658.4	302	355.0	37,669.8	395	20,500	454
28	33	CHEVRON	U.S.	166,339.0 ²	23.6	14,824.0	26	61.2	253,863.0	112	48,600	370
29	29	PING AN INSURANCE ¹	CHINA	163,597.4	13.5	16,237.2	22	23.2	1,040,383.4	27	376,900	29
30	22	FORD MOTOR	U.S.	160,338.0	2.3	3,677.0	174	[51.6]	256,540.0	109	199,000	101
31	31	CHINA CONSTRUCTION BANK ^{1,2}	CHINA	151,110.8	9.0	38,498.4	5	7.4	3,382,421.7	3	366,996	32
32	21	GENERAL MOTORS	U.S.	147,049.0	[6.5]	8,014.0	77	-	227,339.0	121	173,000	125
33	129	MITSUBISHI ^{1,3}	JAPAN	145,243.3	112.7	5,328.0	116	5.4	149,388.3	168	79,994	295
34	30	HONDA MOTOR ^{1,3}	JAPAN	143,302.9	3.4	5,504.6	113	[42.4]	184,504.6	144	219,722	82
35	35	COSTCO WHOLESALE ²	U.S.	141,576.0	9.7	3,134.0	194	17.0	40,830.0	374	194,000	111
36	40	AGRICULTURAL BANK OF CHINA ^{1,2}	CHINA	139,523.6	14.0	30,656.5	8	7.4	3,293,105.0	4	477,526	13
37	52	ALPHABET	U.S.	136,819.0	23.4	30,736.0	7	142.7	232,792.0	118	98,771	242
38	34	CARDINAL HEALTH ³	U.S.	136,809.0	5.3	256.0	437	[80.1]	39,951.0	379	50,200	364
39	36	SAIC MOTOR ²	CHINA	136,392.5	5.9	5,443.8	114	6.9	114,011.7	203	147,738	145
40	43	WALGREENS BOOTS ALLIANCE ²	U.S.	131,537.0	11.3	5,024.0	127	23.2	68,124.0	273	299,000	52
41	47	JPMORGAN CHASE & CO.	U.S.	131,412.0	15.4	32,474.0	6	32.9	2,622,532.0	7	256,105	71
42	49	GAZPROM ^{1,2}	RUSSIA	131,302.0 ²	17.3	23,199.1	12	89.4	300,354.8	96	466,100	15
43	37	VERIZON COMMUNICATIONS	U.S.	130,863.0	3.8	15,528.0	24	[48.4]	264,829.0	104	144,500	150
44	46	BANK OF CHINA ^{1,2}	CHINA	127,714.1	10.6	27,225.2	10	6.7	3,097,612.0	5	310,119	43
45	38	ALLIANZ ¹	GERMANY	126,799.6	2.6	8,806.4	65	14.8	1,025,919.1	28	142,460	152
46	27	AXA ¹	FRANCE	125,578.2	[16.0]	2,525.6	232	[63.9]	1,063,784.4	26	104,065	230
47	39	KROGER ²	U.S.	121,162.0	[1.2]	3,110.0	196	63.1	38,118.0	392	453,000	18
48	41	GENERAL ELECTRIC	U.S.	120,268.0 ¹	[1.6]	[22,355.0]	500	--	309,129.0	93	283,000	61
49	48	FANNIE MAE ¹⁰	U.S.	120,101.0	6.9	15,959.0	23	547.9	3,418,318.0	2	7,400	487
50	63	LUKOIL ¹	RUSSIA	119,145.0 ²	26.9	9,863.7	55	37.3	82,734.8	245	102,500	234

DEFINITIONS, EXPLANATIONS, AND FOOTNOTES ARE ON PAGE F12.

No. 182) and **Tencent** (up 94 spots to No. 237) continued their stratospheric ascents, while Japanese industrial titan **Mitsubishi** rejoined the top 50 for the first time since 2003. Mergers, meanwhile, knocked several familiar U.S. brands off the list, including insurer **Aetna** and media conglomerate **Time Warner**.

RANK 2018	2017	Company	Country	REVENUES		PROFITS			ASSETS		EMPLOYEES	
				\$ millions	% change from 2017	\$ millions	Rank	% change from 2017	\$ millions	Rank	Number	Rank
51	42	CHINA LIFE INSURANCE ⁶	CHINA	116,171.5	(3.4)	(2,566.9)	493	(1,063.1)	580,331.6	61	175,077	122
52	45	JAPAN POST HOLDINGS ^{6,9}	JAPAN	115,220.5	(1.2)	4,324.0	147	4.0	2,585,802.0	8	245,922	73
53	51	BMW GROUP ¹	GERMANY	115,042.8	3.4	8,399.3	73	(13.6)	238,864.1	115	134,682	166
54	67	PHILLIPS 66	U.S.	114,217.0 ^E	24.7	5,595.0	110	9.6	54,302.0	314	14,200	469
55	56	CHINA RAILWAY ENGINEERING GROUP ⁶	CHINA	112,132.7	9.1	1,240.9	336	6.1	137,914.2	176	307,992	47
56	53	CHINA MOBILE COMMUNICATIONS ⁶	CHINA	112,096.0	1.8	11,745.3	43	7.4	255,216.6	111	462,046	16
57	74	VALERO ENERGY	U.S.	111,407.0 ^E	26.0	3,122.0	195	(23.2)	50,155.0	329	10,261	483
58	60	BANK OF AMERICA CORP.	U.S.	110,584.0	10.3	28,147.0	9	54.4	2,354,507.0	11	204,489	92
59	58	CHINA RAILWAY CONSTRUCTION ⁶	CHINA	110,455.9	9.5	1,186.9	340	(9.3)	134,180.2	180	356,326	37
60	71	MICROSOFT ⁹	U.S.	110,360.0	22.7	16,571.0	21	(21.8)	258,848.0	107	131,000	175
61	72	HUAWEI INVESTMENT & HOLDING ¹	CHINA	109,030.4	22.1	8,953.9	63	27.5	96,973.7	223	188,000	112
62	57	HOME DEPOT ¹	U.S.	108,203.0	7.2	11,121.0	48	28.8	44,003.0	361	413,000	22
63	87	CHINA NATIONAL OFFSHORE OIL ⁶	CHINA	108,130.4	32.7	7,331.1	83	142.9	177,193.6	145	93,601	255
64	55	NIPPON TELEGRAPH AND TELEPHONE ^{1,3}	JAPAN	107,146.9	0.6	7,707.5	80	(6.1)	201,456.1	132	303,351	48
65	204	ITOCHU ^{1,3}	JAPAN	104,627.3	110.4	4,514.3	143	24.9	91,250.6	231	139,157	156
66	54	NISSAN MOTOR ³	JAPAN	104,390.6	(3.2)	2,878.4	207	(57.3)	171,251.0	147	148,513	144
67	•	CHINA DEVELOPMENT BANK ^{1,6}	CHINA	103,072.9	28.3	16,744.3	20	0.7	2,356,616.2	10	9,507	485
68	64	BOEING	U.S.	101,127.0	8.3	10,460.0	51	27.6	117,359.0	200	153,000	141
69	62	WELLS FARGO	U.S.	101,060.0	3.4	22,393.0	13	0.9	1,895,883.0	15	258,700	69
70	66	SIEMENS ^{1,4}	GERMANY	98,802.0	7.9	6,908.9	88	3.6	161,335.9	153	379,000	28
71	76	CITIGROUP	U.S.	97,120.0	10.4	18,045.0	18	-	1,917,383.0	14	204,000	93
72	131	MARATHON PETROLEUM ¹¹	U.S.	97,102.0 ^E	43.6	2,780.0	213	(19.0)	92,940.0	228	60,350	337
73	84	SK HOLDINGS ¹	SOUTH KOREA	95,904.5 ^E	14.8	2,048.0	270	38.0	107,069.1	214	104,374	227
74	73	PETROBRAS ^{1,6}	BRAZIL	95,584.0 ^E	7.6	7,173.0	85	-	222,068.0	123	63,361	333
75	80	COMCAST	U.S.	94,507.0	11.8	11,731.0	44	(48.4)	251,684.0	113	184,000	115
76	69	NESTLÉ ¹	SWITZERLAND	93,512.5	2.5	10,364.8	53	42.0	139,045.1	174	308,000	45
77	75	BOSCH GROUP ¹	GERMANY	92,601.9	5.2	3,596.0	176	15.9	95,616.5	225	409,881	23
78	88	UNIPER ¹	GERMANY	92,260.8	13.3	(533.4)	485	-	57,841.5	303	11,828	477
79	70	ANTHEM	U.S.	92,105.0	2.3	3,750.0	168	(2.4)	71,571.0	263	63,900	331
80	86	CHINA RESOURCES ⁶	CHINA	91,986.0	11.9	3,474.6	183	10.2	209,651.5	126	421,274	21
81	68	CARREFOUR ¹	FRANCE	91,955.2	0.7	(862.1)	487	-	54,153.1	315	363,862	34
82	65	DONGFENG MOTOR ⁶	CHINA	90,934.2	(2.5)	1,599.7	307	14.3	66,397.1	281	167,528	130
83	89	ENI ¹	ITALY	90,799.8 ^E	13.5	4,869.4	129	28.0	135,300.3	178	31,701	425
84	93	DELL TECHNOLOGIES ¹	U.S.	90,621.0	15.2	(2,310.0)	492	-	111,820.0	207	157,000	137
85	77	BANCO SANTANDER ¹	SPAIN	90,531.9	3.6	9,217.1	60	23.5	1,667,946.8	19	194,015	110
86	115	ROSNEFT OIL ^{1,6}	RUSSIA	90,055.0 ^E	25.0	8,745.8	69	129.7	189,980.1	137	308,000	45
87	125	CHINA FAW GROUP ⁶	CHINA	89,804.7	29.2	2,660.3	222	(6.8)	66,682.9	280	142,451	153
88	98	SINOCHEM GROUP ⁶	CHINA	89,358.1	16.4	701.4	381	(6.9)	71,332.7	266	66,713	324
89	83	ENEL ¹	ITALY	89,305.7	6.1	5,651.8	108	32.7	189,079.6	139	69,272	318
90	81	DEUTSCHE TELEKOM ¹	GERMANY	89,286.8	5.7	2,556.2	228	(34.5)	166,163.6	149	215,675	87
91	82	CRÉDIT AGRICOLE ¹	FRANCE	88,325.0	4.9	5,192.7	121	26.2	1,856,682.3	16	73,346	308
92	59	ASSICURAZIONI GENERALI ¹	ITALY	88,157.4	(12.3)	2,725.0	219	14.6	589,590.3	58	70,734	314
93	91	CHINA COMMUNICATIONS CONSTRUCTION ⁶	CHINA	88,140.9	11.0	1,585.2	310	2.6	198,943.7	133	178,572	121
94	78	HYUNDAI MOTOR ¹	SOUTH KOREA	87,999.2	3.2	1,370.8	330	(61.6)	161,921.4	152	122,217	194
95	107	PEMEX ^{1,6}	MEXICO	87,403.3	18.4	(9,377.9)	498	-	105,384.4	215	131,108	174
96	108	PEUGEOT ¹	FRANCE	87,364.3	18.9	3,336.3	190	53.4	70,811.1	267	216,539	86
97	96	PACIFIC CONSTRUCTION GROUP	CHINA	86,622.6	12.2	3,390.9	187	7.9	58,175.0	301	387,525	26
98	85	SOFTBANK GROUP ^{1,3}	JAPAN	86,604.7	4.8	12,727.9	34	35.7	326,163.2	89	76,866	300
99	90	HSBC HOLDINGS ¹	BRITAIN	86,131.0	8.2	13,727.0	30	27.1	2,558,124.0	9	235,217	77
100	147	DUPONT ¹²	U.S.	85,977.0	37.2	3,844.0	163	163.3	188,030.0	141	98,000	245

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RANK 2018	RANK 2017	Company	Country	REVENUES		PROFITS			ASSETS		EMPLOYEES	
				\$ millions	% change from 2017	\$ millions	Rank	% change from 2017	\$ millions	Rank	Number	Rank
101	113	CHINA POST GROUP ⁶	CHINA	85,627.9	18.6	4,133.6	152	[16.7]	1,429,122.3	24	935,191	3
102	79	HITACHI ^{1,3}	JAPAN	85,507.8	1.1	2,007.2	276	[38.7]	86,984.7	238	295,941	55
103	102	TESCO ^{1,3,9}	BRITAIN	84,270.6	11.8	1,743.1	293	10.2	65,227.6	285	321,490	40
104	44	BNP PARIBAS ¹	FRANCE	83,973.7	[28.5]	8,881.9	64	1.6	2,332,675.5	12	197,162	104
105	99	JXTC HOLDINGS ^{1,3}	JAPAN	82,733.3 ^c	8.0	2,907.1	205	[11.0]	76,604.4	253	40,695	396
106	148	RELIANCE INDUSTRIES ¹	INDIA	82,331.2 ^e	32.1	5,660.8	106	1.2	144,715.2	171	194,056	109
107	101	CHINA ENERGY INVESTMENT ⁶	CHINA	81,977.7	8.5	3,531.4	181	41.5	259,644.4	105	336,472	39
108	95	STATE FARM INSURANCE COS.	U.S.	81,732.2	4.3	8,788.4	66	298.3	272,518.4	101	56,788	352
109	100	JOHNSON & JOHNSON	U.S.	81,581.0	6.7	15,297.0	25	1,076.7	152,954.0	163	135,100	164
110	94	ELECTRICITÉ DE FRANCE ^{1,9}	FRANCE	81,403.3	3.7	1,389.1	329	[61.2]	323,662.2	90	165,790	131
111	110	CHINA SOUTHERN POWER GRID ⁶	CHINA	80,963.6	11.2	1,782.4	291	[8.0]	118,705.6	196	289,735	58
112	109	CHINA MINMETALS ⁶	CHINA	80,076.4	9.7	[373.6]	482	-	130,626.8	183	199,442	100
113	150	EQUINOR ^{1,6}	NORWAY	79,593.0 ^e	30.1	7,535.0	82	64.2	112,508.0	204	20,525	453
114	92	INTERNATIONAL BUSINESS MACHINES	U.S.	79,591.0	0.6	8,728.0	70	51.7	123,382.0	191	381,100	27
115	112	BASF ¹	GERMANY	78,798.7 ^a	8.4	5,555.1	112	[18.9]	98,933.5	220	122,404	193
116	97	SONY ^{3,9}	JAPAN	78,157.7	1.4	8,264.0	74	86.6	189,586.9	138	114,400	209
117	137	INDIAN OIL ^{6,9}	INDIA	77,587.0 ^e	17.7	2,484.7	236	[27.8]	48,385.6	339	35,442	406
118	103	AEON ^{1,3}	JAPAN	77,122.5	2.4	214.0	443	[2.8]	90,293.6	234	288,326	59
119	111	AMER INTERNATIONAL GROUP	CHINA	76,363.1	4.9	1,483.0	324	[4.1]	21,240.6	451	16,901	463
120	127	ARCELDORMITTAL ¹	LUXEMBOURG	76,033.0	10.7	5,149.0	122	12.7	91,249.0	232	208,583	90
121	117	PEOPLE'S INSURANCE CO. OF CHINA ^{1,6}	CHINA	75,377.3	5.3	1,952.0	281	[18.1]	150,259.3	167	198,457	103
122	116	TARGET ¹	U.S.	75,356.0	4.8	2,937.0	203	0.1	41,290.0	371	360,000	35
123	105	AIRBUS ¹	NETHERLANDS	75,185.0	[0.1]	3,604.2	175	11.3	131,671.3	181	133,671	167
124	119	DEUTSCHE POST DHL GROUP ¹	GERMANY	75,000.9	6.3	2,448.8	239	[19.9]	57,687.2	306	499,018	12
125	126	NIPPON LIFE INSURANCE ³	JAPAN	74,202.3	8.0	2,514.5	234	14.2	712,112.7	48	89,198	268
126	104	ENGIE ¹	FRANCE	74,144.1 ^a	[1.5]	1,219.1	338	[24.0]	175,681.4	146	160,301	135
127	118	ROYAL AHOLD DELHAIZE ¹	NETHERLANDS	74,103.9	4.5	2,116.0	264	3.3	38,097.3	393	225,000	81
128	106	FREDDIE MAC ^{1,9}	U.S.	73,598.0	[1.4]	9,235.0	59	64.2	2,063,060.0	13	6,621	489
129	124	BEIJING AUTOMOTIVE GROUP ⁶	CHINA	72,677.4	4.4	1,097.7	349	[29.4]	66,789.5	279	127,163	186
130	163	PTT ⁶	THAILAND	72,307.2	22.9	3,704.4	172	[7.0]	72,348.4	262	26,613	441
131	114	PANASONIC ^{1,3}	JAPAN	72,178.4	0.2	2,562.8	227	20.3	54,341.1	313	271,869	64
132	138	UNITED PARCEL SERVICE	U.S.	71,861.0	9.1	4,791.0	133	[2.4]	50,016.0	330	364,575	33
133	128	LOWE'S ¹	U.S.	71,309.0	3.9	2,314.0	246	[32.9]	34,508.0	406	245,000	74
134	122	COFCO ⁶	CHINA	71,223.3	2.2	337.8	425	[14.2]	81,657.4	247	117,842	202
135	146	INTEL	U.S.	70,848.0	12.9	21,053.0	15	119.3	127,963.0	187	107,400	219
136	123	U.S. POSTAL SERVICE ^{6,9}	U.S.	70,660.0	1.5	[3,913.0]	495	-	26,688.0	433	565,802	10
137	149	CITIC GROUP ⁶	CHINA	70,659.0	15.2	4,566.0	139	41.6	986,297.0	33	287,500	60
138	230	CHINA EVERGRANDE GROUP ^{1,16}	CHINA	70,478.9	53.2	5,652.6	107	56.8	273,829.0	99	131,694	172
139	181	JD.COM ^{6,19}	CHINA	69,847.6	29.4	[376.7]	483	-	30,465.2	419	178,927	120
140	140	CHINA NORTH INDUSTRIES GROUP ⁶	CHINA	68,777.7	6.4	966.4	359	12.7	57,675.4	307	210,507	89
141	141	CHINA TELECOMMUNICATIONS ⁶	CHINA	68,709.5	7.4	1,664.6	301	[8.5]	122,945.9	192	403,014	24
142	136	METLIFE	U.S.	67,941.0	2.7	5,123.0	123	27.8	687,538.0	51	48,000	372
143	134	RENAULT ¹	FRANCE	67,764.1	2.3	3,896.9	162	[32.4]	131,440.4	182	183,002	116
144	167	CHEMCHINA ⁶	CHINA	67,397.5	16.2	[2,207.6]	491	-	116,353.6	201	138,652	157
145	120	MUNICH RE GROUP ¹	GERMANY	67,225.9	[4.2]	2,726.2	218	544.9	308,802.0	94	41,410	393
146	135	PROCTER & GAMBLE ⁹	U.S.	66,832.0	0.9	9,750.0	56	[36.4]	118,310.0	197	92,000	262
147	130	MARUBENI ^{1,9}	JAPAN	66,753.5	[1.9]	2,082.5	266	9.2	61,526.0	292	46,711	376
148	159	UNITED TECHNOLOGIES	U.S.	66,501.0	11.1	5,269.0	119	15.8	134,211.0	179	240,200	76
149	162	CHINA BAOWU STEEL GROUP ⁶	CHINA	66,310.0	12.5	2,168.2	258	721.3	103,676.1	218	161,399	133
150	168	BANK OF COMMUNICATIONS ¹	CHINA	65,644.8	13.7	11,131.3	47	7.1	1,388,230.0	25	92,714	257

