BILL DODSON

CHINA FAST FORWARD

The Technologies, Green Industries and Innovations Driving the Mainland's Future

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China Fast Forward

The Technologies, Green Industries and Innovations Driving the Mainland's Future

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John Wiley & Sons Singapore Pte. Ltd.

Published by John Wiley & Sons Singapore Pte. Ltd.

1 Fusionopolis Walk, #07-01, Solaris South Tower, Singapore 138628

Other Wiley Editorial Offices

John Wiley & Sons, 111 River Street, Hoboken, NJ 07030, USA

John Wiley & Sons, The Atrium, Southern Gate, Chichester, West Sussex, P019 8SQ, United Kingdo

John Wiley & Sons (Canada) Ltd., 5353 Dundas Street West, Suite 400, Toronto, Ontario, M9B 6HE Canada

John Wiley & Sons Australia Ltd., 42 McDougall Street, Milton, Queensland 4064, Australia

Wiley-VCH, Boschstrasse 12, D-69469 Weinheim, Germany

ISBN 978-1-118-17632-0 (Cloth)

ISBN 978-1-118-17634-4 (ePDF)

ISBN 978-1-118-17633-7 (Mobi)

ISBN 978-1-118-17635-1 (ePub)

For my son, Ashley Xavier “Si Cheng” Dodson

Acknowledgments

Nearly every ambitious effort an individual concludes is couched in collaboration. *China Fa Forward* is an attempt to survey a wide range of industries, technologies, and social developments China that are as disparate as they are fast-moving. The effort required me to extend my shallo perceptions of trends with which I had little experience to a depth that would provide reade informative and engaging insights. None of the revelations could have happened without the extensiv rounds of conversations with the experts, analysts, and practitioners who live the developments eve day in China. Any errors or omissions readers may find are solely mine.

Practitioners who have shared for years the insights and experiences they've gained from the hands-on work in their industries include Peter Holmes, Michael "Mickey" Duff, Mark "Six" Kissne Robert Kong, and Fulvio Hernandez. The continued jovial support and industry-specific banter of th Blue Marlin "Think Tank" over the years in the China-Singapore Suzhou Industrial Park als contributed to insights in the book. Through the accretion of countless conversations during o gatherings I have gained a great appreciation for the efforts involved in cultivating approaches innovation in manufacturing in China.

I owe a debt of gratitude to my friend Andrew Hupert for sharing his thinking and wisdom abo industry trends and government involvement in China. Andrew was an adjunct professor at th Shanghai campus of New York University while I worked on this project. He always made the time t discuss major developments with me and to review drafts of articles and chapters that came to mak up the final publication of *China Fast Forward*.

I talked with countless professionals involved in one way or another with China's energy secto Some of those who offered me their valuable time without reservation included Franz Lang, Po Kristensen, Hans Suo, Johann Wiebe, and Torben Jorgensen. Bhavesh Mistry and Basile Waite als contributed insights into some of the articles I published, that eventually made their way into the fin manuscript. Staff members of the Daoda Heavy Industry Company were great hosts who enlighten me to the special challenges confronting the shipping and wind power industries in China.

I reserve a special note of thanks for the *China Economic Review*, based in Shanghai, for its suppo and encouragement of the China energy and environment column I produced for their publication. particular, great thanks to the publisher, Graham Earnshaw; Pete Sweeny, who while chief edito suggested I contribute to the column; and Ana Swanson, Pete's successor, who encouraged me to di under the surface of China's cleantech sector. Author and China industry analyst Paul French was a always supportive and informative about the publication process throughout the project.

The chapter on services outsourcing trends was several years in the making. Pivotal in i development were the generous introductions that the operations directors gave me to their faciliti in Shanghai. Sushil Asar and Michael Su were warm and informative hosts at Mahindra Satyam, a were Cai Jieru and her colleagues at Shanghai SAFE Software. Local government officials in Chi were also helpful and supportive of my interests in the development of the services outsourcin industry. Daisy Gao in the Suzhou Industrial Park, Juliet Zhu in the Suzhou New District, and Ca Long at the Chengdu Tianfu Software Park were particularly helpful and gracious hosts in explainin to me their operations. The energetic staff at the economic development zone of the Jiangning distri of Nanjing was always a pleasure to visit, and the efficient staff of the Hangzhou New and Hig Technology Park was especially informative. Sustainability should be such a well-defined sector.

Richard Brubaker, professor of Corporate Social Responsibility at the China-Europe Internation

Business School (CEIBS), was exceptional in helping me frame sustainability within the context China's modernization drive. Bambu owners Rachel Speth and Jeff Delkin are tireless business peop whose housewares company should be a model for many businesses to emulate. For a decade the have thought deeply about the practicality of sustainable manufacturing within an Industri Revolution context and have met implementation challenges with grit and honesty. Despite their bus lives in Shanghai, southeast Asia and the United States, they took considerable time in educating m about sustainability issues in business. My greatest thanks to Brubaker, Speth, and Delkin for the tim they spent reviewing portions of the manuscript.

Even before *China Fast Forward* became a manuscript Grace Lu was a most charming an forthcoming guide to charity work in China and the promise of social entrepreneurship. My dee gratitude, as well, to Linda Hou for the sort of unselfish support that helped me reach the finish line the project.

My publisher, Nick Wallwork, and Jules Yap, the editorial executive at the Singapore division o John Wiley & Sons, were instrumental in accepting the initial proposal for *China Fast Forward* and shaping its momentum. I deeply appreciate their patience with this author during the writing an editorial process. Despite her hectic schedule, Emilie Herman in the Hoboken, New Jersey office Wiley, was always positive, considerate, and patient in taking the manuscript from rough to refined.

In no small measure has the unwavering support of my friends Doug Wack, Franziska Gloeckne and Palle Linde enabled this project to come to completion. Their help defined for me the tru meaning of friendship.

My wife, Jessica Zhou, was not always clear about what I was on about with the project and why found it important to invest so much of my time and attention to it. Still, she hung with me during th entire birthing process, for which I am grateful.