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RANK 2018	2017	Company	Country	REVENUES		PROFITS			ASSETS		EMPLOYEES	
				\$ millions	% change from 2017	\$ millions	Rank	% change from 2017	\$ millions	Rank	Number	Rank
151	161	AVIATION INDUSTRY CORP. OF CHINA ⁶	CHINA	65,534.4	10.6	695.0	382	91.4	138,082.7	175	446,613	20
152	155	FEDEX ¹⁵	U.S.	65,450.0	8.5	4,572.0	138	52.6	52,330.0	321	359,530	36
153	145	DAI-ICHI LIFE HOLDINGS ³	JAPAN	64,794.9	2.0	2,029.6	272	[38.2]	505,478.1	68	62,938	334
154	144	PEPSICO	U.S.	64,661.0	1.8	12,515.0	37	157.7	77,648.0	251	267,000	67
155	152	ARCHER DANIELS MIDLAND	U.S.	64,341.0	5.8	1,810.0	288	13.5	40,833.0	373	31,600	426
156	160	PRUDENTIAL FINANCIAL	U.S.	62,992.0	5.5	4,074.0	153	(48.2)	815,078.0	43	50,492	363
157	246	mitsui ¹³	JAPAN	62,751.4	42.1	3,735.9	169	[1.1]	107,940.5	213	43,993	384
158	191	PETRONAS ¹⁶	MALAYSIA	62,230.6 ⁶	19.6	11,868.3	42	35.5	154,071.2	161	48,001	371
159	179	SEVEN & I HOLDINGS ¹³	JAPAN	61,486.5	13.4	1,838.0	287	13.0	52,069.2	323	58,165	347
160	197	DIL & NATURAL GAS ^{6,3}	INDIA	61,420.4 ⁶	19.9	4,360.6	146	27.2	71,563.4	264	43,743	385
161	182	POWERCHINA ⁶	CHINA	61,224.0	13.7	803.8	375	[15.1]	123,815.2	190	185,269	114
162	165	TOYOTA TSUSHO ^{1,9}	JAPAN	60,894.3	4.1	1,196.1	339	1.8	40,132.5	378	58,565	344
163	169	ROCHE GROUP ¹	SWITZERLAND	60,846.2	7.4	10,738.1	50	22.4	79,680.3	248	94,442	253
164	156	AUCHAN HOLDING ¹	FRANCE	60,749.2 ¹	1.2	[1,351.3]	490	[535.9]	41,073.7	372	340,577	38
165	157	ALBERTSONS COS. ¹³	U.S.	60,534.5	1.0	131.1	452	183.2	20,776.6	454	267,000	67
166	177	MITSUBISHI UFJ FINANCIAL GROUP ³	JAPAN	60,405.3	10.3	7,871.0	79	[11.9]	2,811,411.4	6	119,390	200
167	153	UNILEVER ¹	BRITAIN/NETH.	60,167.3	[0.6]	11,080.6	49	62.4	67,958.2	275	154,848	140
168	210	CENTENE	U.S.	60,116.0	23.8	900.0	365	8.7	30,901.0	415	47,300	375
169	194	SINOPHARM ⁶	CHINA	59,980.2	15.7	884.4	367	28.2	49,823.4	332	128,600	185
170	176	WALT DISNEY ^{6,18}	U.S.	59,434.0	7.8	12,598.0	36	40.3	98,598.0	221	201,000	97
171	184	POSCO ¹	SOUTH KOREA	59,223.2	11.2	1,556.1	314	[36.2]	70,607.7	268	33,784	414
172	174	SYSCO ⁹	U.S.	58,727.3	6.1	1,430.8	327	25.2	18,070.4	464	67,000	321
173	190	HP ¹⁷	U.S.	58,472.0	12.3	5,327.0	117	110.9	34,622.0	405	55,000	356
174	121	SOCIÉTÉ GÉNÉRALE ¹	FRANCE	58,390.0	[16.5]	4,560.2	140	44.2	1,496,676.2	21	140,250	155
175	253	PERTAMINA ⁶	INDONESIA	57,933.6 ⁶	34.9	2,526.8	231	[0.5]	64,718.5	287	31,569	427
176	164	TELEFÓNICA ¹	SPAIN	57,465.9	[2.0]	3,931.1	161	11.3	130,355.7	184	120,138	197
177	353	COUNTRY GARDEN HOLDINGS ^{1,14}	CHINA	57,308.7	70.7	5,233.5	120	35.7	237,367.5	117	131,387	173
178	186	TOKYO ELECTRIC POWER ^{6,3}	JAPAN	57,167.4	8.3	2,096.1	265	[27.0]	115,274.2	202	41,086	394
179	183	HUMANA	U.S.	56,912.0	5.8	1,683.0	299	[31.3]	25,413.0	440	41,600	391
180	272	BROOKFIELD ASSET MANAGEMENT ¹	CANADA	56,771.0	39.2	3,584.0	177	145.1	256,281.0	110	100,750	236
181	235	HENGLI GROUP	CHINA	56,198.6	23.3	582.9	390	[42.6]	22,400.3	449	81,350	289
182	300	ALIBABA GROUP HOLDING ^{3,3,14}	CHINA	56,147.2	48.7	13,094.4	33	35.4	143,608.2	173	101,958	235
183	214	RWE ¹	GERMANY	56,016.7 ¹	17.1	465.0	405	[78.8]	91,563.4	229	58,441	345
184	274	FACEBOOK	U.S.	55,838.0	37.4	22,112.0	14	38.8	97,334.0	222	35,587	405
185	178	LG ELECTRONICS ¹	SOUTH KOREA	55,757.4	2.7	1,127.2	345	[26.2]	39,731.5	381	72,600	311
186	198	NIPPON STEEL CORPORATION ^{1,3,18}	JAPAN	55,720.2	8.1	2,265.3	253	38.8	72,734.5	260	115,878	206
187	208	CHRISTIAN DIOR ¹	FRANCE	55,262.6	12.3	3,037.8	200	20.3	88,320.8	235	141,914	154
188	213	CHINA MERCHANTS BANK ¹	CHINA	55,063.5	15.2	12,179.0	38	17.3	982,526.0	34	74,590	304
189	202	GUANGZHOU AUTOMOBILE INDUSTRY GROUP ⁶	CHINA	55,037.2	9.4	885.5	366	[10.5]	42,549.7	369	113,474	211
190	238	CATERPILLAR	U.S.	54,722.0	20.4	6,147.0	100	715.3	78,509.0	250	104,000	231
191	133	ITAU UNIBANCO HOLDING ¹	BRAZIL	54,662.5	[17.5]	6,814.8	90	[9.0]	400,690.8	75	100,335	238
192	170	ANHEUSER-BUSCH INBEV ¹	BELGIUM	54,619.0 ⁶	[3.2]	4,368.0	145	[45.4]	232,103.0	119	172,603	126
193	168	KOREA ELECTRIC POWER ^{1,6}	SOUTH KOREA	54,567.9	4.0	[1,194.9]	489	[204.0]	166,038.4	150	46,377	377
194	217	ENERGY TRANSFER ^{1,19}	U.S.	54,436.0 ¹	14.6	1,694.0	298	77.6	88,246.0	236	11,768	478
195	195	WESFARMERS ^{1,9}	AUSTRALIA	53,985.3 ¹	4.6	927.4	363	[57.2]	27,282.4	430	217,000	84
196	180	AMÉRICA MÓVIL ¹	MEXICO	53,977.6	[0.1]	2,733.0	217	76.3	72,580.0	261	194,431	108
197	200	LOCKHEED MARTIN	U.S.	53,762.0	5.3	5,046.0	126	152.0	44,876.0	355	105,000	224
198	187	PFIZER	U.S.	53,647.0	2.1	11,153.0	46	[47.7]	159,422.0	155	92,400	260
199	220	CHINA PACIFIC INSURANCE (GROUP)	CHINA	53,572.1	13.2	2,724.1	220	25.6	194,584.5	135	107,741	218
200	262	REPSOL ¹	SPAIN	53,176.0 ⁶	27.0	2,762.8	215	15.6	69,469.3	272	22,735	448

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RANK 2018	2017	Country	REVENUES		PROFITS			ASSETS		EMPLOYEES	
			\$ millions	% change from 2017	\$ millions	Rank	% change from 2017	\$ millions	Rank	Number	Rank
201	203	NOVARTIS ¹	53,166.0	6.0	12,611.0	35	63.7	145,563.0	170	125,161	188
202	252	GREENLAND HOLDING GROUP	52,720.9	22.7	1,719.6	296	28.6	150,974.5	166	39,091	398
203	243	CHINA NATIONAL BUILDING MATERIAL GROUP ⁶	52,610.6	17.7	69.4	461	356.3	84,608.2	242	207,958	91
204	259	GOLDMAN SACHS GROUP	52,528.0	24.3	10,459.0	52	144.0	931,796.0	38	36,600	403
205	206	CONTINENTAL ¹	52,404.7	5.6	3,419.3	184	1.6	46,229.1	349	243,226	75
206	226	VINCI ¹	52,345.2	13.1	3,520.4	182	13.7	86,133.1	240	211,233	88
207	196	FINATIS ¹	52,272.0 ¹	1.3	[208.9]	478	-	45,172.5	353	218,923	83
208	211	DEUTSCHE BAHN ^{1,6}	52,004.1	8.1	623.1	386	[25.8]	66,896.4	278	318,528	41
209	192	SUMITOMO MITSUI FINANCIAL GROUP ³	51,728.0	[0.6]	6,554.1	94	[1.1]	1,840,238.1	17	86,659	274
210	299	ALIMENTATION COUCHE-TARD ^{1,20}	51,394.4 ⁶	35.6	1,673.6	300	38.4	23,140.6	447	130,000	177
211	234	SHANDONG ENERGY GROUP ⁶	51,245.6	12.3	573.0	392	17.1	43,756.6	363	160,064	136
212	240	LENOVO GROUP ^{1,3}	51,037.9	12.5	596.3	389	-	29,988.5	420	57,000	351
213	237	INDUSTRIAL BANK	50,991.4	12.1	9,164.5	61	8.3	977,563.4	35	59,659	341
214	239	HBIS GROUP ⁶	50,920.6	12.2	[77.8]	472	-	63,725.2	288	118,656	201
215	218	THYSSENKRUPP ^{1,4}	50,856.1 ¹	7.3	9.5	466	-	39,334.3	383	161,096	134
216	227	SHANGHAI PUDDING DEVELOPMENT BANK ¹	50,545.7	9.2	8,453.0	72	5.3	916,091.0	39	55,692	354
217	158	VODAFONE GROUP ^{1,3}	50,532.4	[15.6]	[9,281.1]	487	[425.7]	160,391.2	154	98,896	241
218	249	MORGAN STANLEY	50,193.0	15.0	8,748.0	68	43.2	853,531.0	42	60,348	338
219	199	JBS ¹	49,709.7	[2.8]	6.9	468	[95.9]	29,454.7	421	230,086	79
220	267	ZHEJIANG GEELY HOLDING GROUP	49,665.4	20.6	1,969.3	280	8.2	48,564.8	336	124,846	191
221	166	BANCO BRADESCO ¹	49,612.3	[14.6]	4,537.5	141	[15.2]	336,888.4	85	86,772	273
222	221	MS&AD INSURANCE GROUP HOLDINGS ³	49,609.6	5.3	1,738.0	294	25.0	209,022.7	127	41,467	392
223	151	GROUPE BPCE ^{1,2}	49,529.3	[19.0]	3,571.2	178	4.8	1,456,097.4	22	100,245	239
224	209	TOKIO MARINE HOLDINGS ³	49,395.7	1.4	2,476.5	237	[3.4]	203,590.9	131	40,848	395
225	212	CISCO SYSTEMS ²¹	49,330.0	2.8	110.0	456	[98.9]	108,784.0	210	74,200	306
226	231	SAINT-GOBAIN ¹	49,300.4	7.2	495.7	399	[71.9]	50,340.0	328	181,001	117
227	219	KIA MOTORS ¹	49,238.4	4.0	1,050.7	353	22.7	46,416.2	348	52,578	360
228	225	ORANGE ¹	48,836.5	5.4	2,306.0	247	7.3	110,404.7	208	150,711	142
229	263	CIGNA ²²	48,850.0	16.9	2,637.0	224	17.9	153,226.0	162	73,800	307
230	229	DENSO ^{1,3}	48,368.0	4.9	2,295.6	249	[20.7]	52,339.5	320	171,992	127
231	250	SUMITOMO ^{1,3}	48,155.7	10.5	2,890.9	206	3.8	71,532.7	265	65,662	326
232	251	CHINA MINSHENG BANKING ¹	47,981.3	10.8	7,608.4	81	3.2	873,155.3	41	58,338	346
233	228	WOOLWORTHS GROUP ^{1,3}	47,842.1 ¹	3.6	1,335.7	332	15.5	17,402.3	470	201,522	96
234	224	BANCO BILBAO VIZCAYA ARGENTARIA ¹	47,608.0	2.4	6,283.2	96	58.4	773,455.5	45	125,627	187
235	207	AMERICAN INTERNATIONAL GROUP	47,389.0	[4.3]	[6.0]	470	-	491,984.0	69	49,600	368
236	216	STATE BANK OF INDIA ^{6,3}	47,286.0	[0.6]	328.8	427	-	561,369.6	64	257,252	70
237	331	TENCENT HOLDINGS ^{1,14}	47,272.7	34.4	11,900.6	41	12.5	105,382.0	216	54,309	357
238	142	ZURICH INSURANCE GROUP ¹	47,180.0	[26.2]	3,716.0	170	23.7	395,342.0	77	52,267	361
239	223	DEUTSCHE BANK ¹	46,969.5	1.0	315.1	429	-	1,540,920.6	20	91,737	264
240	193	BAYER ¹	46,718.1	[10.0]	2,000.4	277	[75.8]	144,343.8	172	116,998	203
241	215	HCA HEALTHCARE	46,677.0	[2.0]	3,787.0	166	70.9	39,207.0	385	229,000	80
242	312	CHINA POLY GROUP ⁶	46,207.1	24.9	1,495.9	323	29.8	158,364.3	157	97,527	249
243	245	CHINA SHIPBUILDING INDUSTRY ⁶	46,114.4	3.8	930.2	362	29.8	73,372.6	257	165,274	132
244	280	CHINA MERCHANTS GROUP ⁶	45,925.7	14.9	4,468.7	144	10.6	203,620.6	130	115,281	207
245	236	KDDI ^{1,3}	45,820.8	0.7	5,570.9	111	7.8	66,236.7	282	41,996	389
246	296	BHP GROUP ^{1,3,23}	45,809.0 ¹	19.7	3,705.0	171	[37.1]	111,993.0	206	27,161	439
247	233	BUNGE ^{3,24}	45,743.0	[0.1]	267.0	436	66.9	19,425.0	458	31,000	430
248	201	CNP ASSURANCES ¹	45,461.3	[10.4]	1,612.9	305	11.4	474,944.3	70	5,243	493
249	270	WUCHAN ZHONGDA GROUP ⁶	45,435.0	11.0	362.4	421	9.6	12,533.7	486	20,142	456
250	256	SINOMACH ⁶	45,424.0	6.5	487.8	400	3.4	57,450.7	308	147,099	146

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RANK 2018	2017	Company	Country	REVENUES		PROFITS			ASSETS		EMPLOYEES	
				\$ millions	% change from 2017	\$ millions	Rank	% change from 2017	\$ millions	Rank	Number	Rank
251	222	ALUMINUM CORP. OF CHINA ⁶	CHINA	45,383.8	(2.8)	112.7	455	—	93,408.3	227	124,965	190
252	281	SABIC ^{1,6}	SAUDI ARABIA	45,096.4	12.9	5,738.3	103	16.8	85,231.2	241	33,000	420
253	286	VOLVO ⁷	SWEDEN	44,957.0	14.8	2,863.9	208	16.6	53,558.6	319	98,652	243
254	332	CHINA VANKE ¹	CHINA	44,912.6	27.9	5,105.7	124	23.0	222,652.2	122	104,300	228
255	205	SBERBANK ^{1,6}	RUSSIA	44,898.4	(9.7)	13,268.5	32	3.1	450,270.0	73	293,752	57
256	292	ROYAL BANK OF CANADA ^{1,17}	CANADA	44,609.3	15.7	9,635.8	57	10.3	1,016,475.5	30	81,870	287
257	260	AMERICAN AIRLINES GROUP	U.S.	44,541.0	5.5	1,412.0	328	(26.4)	60,580.0	294	128,900	182
258	248	WILMAR INTERNATIONAL	SINGAPORE	44,497.7	1.5	1,128.0	344	(7.5)	45,679.9	350	90,000	266
259	285	PEGATRON ⁷	TAIWAN	44,453.3	13.3	368.7	419	(23.6)	19,011.9	460	156,477	138
260	266	DELTA AIR LINES	U.S.	44,438.0	7.7	3,935.0	160	10.0	60,266.0	297	88,680	270
261	244	HANWHA ¹	SOUTH KOREA	44,303.0	(0.6)	425.8	413	18.7	151,966.1	165	58,070	348
262	273	CHINA UNITED NETWORK COMMUNICATIONS ⁶	CHINA	43,974.4	8.1	616.9	387	879.1	78,908.5	249	246,299	72
263	288	SHAANXI YANCHANG PETROLEUM (GROUP) ⁶	CHINA	43,858.1 ⁵	12.8	306.5	432	83.7	53,958.1	317	136,016	162
264	264	CHARTER COMMUNICATIONS	U.S.	43,634.0	4.9	1,230.0	337	(87.6)	146,130.0	169	98,000	245
265	232	TATA MOTORS ³	INDIA	43,599.2	(4.9)	(4,122.0)	496	(395.6)	44,349.0	360	81,090	290
266	268	ZF FRIEDRICHSHAFEN ⁷	GERMANY	43,582.4	6.1	1,064.5	352	(12.9)	30,897.6	416	148,969	143
267	269	METRO ^{7,9}	GERMANY	43,466.5 ⁸	6.1	409.3	414	14.2	17,702.1	468	132,293	169
268	258	NEW YORK LIFE INSURANCE	U.S.	43,425.3	2.7	880.0	368	(52.9)	311,449.3	92	11,388	479
269	175	BANCO DO BRASIL ^{1,6}	BRAZIL	43,332.9	(21.6)	3,782.9	167	13.6	360,361.1	81	96,889	250
270	327	AMERICAN EXPRESS	U.S.	43,281.0	21.6	6,921.0	87	153.0	188,602.0	140	59,000	343
271	247	NATIONWIDE	U.S.	43,270.0	(1.5)	512.6	396	107.9	214,141.9	125	30,472	431
272	284	ACS ⁷	SPAIN	43,263.2	10.0	1,079.9	350	19.5	39,199.6	386	195,461	106
273	185	SHANDONG WEIQIAO PIONEERING GROUP	CHINA	43,008.4	(19.2)	852.6	370	(32.9)	35,359.2	400	106,044	221
274	306	UBS GROUP ¹	SWITZERLAND	42,960.0	7.6	4,516.0	142	322.1	958,489.0	36	66,888	323
275	314	BHARAT PETROLEUM ^{6,3}	INDIA	42,935.6 ⁵	16.5	1,115.7	347	(20.2)	19,768.3	457	12,865	474
276	261	BEST BUY ¹	U.S.	42,879.0	1.7	1,464.0	326	46.4	12,901.0	484	125,000	189
277	362	XIAMEN CBD ⁶	CHINA	42,726.3	31.1	631.3	384	106.9	36,868.0	397	24,016	444
278	255	LIBERTY MUTUAL INSURANCE GROUP	U.S.	42,685.0 ⁴	(0.0)	2,160.0	260	12,605.9	125,989.0	189	50,000	365
279	335	CHINA COSCO SHIPPING ⁶	CHINA	42,607.7	22.9	1,554.5	315	10.7	117,702.0	198	111,397	214
280	283	JARDINE MATHESON ^{1,25}	CHINA	42,527.0	7.8	1,732.0	295	(54.2)	86,258.0	239	469,000	14
281	294	SHAANXI COAL & CHEMICAL INDUSTRY ⁶	CHINA	42,418.8	10.2	90.8	459	23.3	72,966.0	259	120,095	198
282	291	TALANX ¹	GERMANY	42,390.5	9.8	829.7	374	9.5	186,170.7	143	20,780	452
283	371	CHINA NATIONAL AVIATION FUEL GROUP ⁶	CHINA	42,370.9	32.6	476.2	404	18.6	8,054.1	494	13,181	473
284	277	LUFTHANSA GROUP ¹	GERMANY	42,302.0	5.5	2,552.7	229	(4.2)	43,677.5	364	115,882	205
285	276	MERCK	U.S.	42,294.0	5.4	6,220.0	98	159.8	82,637.0	246	69,000	319
286	289	CHINA HUANENG GROUP ⁶	CHINA	42,280.9 ⁴	8.8	8.9	467	(95.9)	156,327.2	160	136,031	161
287	307	BOUYGUES ¹	FRANCE	42,179.2	13.2	1,547.2	316	26.5	43,084.2	366	129,275	180
288	271	SANOFI ¹	FRANCE	42,104.9	3.2	5,081.8	125	(46.5)	127,339.3	188	104,226	229
289	322	CHINA EVERBRIGHT GROUP ⁶	CHINA	41,879.7	16.9	1,890.8	284	(0.2)	696,969.9	50	70,000	316
290	275	HONEYWELL INTERNATIONAL	U.S.	41,802.0	3.1	6,765.0	91	308.8	57,773.0	304	114,000	210
291	360	XIAMEN ITS HOLDING GROUP ⁶	CHINA	41,437.5	25.9	62.8	462	(41.0)	15,123.3	476	23,159	447
292	330	IBERDROLA ¹	SPAIN	41,395.4	17.5	3,557.1	179	12.5	129,202.3	185	33,216	419
293	301	UNITED AIRLINES HOLDINGS ³⁹	U.S.	41,303.0	9.5	2,129.0	263	(0.1)	44,792.0	356	92,000	262
294	305	MAERSK GROUP ¹	DENMARK	41,256.0 ⁴	10.0	3,169.0	192	—	56,636.0	311	84,404	281
295	337	TORONTO-DOMINION BANK ^{1,17}	CANADA	41,198.7	19.4	8,751.5	67	10.1	1,016,604.2	28	84,383	282
296	290	GLAXOSMITHKLINE ¹	BRITAIN	41,108.5	5.8	4,832.3	131	145.0	73,941.2	256	95,490	252
297	319	TIAA	U.S.	41,052.1	14.0	1,560.5	312	48.7	568,190.2	63	17,643	460
298	316	ACCENTURE ^{6,8}	IRELAND	40,993.0	11.5	4,059.9	154	17.8	24,449.1	444	459,000	17
299	287	MAGNA INTERNATIONAL ⁵	CANADA	40,827.0	4.8	2,296.0	248	4.1	25,945.0	437	174,000	124
300	279	MITSUBISHI ELECTRIC ^{1,3}	JAPAN	40,766.1	1.9	2,044.2	271	(16.7)	39,362.2	382	145,817	148

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RANK 2018	2017	Company	Country	REVENUES		PROFITS			ASSETS		EMPLOYEES	
				\$ millions	% change from 2017	\$ millions	Rank	% change from 2017	\$ millions	Rank	Number	Rank
301	361	CEAR HOLDINGS GROUP	CHINA	40,640.8	24.2	844.7	372	[20.9]	20,932.8	453	31,547	428
302	173	LOUIS DREYFUS ¹	NETHERLANDS	40,571.0*	[26.8]	355.0	422	12.0	18,440.0	463	16,785	464
303	278	RIO TINTO GROUP [†]	BRITAIN	40,522.0	1.2	13,638.0	31	55.6	90,949.0	233	47,458	374
304	310	EDEKA ZENTRALE ^{C,26}	GERMANY	40,454.2	9.0	380.0	417	10.1	8,322.9	493	376,000	30
305	•	CAIXA ECONOMICA FEDERAL ⁶	BRAZIL	40,240.5	[26.1]	2,833.3	210	[27.7]	326,182.5	88	84,952	280
306	297	TYSON FOODS ⁴	U.S.	40,052.0	4.7	3,024.0	201	70.5	29,109.0	423	121,000	196
307	302	ORACLE ¹⁵	U.S.	39,831.0	5.6	3,825.0	164	[59.0]	137,264.0	177	137,000	159
308	293	ALLSTATE	U.S.	39,815.0	3.4	2,252.0	254	[29.4]	112,249.0	205	45,420	381
309	351	WORLD FUEL SERVICES	U.S.	39,750.3	18.0	127.7	454	-	5,676.9	499	5,000	494
310	171	ING GROUP [†]	NETHERLANDS	39,598.2	[29.7]	5,618.8	109	[8.8]	1,011,101.2	32	53,768	359
311	318	CENTRICA [†]	BRITAIN	39,594.7	9.7	244.1	439	[43.1]	26,177.3	435	31,780	424
312	323	MIDEA GROUP	CHINA	39,581.6	10.6	3,058.5	199	19.6	38,408.5	391	114,765	208
313	298	FRESENIUS ^{1,P}	GERMANY	39,571.0	3.6	2,392.2	240	17.0	64,811.5	286	276,750	62
314	357	MASSACHUSETTS MUTUAL LIFE INSURANCE	U.S.	39,267.2	17.2	397.9	416	[22.4]	265,812.6	103	9,844	484
315	324	INTESA SANPAOLO [†]	ITALY	39,050.6	9.2	4,779.7	134	[42.0]	900,365.1	40	92,117	261
316	338	LYONDELLBASELL INDUSTRIES ⁶	NETHERLANDS	39,004.0	13.1	4,688.0	135	[3.9]	28,278.0	426	19,450	459
317	321	TJX ¹	U.S.	38,972.9	8.7	3,059.8	198	17.3	14,326.0	478	270,000	65
318	399	YANKUANG GROUP ⁶	CHINA	38,887.3	31.9	[258.0]	481	-	44,774.8	357	104,668	225
319	363	CONOCOPHILLIPS	U.S.	38,727.0	18.9	6,257.0	97	-	69,980.0	271	10,800	480
320	336	BARCLAYS [†]	BRITAIN	38,278.3	10.9	2,862.3	209	-	1,443,122.6	23	83,500	283
321	303	J. SAINSBURY ^{1,3}	BRITAIN	38,064.0	0.9	287.4	434	[29.8]	30,669.2	418	116,400	204
322	346	CHINA AEROSPACE SCIENCE & INDUSTRY ⁶	CHINA	37,869.8	11.1	1,846.4	286	14.9	47,048.1	343	146,346	148
323	343	CHINA AEROSPACE SCIENCE & TECHNOLOGY ⁶	CHINA	37,727.6	10.1	2,463.7	238	10.7	63,496.8	289	179,788	118
324	309	MEIJI YASUDA LIFE INSURANCE ³	JAPAN	37,722.9	1.5	2,070.6	267	[13.4]	380,597.4	78	42,950	387
325	308	GEORGE WESTON [†]	CANADA	37,474.8	0.7	442.9	408	[24.3]	32,084.1	412	197,000	105
326	320	SNCF MOBILITÉS ^{1,6}	FRANCE	37,388.9	4.2	5,313.1	118	314.9	48,482.6	337	203,865	94
327	342	DAIWA HOUSE INDUSTRY ³	JAPAN	37,371.2	9.1	2,141.5	261	0.4	39,161.8	387	44,947	383
328	341	ABB ⁵	SWITZERLAND	37,360.0*	8.9	2,173.0	257	[1.8]	44,441.0	359	146,600	147
329	394	DEERE ¹⁷	U.S.	37,357.7	25.6	2,368.4	242	9.7	70,108.0	270	74,413	305
330	315	TECH DATA ¹	U.S.	37,299.0	1.3	340.6	424	192.0	12,986.6	483	14,000	470
331	282	POWER CORP. OF CANADA [†]	CANADA	37,112.2	[6.0]	1,033.2	355	0.2	331,211.9	86	30,000	434
332	257	SWISS RE ⁶	SWITZERLAND	37,047.0	[12.8]	462.0	407	16.1	207,570.0	129	14,943	468
333	427	SUNING.COM GROUP	CHINA	37,032.2	33.2	2,014.8	273	223.3	29,052.7	424	130,455	176
334	311	MITSUBISHI HEAVY INDUSTRIES ^{1,3}	JAPAN	36,783.5	[0.3]	914.1	364	-	46,469.0	345	80,744	293
335	442	SK HYNIX [†]	SOUTH KOREA	36,763.1	38.0	14,125.4	29	50.0	57,056.9	309	33,000	420
336	325	VALE [†]	BRAZIL	36,696.0*	2.8	6,860.0	89	24.6	88,190.0	237	70,270	315
337	403	ENTERPRISE PRODUCTS PARTNERS ⁹	U.S.	36,534.2	24.9	4,172.4	151	49.1	56,969.8	310	7,000	488
338	375	XMXYG ^{6,27}	CHINA	36,503.7	15.2	199.3	444	35.4	16,891.8	473	10,350	482
339	329	AISIN SEIKI ^{1,3}	JAPAN	36,465.7	3.4	993.2	357	[18.2]	33,901.5	407	119,732	199
340	364	JIANGSU SHAGANG GROUP	CHINA	36,440.9	11.9	1,869.2	285	76.0	33,173.7	411	31,290	429
341	340	NIKE ¹⁵	U.S.	36,397.0	6.0	1,933.0	282	[54.4]	22,536.0	448	73,100	309
342	334	PUBLIX SUPER MARKETS	U.S.	36,395.7	4.5	2,381.2	241	3.9	18,982.5	461	202,000	95
343	383	GENERAL DYNAMICS	U.S.	36,193.0	16.9	3,345.0	189	14.9	45,408.0	352	105,600	223
344	356	EXELON	U.S.	35,985.0	7.3	2,010.0	274	[46.7]	119,666.0	194	33,383	417
345	317	CANON ³	JAPAN	35,796.9	[1.6]	2,289.5	251	6.1	44,662.4	358	195,056	107
346	345	ENBRIDGE ³	CANADA	35,785.0	4.6	2,223.7	256	0.9	122,221.0	193	12,000	476
347	359	JIZHONG ENERGY GROUP ⁶	CHINA	35,721.3	7.6	[152.8]	475	-	33,772.3	408	112,859	212
348	254	E.ON [†]	GERMANY	35,703.6*	[16.6]	3,803.7	165	[14.0]	62,092.3	291	43,302	386
349	313	FUJITSU ^{1,3}	JAPAN	35,647.9	[3.6]	943.1	360	[38.3]	28,055.0	427	132,138	170
350	367	MIZUHO FINANCIAL GROUP ³	JAPAN	35,406.3	10.2	870.9	369	[83.3]	1,814,332.9	18	59,132	342

DEFINITIONS, EXPLANATIONS, AND FOOTNOTES ARE ON PAGE F12.

RANK 2018	2017	Company	Country	REVENUES		PROFITS			ASSETS		EMPLOYEES	
				\$ millions	% change from 2017	\$ millions	Rank	% change from 2017	\$ millions	Rank	Number	Rank
351	352	MITSUBISHI CHEMICAL HOLDINGS ^{1,3}	JAPAN	35,386.4	5.3	1,529.0	319	(20.0)	50,352.5	327	72,020	312
352	374	CK HUTCHISON HOLDINGS ^{1,28}	CHINA	35,361.2	10.9	4,976.3	128	10.5	157,392.8	158	300,000	50
353	189	LLOYDS BANKING GROUP ¹	BRITAIN	35,251.9	(32.8)	5,737.9	104	17.1	1,015,661.3	31	64,928	327
354	398	IDEMITSU KOSAN ³	JAPAN	35,091.0 ^e	18.5	734.6	378	(49.9)	26,116.4	436	9,476	486
355	304	POSTE ITALIANE ^{1,6}	ITALY	35,071.1	(7.0)	1,651.1	303	112.6	238,753.3	116	132,388	168
356	358	JFE HOLDINGS ³	JAPAN	34,937.4	6.7	1,474.7	325	67.3	42,551.7	368	62,083	336
357	348	SUZUKI MOTOR ³	JAPAN	34,917.9	3.0	1,612.3	306	(17.2)	30,739.8	417	67,721	320
358	370	JIANGXI COPPER ⁵	CHINA	34,870.0	9.1	131.4	451	15.8	18,618.3	462	23,194	446
359		• CRRC GROUP ⁶	CHINA	34,673.0	8.0	486.6	401	(28.7)	58,038.3	302	187,959	113
360	373	CREDIT SUISSE GROUP ³	SWITZERLAND	34,284.2	7.5	2,069.9	268	-	780,308.5	44	45,680	379
361		• TSINGSHAN HOLDING GROUP	CHINA	34,242.2	43.2	578.6	391	50.7	8,522.6	492	56,088	353
362	395	STATE POWER INVESTMENT ⁶	CHINA	34,229.2	15.1	170.7	446	(14.0)	157,347.6	159	124,678	192
363	368	TAIWAN SEMICONDUCTOR MANUFACTURING ¹	TAIWAN	34,218.2	6.5	12,043.9	39	6.2	67,999.5	274	48,752	369
364	333	CHINA ENERGY ENGINEERING GROUP ⁶	CHINA	34,176.5	(2.5)	432.6	412	16.4	57,758.7	305	129,929	179
365	354	QUANTA COMPUTER ¹	TAIWAN	34,102.6	1.6	501.5	398	6.2	21,455.9	450	112,421	213
366	452	PLAINS GP HOLDINGS ⁵	U.S.	34,055.0	29.9	334.0	426	-	26,830.0	432	4,900	495
367	242	CHINA SOUTH INDUSTRIES GROUP ⁶	CHINA	33,895.8	(24.3)	268.1	435	(63.7)	48,455.2	338	198,932	102
368	464	YANGU LONGKING GROUP	CHINA	33,394.8	30.4	613.6	388	35.6	51,585.3	325	21,849	450
369		• JINCHUAN GROUP ⁶	CHINA	33,391.6	4.0	234.0	442	90.0	16,925.3	472	27,594	438
370	388	CHINA ELECTRONICS TECHNOLOGY GROUP ⁶	CHINA	33,323.8	10.4	1,755.2	292	(1.1)	51,672.9	324	179,636	119
371	326	TOSHIBA ^{3,3}	JAPAN	33,312.8	(6.5)	9,138.8	62	25.9	38,830.3	388	128,697	184
372	50	PRUDENTIAL ¹	BRITAIN	33,252.6	(70.2)	4,014.7	157	30.5	647,708.5	54	23,792	445
373	349	COMMONWEALTH BANK OF AUSTRALIA ^{1,9}	AUSTRALIA	33,186.3 ¹	(2.1)	7,228.0	84	(3.4)	720,354.4	47	45,753	378
374	365	BRIDGESTONE	JAPAN	33,062.9	1.7	2,641.7	223	2.7	35,220.6	401	143,509	151
375	369	CHINA ELECTRONICS ⁶	CHINA	33,055.7	3.3	350.3	423	110.0	40,323.2	375	135,297	163
376	438	GS CALTEX ¹	SOUTH KOREA	33,052.7 ^e	23.2	639.5	383	(49.7)	17,531.2	469	3,212	498
377	347	SOMPO HOLDINGS ³	JAPAN	32,857.4	(3.4)	1,322.5	334	4.8	108,595.4	212	49,837	367
378	350	SUMITOMO LIFE INSURANCE ³	JAPAN	32,825.0	(2.9)	435.3	410	(30.9)	341,659.6	84	42,848	388
379	386	SCHLUMBERGER ^{3,29}	U.S.	32,815.0	7.8	2,138.0	262	-	70,507.0	269	100,000	240
380	376	3M	U.S.	32,765.0	3.5	5,349.0	115	10.1	36,500.0	339	93,516	256
381	422	ABBVIE	U.S.	32,753.0	16.1	5,687.0	105	7.1	59,352.0	299	30,000	434
382	366	CHUBB ⁵	SWITZERLAND	32,717.0	1.5	3,962.0	158	2.6	167,771.0	148	32,700	422
383	372	CHS ^{6,8}	U.S.	32,683.3	2.0	775.9	377	983.8	16,381.2	475	10,495	481
384	453	BRITISH AMERICAN TOBACCO ¹	BRITAIN	32,667.0 ^e	25.0	8,045.4	76	(83.4)	186,351.9	142	63,877	332
385	428	ANSTEEL GROUP ⁶	CHINA	32,619.4	17.4	(254.5)	480	(516.6)	49,469.6	333	136,319	160
386	397	CHINA HUADIAN ⁶	CHINA	32,421.4	9.5	464.4	406	39.3	118,796.5	195	97,629	247
387	391	CAPITAL ONE FINANCIAL	U.S.	32,377.0	7.9	6,015.0	101	203.5	372,538.0	79	47,600	373
388	295	AIA GROUP ¹	CHINA	32,369.0	(18.8)	2,597.0	226	(60.0)	229,806.0	120	22,000	449
389	378	MAZDA MOTOR ³	JAPAN	32,150.8	2.5	572.5	393	(43.4)	25,942.2	439	49,998	366
390	404	COMPAL ELECTRONICS ¹	TAIWAN	32,102.8	10.0	295.7	433	56.5	13,007.4	482	82,374	285
391	437	PROGRESSIVE	U.S.	31,979.0	19.2	2,615.3	225	64.3	46,575.0	344	37,346	402
392	355	OZ BANK ^{1,6}	GERMANY	31,975.5	(4.7)	972.5	358	(9.9)	592,911.8	57	28,682	437
393	380	HYUNDAI MOBIS ¹	SOUTH KOREA	31,949.4	2.8	1,716.9	297	23.8	38,604.6	389	34,782	409
394	436	CPC ^{1,6}	TAIWAN	31,928.9 ^e	17.8	1,137.6	342	(14.1)	25,035.7	442	15,712	466
395	328	COCA-COLA	U.S.	31,856.0	(10.0)	6,434.0	95	415.5	83,216.0	244	62,600	335
396	392	L'ORÉAL ¹	FRANCE	31,790.7	6.2	4,597.2	136	13.9	43,956.9	362	86,030	275
397	382	CRH ¹	IRELAND	31,625.0 ¹	1.8	2,970.5	202	39.1	40,202.7	376	89,831	267
398	430	BANK OF NOVA SCOTIA ^{1,17}	CANADA	31,589.3	14.6	6,642.5	93	8.6	760,409.0	46	97,629	247
399	389	JOHNSON CONTROLS INTERNATIONAL ^{3,4}	IRELAND	31,400.0	4.1	2,182.0	259	34.2	48,797.0	335	122,000	195
400	390	UNITED SERVICES AUTOMOBILE ASSN.	U.S.	31,367.8	4.5	2,291.9	250	(5.4)	158,506.8	156	33,689	416