The true inspiration for *China Fast Forward* was my son, Ashley Xavier "Si Cheng," who was just few months old while I was writing the book. Throughout the writing process I considered just wh sort of world he would be living in when he reached adulthood. Both of American and Chines ancestry, he will be confronted with choices and challenges I can scant imagine. If he one day read this book and excavates even a single nugget of insight that helps inform his decisions, I will hav considered *China Fast Forward* a success.

Introduction

China today is a train traveling through a lightning storm. None of us are spectators; all of us are passengers.

—A Chinese user of Sina.com's Weibo, a Twitter-like Internet application, July 24th, 201

On the night of July 23, 2011, China's perceptions about its society, its leadership, and the direction i which the country was developing shattered like a mirror under a hammer blow. Even the Chines Communist Party (CCP) was forced to recognize its own disjointed reflection in the glare of th frightful lightning strike that changed the course of the central government's momentum for glob leadership status. A high-speed train traveling nearly 400 kilometers per hour (240 miles per hou came to a crawl and then a full-stop when lightning struck the high-tension wire that had lured through the mountainous countryside. Night poured into the disabled train, black as pitch. Sudden great sparks sprayed from the tail-end of the marooned vessel as another express train smashed into like the hammer of a gun firing its load into the gully below. Forty people died that night. Tw hundred more were injured.

Just three weeks before the incident, CCP officials were extolling the virtues of their super-fa trains to the international community. They charmed the Americans with the promise of cheap high speed rail to lace together its far-flung cities. They told the Germans "finder's keepers" in reference the train technology the Chinese had acquired from the Europeans and now exported to oth countries. They extended, too, a metaphorical middle finger to their arch-enemies, the Japanese, wh had warned the world months before that the Chinese leadership was driving trains too hard, too fas and using Japanese technologies not thoroughly tested on Chinese rails.

Within hours of the accident, the Ministry of Railways buried the damaged coaches in heaps of ear not far from the bridge where they had cascaded. Some Chinese who viewed the video of the cover-u claimed to have seen unrecovered bodies still flopping around in the cars. Nevertheless, one little gi named Yiyi was discovered still alive nearly a day after the accident as officials prepared to bury wh would have become her coffin. She was wedged between her parents, both dead.

Millions of Weibo "tweets" had already been aflame with news and views of the accident. The shee number of text messages proved to expose the crisis of confidence citizens had in its leadership an the direction in which the country was developing. With Twitter blocked in China, Weibo had becom the default microblogger of choice for hundreds of millions of Internet users in the country. During prime-time slot Central China Television (CCTV) broadcaster Qiu Qiming echoed Internet calls fo accountability from central government authorities:

"If nobody can be safe, do we still want this speed?" he said. ". . . Can the roads we travel on in ou cities not collapse? Can we travel in safe trains? And if and when a major accident does happen, ca we not be in a hurry to bury the trains? China, please slow down. If you're too fast, you may leave th souls of your people behind."

The short message encapsulated the times in which 1.5 billion people—including my family and I- were living in the country: Economic growth and modernization had morphed dangerously out control. The event itself and the government's response to public excoriation were truly historic.

Conventional media grilled the CCP and the Ministry of Railways. Traditional Party mouthpiece like the national television network CCTV, the *China Daily* and the sensationalist *Global Time*

roasted the highest levels of authority. Weibo and blogs authored by millions of Chinese Internet use continued the flow of vitriol for weeks. Beijing then did the most unexpected thing.

It did not shut down the media channels. Any of them.

Some high-profile media commentators were censured, according to sources, while others we suspended or may have been fired. However, none of the popular, unofficial Internet sources of nev suffered wholesale censorship. The armies of censors at first tried to filter out messages wi keywords deemed inflammatory, and, initially, some blogs were pulled down. The centr government, however, did not block the most sensitive parts of the incident from the publi Apparatchiks understood that they would have to act quickly, decisively, to keep the populace fro massing against them.

Another completely unexpected—and, for the central government, a highly embarrassing—mov was to slow trains with a top design speed of 350 km/h to 300 km/h. Trains designed to run up to 25 km/h were not allowed to exceed 200 km/h. The CSR Corporation Ltd., makers of the trains for th highly publicized Beijing-Shanghai line, recalled over 40 coaches built specifically for the line, th crown jewel of China's high-speed rail. Authorities reverted to the older equipment of the tradition overnight train between Beijing and Shanghai, which resulted in a dramatic change in travel time fro 6 hours by high-speed rail to 11 hours with conventional rolling stock and locomotives. In addition, a newly built high-speed rail lines were to undergo a thorough inspection. By the end of 2011, all ne construction on the rail lines had come to an abrupt stop. Innovation with Chinese characteristics- what the central government called "indigenous innovation"—was in for a serious review.

• • •

In 2006 Beijing implemented a national initiative that required foreign companies with proprieta technologies to share those technologies with local partners. The policy applied for the most part industries the country deemed strategic to its economic preeminence, like information technolog aerospace, biotechnology, and cleantech. Joint cooperation meant Chinese interests having access product blueprints, in some product categories. The Chinese would then localize the technology meet conditions within the country's borders, and patent the remake in international markets China's own. Beijing called the policy "indigenous innovation." The innovation policy faile however, in the critical signaling technology the Japanese had passed over to the Chinese to build th Beijing-Shanghai high-speed rail line.

The Japanese had placed their technology in a black box the Chinese were unable to revers engineer. Their best railway technicians set about replicating the contents of the black box witho fully understanding the design. The misunderstanding in how signaling works within a Japane context and how it needed to be adjusted in Mainland China was a major contributor in the Hangzho Wenzhou train crash. The ripple effects of the innovation misstep touched on every major aspect modern Chinese society's vision of the perfect future its leadership had been molding for its peop and promoting to the world. *China Fast Forward* explores the critical juncture at which the socie then found its development and the choices remaining open to it in the near future.

China Fast Forward is a survey of some the many technologies, industries, and innovations China adopting from the West, modifying in many instances, and applying to build and consolidate i position in the world as a global leader. To be a superpower in modern terms implies the highest lev of social development any country can attain in an epoch, as well as the greatest capacity the nati has to sustain the lofty heights it has attained. *China Fast Forward* explores the nature of innovati

in the manner in which China understands it and the nation's interpretation of the mechanism b
which discoveries are made and integrated with the world in which we live. The book also explor
whether the society's innovation priorities will assist it—and the rest of the world—in overcoming th
energy, resource, and environmental constraints against which it is already pressing.

In 2011 China's central planners understood they had reached a tipping point in the nation
economic and social development. The quality of the innovations central planners intended for ma
consumption was becoming more important to citizens than the quantity and the speed with whic
products were offered up for consumption. This included infrastructure projects. Whether high-spe
trains, bridges, roadways, residential property, or a plethora of other government and commerci
interests, Chinese were beginning to fatigue under the constant stress of not knowing whether the ca
they drove in, the airplanes they flew in, or the trains in which they commuted were going
disintegrate mid-operation. For instance, six months before the bullet train accident, centr
authorities had placed a moratorium on any further development of wind power farms. Half the wir
turbines manufacturers had built were off-line and the half that were online were having consta
maintenance problems. Three months later, the nuclear power plant disaster at the Fukushima-Daiic
facility in north Japan forced Chinese central authorities to place a moratorium on the approval of ne
projects. Nuclear power promoters within the government had slated 77 new nuclear power plants
be built in the nine years leading up to 2020—the most any country in history had attempted to bui
in such a short time span. Before the end of 2011 the central government had announced it would b
paring down the number of nuclear power projects that would actually be built and that the ne
facilities would use safer third-generation technology, imported from Europe. Re-innovation, th
central authorities were beginning to admit, had its limitations in building a modern, digital society.

The public shortcomings of re-innovation impacted the credibility of Chinese scientists an
researchers filing the second most patents in the world by 2010. Critics charged that if the paten
were simply adaptations and localizations of technologies copied from designs implemente
elsewhere, were those real innovations? And what was so earth-shattering about them? Ultimately, di
answers to these questions matter to us in the West, or to other developing nations?

The answers, it seemed, did matter to any nation that had been or was building its society o
outmoded paradigms of the Industrial Revolution. How China in particular adapted importe
technologies to develop its high-speed rail system and other critical projects reflected on China
understanding of the nature of innovation. The integrity of its undertakings illustrated how it wa
spending its creative capital to meet the challenges of modernization, overpopulation, and agin
demographics.

For instance, just over half the country's population lived in cities by 2012. By 2020 China's urba
centers will support a migration of 100 million people from rural to urban life. By 2025 China wi
have more than 220 cities with populations greater than 1 million. The country will have paved
billion square meters of road and built 5 million buildings, including 50,000 high rises.[1]

The leadership will have to find jobs for its newly urbanized. It will have to ensure ample water an
food for the new city dwellers. It will also have to provide constant supplies of electricity, quadrup
the amount their rural cousins require. Governments at every level will also be responsible f
moderating air, water, and land pollution to ensure the spaces are livable for residents. The high-spee
rail was one of the country's most important components in reducing its carbon emissions. Still, bull
trains require their electricity to come from somewhere. The fount of energy will likely be one of th
thousands of coal-burning power stations pock-marking the Chinese landscape. The ways, means, an

will with which the country ameliorates its dependency on fossil fuels—especially coal—matte greatly. Climate change will dramatically affect the degree to which China will be able to build an sustain a post-industrial society—its digital dynasty. However, just as China fully realizes its visio mid-century it will meet a "hard ceiling" of social development similar to what it has hit several tim before in its long history. The Industrial Revolution paradigms upon which it has careened in modernity have exposed resource, environmental, and energy constraints on a global scal Modernization has created new problems and conditions the country must resolve to maintain livi standards.

Ian Morris, in his thought-provoking book *Why the West Rules—For Now: The Patterns of Histo and What They Reveal About the Future*, defines social development as a society's ability to get thing done, to shape its physical, economic, social, and intellectual environments to its own end. Morr relates four essential measures of social development: energy capture, urbanism, informatio processing, and a society's capacity to make war. Energy capture is a society's ability to harnes energy, as in burning coal to heat water into motive steam that drives turbines. Urbanism represents society's ability to organize its resources—like energy, people, and matériel—into rational drive that facilitate the society's efforts to achieve its goals. Information processing reflects th sophistication, the rapidity with which information travels, and the capture rates of the transmission The Internet has proven a much more effective means of communications than the telegraph, f instance. And a society's wherewithal to make war on others or to defend itself is critical in som instances to preservation of the society. The hard ceiling, as Morris defines it, is the point in society's lifetime when it can no longer sustain current levels of complexity in its society. Josep Tainter, in his book *The Collapse of Complex Societies*, places the base of the pyramid of soci measures squarely on the ability of a society to find and integrate ever-greater sources of energy; o even more effective, energy sources with greater bangs for the buck than those previously used.

China and the Western core—today's European Union—have hit their hard ceilings three othe times in history, almost in synchrony, with equally disheartening results: in the 1st century C (Common Era), when the Han Dynasty and Roman Empire disintegrated; in the 13th century with th Mongol invasions and black plague that brought the Song Dynasty and medieval Europe low; and the again in the 17th century, when the populations in both Eastern and Western cores doubled in size in matter of decades and adequately feeding, clothing, and housing citizens became a very real concer for the governments of both regions. The Europeans, on the other hand, realized in the 17th centu that technology had cleared an avenue to a new way of negotiating with the limitations of soci development.

The philosophical antecedents of the Industrial Revolution can be found in the thought of Franc Bacon, the English philosopher, scientist, and statesman who looked to the mechanical nature of th clock rather than the natural philosophy of the ancient Greeks. In France, Rene Descartes, anoth philosopher and a mathematician, wrote, "It is not less natural for a clock, made of the requisi number of wheels, to indicate the hours, than for a tree which has sprung from this or that seed, produce a particular fruit." Bacon and Descartes and other thinkers intuitively understood that Europ together with the colonies in the New World, could transform the cycles of war, famine, an pestilence that characterized Western history for millennia.

The Chinese core, however, cloistered from influences from the West, allowed the Industria Revolution to pass it by in favor of reviving the ancient Chinese classics to consolidate the politic power of its new foreign rulers, the Manchus. Chinese society fell into ruin and chaos 200 years late in the 1800s. Morris called the dynamics behind the rise and fall and rise again of societies "Th

Paradox of Development." He writes, "rising social development generates the very forces th undermine further social development." Or, as Albert Einstein so plainly put it, "We can't solv problems by using the same kind of thinking we used when we created them."