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RANK 2018	2017	Country	REVENUES		PROFITS		ASSETS		EMPLOYEES		
			\$ millions	% change from 2017	\$ millions	Rank	% change from 2017	\$ millions	Rank	Number	Rank
401	406	AIR FRANCE-KLM GROUP [†]	31,292.2	7.7	482.7	403	—	33,212.2	410	81,527	288
402	431	SHOUGANG GROUP ^⑥	31,103.8	13.2	84.2	460	9,568.3	73,067.1	258	108,086	217
403	413	COMPASS GROUP ^{1,4}	30,878.8	8.1	1,512.7	322	2.9	16,443.5	474	595,841	9
404	409	HEWLETT PACKARD ENTERPRISE ¹⁷	30,852.0	6.9	1,906.0	283	454.7	55,493.0	312	60,000	340
405	377	BT GROUP ^{1,3}	30,743.0	[2.2]	2,833.1	211	5.2	60,302.7	296	106,700	220
406	408	INDITEX ^{1,3}	30,686.7	6.2	4,042.3	155	5.3	24,878.1	443	174,386	123
407	419	VEOLIA ENVIRONNEMENT [†]	30,579.5	8.0	518.4	395	14.5	42,968.6	367	170,819	129
408	433	ABBOTT LABORATORIES	30,578.0	11.6	2,368.0	243	396.4	67,173.0	277	103,000	233
409	•	MICRON TECHNOLOGY [®]	30,391.0	49.5	14,135.0	28	177.8	43,376.0	365	36,000	404
410	469	PKN ORLEN GROUP [†]	30,389.9 ^⑤	20.3	1,539.1	317	[12.7]	17,079.2	471	21,282	451
411	424	SCHNEIDER ELECTRIC [†]	30,353.9	8.8	2,754.5	216	13.7	48,302.0	340	137,534	158
412	417	PHOENIX PHARMA ^{1,1}	30,296.0	6.7	[174.5]	476	[194.7]	9,599.5	491	29,631	436
413	407	TRAVELERS COS.	30,282.0	4.8	2,523.0	233	22.7	104,233.0	217	30,400	432
414	•	GREE ELECTRICAL APPLIANCES	30,239.4	36.2	3,961.3	159	19.5	36,592.7	398	88,800	269
415	412	COOP GROUP ^③	30,235.4	5.7	483.7	402	[1.8]	20,665.7	456	77,448	297
416	461	NORTHROP GRUMMAN	30,095.0	16.6	3,229.0	191	60.2	37,653.0	396	85,000	279
417	476	SUNCOR ENERGY [†]	30,081.4 ^⑤	21.3	2,540.9	230	[26.0]	65,596.8	283	12,480	475
418	241	MANULIFE FINANCIAL [†]	30,070.6	[33.1]	3,703.7	173	128.4	549,407.6	65	34,000	412
419	396	MEOTRONIC ^{⑤,20}	29,953.0	0.8	3,104.0	197	[22.9]	91,393.0	230	98,003	244
420	420	KANSAI ELECTRIC POWER ^③	29,832.5	5.5	1,037.9	354	[24.3]	65,576.6	284	32,597	423
421	440	ARROW ELECTRONICS	29,676.8	10.7	716.2	380	78.2	17,784.4	467	20,100	457
422	411	PHILIP MORRIS INTERNATIONAL	29,625.0 ^⑤	3.1	7,911.0	78	31.1	39,801.0	380	77,400	298
423	435	KOC HOLDING [†]	29,592.3	9.2	1,149.8	341	[15.0]	23,570.7	446	92,631	259
424	432	WISTRON [†]	29,509.5	7.4	162.8	447	27.5	11,032.7	489	82,955	284
425	402	UNICREDIT GROUP [†]	29,332.3 [†]	0.3	4,593.7	137	[25.5]	950,368.8	37	86,786	272
426	421	SAMSUNG LIFE INSURANCE [†]	29,305.8	3.7	1,512.9	321	46.7	259,413.5	106	5,420	491
427	446	SAP [†]	29,159.6	10.9	4,818.6	132	6.4	58,854.2	300	96,498	251
428	434	LA POSTE ^{1,6}	29,149.0	7.3	941.8	361	[1.8]	298,904.8	97	233,076	78
429	401	NORTHWESTERN MUTUAL	29,124.0	[0.7]	783.0	376	[23.0]	272,167.0	102	5,870	490
430	429	NATURGY ENERGY GROUP ^{1,30}	29,123.0 [†]	5.3	[3,330.4]	494	[317.2]	46,441.2	346	13,945	471
431	415	MIGROS GROUP ^③	29,098.2	2.0	511.3	397	[2.5]	67,587.8	276	79,913	296
432	426	DANONE [†]	29,092.3	4.6	2,772.2	214	0.3	50,494.3	326	105,783	222
433	414	WESTPAC BANKING ^{1,4}	29,027.9	1.6	6,151.5	99	1.1	636,296.9	55	35,029	408
434	471	KB FINANCIAL GROUP [†]	29,000.9	15.8	2,782.5	212	[5.0]	429,854.2	74	27,040	440
435	460	INTERNATIONAL AIRLINES GROUP ^{1,31}	28,803.2	11.2	3,404.8	186	51.0	32,042.9	413	64,734	329
436	418	MEDIPAL HOLDINGS ^③	28,698.5	1.1	309.9	431	[1.3]	14,619.2	477	15,623	467
437	425	SUMITOMO ELECTRIC INDUSTRIES ^③	28,682.9	3.0	1,064.8	351	[2.0]	27,588.9	429	272,796	63
438	468	CHINA DATANG ^⑥	28,654.9	13.3	323.4	428	[5.4]	108,633.2	211	93,800	254
439	456	XINJIANG GUANGHUI INDUSTRY INVESTMENT	28,564.0	9.4	137.0	450	321.8	38,415.2	390	82,175	286
440	384	SUBARU ^③	28,505.4	[7.3]	1,333.1	333	[33.0]	26,951.5	431	34,200	411
441	•	ANHUI CONCH GROUP ^⑥	28,499.0	144.1	1,628.9	304	92.1	27,967.9	428	55,380	355
442	•	HUAXIA LIFE INSURANCE	28,492.8	87.4	398.8	415	[33.9]	74,401.5	255	500,000	11
443	454	CFE ^{1,6}	28,457.1	9.0	2,322.3	245	[59.3]	84,234.7	243	91,369	265
444	458	SAMSUNG C&T [†]	28,319.4	9.3	1,556.9	313	175.1	38,009.0	394	17,274	461
445	441	ADECCO GROUP ^⑤	28,167.1	5.6	540.5	394	[39.1]	11,107.7	488	34,000	412
446	450	RANDSTAD [†]	28,102.2	7.1	830.8	373	16.7	11,359.1	487	38,820	399
447	444	LAFARGEHOLCIM [†]	28,088.8	5.8	1,536.1	318	—	60,579.5	295	77,055	299
448	499	HAIER SMART HOME ³²	27,713.6	17.6	1,124.8	346	9.8	24,280.1	445	87,447	271
449	400	INTL FCSTONE ^{4,33}	27,622.7	[6.1]	55.5	463	767.2	7,824.7	498	1,701	499
450	449	ANGLO AMERICAN [†]	27,610.0	5.2	3,549.0	180	12.1	52,196.0	322	64,000	330

DEFINITIONS, EXPLANATIONS, AND FOOTNOTES ARE ON PAGE F12.

RANK 2018	2017	Country	REVENUES		PROFITS			ASSETS		EMPLOYEES	
			\$ millions	% change from 2017	\$ millions	Rank	% change from 2017	\$ millions	Rank	Number	Rank
451	465	CHINA TAIPING INSURANCE GROUP ⁶	27,485.8	7.4	434.0	411	[3.4]	96,189.1	224	75,341	303
452	439	MAPFRE GROUP ¹	27,423.5	2.3	624.1	385	[21.0]	76,913.4	252	35,390	407
453	462	CHUBU ELECTRIC POWER ³	27,374.1	6.3	716.3	379	6.7	54,102.5	316	30,321	433
454		• PBF ENERGY	27,186.1 ²	24.8	128.3	453	[69.1]	8,005.4	496	3,266	497
455	410	CATHAY LIFE INSURANCE ¹	27,183.4	[5.6]	1,001.5	356	[16.0]	207,944.9	128	38,694	400
456		• FINANCIÈRE DE L'OOET ¹	27,172.7	31.5	144.1	448	[65.4]	61,194.7	293	81,003	291
457	448	AUSTRALIA & NEW ZEALAND BANKING GROUP ^{1,4}	27,147.9 ¹	3.3	4,863.4	130	[0.3]	681,894.2	52	39,924	397
458	443	EAST JAPAN RAILWAY ³	27,076.1	1.7	2,662.6	221	2.1	75,537.0	254	85,718	276
459		• OMV GROUP ¹	27,061.3 ²	18.7	1,789.1	290	195.0	42,246.4	370	20,231	455
460	467	RAYTHEON	27,058.0	6.7	2,909.0	204	43.7	31,864.0	414	67,000	321
461		• TONGLING NONFERROUS METALS GROUP ⁶	26,846.7	15.3	[70.2]	471	-	12,668.5	485	24,848	443
462	495	SHANXI LUAN MINING GROUP ⁶	26,840.5	12.8	1.2	469	139.0	35,084.4	402	100,637	237
463	493	CJ CORP. ¹	26,835.7	12.8	250.9	438	[38.8]	28,439.1	425	64,832	328
464	497	DATONG COAL MINE GROUP ⁶	26,697.6	12.7	[181.8]	477	[372.0]	49,898.2	331	156,268	139
465		• SHANXI COKING COAL GROUP ⁶	26,692.8	18.2	141.6	449	19.3	49,288.0	334	199,872	99
466	457	NOKIA ¹	26,628.1	2.1	[401.3]	484	-	45,167.9	354	103,083	232
467	475	HEINEKEN HOLDING ¹	26,608.1 ²	7.2	1,134.1	343	3.0	47,955.7	342	85,610	277
468		• XIAOMI ^{1,14}	26,443.5	55.9	2,049.1	269	-	21,152.7	452	16,683	465
469	494	YANGQUAN COAL INDUSTRY GROUP ⁶	26,290.1	10.5	[131.1]	473	-	34,909.5	403	129,150	181
470	463	NEC ^{1,3}	26,277.0	2.4	362.5	420	[12.4]	26,661.6	434	110,595	216
471	479	FUBON FINANCIAL HOLDING ¹	26,276.5	6.4	1,583.4	311	[11.0]	251,010.5	114	45,174	382
472	451	KRAFT HEINZ	26,268.0	0.7	[10,192.0]	499	[193.2]	103,461.0	219	38,000	401
473		• HAILIANG GROUP	26,251.0	9.1	237.6	440	[11.5]	8,036.4	495	19,510	458
474	466	FLEX ^{3,3}	26,210.5	3.0	93.4	458	[78.2]	13,499.4	479	200,000	98
475	381	XINXING CATHAY INTERNATIONAL GROUP ⁶	26,207.9	[15.7]	103.6	457	[76.4]	20,671.3	455	52,024	362
476	474	EMIRATES GROUP ^{1,3,3}	26,147.7	5.3	237.1	441	[68.8]	34,687.8	404	60,282	339
477	486	CECONOMY ^{1,4}	26,129.4 ¹	6.9	[252.2]	479	[120.8]	9,842.9	490	53,954	358
478	478	MICHELIN ¹	25,996.7	5.0	1,979.1	279	3.3	33,659.1	409	111,117	215
479	485	NATIONAL AUSTRALIA BANK ^{1,4}	25,942.7	5.7	4,220.6	150	4.9	583,429.3	60	33,283	418
480	459	MONDELEZ INTERNATIONAL	25,938.0	0.2	3,381.0	188	15.7	62,729.0	290	80,000	294
481	480	ADIDAS ¹	25,920.0 ¹	5.1	2,008.6	275	62.4	17,844.5	466	57,016	350
482	481	SHANXI JINCHENG ANTHRACITE COAL MINING ⁶	25,844.7	4.8	52.6	464	[8.2]	40,137.8	377	128,795	183
483	492	RABOBANK GROUP ^{1,C}	25,823.3	8.4	2,235.2	255	31.4	674,869.5	53	41,861	390
484	496	HENAN ENERGY & CHEMICAL ⁶	25,781.9	8.8	[133.3]	474	-	39,328.4	384	171,334	128
485		• CHINA GENERAL TECHNOLOGY ⁶	25,779.1	11.0	442.7	409	7.8	25,230.8	441	34,752	410
486	490	U.S. BANCORP	25,775.0	7.4	7,096.0	86	14.1	467,374.0	72	75,772	302
487	473	MACY'S ¹	25,739.0	3.6	1,108.0	348	[28.4]	19,194.0	459	130,000	177
488	487	FOMENTO ECONÓMICO MEXICANO ¹	25,679.0 ^{2,E}	5.5	1,247.3	335	[44.4]	29,270.3	422	297,073	54
489		• DOLLAR GENERAL ¹	25,625.0	9.2	1,589.5	309	3.3	13,204.0	480	135,000	165
490		• LG CHEM ¹	25,617.3	12.7	1,338.5	331	[22.2]	25,942.6	438	33,694	415
491	447	QXEC ¹	25,606.0 ¹	[2.6]	[663.0]	488	[127.7]	45,417.0	351	217,000	84
492		• FORMOSA PETROCHEMICAL ^{1,14}	25,462.8 ²	24.1	1,993.4	278	[24.3]	13,201.8	481	5,285	492
493		• SAFRAN ¹	25,191.9	24.4	1,514.2	320	[72.0]	46,428.7	347	92,639	258
494	472	ACHEMIA ¹	25,180.1	1.2	370.6	418	52.9	93,515.7	226	13,714	472
495	405	RAJESH EXPORTS ³	25,142.6	[13.7]	184.8	445	[5.9]	4,163.8	500	383	500
496		• NUCOR	25,067.3	23.8	2,360.8	244	79.0	17,920.6	465	26,300	442
497		• BANK OF MONTREAL ^{1,3,7}	25,002.7	16.5	4,235.1	149	3.6	589,481.4	59	45,454	380
498	489	TAIKANG INSURANCE GROUP	24,931.7	3.6	1,794.6	289	6.6	117,398.3	199	57,406	349
499	470	ULTRAPAR HOLDINGS ¹	24,816.0	[1.0]	314.8	430	[36.2]	7,870.2	497	17,034	462
500		• AIR LIQUIDE ¹	24,796.6	7.1	2,494.2	235	0.6	47,983.8	341	66,000	325
TOTALS			32,663,911.0		2,153,759.1			134,192,958.5		69,264,634	

WINNERS AND LOSERS

NEWCOMERS AND RETURNEES

	500 rank 2018
1 AIR LIQUIDE*	500
2 ANHUI CONCH GROUP	441
3 BANK OF MONTREAL*	497
4 CAIXA ECONOMICA FEDERAL	305
5 CHINA DEVELOPMENT BANK*	67
6 CHINA GENERAL TECHNOLOGY*	485
7 CRRC GROUP	359
8 DOLLAR GENERAL*	489
9 FINANCIERE DE L'ODET	456
10 FORMOSA PETROCHEMICAL*	492
11 GREE ELECTRICAL APPLIANCES	414
12 HAILIANG GROUP	473
13 HUAXIA LIFE INSURANCE	442
14 JINCHUAN GROUP	369
15 LG CHEM	490
16 MICRON TECHNOLOGY	409
17 NUCOR*	496
18 OMV GROUP*	459
19 PBF ENERGY	454
20 SAFRAN	493
21 SAUDI ARAMCO	6
22 SHANXI COKING COAL GROUP*	465
23 TONGLING NONFERROUS METALS GROUP HOLDING	461
24 TSINGSHAN HOLDING GROUP	361
25 XIAMI	468

* A RETURNEE TO THE FORTUNE GLOBAL 500 LIST.