• • •

I open *China Fast Forward* with a chapter on the nature of modern Chinese scientific research, and th ways in which the nation is going about innovation in industry to frame the ensuing discussio Chapter 2 discusses the intersection between government and business in Chinese cyberspace domestic Internet companies struggle to be free of the ideology that dictates the boundaries innovation. Chapter 3 conveys my exploration of an aspect of the services sector that is dependent digital technologies and that the central government considers vital to the country's continued growt services outsourcing. Chapter 4 details how China is developing heavy industries to pull the count up the value-chain of sophisticated export products. Chapter 5 investigates the "soft" innovatio China and its corporations need to make to re-image themselves in the eyes of the world and becom truly incomparable international brands. Chapters 6 through 9 reflect my belief that energy generatio and mobilization and the sector's relationship with the environment are fundamental to the society viability in the long run. The last chapter addresses perhaps the most important innovation China mu undertake to remain a viable modern society. It is incumbent on its leadership to create a safe an supportive context for the assembly of individuals with social interests that lie beyond the sole commercial and political. Charities, non-governmental organizations (NGOs), and eldercare wi become increasingly important in China's future. By 2050 about 30 percent of the population will b over the age of 60, while drought, climate change, and energy constraints will force open a floodga of rural refugees into the cities.

A China at the leading edge of history is meeting global challenges ahead of most countries. Its hug population, its dearth of energy and mineral resources, and its concentrated pollution issues a mobilizing the country for dramatic change. The approach the country takes to resolve these issu and the level of success it attains in building a sustainable society will hold important lessons for a of us, no matter where we live on this fast-shrinking planet.

Chapter 1

Innovation Nation

The interview with the reporters from Liaoning province had been an easy one, Fang Shim considered; a simple case of fraud. He had exposed the self-anointed Taoist "Supreme Master" Li Y as a fake. Li and his 30,000 adherents had claimed throughout 2010 that he could sit underwater f two hours while holding his breath in a lotus position and could withstand 220 volts shot througho his body, as well as other impossible feats. Fang simply laid the facts out before the reporters: Li ha practiced the underwater stunt in front of cameras in Chongqing ten years before while encased glass, insulated from the water; and there was no objective evidence of Li ever survivi electrification.[1]

Fang stepped out of the hotel onto the wide Beijing sidewalk into a hot, mid-afternoon August da filled with the cacophony of traffic noise, blaring horns, pedestrians talking on their cell phones, ar street vendors hawking fruit, vegetables, sunglasses, hair clips, and the like. Sometimes he missed th blandness and isolation of his life back in California, when he simply went to his biochemistry lab the Salk Institute, put in long but fruitful hours, and then went home. When royalties from paten began to flow in, he decided to return to China to pursue work that would benefit his society, makin it a better place for the country's countless millions who had not been as fortunate as he. Applying th scientific method used in Western institutions and combining it with his hatred of bullies ar fraudsters, he took on the mantle of China's "Science Cop." His pen name was Fang Zhouzi, a nam millions came to know throughout China for his forthright approach to the lies and inequalities th permeated his beloved country.

Nearly home, he grew excited at the thought of the evening ahead, filled with further research in the medical fraudster Xiao Chuanguo. Xiao Chuanguo claimed that he cured the urinary incontinen of many children by operating on certain nerves.[2] Fang Shimin was sure Xiao had falsified the dat To Fang Shimin, Xiao Chuanguo was a public menace.

He turned down a side street. The neighborhood was quieter now, and he felt more relaxed. As h rounded the corner a big man stepped in his way. Fang Shimin saw a shadow, a blur, and then a bottl held up to his face. His friend Fang Xuancheng had been attacked on the street just two months befo in just such a manner. Fang Xuancheng had been badly beaten and hospitalized. Fang Xuancheng wa a correspondent for *Caijing*, a Chinese financial journal that took controversial stances again companies and institutions in China. This was no time to wonder if this was a similar sort of attac though.

Fang Shimin ducked, instinctively. Still, part of his face was caught in the mist of pepper spray. H cheek stung, then numbed. He blindly sprinted into the street to escape the assault. Fang Shimin hea an iron bar clamber to the ground, and two men cursing behind him. "Goddamn it, Xu! You spraye me in the face instead! You turtle's egg!" one of them shouted.

"Shut up!" Fang Shimin heard a second voice shout, "Catch him!"

"Your mother and father! I can't f—king see!" Xu screamed.

Xu leaped over his comrade, who lay crumpled on the sidewalk, and dashed into the street after Fan

Shimin. He pounded the air with the hammer in his hand to know its heft, to feel how hard he wou have to wield it to crack Fang Shimin's skull.

Fang Shimin knew if he hesitated for even a second the thug would kill him. He laced his wa through traffic and was nearly run over twice by irate drivers who honked their horns at hir Meanwhile, the assassin had closed the distance between them. As Fang Shimin changed directio once more, he saw out of the corner of his eye his assailant lobbing something long and heavy at hir Again Fang Shimin's instincts took hold and he ducked his wiry frame to protect his head. When h looked up he saw a hammer coming at him. He ran faster. A moment later he felt a stab of pain in or of his shoulder blades. Fang Shimin dared not slow his pace. He rounded the next corner and sprinte through the gate of his apartment complex.

Xu stopped his pursuit a hundred meters before the gate of Fang Shimin's residence. He glared the guards gaping at him. After a time, he realized others were staring at him, too. He had failed. H would have to return the ¥50,000 yuan[3] ($7,000) advance to Big Brother Dai. Dai Jianxiang had truste Xu and Long Guangxing to teach that turtle's egg a lesson. Xu cursed again and then set off to brin back Long. It was turning out to be a very bad day.

Actually, it turned out to be a bad week for "brothers" Dai Jianxiang, Xu, and Long Guangxin Days later police picked up Xu, who had been recorded on closed-circuit television cameras stalkin Fang just before the incident. Xu led the authorities to Long Guangxing and both confessed that the had been paid to teach Fang Shimin a lesson by Dai Jianxiang. With little pressure applied, D Jianxiang admitted Dr. Xiao Chuanguo—Fang's arch enemy—had paid Dai Jianxiang, a distant cousi of Xiao Chuanguo's, ¥100,000 to make all the arrangements. So informed, the Police picked up Xia Chuanguo at the Beijing airport after he had just returned from a trip abroad.[4] Xiao Chuangu confessed to the crime within hours of incarceration. He also confessed to having arranged for th attack on Fang Xuancheng, the financial news reporter at *Caijing*. Both Fang Xuancheng's med assault on Xiao Chuanguo's background, credibility, and research work had caused the Chines Academy of Sciences to deny his application. Years of Xiao Chuanguo's work was held in ill-repute i China, though Western scientists found some of his research promising. His endless defamation sui against Fang Shimin had only brought more attention to him, instead of absolving him.

Dr. Xiao Chuanguo pleaded not guilty, despite having already confessed his crime to the police. Th court passed judgment down in less than a day, without Fang Shimin, Fang Xuancheng, and the lawyers present in the court room. The court found Dr. Xiao merely guilty of creating a publ nuisance. The triumvirate of judges fined Xiao Chuanguo several thousand dollars and sentenced hi to five and a half months in prison. Immediately both Fangs and their attorneys accused the court backroom dealings that denied them justice. They filed an appeal to a higher court, the outcome which would take years to finalize.[5] The case, however, did not deter the Science Cop from h mission to continue uncovering fakery in the fields of science and technology.

Impure Research

Fake permeates Chinese society. For many without the connections or money, making up one's past the only way to achieve the social and economic status one seeks. The walls of alleyways in son cities are littered with the phone numbers of agents who can get you a technical certificate university diploma, or even PhD. In August 2010 authorities discovered that several dozen pilots ha faked their flying histories. It took a plane crash in northeast China and the death of 42 passengers

begin an investigation into the mass deception.[6]

In 2010, Science Cop Fang Shimin revealed that the former head of Microsoft China, Tang Jun, ha falsified his resume. He had presented to his employers that he had received his doctorate from th California Institute of Technology. The deception had facilitated his rise to become a millionaire an a sort of modern-day Chinese folk hero, who with grit and determination had overcome adversity.[7]

Zhang Ming, a professor of international relations at Renmin University in Beijing admitted that great many Chinese academics prefer to serve a more economically practical cause than seeking th truth through research. "We need to focus on seeking truth, not serving the agenda of some bureaucr or satisfying the desire for personal profit," he said.[8] However, the plea fell on the deaf ears of 5 percent of his colleagues surveyed by the China Association for Science and Technology, who claime to know someone who had falsified research findings or plagiarized papers for publication. Six of th country's top research institutions admitted in a government report that they had falsified data c copied research results from other researchers. In December of 2009 a British scientific journal had withdraw more than 70 papers after editors discovered findings of questionable veracity.[9] A bit o software called CrossCheck, which checks for plagiarism, flagged nearly a third of the pape submitted for testing as highly suspicious. In some instances, the software found 80 percent of son papers had been copied from elsewhere.[10]

The sort of veracity and transparency Western scientific research institutions take to with religiou zeal is far from affecting the agendas of the political leaders who have been appointed to manag Chinese research organizations. The Communist Party appointees who direct daily affairs at th departments dole out budgets, housing, and reputations. Nepotism is rife. *The Party ultimately defin the meanings of discovery and invention in China.*

The Patronage Party

The public accusations against Dr. Xiao Chuanguo, his confessed attacks on his accusers, and th court's light sentences for his crimes point to a fundamental flaw in China's plan to surpass the Unite States as a preeminent innovation nation. The country lacks checks and balances within its ov scientific community and society. Science prides itself on its scientific method of repeatable resul rigorously tested and approved by a group of peers. As Thomas Kuhn wrote in his seminal study of th work of scientists, *The Structure of Scientific Revolutions*, most often discoveries are resisted by pee who have vested interests, yet eventually the community of scientists adapts—typically in nonviole ways—as the discovery becomes a fact that expands on previous understanding. The scientific metho is supposed to weed out wrong or misleading results and researchers contribute to a base of standin knowledge upon which others may continue to build. The court systems in a civil society functio similarly, with judgments passed based on a body of evidence that is indisputable in its objectivity an certainty. Both science and society in China are based on patronage, though.

Patrons are typically political appointees with ties to the Chinese Communist Party (CCP), who a made department heads, school directors, and research presidents. Often, political appointees hav little or no experience in the fields they are charged to manage. Subsequently, patrons themselves do out positions of responsibility to scientists, funding for projects, even living quarters for the famili of researchers. Consequently, researchers learn not to "bite the hand that feeds" if one wants t advance his or her career.

Judges on the bench are also political appointees with little training or experience in th

complexities of litigation and judgment. As a Beijing lawyer once told me, she practiced "fake law For most cases, she told me, she was expected to take the judges out to dinner and treat them we Sometimes she would have to play drinking games with a judge to decide the outcome of a case.

In other words, the two most important systems supporting innovation in a society are woeful skewed to meeting the demands and vanity of CCP sponsorship. Ultimately, Chinese business ar industry is beholden to the same kind of patronage; and the larger the enterprise and more close aligned with national industrial policy, the fewer degrees of freedom of research and developme (R&D) interests and commercial viability the entity has—the State directs the former and decides th latter, as Richard McGregor so engagingly wrote in his penetrating expose *The Party: The Secr World of China's Communist Rulers* . Yigong Shi and Yi Rao, deans of Life Sciences at Tsinghua an Peking Universities respectively, noted in an editorial in *Science Magazine*, "it is an open secret th doing good research is not as important as schmoozing with powerful bureaucrats and their favori experts. China's current research culture . . . wastes resources, corrupts the spirit, and stymi innovation."[11]

The network of patronage that laces China's R&D efforts affects the objectivity, quality, an veracity of efforts to push back the frontiers of science and to address some of the most profou challenges humankind has ever faced. Issues such as meeting burgeoning energy requirement growing pollution hazards to the earth's ecosystem; and consumption of nonrenewable resources suc as land and water require a clear-eyed, apoliticized approach that will ensure the habitability of th country. Britain's National Endowment for Science, Technology and the Arts offered that China' economic rise and new-found geopolitical heft make the country hugely important in working wi other countries to resolve such sustainability issues.[12]