DISPLACED FROM LIST

	500 rank 2017
1 AEGON	139
2 AETNA	154
3 ALTICE EUROPE	445
4 ANDEAVOR	344
5 AVIVA	143
6 BAE SYSTEMS	498
7 BOEHRINGER INGELHEIM	491
8 CHINA STATE SHIPBUILDING†	393
9 CRRC CORP.	385
10 DXC TECHNOLOGY	484
11 ENERGIE BADEN-WÜRTTEMBERG	477
12 ERICSSON	500
13 EXPRESS SCRIPTS HOLDING	61
14 GILEAD SCIENCES	455
15 HERAEUS HOLDING	482
16 LEGAL & GENERAL GROUP	172
17 LG DISPLAY	483
18 NOBLE GROUP	339
19 RITE AID	387
20 ROYAL PHILIPS	423
21 SSE	265
22 TEWOO GROUP†	132
23 TIME WARNER	379
24 TWENTY-FIRST CENTURY FOX	416
25 US FOODS HOLDING	488

† COMPANY DID NOT PROVIDE REQUIRED FINANCIALS FOR INCLUSION IN THE FORTUNE GLOBAL 500 LIST.

THE 31 MONEY LOSERS

	2018 rank	Loss \$ millions
GENERAL ELECTRIC	48	22,355.0*
KRAFT HEINZ	472	10,192.0
PEMEX	95	9,377.9*
VODAFONE GROUP	217	9,281.1
TATA MOTORS	265	4,122.0
U.S. POSTAL SERVICE	136	3,913.0*
NATURGY ENERGY GROUP	430	3,330.4
CHINA LIFE INSURANCE	51	2,566.9
DELL TECHNOLOGIES	84	2,310.0*
CHEMCHINA	144	2,207.6*
AUCHAN HOLDING	164	1,351.3
KOREA ELECTRIC POWER	193	1,194.9
ONEX	491	663.0
CARREFOUR	81	662.1*
CVS HEALTH	19	594.0
UNIPER	78	533.4*
NOKIA	466	401.3*
JD.COM	139	376.7*
CHINA MINMETALS	112	373.6*
YANKUANG GROUP	318	258.0*
ANSTEEL GROUP	385	254.5
CECONOMY	477	252.2
FINATIS	207	208.9*
DATONG COAL MINE GROUP	464	181.8
PHOENIX PHARMA	412	174.5
JIZHONG ENERGY GROUP	347	152.8*
HENAN ENERGY & CHEMICAL	484	133.3*
YANGQUAN COAL INDUSTRY GROUP	469	131.1*
HBIS GROUP	214	77.8*
TONGLING NONFERROUS METALS GROUP	461	70.2*
AMERICAN INTERNATIONAL GROUP	235	6.0*
TOTAL LOSS		77,707.3
MEDIAN LOSS		533.4

* ALSO LOST MONEY IN 2017.

UPS AND DOWNS

20 THAT CLIMBED			20 THAT STUMBLED		
Company	2018 rank	Rank gain from 2017	Company	2018 rank	Rank loss from 2017
COUNTRY GARDEN HOLDINGS	177	176	FACEBOOK	184	90
ITOCHU	65	139	ALIMENTATION COUCHE-TARD	210	89
ALIBABA GROUP HOLDING	182	118	MITSUMI	157	89
SK HYNIX	335	107	CHINA NATL. AVIATION FUEL GROUP	283	88
mitsubishi	33	96	PLAINS GP HOLDINGS	366	86
YANGU LONGKING GROUP	368	96	XIAMEN C&D	277	85
SUNING.COM GROUP	333	94	YANKUANG GROUP	318	81
TENCENT HOLDINGS	237	94	CHINA VANKE	254	78
BROOKFIELD ASSET MANAGEMENT	180	92	PERTAMINA	175	78
CHINA EVERGRANDE GROUP	138	92	CHINA POLY GROUP	242	70
PRUDENTIAL	372	-322			
MANULIFE FINANCIAL	418	-177			
LLOYDS BANKING GROUP	353	-164			
ING GROUP	310	-139			
LOUIS DREYFUS	302	-129			
CHINA SOUTH INDUSTRIES GROUP	367	-125			
ZURICH INSURANCE GROUP	238	-96			
BANCO DO BRASIL	269	-94			
E.ON	348	-94			
XINXING CATHAY INTL. GROUP	475	-94			
AIA GROUP	388	-93			
RAJESH EXPORTS	495	-90			
SHANDONG WEIQIAO PIONEERING GRP.	273	-88			
SWISS RE	332	-75			
GROUPE BPCE	223	-72			
COCA-COLA	395	-67			
BNP PARIBAS	104	-60			
VODAFONE GROUP	217	-59			
ITAÚ UNIBANCO HOLDING	191	-58			
SUBARU	440	-56			

NOTES

DEFINITIONS AND EXPLANATIONS

METHODOLOGY

Companies are ranked by total revenues for their respective fiscal years ended on or before March 31, 2019. All companies on the list must publish financial data and report part or all of their figures to a government agency. Figures are as reported, and comparisons are with the prior year's figures as originally reported for that year. *Fortune* does not restate the prior year's figures for changes in accounting.

REVENUES

Revenue figures include consolidated subsidiaries and reported revenues from discontinued operations, but exclude excise taxes. For banks, revenue is the sum of gross interest income and gross non-interest income. For insurance companies, revenue includes premium and annuity income, investment income, realized capital gains or losses, and other income, but excludes deposits.

PROFITS

Profits are shown after taxes, extraordinary credits or charges, cumulative effects of accounting changes, and noncontrolling (minority) interests, but before preferred dividends. Figures in parentheses indicate a loss. Profit declines of more than 100% reflect swings from 2017 profits to 2018 losses. Profits for partnerships and cooperatives are reported but are not comparable with those of the other companies on the list because they are not taxed on a comparable basis. Profits for mutual insurance companies are based on statutory accounting. Revenue and profit figures for non-U.S. companies have been converted to U.S. dollars at the average exchange rate during each company's fiscal year (ended Dec. 31, 2018, unless otherwise noted).

BALANCE SHEET

Assets shown are those at the company's fiscal year-end. Stockholders' equity is the sum of capital stock, paid-in capital, and retained earnings on the same date. Noncontrolling (minority) interest is not included. Figures for non-U.S. companies have been converted to U.S. dollars at the exchange rate at each company's fiscal year-end.

EMPLOYEES

The figure shown is either a fiscal year-end or yearly average number, as published by the company. Where the breakdown between full- and part-time employees is supplied, a part-time employee is counted as one half of a full-time employee.

MEDIANS

The medians for profit changes from 2017 do not include companies that lost money in 2017 or lost money in both 2017 and 2018, because no meaningful percentage changes can be calculated in such cases.

CREDITS

This year's *Fortune* Global 500 was prepared under the direction of list editor Scott DeCarlo. Financial statements and annual reports were reviewed by reporter Douglas Elam, accounting specialist Rhona Altschuler, and markets editor Kathleen Smyth. Zhang Dan provided figures for Chinese companies. The data verification process was aided substantially by S&P Global Market Intelligence and Refinitiv.

FOOTNOTES

- ¹ Figures prepared in accordance with International Accounting Standards.
- ² Figures prepared in accordance with U.S. Generally Accepted Accounting Principles.
- ³ Includes revenues from discontinued operations.
- ⁴ A cooperative.
- ⁵ Excise taxes have been deducted.
- ⁶ Government owned 50% or more.
- ⁷ A partnership.
- ⁸ Figures are for fiscal year ended Jan. 31, 2019.
- ⁹ Company is incorporated in Britain. Executive offices are in the Netherlands.
- ¹⁰ Figures are for fiscal year ended March 31, 2019.
- ¹¹ Figures are for fiscal year ended Sept. 30, 2018.
- ¹² Company is incorporated in Jersey. Executive offices are in Switzerland.
- ¹³ Acquired Aetna (2017 rank: 154), Nov. 28, 2018.
- ¹⁴ Acquired Time Warner (2017 rank: 379), June 14, 2018.
- ¹⁵ Figures are for fiscal year ended Aug. 31, 2018.
- ¹⁶ Figures are for fiscal year ended June 30, 2018.
- ¹⁷ Company's senior preferred stock is owned by the U.S. Treasury, which also holds a warrant to purchase 79.9% of the common stock.
- ¹⁸ Acquired Andeavor (2017 rank: 344), Oct. 1, 2018.
- ¹⁹ Changed name from DowDuPont, June 3, 2019. Figures are prior to spinoff of Corteva and Dow into independent public companies.
- ²⁰ Figures are for fiscal year ended Feb. 28, 2019.
- ²¹ Company is incorporated in the Cayman Islands. Executive offices are in China.
- ²² Figures are for fiscal year ended May 31, 2018.
- ²³ Acquired Twenty-First Century Fox (2017 rank: 416), March 20, 2019.
- ²⁴ Figures are for fiscal year ended Oct. 31, 2018.
- ²⁵ Changed name from Nippon Steel & Sumitomo Metal, April 1, 2019.
- ²⁶ Changed name from Energy Transfer Equity, Oct. 19, 2018.
- ²⁷ Figures are for fiscal year ended April 30, 2018.
- ²⁸ Figures are for fiscal year ended July 31, 2018.
- ²⁹ Acquired Express Scripts (2017 rank: 61), Dec. 20, 2018.
- ³⁰ Changed name from BHP Billiton, Nov. 19, 2018.
- ³¹ Company is incorporated in Bermuda. Executive offices are in the U.S.
- ³² Company is incorporated in Bermuda. Executive offices are in Hong Kong.
- ³³ Figures include operations for entire cooperative, including members.
- ³⁴ Changed name from Xiamen Xiangyu Group, Aug. 14, 2018.
- ³⁵ Company is incorporated in the Cayman Islands. Executive offices are in Hong Kong.
- ³⁶ Company is incorporated in Curaçao. Executive offices are in the U.S.
- ³⁷ Changed name from Gas Natural Fenosa, June 27, 2018.
- ³⁸ Company is incorporated in Spain. Executive offices are in Britain.
- ³⁹ Changed name from Qingdao Haier, June 30, 2019.
- ⁴⁰ Company reports sale of physical commodities on a gross basis.
- ⁴¹ Changed name from United Continental Holdings, June 27, 2019.

THE TOP 50 EMPLOYERS

RANK	Company	500 rank	No. of employees
1	WALMART	1	2,200,000
2	CHINA NATIONAL PETROLEUM	4	1,382,401
3	CHINA POST GROUP	101	935,191
4	STATE GRID	5	917,717
5	HON HAI PRECISION INDUSTRY	23	667,680
6	VOLKSWAGEN	9	664,496
7	AMAZON.COM	13	647,500
8	SINOPEC GROUP	2	619,151
9	COMPASS GROUP	403	595,841
10	U.S. POSTAL SERVICE	136	565,802
11	HUAXIA LIFE INSURANCE	442	500,000
12	DEUTSCHE POST DHL GROUP	124	499,018
13	AGRICULTURAL BANK OF CHINA	36	477,526
14	JARDINE MATHESON	280	469,000
15	GAZPROM	42	466,100
16	CHINA MOBILE COMMUNICATIONS	56	462,046
17	ACCENTURE	298	459,000
18	KROGER	47	453,000
19	INDUSTRIAL & COMMER. BANK OF CHINA	26	449,296
20	AVIATION INDUSTRY CORP. OF CHINA	151	446,613
21	CHINA RESOURCES	80	421,274
22	HOME DEPOT	62	413,000
23	BOSCH GROUP	77	409,881
24	CHINA TELECOMMUNICATIONS	141	403,014
25	BERKSHIRE HATHAWAY	12	389,000
26	PACIFIC CONSTRUCTION GROUP	97	387,525
27	INTERNATIONAL BUSINESS MACHINES	114	381,100
28	SIEMENS	70	379,000
29	PING AN INSURANCE	29	376,900
30	EDEKA ZENTRALE	304	376,000
31	TOYOTA MOTOR	10	370,870
32	CHINA CONSTRUCTION BANK	31	366,996
33	UNITED PARCEL SERVICE	132	364,575
34	CARREFOUR	81	363,862
35	TARGET	122	360,000
36	FEDEX	152	359,530
37	CHINA RAILWAY CONSTRUCTION	59	356,326
38	AUCHAN HOLDING	164	340,577
39	CHINA ENERGY INVESTMENT	107	338,472
40	TESCO	103	321,490
41	DEUTSCHE BAHN	208	318,528
42	EXOR GROUP	24	314,790
43	BANK OF CHINA	44	310,119
44	SAMSUNG ELECTRONICS	15	309,630
45	NESTLÉ	76	308,000
45	ROSNFT OIL	86	308,000
47	CHINA RAILWAY ENGINEERING	55	307,992
48	NIPPON TELEGRAPH AND TELEPHONE	64	303,351
49	CHINA STATE CONSTR. ENGINEERING	21	302,827
50	CK HUTCHISON HOLDINGS	352	300,000
50	UNITEDHEALTH GROUP	14	300,000

THE GLOBAL 500 MEDIAN

96,694

INNOVATION

THE RIVIERA OF THE MIDDLE EAST

Q&A with Nicholas Naples
CEO, AMAALA



On the sparkling shores of the Red Sea, the Kingdom of Saudi Arabia is developing the ultimate luxury resort, which promises to provide local and international visitors with a new level of refinement and luxurious comfort. The AMAALA resort will offer its guests adventure, culture, history, sports, relaxation, and atelier retail shopping, while they bask in the very highest standards of wellness and healthy living. CEO Nicholas Naples introduces AMAALA and discusses his vision for this once-in-a-lifetime project.

When will AMAALA open for business?

We are building the project across three large phases and plan to start construction by the end of this year. The first phase will open a few years from now, with all phases completed by 2028. AMAALA will be a singular luxury resort destination exceeding all expectations. The values, the experience, and the opportunity for self-discovery will differentiate us from every other resort on the planet. We are focusing on transformative experiences and transformational luxury. We seek to inspire our visitors with art, culture, wellness, and the natural wonders and beauty of the Red Sea. We have an opportunity to create something truly unique, disrupting contemporary concepts of an ultra-luxury resort experience.



Top: Aerial view of the Triple Bay master plan
Bottom: An underwater guest villa
Right: An ultra-luxury hotel on The Island

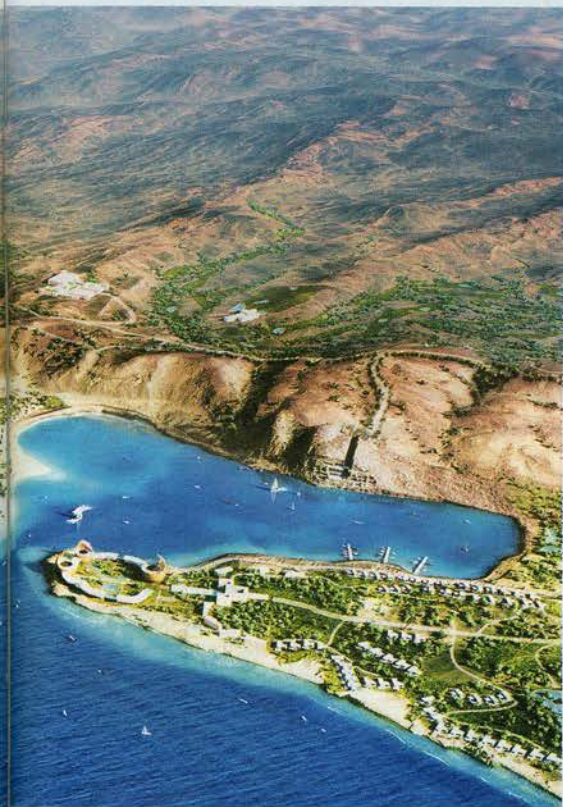
How many visitors do you expect? Where will they come from?

We expect approximately 500,000 overnight guests per year once the project is completed. Additionally, we will host up to 1 million annual event participants and respite-seeking day-trippers enjoying our yearlong calendar of art shows, festivals, and other curated activities. There will be a broad range of amenity options, including retail and restaurants, all set in a comfortable, relaxed, and unhurried atmosphere.

A key aspect of AMAALA is our ability to create truly individualized experiences. We will provide unique amenities and personalized services, enabling each guest to shape their own ultra-luxury experience. AMAALA will celebrate arts, culture, fashion, wellness, and sports, providing guests with a bespoke luxury lifestyle of their own design. We will cater to singles, couples, and families from the Saudi Arabia and GCC region, as well as international clients from China, Brazil, Russia, India, Western Europe, the U.S., and Japan.

How easy will it be for your international guests to reach AMAALA?

Saudi Arabia is far closer to major international cities than you might realize. And due to its close proximity to major



resort destinations in the region, including Marrakech, Petra/Jordan, Cairo, Beirut, Dubai, and Istanbul, AMAALA is well positioned to become the heart of the new Red Sea Riviera.

AMAALA will have its own airport, initially serving private jet and charter arrivals, with the aim of later receiving commercial flights. Visitors will receive an automatic entry visa via an online portal or upon arrival.

When is the best time to visit AMAALA?

AMAALA is a 12-month-a-year destination thanks to the unique climate along the Red Sea coast. Our weather is very similar to that of the Mediterranean, without the humidity of Dubai. We benefit from our close proximity to the Suez Canal, the gateway from the Mediterranean to the Red Sea. With our temperate climate, AMAALA will be a desirable year-round yachting destination.

What activities will guests be able to enjoy?

Our guests will have access to a suite of services, including arts exhibitions, cultural events and exciting sports offerings. There will be a range of ultra-luxury, internationally branded hotels and private villas, a retail

“
THE VALUES,
EXPERIENCE
AND
OPPORTUNITY
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DISCOVERY
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FROM EVERY
OTHER
RESORT ON
THE PLANET.
”

—
NICHOLAS
NAPLES

souk, an active arts village hosting an international academy of the arts, and a world-class marine research facility.

AMAALA's offerings will strike an emotional chord with guests. Through curated wellness and rejuvenation programs, we will connect with our guests' hearts and minds. At our Triple Bay resort location, we will partner with some of the world's most exclusive wellness institutes and best practitioners, offering specialized medical, aesthetic, and integrative wellness treatments to enhance health and lifestyle. There will also be a major focus on sports, including an elite training facility for tennis, golf, and soccer, taught by some of the best athletes and trainers in the world, along with family-related activities such as equestrian, camel beauty, and falconry events as well as competitive polo, sailing, yachting, diving, snorkeling, and windsurfing.

Arts and culture offerings at our island resort location are integral to our brand promise. We expect our arts foundation to fund an academy of the arts, sponsoring up to 30 up-and-coming artists from around the world. Their workshops in the artisan village will host events where guests can interact with the resident artists and master craftspeople. There will be opportunities for philanthropic art co-creation, where guests can make a bespoke work of art alongside artisans of their choosing, promising an immersive learning experience quite unlike anything offered at luxury resorts today.

How important is sustainability to AMAALA?

Sustainability is a cornerstone of the project and we are building AMAALA with a zero-carbon footprint as a primary goal. We utilize international sustainability standards in our operational protocols, covering everything from the use of solar power, advanced waste management technologies, and sustainable farming to recycling and much more.

Our coral reefs are pristine. And, vitally, our marine biosphere has been spared from the ongoing environmental havoc contributing to rapidly disappearing reefs in most other parts of the planet. We are going to great lengths to preserve and enhance our coral reefs, taking our role as their custodians very seriously. We intend to establish a marine life institute focused on research for the propagation of corals and the preservation and enhancement of reefs around the world. We've partnered with the Prince Albert Foundation in Monaco to support research into oceanic and marine life conservation. Our aim is to heighten awareness through education and experience-based initiatives at our resort properties. ●



HOW THE COMPANIES STACK UP

In the splashiest Global 500 debut in memory, state-owned oil giant **Saudi Aramco** topped the profits list, with \$111 billion in earnings in 2018. But the profitmaking power of tech companies was on display as well, with **Apple**, **Samsung Electronics**, and **Alphabet** combining to earn more than \$130 billion.



PUMPING OUT PROFITS: A Saudi Aramco processing facility in Shaybah oilfield, Saudi Arabia.

BIGGEST PROFITS

RANK	500rank	2018 profits \$ millions	Profits % change from 2017	
1	SAUDI ARAMCO	6	110,974.5	46.9
2	APPLE	11	59,531.0	23.1
3	INDUSTRIAL & COMMERCIAL BANK OF CHINA	26	45,002.3	6.3
4	SAMSUNG ELECTRONICS	15	39,895.2	9.1
5	CHINA CONSTRUCTION BANK	31	38,498.4	7.4
6	JPMORGAN CHASE & CO.	41	32,474.0	32.9
7	ALPHABET	37	30,736.0	142.7
8	AGRICULTURAL BANK OF CHINA	36	30,656.5	7.4
9	BANK OF AMERICA CORP.	58	28,147.0	54.4
10	BANK OF CHINA	44	27,225.2	6.7
11	ROYAL DUTCH SHELL	3	23,352.0	79.9
12	GAZPROM	42	23,199.1	89.4
13	WELLS FARGO	69	22,393.0	0.9
14	FACEBOOK	184	22,112.0	38.8
15	INTEL	135	21,053.0	119.3
16	EXXON MOBIL	8	20,840.0	5.7
17	AT&T	25	19,370.0	(34.2)
18	CITIGROUP	71	18,045.0	-
19	TOYOTA MOTOR	10	16,982.0	(24.6)
20	CHINA DEVELOPMENT BANK	67	16,744.3	0.7
21	MICROSOFT	60	16,571.0	(21.8)
22	PING AN INSURANCE	29	16,237.2	23.2
23	FANNIE MAE	49	15,959.0	547.9
24	VERIZON COMMUNICATIONS	43	15,528.0	(48.4)
25	JOHNSON & JOHNSON	109	15,297.0	1,076.7

RANK	500rank	2018 profits \$ millions	Profits % change from 2017	
26	CHEVRON	28	14,824.0	61.2
27	VOLKSWAGEN	9	14,322.5	9.3
28	MICRON TECHNOLOGY	409	14,135.0	177.8
29	SK HYNIX	335	14,125.4	50.0
30	HSBC HOLDINGS	99	13,727.0	27.1
31	RIO TINTO GROUP	303	13,638.0	55.6
32	SBERBANK	255	13,268.5	3.1
33	ALIBABA GROUP HOLDING	182	13,094.4	35.4
34	SOFTBANK GROUP	98	12,727.9	35.7
35	NOVARTIS	201	12,611.0	63.7
36	WALT DISNEY	170	12,598.0	40.3
37	PEPSICO	154	12,515.0	157.7
38	CHINA MERCHANTS BANK	188	12,179.0	17.3
39	TAIWAN SEMICONDUCTOR MANUFACTURING	363	12,043.9	6.2
40	UNITEDHEALTH GROUP	14	11,986.0	13.5
41	TENCENT HOLDINGS	237	11,900.6	12.5
42	PETRONAS	158	11,868.3	35.5
43	CHINA MOBILE COMMUNICATIONS	56	11,745.3	7.4
44	COMCAST	75	11,731.0	(48.4)
45	TOTAL	20	11,446.0	32.6
46	PFIZER	198	11,153.0	(47.7)
47	BANK OF COMMUNICATIONS	150	11,131.3	7.1
48	HOME DEPOT	62	11,121.0	28.9
49	UNILEVER	167	11,080.6	62.4
50	ROCHE GROUP	163	10,738.1	22.4
	THE GLOBAL 500 MEDIAN		2,290.7	7.4

BIGGEST INCREASES IN REVENUES

RANK		500rank	Revenues % change from 2017	2018 revenues \$ millions
1	ANHUI CONCH GROUP	441	144.1	28,499.0
2	mitsubishi	33	112.7	145,243.3
3	ITOCHU	65	110.4	104,627.3
4	HUAXIA LIFE INSURANCE	442	87.4	28,492.8
5	COUNTRY GARDEN HOLDINGS	177	70.7	57,308.7
6	XIAOMI	468	55.9	26,443.5
7	CHINA EVERGRANDE GROUP	138	53.2	70,478.9
8	MICRON TECHNOLOGY	409	49.5	30,391.0
9	ALIBABA GROUP HOLDING	182	48.7	56,147.2
10	MARATHON PETROLEUM	72	43.6	97,102.0
11	TSINGSHAN HOLDING GROUP	361	43.2	34,242.2
12	mitsui	157	42.1	62,751.4
13	BROOKFIELD ASSET MANAGEMENT	180	39.2	56,771.0
14	SK HYNIX	335	38.0	36,763.1
15	FACEBOOK	184	37.4	55,838.0
16	DUPONT	100	37.2	85,977.0
17	GREE ELECTRICAL APPLIANCES	414	36.2	30,239.4
18	ALIMENTATION COUCHE-TARD	210	35.6	51,394.4
19	SAUDI ARAMCO	6	35.3	355,905.0
20	PERTAMINA	175	34.9	57,933.6
21	TENCENT HOLDINGS	237	34.4	47,272.7
22	SUNING.COM GROUP	333	33.2	37,032.2
23	CHINA NATIONAL OFFSHORE OIL	63	32.7	108,130.4
24	CHINA NATIONAL AVIATION FUEL GROUP	283	32.6	42,370.9
25	TRAFIGURA GROUP	22	32.5	180,744.1
26	RELIANCE INDUSTRIES	106	32.1	82,331.2
27	YANKUANG GROUP	318	31.9	38,887.3
28	FINANCIÈRE DE L'ODET	456	31.5	27,172.7
29	XIAMEN C&D	277	31.1	42,726.3
30	AMAZON.COM	13	30.9	232,887.0
31	YANGO LONGKING GROUP	368	30.4	33,394.8
32	EQUINOR	113	30.1	79,593.0
33	PLAINS GP HOLDINGS	366	29.9	34,055.0
34	JD.COM	139	29.4	69,847.6
35	CHINA FAW GROUP	87	29.2	89,804.7
36	CHINA DEVELOPMENT BANK	67	28.3	103,072.9
37	CHINA VANKE	254	27.9	44,912.6
38	ROYAL DUTCH SHELL	3	27.2	396,556.0
39	REPSOL	200	27.0	53,176.0
40	LUKOIL	50	26.9	119,145.0
41	SINOPEC GROUP	2	26.8	414,649.9
42	VALERO ENERGY	57	26.0	111,407.0
43	XIAMEN ITS HOLDING GROUP	291	25.9	41,437.5
44	DEERE	329	25.6	37,357.7
45	ROSNEFT OIL	86	25.0	90,055.0
46	BRITISH AMERICAN TOBACCO	384	25.0	32,667.0
47	ENTERPRISE PRODUCTS PARTNERS	337	24.9	36,534.2
48	CHINA POLY GROUP	242	24.9	46,207.1
49	PBF ENERGY	454	24.8	27,186.1
50	PHILLIPS 66	54	24.7	114,217.0
	THE GLOBAL 500 MEDIAN		7.4	45,403.9

BIGGEST INCREASES IN PROFITS

RANK		500rank	Profits % change from 2017	2018 profits \$ millions
1	LIBERTY MUTUAL INSURANCE GROUP	278	12,605.9	2,160.0
2	SHOUgang GROUP	402	9,568.3	84.2
3	JOHNSON & JOHNSON	109	1,076.7	15,297.0
4	CHS	383	983.8	775.9
5	CHINA UNITED NETWORK COMMUNICATIONS	262	879.1	616.9
6	INTL FCSTONE	449	767.2	55.5
7	CHINA BAOWU STEEL GROUP	149	721.3	2,168.2
8	CATERPILLAR	130	715.3	6,147.0
9	FANNIE MAE	49	547.9	15,959.0
10	MUNICH RE GROUP	145	544.9	2,726.2
11	HEWLETT PACKARD ENTERPRISE	404	454.7	1,908.0
12	COCA-COLA	395	415.5	6,434.0
13	ABBOTT LABORATORIES	408	396.4	2,368.0
14	CHINA NATIONAL BUILDING MATERIAL GROUP	203	356.3	69.4
15	AMERISOURCEBERGEN	27	355.0	1,658.4
16	UBS GROUP	274	322.1	4,516.0
17	XINJIANG GUANGHUI INDUSTRY INVESTMENT	439	321.8	137.0
18	SNCF MOBILITÉS	326	314.9	5,313.1
19	HONEYWELL INTERNATIONAL	290	308.8	6,765.0
20	STATE FARM INSURANCE COS.	108	298.3	8,788.4
21	SINOPEC GROUP	2	280.1	5,845.0
22	AMAZON.COM	13	232.1	10,073.0
23	SUNING.COM GROUP	333	223.3	2,014.8
24	CAPITAL ONE FINANCIAL	387	203.5	6,015.0
25	DMV GROUP	459	195.0	1,789.1
26	TECH DATA	330	192.0	340.6
27	ALBERTSONS COS.	165	183.2	131.1
28	MICRON TECHNOLOGY	409	177.8	14,135.0
29	BP	7	176.9	9,383.0
30	SAMSUNG C&T	444	175.1	1,556.9
31	DUPONT	100	163.3	3,844.0
32	MERCK	285	159.8	6,220.0
33	PEPSICO	154	157.7	12,515.0
34	AMERICAN EXPRESS	270	153.0	6,921.0
35	LOCKHEED MARTIN	197	152.0	5,046.0
36	BROOKFIELD ASSET MANAGEMENT	180	145.1	3,584.0
37	GLAXOSMITHKLINE	296	145.0	4,832.3
38	GOLDMAN SACHS GROUP	204	144.0	10,459.0
39	CHINA NATIONAL OFFSHORE OIL	63	142.9	7,331.1
40	ALPHABET	37	142.7	30,736.0
41	SHANXI LUAN MINING GROUP	462	139.0	1.2
42	ROSNEFT OIL	86	129.7	8,745.8
43	MANULIFE FINANCIAL	418	128.4	3,703.7
44	INTEL	135	119.3	21,053.0
45	POSTE ITALIANE	355	112.6	1,651.1
46	HP	173	110.9	5,327.0
47	CHINA ELECTRONICS	375	110.0	350.3
48	NATIONWIDE	271	107.9	512.6
49	XIAMEN C&D	277	106.9	631.3
50	ANHUI CONCH GROUP	441	92.1	1,628.9
	THE GLOBAL 500 MEDIAN		7.4	2,290.7

RANKED WITHIN COUNTRIES

Boosted by newcomers like consumer-electronics maker **Xiaomi**, China threatened the U.S.'s title as the country with the most Global 500 companies. Turmoil around Brexit, meanwhile, sent ripples through the list: Britain, which boasted 40 Global 500 companies in 2000, has just 17 this year, four fewer than in 2018.



SNAP JUDGMENT: A trade-show guest tests the cameras on two new Xiaomi smartphones.

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
AUSTRALIA 7 COMPANIES			
1	WESFARMERS Perth	195	53,985.3
2	WOOLWORTHS GROUP Bella Vista	233	47,842.1
3	BHP GROUP Melbourne	246	45,809.0
4	COMMONWEALTH BANK OF AUSTRALIA Sydney	373	33,186.3
5	WESTPAC BANKING Sydney	433	29,027.9
6	AUSTRALIA & NEW ZEALAND BANKING GROUP Docklands	457	27,147.9
7	NATIONAL AUSTRALIA BANK Docklands	479	25,942.7
TOTAL			262,941.2

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
AUSTRIA 1 COMPANY			
1	OMV GROUP Vienna	459	27,061.3
TOTAL			27,061.3

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
BELGIUM 1 COMPANY			
1	ANHEUSER-BUSCH INBEV Leuven	192	54,619.0
TOTAL			54,619.0

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
BRAZIL 8 COMPANIES			
1	PETROBRAS Rio de Janeiro	74	95,584.0
2	ITAÚ UNIBANCO HOLDING São Paulo	191	54,662.5
3	JBS São Paulo	219	49,709.7
4	BANCO BRADESCO Osasco	221	49,612.3
5	BANCO DO BRASIL Brasília	269	43,332.9
6	CAIXA ECONÔMICA FEDERAL Brasília	305	40,240.5
7	VALE Rio de Janeiro	336	36,696.0
8	ULTRAPAR HOLDINGS São Paulo	499	24,816.0
TOTAL			394,653.9

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
BRITAIN 16 COMPANIES			
1	BP London	7	303,738.0
2	HSBC HOLDINGS London	99	86,131.0
3	TESCO Welwyn Garden City	103	84,270.6
4	VODAFONE GROUP Newbury	217	50,532.4
5	GLAXOSMITHKLINE Brentford	296	41,108.5
6	RIO TINTO GROUP London	303	40,522.0
7	CENTRICA Windsor	311	39,594.7
8	BARCLAYS London	320	38,278.3
9	J. SAINSBURY London	321	38,064.0
10	LLDYS BANKING GROUP London	353	35,251.9
11	PRUDENTIAL London	372	33,252.6
12	BRITISH AMERICAN TOBACCO London	384	32,667.0
13	COMPASS GROUP Chertsey	403	30,878.8
14	BT GROUP London	405	30,743.0
15	INTERNATIONAL AIRLINES GROUP Harmondsworth	435	28,803.2
16	ANGLO AMERICAN London	450	27,610.0
TOTAL			941,446.0

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
BRITAIN/NETHERLANDS 1 COMPANY			
1	UNILEVER London	167	60,167.3
TOTAL			60,167.3

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
CANADA 13 COMPANIES			
1	BROOKFIELD ASSET MANAGEMENT Toronto, Ontario	180	56,771.0
2	ALIMENTATION COUCHE-TARD Laval, Quebec	210	51,394.4
3	ROYAL BANK OF CANADA Toronto, Ontario	256	44,609.3
4	TORONTO-DOMINION BANK Toronto, Ontario	295	41,198.7
5	MAGNA INTERNATIONAL Aurora, Ontario	299	40,827.0

RANK	Company, Headquarters	500rank	REVENUES \$ millions
6	GEORGE WESTON Toronto, Ontario	325	37,474.8
7	POWER CORP. OF CANADA Montreal, Quebec	331	37,112.2
8	ENBRIDGE Calgary, Alberta	346	35,785.0
9	BANK OF NOVA SCOTIA Toronto, Ontario	398	31,589.3
10	SUNCOR ENERGY Calgary, Alberta	417	30,081.4
11	MANULIFE FINANCIAL Toronto, Ontario	418	30,070.6
12	ONEX Toronto, Ontario	491	25,606.0
13	BANK OF MONTREAL Toronto, Ontario	497	25,002.7
TOTAL			487,522.4

CHINA 119 COMPANIES

1	SINOPEC GROUP Beijing	2	414,649.9
2	CHINA NATIONAL PETROLEUM Beijing	4	392,976.6
3	STATE GRID Beijing	5	387,056.0
4	CHINA STATE CONSTRUCTION ENGINEERING Beijing	21	181,524.5
5	INDUSTRIAL & COMMERCIAL BANK OF CHINA Beijing	26	168,979.0
6	PING AN INSURANCE Shenzhen	29	163,597.4
7	CHINA CONSTRUCTION BANK Beijing	31	151,110.8
8	AGRICULTURAL BANK OF CHINA Beijing	36	139,523.6
9	SAIC MOTOR Shanghai	39	136,392.5
10	BANK OF CHINA Beijing	44	127,714.1
11	CHINA LIFE INSURANCE Beijing	51	116,171.5
12	CHINA RAILWAY ENGINEERING GROUP Beijing	55	112,132.7
13	CHINA MOBILE COMMUNICATIONS Beijing	56	112,096.0
14	CHINA RAILWAY CONSTRUCTION Beijing	59	110,455.9
15	HUAWEI INVESTMENT & HOLDING Shenzhen	61	109,030.4
16	CHINA NATIONAL OFFSHORE OIL Beijing	63	108,130.4
17	CHINA DEVELOPMENT BANK Beijing	67	103,072.9
18	CHINA RESOURCES Hong Kong	80	91,986.0
19	DONGFENG MOTOR Wuhan	82	90,934.2
20	CHINA FAW GROUP Changchun	87	89,804.7
21	SINOCHEM GROUP Beijing	88	89,358.1
22	CHINA COMMUNICATIONS CONSTRUCTION Beijing	93	88,140.9
23	PACIFIC CONSTRUCTION GROUP Urumqi	97	86,622.6
24	CHINA POST GROUP Beijing	101	85,627.9
25	CHINA ENERGY INVESTMENT Beijing	107	81,977.7
26	CHINA SOUTHERN POWER GRID Guangzhou	111	80,963.6
27	CHINA MINMETALS Beijing	112	80,076.4
28	AMER INTERNATIONAL GROUP Shenzhen	119	76,363.1
29	PEOPLE'S INSURANCE CO. OF CHINA Beijing	121	75,377.3
30	BEIJING AUTOMOTIVE GROUP Beijing	129	72,677.4
31	COFCO Beijing	134	71,223.3
32	CITIC GROUP Beijing	137	70,659.0
33	CHINA EVERGRANDE GROUP Shenzhen	138	70,478.9
34	JD.COM Beijing	139	69,847.6
35	CHINA NORTH INDUSTRIES GROUP Beijing	140	68,777.7
36	CHINA TELECOMMUNICATIONS Beijing	141	68,709.5
37	CHEMCHINA Beijing	144	67,397.5
38	CHINA BAOWU STEEL GROUP Shanghai	149	66,310.0
39	BANK OF COMMUNICATIONS Shanghai	150	65,644.8
40	AVIATION INDUSTRY CORP. OF CHINA Beijing	151	65,534.4
41	POWERCHINA Beijing	161	61,224.0
42	SINOPHARM Beijing	169	59,980.2
43	COUNTRY GARDEN HOLDINGS Foshan	177	57,308.7
44	HENGLI GROUP Suzhou City	181	56,198.6
45	ALIBABA GROUP HOLDING Hangzhou	182	56,147.2