Chinese patronage also affects the efforts of organizations that are attempting to blaze trails beyo a stultifying domestic environment into a world bristling with ideas and applications. Fields such services outsourcing and Internet applications risk being smothered for fear that devolution of creati energy destabilizes the country. The gravity well of patronage also pulls on and warps genuine effor of Chinese companies to become innovative global players that can go toe-to-toe against titans such IBM, General Electric, Procter & Gamble, and others. Whatever plans the country has to become global innovation powerhouse, it first has to surmount huge, self-inflicted challenges. Some of th challenges are based in historic patterns that have become habits of thinking and actions that ru counter to international norms of transparency and reportage, and to the scientific method itself. Oth hurdles the nation needs to overcome are socio-political. The leadership will need to learn how balance the will to survive, and maintain control over the society and economy, with the very re expediencies of creating safe environments in which creativity, enquiry, and impassioned dialog ca ensue. With so many conflicts of interest throughout China's government, educational, and researc institutions, it is little wonder that so much of the country's innovation should be constrained to th inconsequential.

Gimme a Big "I"!

In November 2010 the State Intellectual Property Office of China published its *National Pate Development Strategy*, which outlined the country's plans for innovation ascendance. China planned register patents at a rate of two million per year by 2015. In 2009 Chinese would-be inventors file 600,000 patents with its patent office. By September 2010 Americans had filed 480,000 patents in th

United States patent office. China also planned to double the number of patent examiners by 2015, 9,000. The United States in 2010 had 6,300 inspectors.[13] China was able to accelerate the manufactu of patents at such an astounding rate because of its growing R&D budget in relation to its Gro Domestic Product (GDP).

China's R&D expenditure increased to 1.5 percent of GDP in 2010 from about 1 percent in 200 The government aimed in 2010 to have its R&D budget at 2.5 percent of its GDP by 2020. Its share the world's total R&D expenditure was a little more than 12 percent in 2010, while the United State contribution was around 35 percent.[14]

Some of the other metrics the original strategy cites include, "The quantity of patents for inventio [made in China] for every one million citizens and the quantity of patent applications in foreig countries will quadruple." And, "The proportion of patent applications in industrial enterprises abov [a] designated size will reach 10%." The paper, though, does not designate the size of said enterprise However, the plan does include designating 10 "model cities" that will be patent examination hubs.

A closer look at the kinds of patents China is encouraging reveals a skew in the numbers. The pate goals breakdown into 1 million patents for each of China's patent types: utility-model patents ar invention patents. Utility-model patents are incremental improvements or lateral changes to produc and invention patents are true patents for new inventions.

Most of the patent applications were expected at the time to be in what the central governme called "pillar" industries, areas the government considered of vital interest to the country's econom and social stability. These industries included solar and wind energy, information technology ar telecommunications, and battery and manufacturing technologies for automobiles, according to Dav J. Kappos, director of the United States Patent and Trademark Office (USPTO).[15] John Kao, innovation consultant, described the central government plan as "a brute-force approach at this stag emphasizing the quantity of innovation assets more than the quality."[16]

Research by Anil Gupta and Haiyan Wang into the complexion of Chinese patents revealed Chines institutions were nowhere near as creative as they would have the world believe. Based on more tha 95 percent of the patents filed with China's own patent office, Gupta and Wang found that the va majority of these patents are "tweaks" to current developments. A more telling number of Chines patents filed with three of the world's leading patent offices in the United States, Japan, and th European Union revealed a different story. The "triadic" international patent standard involv approval by each of these patent offices. In 2008, the Organization for Economic Cooperation ar Development (OECD) cited only 473 triadic patent filings from China versus 14,399 from the Unit States, 14,525 from Europe, and 13,446 from Japan.[17] The Chinese were actually far behind oth countries in meeting international standards for invention patents. The statistics did not dissua China's leadership from centrally planning innovation, however.

China, in its efforts to become the "workshop" of the world, has never let the emphasis on quanti ahead of quality deter its efforts. In late 2010, Wang Yong, chairman of the state-owned Asset Supervision and Administration Commission of the State Council (SASAC), announced the Counc would develop 50 state-owned enterprises (SOEs) to become top-ranking global companies befo 2015. The key to moving into this top tier entailed upgrading their innovative capacities to me international competition head-on.[18] The move came as regulators called for the upgrading innovative capacities to strengthen the international competitiveness of the SOEs. Thirty-five of th companies had already pledged before the announcement to develop into global industrial gian possessing advanced technology in line with international standards.

The technocrats who run the Chinese Communist Party (CCP) seem to believe that innovation ca be constructed in much the same way as a bridge or a dam or a highway. The approach runs in th same vein as the way in which the leadership has carved up its ecology in favor of economic grow over environmental sustainability. China's leadership anoints cities throughout the country as beir innovation centers of services outsourcing, animation, information technology research, aviation, ar so forth. Entire cities in the country also have the unfortunate reputation as centers of counterfeitir products, designs, and innovations.

What's a Little Intellectual Property Theft between Friends?

If there is any aspect of "Brand China" that is well-known to foreigners, it is the extent to whic Chinese businesses play fast and loose with the intellectual property of original inventors and artist Chinese counterfeiting of American products alone cost American businesses at least $60 billion.[19]

Chinese merchants have considered everything from consumer products, industrial equipmer vehicles, music, movies, and art as fair game in the hunt for profits. A walk through nearly an emporium in any Chinese city will leave visitors breathless from the extent of copied products for sa at steep discounts. Many of these malls—indoor and outdoor—have booths or small alcoves whe energetic sales staff call out to passersby to entice them to browse what's on sale. In the summe indoor corridors are not air-conditioned, leaving visitors gasping for breath and relief from th incessant heat and din. In the winter, the corridors are often freezing cold. The only real protection th display tables have from the rain at outdoor emporia are tarpaulins drawn down with clothes line.

The markets sell all manner of brands, typically within a single industry, such as textiles, shoes, lady's bags. One visit to the Hongqiao Pearl Market in Shanghai revealed warrens chock full of Lou Vuitton hands bags, Tommy Hilfiger shirts, and Gucci shoes. In some instances—such as the alligato shirt a German tourist may be fingering—the merchandise is actually a genuine article that has "falle off the truck during shipping" and made its way to the fake market. The item was actual commissioned by a brand-name company to be manufactured in China. Factory owners make a fe extra sets of the product, matching the same specifications the factory's corporate buyer had la down for operators. Employees ship the extra sets out of the factory to middlemen to find retail she space in some emporium, where they'll be sold for 20 to 50 percent of the original retail price.

The phenomenon reaches into industrial components and equipment. One Danish manufacturer parts for heating, ventilation and air conditioning (HVAC) systems took a phone call while we wer having lunch near his factory in the Yangtze River Delta. It was a Western customer. The conversatio was about how the customer could be a great help to my friend by visiting a competing Chine HVAC-parts manufacturer, taking photos of the knock-off parts to pass on to my friend. Then, m friend would have his lawyer in China send the offending party a warning letter about the course m friend's company would be taking if the Chinese maker continued to copy my friend's HVAC parts.

I myself have visited Chinese manufacturers with my own Western clients to have my custome whisper to me, "Those are our products in their display case!" Either the manufacturer was nonchala about the rip-off, and felt safe enough that they did not have to protect themselves, or they had simp forgotten they had copied a potential foreigner partner's part and left it in the display case for all see. Entire cities in China are devoted to copying products from abroad and selling them to gra

markets or even exporting them to developing countries as originals. Putian, in Fujian province, on th coast across from Taiwan, is well-known as a knock-off capital for sneakers. Dongguan, in Guangdon province, is famous for knock-offs of shoes, golf clubs, furniture, you name it (and your price).

The culture of IPR infringement, mass copying, and outright fakery has its roots in China's histor and has carried forward into the 21st century through the trunk and branches of its education syster The copy culture has such a strong hold on China's modernizing society that its grip sometimes mak for actual casualties.

Education

Jo Jo (a pseudonym) was 11-years old when he took his own life. His mother discovered him at the home, just after lunchtime one wintry January school day in Yunnan province. The boy had bee starving. Teacher Tang, who was close to retirement, had kept Jo Jo after class to copy by hand page from a Language Training Materials textbook. Old Tang was disciplining the boy, though for what, i the end, no one was quite sure. Jo Jo had had to copy in his neatest handwriting four chapters from th textbook, a total of seven densely-filled pages of Chinese characters. Jo Jo complained to his moth he was sure he wouldn't be able to finish the assignment by the end of the day. She assured him h would be able to, as he was a clever boy, and served him a bowl of sweet, glutinous rice balls fille with black sesame paste—a favorite of Chinese children. She returned to work, and assured him sh would call to remind him he had to go back to school an hour before his scheduled return. Later, whe she called, no one answered the phone. As only a parent's intuition would have it, she returned hom concerned something might be the matter.

Jo Jo had hung himself with his Red Pioneer's scarf tied to the door knob. He sat listless on the flo when his mother discovered him, the scarf still strangling what life may have remained in the lim body. The little red scarf, worn by hundreds of millions of children in classrooms during the scho year, is the symbol of the sacrifice every citizen of the country must make to promote the welfare o the People. In this case, Jo Jo's sacrifice presented to the society the rigidness, insularity, and sou crushing weight of its conformist approach to education and socialization. His mother stated her so was ashamed he would not be able to finish the copying exercise by the end of the day, and was not u to facing further punishment. Teacher Tang checked himself into a hospital and made himse unavailable for comment on the matter. By his and the school's reckoning, Jo Jo had stayed after clas for some extra help on his schoolwork, but Chinese parents and students know the system work otherwise. The system will survive such sacrifices as little Jo Jo's, however.

Chen Zhiwu, a finance professor at Yale University, tweeted in response to an online publi discussion in China about why China could not produce a Steve Jobs. Chen felt that in Chine schools, "the first thing the teachers do is to rub down the edges of those students who are differe from the crowd."[20]

The modern Chinese education system has its roots in the sort of study required to pass the imperi examination for entry into China's government. During the Sui Dynasty in 605 AD the country foun itself with too many people and too few routes to prosperity. Nepotism for plum government position was rife. The emperor commanded administrators to build a meritocratic bureaucracy. They develope a rigid examination system that would filter the best educated for government seats. Passing th imperial system for nearly 1500 years also assured that the backgrounds, thinking, philosophies, an initiative of bureaucrats were near harmonious, no matter where in China they were from. Since the

the Chinese examinations at all levels of education emphasize regurgitation of memorized treatis over individual displays of creativity, personal insight, and hands-on experience.

China—or rather, specifically, Shanghai—was quite proud when in 2010 its students placed first i the world in scoring on an international math examination, ahead of South Korea, Singapore, ar Hong Kong. Finland finished very strongly, with America coming in 25th out of 34 countries. Man infer—including Americans—that the Chinese approach—or, at least, the Shanghai approach—t education is superior to the American system. They further infer that, *ipso facto*, China is able produce superior engineers and scientists who will file more patents and publish more research pape than the United States. The line of thought concludes that China, then, will be a first-rate innovatio nation. Chinese ascribe their success on such examinations, as well as in business, to "Confucia values."

Confucian theory is basically one of maintaining harmony within a family, a community, and i greater society. A society will remain stable through constant, self-referential study of social an historical phenomena, and by following those in authority. It is, at its most simplistic, a philosophy o follow-the-leader: the wife follows the husband (and the husband's mother); the husband follows h boss; the boss follows local government officials and so on, all the way to the seat of central authorit in Beijing. A Chinese middle-aged mother of a ten-year-old boy explained to me, "Chinese people a an individual level do not really know what they want. Their entire lives they are told what to thin what to say, what to desire." The culture of following and copying makes it difficult for multinationa invested in China to find educated and creative professionals with initiative to make breakthroughs invention. Instead, foreign companies and their local hires find themselves constrained to adaptin tried-and-true technologies for the country's domestic market.