RANK	Company, Headquarters	500rank	REVENUES \$ millions
46	CHINA MERCHANTS BANK Shenzhen	188	55,063.5
47	GUANGZHOU AUTOMOBILE INDUSTRY GROUP Guangzhou	189	55,037.2
48	CHINA PACIFIC INSURANCE (GROUP) Shanghai	199	53,572.1
49	GREENLAND HOLDING GROUP Shanghai	202	52,720.9
50	CHINA NATIONAL BUILDING MATERIAL GROUP Beijing	203	52,610.6
51	SHANDONG ENERGY GROUP Jinan	211	51,245.6
52	LENDVO GROUP Hong Kong	212	51,037.9
53	INDUSTRIAL BANK Fuzhou	213	50,991.4
54	HBIS GROUP Shijiazhuang	214	50,920.6
55	SHANGHAI PUDONG DEVELOPMENT BANK Shanghai	216	50,545.7
56	ZHEJIANG GEELY HOLDING GROUP Hangzhou	220	49,665.4
57	CHINA MINSHENG BANKING Beijing	232	47,981.3
58	TENCENT HOLDINGS Shenzhen	237	47,272.7
59	CHINA POLY GROUP Beijing	242	46,207.1
60	CHINA SHIPBUILDING INDUSTRY Beijing	243	46,114.4
61	CHINA MERCHANTS GROUP Hong Kong	244	45,925.7
62	WUCHAN ZHONGDA GROUP Hangzhou	249	45,435.0
63	SINOMACH Beijing	250	45,424.0
64	ALUMINUM CORP. OF CHINA Beijing	251	45,383.8
65	CHINA VANKE Shenzhen	254	44,912.6
66	CHINA UNITED NETWORK COMMUNICATIONS Beijing	262	43,974.4
67	SHAANXI YANCHANG PETROLEUM (GROUP) Xi'an	263	43,858.1
68	SHANDONG WEIQIAO PIONEERING GROUP Shandong	273	43,008.4
69	XIAMEN C&D Xiamen	277	42,726.3
70	CHINA COSCO SHIPPING Shanghai	279	42,607.7
71	JARDINE MATHESON Hong Kong	280	42,527.0
72	SHAANXI COAL & CHEMICAL INDUSTRY Xi'an	281	42,418.8
73	CHINA NATIONAL AVIATION FUEL GROUP Beijing	283	42,370.9
74	CHINA HUANENG GROUP Beijing	286	42,280.9
75	CHINA EVERBRIGHT GROUP Beijing	289	41,879.7
76	XIAMEN ITC HOLDING GROUP Xiamen	291	41,437.5
77	CEDAR HOLDINGS GROUP Guangzhou	301	40,640.8
78	MIDEA GROUP Foshan	312	39,581.6
79	YANKUANG GROUP Zoucheng	318	38,887.3
80	CHINA AEROSPACE SCIENCE & INDUSTRY Beijing	322	37,869.8
81	CHINA AEROSPACE SCIENCE & TECHNOLOGY Beijing	323	37,727.6
82	SUNING.COM GROUP Nanjing	333	37,032.2
83	XMYG Xiamen	338	36,503.7
84	JIANGSU SHAGANG GROUP Zhongjiaogang	340	36,440.9
85	JIZHONG ENERGY GROUP Xingtai	347	35,721.3
86	CK HUTCHISON HOLDINGS Hong Kong	352	35,361.2
87	JIANGXI COPPER Guixi	358	34,870.0
88	CRRC GROUP Beijing	359	34,673.0
89	TSINGSHAN HOLDING GROUP Wenzhou	361	34,242.2
90	STATE POWER INVESTMENT Beijing	362	34,229.2
91	CHINA ENERGY ENGINEERING GROUP Beijing	364	34,176.5
92	CHINA SOUTH INDUSTRIES GROUP Beijing	367	33,895.8
93	YANGU LONGKING GROUP Fuzhou	368	33,394.8
94	JINCHUAN GROUP Jinchang City	369	33,391.6
95	CHINA ELECTRONICS TECHNOLOGY GROUP Beijing	370	33,323.8
96	CHINA ELECTRONICS Beijing	375	33,055.7
97	ANSTEEL GROUP Anshan	385	32,619.4
98	CHINA HUADIAN Beijing	386	32,421.4
99	AIA GROUP Hong Kong	388	32,369.0
100	SHOUGANG GROUP Beijing	402	31,103.8
101	GREE ELECTRICAL APPLIANCES Zhuhai	414	30,239.4
102	CHINA DATANG Beijing	438	28,654.9

RANKED WITHIN COUNTRIES

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
103	XINJIANG GUANGHUI INDUSTRY INVESTMENT Urumqi	439	28,564.0
104	ANHUI CONCH GROUP Wuhu	441	28,499.0
105	HUAXIA LIFE INSURANCE Beijing	442	28,492.8
106	HAIER SMART HOME Qingdao	448	27,713.6
107	CHINA TAIPING INSURANCE GROUP Hong Kong	451	27,485.8
108	TONGLING NONFERROUS METALS GROUP Tangling	461	26,846.7
109	SHANXI LUAN MINING GROUP Changzhi	462	26,840.5
110	DATONG COAL MINE GROUP Datong	464	26,697.6
111	SHANXI COKING COAL GROUP Taiyuan	465	26,692.8
112	XIAOMI Beijing	468	26,443.5
113	YANGQUAN COAL INDUSTRY GROUP Yangquan	469	26,290.1
114	HAILIANG GROUP Hangzhou	473	26,251.0
115	XINXING CATHAY INTERNATIONAL GROUP Beijing	475	26,207.9
116	SHANXI JINCHENG ANTHRACITE COAL MINING GROUP Jincheng	482	25,844.7
117	HENAN ENERGY & CHEMICAL Zhengzhou	484	25,781.9
118	CHINA GENERAL TECHNOLOGY Beijing	485	25,779.1
119	TAIKANG INSURANCE GROUP Beijing	498	24,931.7
TOTAL			7,914,912.3

DENMARK 1 COMPANY

1	MAERSK GROUP Copenhagen	294	41,256.0
TOTAL			41,256.0

FINLAND 1 COMPANY

1	NOKIA Espoo	466	26,628.1
TOTAL			26,628.1

FRANCE 31 COMPANIES

1	TOTAL Courbevoie	20	184,106.0
2	AXA Paris	46	125,578.2
3	CARREFOUR Massy	81	91,955.2
4	CRÉDIT AGRICOLE Paris	91	88,325.0
5	PEUGEOT Rueil-Malmaison	96	87,364.3
6	BNP PARIBAS Paris	104	83,973.7
7	ELECTRICITÉ DE FRANCE Paris	110	81,403.3
8	ENGIE Courbevoie	126	74,144.1
9	RENAULT Boulogne-Billancourt	143	67,764.1
10	AUCHAN HOLDING Croix	164	60,749.2
11	SOCIÉTÉ GÉNÉRALE Paris	174	58,390.0
12	CHRISTIAN DIOR Paris	187	55,262.6
13	VINCI Rueil-Malmaison	206	52,345.2
14	FINATIS Paris	207	52,272.0
15	GROUPE BPCE Paris	223	49,529.3
16	SAINT-GOBAIN Courbevoie	226	49,300.4
17	ORANGE Paris	228	48,836.5
18	CNP ASSURANCES Paris	248	45,461.3
19	BOUYGUES Paris	287	42,179.2
20	SANOFI Paris	288	42,104.8
21	SNCF MOBILITÉS St. Denis	326	37,388.9
22	L'ORÉAL Clichy	396	31,790.7
23	AIR FRANCE-KLM GROUP Paris	401	31,292.2
24	VEOLIA ENVIRONNEMENT Aubervilliers	407	30,579.5
25	SCHNEIDER ELECTRIC Rueil-Malmaison	411	30,353.9
26	LA POSTE Paris	428	29,149.0
27	DANONE Paris	432	29,092.3

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
28	FINANCIÈRE DE L'ODET Paris	456	27,172.7
29	MICHELIN Clermont-Ferrand	478	25,996.7
30	SAFRAN Paris	498	25,191.9
31	AIR LIQUIDE Paris	500	24,796.6
TOTAL			1,763,848.9

GERMANY 29 COMPANIES

1	VOLKSWAGEN Wolfsburg	9	278,341.5
2	DAIMLER Stuttgart	18	197,515.3
3	ALLIANZ Munich	45	126,799.6
4	BMW GROUP Munich	53	115,042.8
5	SIEMENS Munich	70	98,802.0
6	BOSCH GROUP Stuttgart	77	92,601.9
7	UNIPER Düsseldorf	78	92,260.8
8	DEUTSCHE TELEKOM Bonn	90	89,286.8
9	BASF Ludwigshafen	115	78,798.7
10	DEUTSCHE POST DHL GROUP Bonn	124	75,000.9
11	MUNICH RE GROUP Munich	145	67,225.9
12	RWE Essen	183	56,016.7
13	CONTINENTAL Hanover	205	52,404.7
14	DEUTSCHE BAHN Berlin	208	52,004.1
15	THYSSENKRUPP Essen	215	50,856.1
16	DEUTSCHE BANK Frankfurt	239	46,969.5
17	BAYER Leverkusen	240	46,718.1
18	ZF FRIEDRICHSHAFEN Friedrichshafen	266	43,582.4
19	METRO Düsseldorf	267	43,466.5
20	TALANX Hanover	282	42,390.5
21	LUFTHANSA GROUP Cologne	284	42,302.0
22	EDEKA ZENTRALE Hamburg	304	40,454.2
23	FRESENIUS Bad Hamburg	313	39,571.0
24	E.ON Essen	348	35,703.6
25	DZ BANK Frankfurt	392	31,975.5
26	PHOENIX PHARMA Mannheim	412	30,296.0
27	SAP Walldorf	427	29,159.6
28	CECONOMY Düsseldorf	477	26,129.4
29	ADIDAS Herzogenaurach	481	25,920.0
TOTAL			2,047,596.1

INDIA 7 COMPANIES

1	RELIANCE INDUSTRIES Mumbai	106	82,331.2
2	INDIAN OIL New Delhi	117	77,587.0
3	OIL & NATURAL GAS New Delhi	160	61,420.4
4	STATE BANK OF INDIA Mumbai	236	47,286.0
5	TATA MOTORS Mumbai	265	43,599.2
6	BHARAT PETROLEUM Mumbai	275	42,935.6
7	RAJESH EXPORTS Bengaluru	495	25,142.6
TOTAL			380,302.0

INDONESIA 1 COMPANY

1	PERTAMINA Jakarta	175	57,933.6
TOTAL			57,933.6

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
IRELAND 4 COMPANIES			
1	ACCENTURE Dublin	298	40,993.0
2	CRH Dublin	397	31,625.0
3	JOHNSON CONTROLS INTERNATIONAL Cork	399	31,400.0
4	MEDTRONIC Dublin	419	29,953.0
TOTAL			133,971.0

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
ITALY 6 COMPANIES			
1	ENI Rome	83	90,799.8
2	ENEL Rome	89	89,305.7
3	ASSICURAZIONI GENERALI Trieste	92	88,157.4
4	INTESA SANPAOLO Turin	315	39,050.6
5	POSTE ITALIANE Rome	355	35,071.1
6	UNICREDIT GROUP Milan	425	29,332.3
TOTAL			371,716.9

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
JAPAN 52 COMPANIES			
1	TOYOTA MOTOR Toyota	10	272,612.0
2	MITSUBISHI Tokyo	33	145,243.3
3	HONDA MOTOR Tokyo	34	143,302.9
4	JAPAN POST HOLDINGS Tokyo	52	115,220.5
5	NIPPON TELEGRAPH AND TELEPHONE Tokyo	64	107,146.9
6	ITOCHU Osaka	65	104,627.3
7	NISSAN MOTOR Yokohama	66	104,390.6
8	SOFTBANK GROUP Tokyo	98	86,604.7
9	HITACHI Tokyo	102	85,507.8
10	JXTG HOLDINGS Tokyo	105	82,733.3
11	SONY Tokyo	116	78,157.7
12	AEON Chiba	118	77,122.5
13	NIPPON LIFE INSURANCE Osaka	125	74,202.3
14	PANASONIC Osaka	131	72,178.4
15	MARUBENI Tokyo	147	66,753.5
16	DAI-ICHI LIFE HOLDINGS Tokyo	153	64,794.9
17	MITSUI Tokyo	157	62,751.4
18	SEVEN & I HOLDINGS Tokyo	159	61,486.5
19	TOYOTA TSUSHO Nagoya	162	60,994.3
20	MITSUBISHI UFJ FINANCIAL GROUP Tokyo	166	60,405.3
21	TOKYO ELECTRIC POWER Tokyo	178	57,167.4
22	NIPPON STEEL CORPORATION Tokyo	186	55,720.2
23	SUMITOMO MITSUI FINANCIAL GROUP Tokyo	209	51,728.0
24	MS&AD INSURANCE GROUP HOLDINGS Tokyo	222	49,609.6
25	TOKIO MARINE HOLDINGS Tokyo	224	49,395.7
26	DENSO Kariya	230	48,368.0
27	SUMITOMO Tokyo	231	48,155.7
28	KDDI Tokyo	245	45,820.8
29	MITSUBISHI ELECTRIC Tokyo	300	40,766.1
30	MEIJI YASUDA LIFE INSURANCE Tokyo	324	37,722.9
31	DAIWA HOUSE INDUSTRY Osaka	327	37,371.2
32	MITSUBISHI HEAVY INDUSTRIES Tokyo	334	36,783.5
33	AISIN SEIKI Kariya	339	36,465.7
34	CANON Tokyo	345	35,796.9
35	FUJITSU Tokyo	349	35,647.9
36	MIZUHO FINANCIAL GROUP Tokyo	350	35,406.3
37	MITSUBISHI CHEMICAL HOLDINGS Tokyo	351	35,386.4
38	IDEMITSU KOSAN Tokyo	354	35,091.0

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
39	JFE HOLDINGS Tokyo	356	34,937.4
40	SUZUKI MOTOR Hamamatsu	357	34,917.9
41	TOSHIBA Tokyo	371	33,312.8
42	BRIDGESTONE Tokyo	374	33,062.9
43	SOMPO HOLDINGS Tokyo	377	32,857.4
44	SUMITOMO LIFE INSURANCE Osaka	378	32,825.0
45	MAZDA MOTOR Hiroshima	389	32,150.8
46	KANSAI ELECTRIC POWER Osaka	420	29,832.5
47	MEDIPAL HOLDINGS Tokyo	436	28,698.5
48	SUMITOMO ELECTRIC INDUSTRIES Osaka	437	28,662.9
49	SUBARU Tokyo	440	28,505.4
50	CHUBU ELECTRIC POWER Nagoya	453	27,374.1
51	EAST JAPAN RAILWAY Tokyo	458	27,076.1
52	NEC Tokyo	470	26,277.0
TOTAL			3,129,130.1

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
LUXEMBOURG 1 COMPANY			
1	ARCELORMITTAL Luxembourg	120	76,033.0
TOTAL			76,033.0

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
MALAYSIA 1 COMPANY			
1	PETRONAS Kuala Lumpur	158	62,230.6
TOTAL			62,230.6

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
MEXICO 4 COMPANIES			
1	PEMEX Mexico City	95	87,403.3
2	AMÉRICA MÓVIL Mexico City	196	53,977.6
3	CFE Mexico City	443	28,457.1
4	FOMENTO ECONÓMICO MEXICANO Monterrey	488	25,679.0
TOTAL			195,517.0

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
NETHERLANDS 11 COMPANIES			
1	ROYAL DUTCH SHELL The Hague	3	396,556.0
2	EXOR GROUP Amsterdam	24	175,009.5
3	AIRBUS Leiden	123	75,185.0
4	ROYAL AHOLD DELHAIZE Zaandam	127	74,103.9
5	LOUIS DREYFUS Rotterdam	302	40,571.0
6	ING GROUP Amsterdam	310	39,598.2
7	LYONDELLBASELL INDUSTRIES Rotterdam	316	39,004.0
8	RANDSTAD Diemen	446	28,102.2
9	HEINEKEN HOLDING Amsterdam	467	26,608.1
10	RABOBANK GROUP Utrecht	483	25,823.3
11	ACHMEA Zeist	494	25,180.1
TOTAL			945,741.3

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
NORWAY 1 COMPANY			
1	EQUINOR Stavanger	113	79,593.0
TOTAL			79,593.0

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
POLAND 1 COMPANY			
1	PKN ORLEN GROUP Plock	410	30,389.9
TOTAL			30,389.9

RANKED WITHIN COUNTRIES

RANK	Company, Headquarters	500rank	REVENUES \$ millions
RUSSIA 4 COMPANIES			
1	GAZPROM Moscow	42	131,302.0
2	LUKOIL Moscow	50	119,145.0
3	ROSNEFT OIL Moscow	86	90,055.0
4	SBERBANK Moscow	255	44,898.4
TOTAL			385,400.4

RANK	Company, Headquarters	500rank	REVENUES \$ millions
SAUDI ARABIA 2 COMPANIES			
1	SAUDI ARAMCO Dhahran	6	355,905.0
2	SABIC Riyadh	252	45,096.4
TOTAL			401,001.4

RANK	Company, Headquarters	500rank	REVENUES \$ millions
SINGAPORE 3 COMPANIES			
1	TRAFIGURA GROUP Singapore	22	180,744.1
2	WILMAR INTERNATIONAL Singapore	258	44,497.7
3	FLEX Singapore	474	26,210.5
TOTAL			251,452.3

RANK	Company, Headquarters	500rank	REVENUES \$ millions
SOUTH KOREA 16 COMPANIES			
1	SAMSUNG ELECTRONICS Suwon	15	221,579.4
2	SK HOLDINGS Seoul	73	95,904.5
3	HYUNDAI MOTOR Seoul	94	87,999.2
4	POSCO Seoul	171	59,223.2
5	LG ELECTRONICS Seoul	185	55,757.4
6	KOREA ELECTRIC POWER Jeollanam-do	193	54,567.9
7	KIA MOTORS Seoul	227	49,238.4
8	HANWHA Seoul	261	44,303.0
9	SK HYNIX Gyeonggi	335	36,763.1
10	GS CALTEX Seoul	376	33,052.7
11	HYUNDAI MOBIS Seoul	393	31,949.4
12	SAMSUNG LIFE INSURANCE Seoul	426	29,305.8
13	KB FINANCIAL GROUP Seoul	434	29,000.9
14	SAMSUNG C&T Seoul	444	28,319.4
15	CJ CORP. Seoul	463	26,835.7
16	LG CHEM Seoul	490	25,617.3
TOTAL			909,417.3

RANK	Company, Headquarters	500rank	REVENUES \$ millions
SPAIN 9 COMPANIES			
1	BANCO SANTANDER Madrid	85	90,531.9
2	TELEFÓNICA Madrid	176	57,465.9
3	REPSOL Madrid	200	53,176.0
4	BANCO BILBAO VIZCAYA ARGENTARIA Bilbao	234	47,608.0
5	ACS Madrid	272	43,263.2
6	IBERDROLA Bilbao	292	41,395.4
7	INDITEX Arteixo	406	30,686.7
8	NATURGY ENERGY GROUP Madrid	430	29,123.0
9	MAPFRE GROUP Madrid	452	27,423.5
TOTAL			420,673.6

RANK	Company, Headquarters	500rank	REVENUES \$ millions
SWEDEN 1 COMPANY			
1	VOLVO Göteborg	253	44,957.0
TOTAL			44,957.0

RANK	Company, Headquarters	500rank	REVENUES \$ millions
SWITZERLAND 14 COMPANIES			
1	GLENCORE Baar	16	219,754.0
2	NESTLÉ Vevey	76	93,512.5
3	ROCHE GROUP Basel	163	60,846.2
4	NOVARTIS Basel	201	53,166.0
5	ZURICH INSURANCE GROUP Zurich	238	47,180.0
6	UBS GROUP Zurich	274	42,960.0
7	ABB Zurich	328	37,360.0
8	SWISS RE Zurich	332	37,047.0
9	CREDIT SUISSE GROUP Zurich	360	34,284.2
10	CHUBB Zurich	382	32,717.0
11	COOP GROUP Basel	415	30,235.4
12	MIGROS GROUP Zurich	431	29,098.2
13	ADECCO GROUP Zurich	445	28,167.1
14	LAFARGEHOLCIM Jona	447	28,088.8
TOTAL			774,416.4

RANK	Company, Headquarters	500rank	REVENUES \$ millions
TAIWAN 10 COMPANIES			
1	HON HAI PRECISION INDUSTRY New Taipei City	23	175,617.0
2	PEGATRON Taipei	259	44,453.3
3	TAIWAN SEMICONDUCTOR MANUFACTURING Hsinchu	363	34,218.2
4	QUANTA COMPUTER Taoyuan	365	34,102.6
5	COMPAL ELECTRONICS Taipei	390	32,102.8
6	CPC Kaohsiung	394	31,928.9
7	WISTRON Taipei	424	29,509.5
8	CATHAY LIFE INSURANCE Taipei	455	27,183.4
9	FUBON FINANCIAL HOLDING Taipei	471	26,276.5
10	FORMOSA PETROCHEMICAL Mailiao	492	25,462.8
TOTAL			460,855.0

RANK	Company, Headquarters	500rank	REVENUES \$ millions
THAILAND 1 COMPANY			
1	PTT Bangkok	130	72,307.2
TOTAL			72,307.2

RANK	Company, Headquarters	500rank	REVENUES \$ millions
TURKEY 1 COMPANY			
1	KOC HOLDING Istanbul	423	29,592.3
TOTAL			29,592.3

RANK	Company, Headquarters	500rank	REVENUES \$ millions
UNITED ARAB EMIRATES 1 COMPANY			
1	EMIRATES GROUP Dubai	476	26,147.7
TOTAL			26,147.7

RANK	Company, Headquarters	500rank	REVENUES \$ millions
U.S. 121 COMPANIES			
1	WALMART Bentonville, Ark.	1	514,405.0
2	EXXON MOBIL Irving, Texas	8	290,212.0
3	APPLE Cupertino, Calif.	11	265,595.0
4	BERKSHIRE HATHAWAY Omaha, Neb.	12	247,837.0
5	AMAZON.COM Seattle, Wash.	13	232,887.0
6	UNITEDHEALTH GROUP Minnetonka, Minn.	14	226,247.0
7	MCKESSON Irving, Texas	17	214,319.0
8	CVS HEALTH Woonsocket, R.I.	19	194,579.0

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
9	AT&T Dallas, Texas	25	170,756.0
10	AMERISOURCEBERGEN Chesterbrook, Pa.	27	167,939.6
11	CHEVRON San Ramon, Calif.	28	166,339.0
12	FORD MOTOR Dearborn, Mich.	30	160,338.0
13	GENERAL MOTORS Detroit, Mich.	32	147,049.0
14	COSTCO WHOLESALE Issaquah, Wash.	35	141,576.0
15	ALPHABET Mountain View, Calif.	37	136,819.0
16	CARDINAL HEALTH Dublin, Ohio	38	136,809.0
17	WALGREENS BOOTS ALLIANCE Deerfield, Ill.	40	131,537.0
18	JPMORGAN CHASE & CO. New York, N.Y.	41	131,412.0
19	VERIZON COMMUNICATIONS New York, N.Y.	43	130,863.0
20	KROGER Cincinnati, Ohio	47	121,162.0
21	GENERAL ELECTRIC Boston, Mass.	48	120,268.0
22	FANNIE MAE Washington, D.C.	49	120,101.0
23	PHILLIPS 66 Houston, Texas	54	114,217.0
24	VALERO ENERGY San Antonio, Texas	57	111,407.0
25	BANK OF AMERICA CORP. Charlotte, N.C.	58	110,584.0
26	MICROSOFT Redmond, Wash.	60	110,360.0
27	HOME DEPOT Atlanta, Ga.	62	108,203.0
28	BOEING Chicago, Ill.	68	101,127.0
29	WELLS FARGO San Francisco, Calif.	69	101,060.0
30	CITIGROUP New York, N.Y.	71	97,120.0
31	MARATHON PETROLEUM Findlay, Ohio	72	97,102.0
32	COMCAST Philadelphia, Pa.	75	94,507.0
33	ANTHEM Indianapolis, Ind.	79	92,105.0
34	DELL TECHNOLOGIES Round Rock, Texas	84	90,621.0
35	DUPONT Wilmington, Del.	100	85,977.0
36	STATE FARM INSURANCE COS. Bloomington, Ill.	108	81,732.2
37	JOHNSON & JOHNSON New Brunswick, N.J.	109	81,581.0
38	INTERNATIONAL BUSINESS MACHINES Armonk, N.Y.	114	79,591.0
39	TARGET Minneapolis, Minn.	122	75,356.0
40	FREDDIE MAC McLean, Va.	128	73,598.0
41	UNITED PARCEL SERVICE Atlanta, Ga.	132	71,861.0
42	LOWE'S Mooresville, N.C.	133	71,309.0
43	INTEL Santa Clara, Calif.	135	70,848.0
44	U.S. POSTAL SERVICE Washington, D.C.	136	70,660.0
45	METLIFE New York, N.Y.	142	67,941.0
46	PROCTER & GAMBLE Cincinnati, Ohio	146	66,832.0
47	UNITED TECHNOLOGIES Farmington, Conn.	148	66,501.0
48	FEDEX Memphis, Tenn.	152	65,450.0
49	PEPSICO Purchase, N.Y.	154	64,661.0
50	ARCHER DANIELS MIDLAND Chicago, Ill.	155	64,341.0
51	PRUDENTIAL FINANCIAL Newark, N.J.	156	62,992.0
52	ALBERTSONS COS. Boise, Idaho	165	60,534.5
53	CENTENE St. Louis, Mo.	168	60,116.0
54	WALT DISNEY Burbank, Calif.	170	59,434.0
55	SYSCO Houston, Texas	172	58,727.3
56	HP Palo Alto, Calif.	173	58,472.0
57	HUMANA Louisville, Ky.	179	56,912.0
58	FACEBOOK Menlo Park, Calif.	184	55,838.0
59	CATERPILLAR Deerfield, Ill.	190	54,722.0
60	ENERGY TRANSFER Dallas, Texas	194	54,436.0
61	LOCKHEED MARTIN Bethesda, Md.	197	53,762.0
62	PFIZER New York, N.Y.	198	53,647.0
63	GOLDMAN SACHS GROUP New York, N.Y.	204	52,528.0
64	MORGAN STANLEY New York, N.Y.	218	50,193.0
65	CISCO SYSTEMS San Jose, Calif.	225	49,330.0

RANK	Company, Headquarters	500 rank	REVENUES \$ millions
66	CIGNA Bloomfield, Conn.	229	48,650.0
67	AMERICAN INTERNATIONAL GROUP New York, N.Y.	235	47,389.0
68	HCA HEALTHCARE Nashville, Tenn.	241	46,677.0
69	BUNGE White Plains, N.Y.	247	45,743.0
70	AMERICAN AIRLINES GROUP Fort Worth, Texas	257	44,541.0
71	DELTA AIR LINES Atlanta, Ga.	260	44,438.0
72	CHARTER COMMUNICATIONS Stamford, Conn.	264	44,634.0
73	NEW YORK LIFE INSURANCE New York, N.Y.	268	43,425.3
74	AMERICAN EXPRESS New York, N.Y.	270	43,281.0
75	NATIONWIDE Columbus, Ohio	271	43,270.0
76	BEST BUY Richfield, Minn.	276	42,879.0
77	LIBERTY MUTUAL INSURANCE GROUP Boston, Mass.	278	42,685.0
78	MERCK Kenilworth, N.J.	285	42,294.0
79	HONEYWELL INTERNATIONAL Morris Plains, N.J.	290	41,802.0
80	UNITED AIRLINES HOLDINGS Chicago, Ill.	293	41,303.0
81	TIAA New York, N.Y.	297	41,052.1
82	TYSON FOODS Springdale, Ark.	306	40,052.0
83	ORACLE Redwood City, Calif.	307	39,831.0
84	ALLSTATE Northbrook, Ill.	308	39,815.0
85	WORLD FUEL SERVICES Miami, Fla.	309	39,750.3
86	MASSACHUSETTS MUTUAL LIFE INSURANCE Springfield, Mass.	314	39,267.2
87	TJX Framingham, Mass.	317	38,972.9
88	CONOCOPHILLIPS Houston, Texas	319	38,727.0
89	DEERE Moline, Ill.	329	37,357.7
90	TECH DATA Clearwater, Fla.	330	37,239.0
91	ENTERPRISE PRODUCTS PARTNERS Houston, Texas	337	36,534.2
92	NIKE Beaverton, Ore.	341	36,397.0
93	PUBLIX SUPER MARKETS Lakeland, Fla.	342	36,395.7
94	GENERAL DYNAMICS Falls Church, Va.	343	36,193.0
95	EXELON Chicago, Ill.	344	35,985.0
96	PLAINS GP HOLDINGS Houston, Texas	366	34,055.0
97	SCHLUMBERGER Houston, Texas	379	32,815.0
98	3M St. Paul, Minn.	380	32,765.0
99	ABBVIE North Chicago, Ill.	381	32,753.0
100	CHS Inver Grove Heights, Minn.	383	32,683.3
101	CAPITAL ONE FINANCIAL McLean, Va.	387	32,377.0
102	PROGRESSIVE Mayfield Village, Ohio	391	31,979.0
103	COCA-COLA Atlanta, Ga.	395	31,856.0
104	UNITED SERVICES AUTOMOBILE ASSN. San Antonio, Texas	400	31,367.8
105	HEWLETT PACKARD ENTERPRISE Palo Alto, Calif.	404	30,852.0
106	ABBOTT LABORATORIES Abbott Park, Ill.	408	30,578.0
107	MICRON TECHNOLOGY Boise, Idaho	409	30,391.0
108	TRAVELERS COS. New York, N.Y.	413	30,282.0
109	NORTHROP GRUMMAN Falls Church, Va.	416	30,095.0
110	ARROW ELECTRONICS Centennial, Colo.	421	29,676.8
111	PHILIP MORRIS INTERNATIONAL New York, N.Y.	422	29,625.0
112	NORTHWESTERN MUTUAL Milwaukee, Wis.	429	29,124.0
113	INTL FCSTONE New York, N.Y.	449	27,622.7
114	PBF ENERGY Parsippany, N.J.	454	27,186.1
115	RAYTHEON Waltham, Mass.	460	27,058.0
116	KRAFT HEINZ Pittsburgh, Pa.	472	26,268.0
117	MONDELEZ INTERNATIONAL Deerfield, Ill.	480	25,938.0
118	U.S. BANCORP Minneapolis, Minn.	486	25,775.0
119	MACY'S Cincinnati, Ohio	487	25,739.0
120	DOLLAR GENERAL Goodlettsville, Tenn.	489	25,625.0
121	NUCOR Charlotte, N.C.	496	25,067.3
TOTAL			9,402,480.0



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Company	Country	Global 500 rank	
ABB	SWITZERLAND	328	
ABBOTT LABORATORIES	U.S.	408	
ABBVIE	U.S.	381	
ACCENTURE	IRELAND	298	
ACHMEA	NETHERLANDS	494	
ACS	SPAIN	272	
ADECCO GROUP	SWITZERLAND	445	
ADIDAS	GERMANY	481	
AEON	JAPAN	118	
AGRICULTURAL BANK OF CHINA	CHINA	36	
AIA GROUP	CHINA	388	
AIRBUS	NETHERLANDS	123	
AIR FRANCE-KLM GROUP	FRANCE	401	
AIR LIQUIDE	FRANCE	500	
AISIN SEIKI	JAPAN	339	
ALBERTSONS COS.	U.S.	165	
ALIBABA GROUP HOLDING	CHINA	182	
ALIMENTATION COUCHE-TARD	CANADA	210	
ALLIANZ	GERMANY	45	
ALLSTATE	U.S.	308	
ALPHABET	U.S.	37	
ALUMINUM CORP. OF CHINA	CHINA	251	
AMAZON.COM	U.S.	13	
AMÉRICA MÓVIL	MEXICO	196	
AMERICAN AIRLINES GROUP	U.S.	257	
AMERICAN EXPRESS	U.S.	270	
AMERICAN INTERNATIONAL GROUP	U.S.	235	
AMER INTERNATIONAL GROUP	CHINA	119	
AMERISOURCEBERGEN	U.S.	27	
ANGLO AMERICAN	BRITAIN	450	
ANHEUSER-BUSCH INBEV	BELGIUM	192	
ANHUI CONCH GROUP	CHINA	441	
ANSTEEL GROUP	CHINA	385	
ANTHEM	U.S.	79	
APPLE	U.S.	11	
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ARCHER DANIELS MIDLAND	U.S.	155	
ARROW ELECTRONICS	U.S.	421	
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BANCO BILBAO VIZCAYA ARGENTARIA	SPAIN	234	
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BANCO DO BRASIL	BRAZIL	269	
BANCO SANTANDER	SPAIN	85	
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BANK OF COMMUNICATIONS	CHINA	150	
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BANK OF NOVA SCOTIA	CANADA	398	
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BAYER	GERMANY	240	
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BERKSHIRE HATHAWAY	U.S.	12	
BEST BUY	U.S.	276	
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BHP GROUP	AUSTRALIA	246	
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BRIDGESTONE	JAPAN	374	
BRITISH AMERICAN TOBACCO	BRITAIN	384	
BROOKFIELD ASSET MANAGEMENT	CANADA	180	
BT GROUP	BRITAIN	405	
BUNGE	U.S.	247	
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CAPITAL ONE FINANCIAL	U.S.	387	
CARDINAL HEALTH	U.S.	38	
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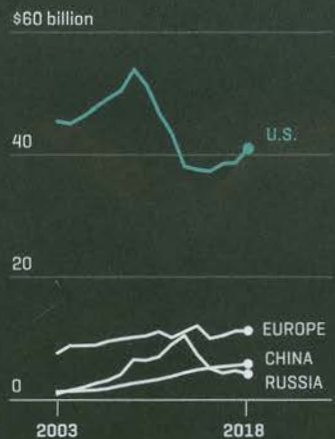
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KANSAI ELECTRIC POWER JAPAN	420	NIPPON TELEGRAPH AND TELEPHONE JAPAN	64	SAMSUNG ELECTRONICS SOUTH KOREA	15	TOYOTA TSUSHO JAPAN	162
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MICROSOFT U.S.	60	RABOBANK NETHERLANDS	483	SUNING.COM GROUP CHINA	333	XINXING CATHAY INTERNATIONAL CHINA	475
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MITSUBISHI JAPAN	33	RAYTHEON U.S.	460	SYSCO U.S.	172	YANGQUAN COAL INDUSTRY GROUP CHINA	469
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MONEY RACES INTO SPACE

COUNTRIES WITH GOVERNMENT SPENDING ON SPACE PROGRAMS GREATER THAN \$200 MILLION IN 2018



ANNUAL PROGRAM SPENDING (ADJUSTED FOR INFLATION)



FIFTY YEARS after the Apollo 11 astronauts first walked on the moon, global investment in space is blasting off again. According to new data from space-market specialists Euroconsult, last year 18 countries spent at least \$200 million on space-related activities, from satellites to exploration. While the U.S. remains on top, other nations are gaining. China has increased space spending 349% over 15 years. That's just on the government side. Private investment in space is also reaching a new orbit. A total of \$22.3 billion has been invested in 476 space companies since 2009, according to investment firm Space Angels. —BRIAN O'KEEFE

BAGS WITH A MISSION FOR WOMEN ON A MISSION

FEED Founder, Lauren Bush Lauren,
carrying the Leather FEED 1 Bag,
which provides 185 school meals.

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