Grafting Innovation

It was during a flight from Shanghai to Chicago that I realized Western-style innovation for Chin would be a transplant conception, not something indigenous to Chinese society (despite the Chine leadership's promotion of its efforts at "indigenous innovation"). I sat next to a charming Chines engineer who was, for much of the trip, engrossed in an American patent for AC-electric motor Applications for such motors include the paper industry and the steel industry, in which extremel thin sheets of material need to be manufactured at exacting thicknesses without interruption and at th same rotational speed. Though shy at first about speaking English, the technologist quickly warmed u to chatting with me when I offered her (and her husband) sticks of gum near the end of the long fligh

It turned out she was indeed a rocket scientist, or nearly so; she specialized in the research an design of electric motors that would be efficient and steady. Surnamed Wang, she had been workin for an American aerospace manufacturer since 2000. She was the first of the three researchers hire into the Shanghai R&D center years before. The R&D center was the first of its kind for the compan in China. She was fairly certain that only IBM, at the time, had already established an R&D center China.

When we spoke, the engineer's R&D center had thirty researchers. It was one of the few in the wor that was at "headquarters level"; that is, most of the R&D done for the company was at the product department level. The Shanghai R&D center reported directly to HQ in the States for projects f current, high-profile customers.

I noted that it was impressive the American company had established a China R&D center given th

China-market conditions and product requirements could be quite different from America's. Th engineer responded in PhD-speak (for I think she would have struggled to use English nouns an adjectives of less than three syllables) that most of the R&D work the Shanghai Center was doing wa for Western customers, though they were receiving more projects from China-based companies. was just in Suzhou at a manufacturer's factory to hear their voice." Suzhou is a manufacturing hu little more than an hour's drive west of Shanghai. What she meant was that they had told her wh they needed from the motors she designs.

She noted that the American company was extremely conservative in setting up the R&D cent eight years before. Not only in the number of researchers they hired, but also in the size and kind projects they gave the Shanghai group. "They watched us very closely," she said, "to see the kind work we did, the quality, how we solved the problems . . . At first we had to listen to everything the said. There seemed to be only one way . . . But China is very old, and has some good things contribute. Now they listen to us to help solve the problems." I did not mention anything to her abo the level of discomfort with intellectual property rights (IPR) issues the company must have initial had; no need in making the kindly and talkative engineer squirm in her too-narrow seat. IPR concern however, seemed to deter foreign investors from setting up R&D operations in China.

By 2010 China became host to more than 1,000 foreign-owned R&D centers. Nearly all tho centers, however, focused on adapting technologies developed in other countries to local mark conditions in China. A culture of copying, weak intellectual property rights (IPR) enforcement an Beijing's expressed policy of "indigenous innovation" forced foreign multinationals to keep the leading technologies in countries in which they felt their IPR was protected. Anil Gupta and Haiya Wang identified that half of the top 10 U.S.-based technology giants that received the most paten from the U.S. Patent and Trademark Office (USPTO) between 2006 and 2010 were not doing an significant R&D work in China. During the same years the USPTO did not award a single patent any China-based units for 5 out of the 10 companies. However, 9 out of 10 centers in India *did* receiv patents from the USPTO. *India does not have a policy of indigenous innovation, nor does it forc foreign technology companies into joint ventures with domestic companies with the sole aim transferring technology*. Seven out of 10 of the Indian units of the multinationals received mo patents from the USPTO than their Chinese labs, with a tally of 978 versus 164.[21]

As Gupta and Wang wrote, "Yet Beijing is standing in the way, because it's looking at the problem from the wrong angle. Instead of trying to extract technology from foreign firms today, it should b creating a hospitable environment for these firms to create and train world-class innovators."[22]

The probability, in other words, of the charming Ms. Wang working on state-of-the-art R& projects for a foreign lab in China was remote. She would have to move to a country that did not forc investors to transfer their technologies to local champions, nor local champions to give up their spoi to the government.

A Cautionary Tale

An indicator of how a country's government may treat foreign-invested companies—especially in th worst of times—is to look at how its domestic champions fare. Multinational corporations with R& operations in China have much with which to be concerned in light of the legal case of Catha Industrial Biotech (Cathay).

Cathay produced a chemical building block of nylon—called a diacid—through a process

fermentation. It produced about half the world's inventory of the polymer-grade diacids, and counte the chemical giant DuPont among its customers. Manufacturers use nylon ingredients to make son lubricants, while pharmaceutical companies produce diabetes drugs with the nylon components. L Xiucai established Cathay in 1997 in Shangdong province, near the Korean peninsula, when he was 4 years old.[23]

Born and raised in China he was a victim of the purges of the Cultural Revolution in the 1970s. H was amongst the first graduates of universities that had reopened in 1977 after a decade of beir shuttered. Afterward, he went to the United States to receive his Masters and PhD in Chemistry. H returned to China in 1989 with the idea of finding Chinese investors to commercialize projects base on outdated patents in the West. Liu Xiucai became a darling of the Chinese Academy of Sciences an of the Beijing elite after he helped China become the largest export manufacturer of industrial produced Vitamin C in the world, with 80 percent of the market in 2010. Cathay was to be his definir moment as an entrepreneur and innovator. From its inception the central government lavishe subsidies and tax breaks on the investment to ensure its success. Government largesse ended, howeve when patrons found another, less willful supplicant than Liu Xiucai.[24]

In 2011 Cathay filed a patent infringement suit against Hilead Biotech, another private Chines company in Shandong province. Liu Xiucai accused his former plant manager, Wang Zhizhou, o infringing on patents and stealing trade secrets from his former employer and setting up Hilead 2009 with six other former employees of Cathay. Hilead received direct assistance from the highe levels of the Shandong provincial government, where the company was being set up. The CCP's Par Secretary for Shandong province accelerated government approvals and financing for the project. Th Chinese Academy of Sciences also did its part to sponsor and promote the company and i technologies as national priorities. The state-run China Development Bank gave Hilead a US$30 million loan to get up and running. Hilead captured a tenth of the global market for the nylo components a year after it had started up. The irony of the cut-throat competitor that Cathay ha spawned was not to be lost on Liu Xiucai.[25]

He used his own patrons at local and national levels of government to hobble Hilead. Liu Xiuca though, had made enemies during his rise to national glory. Liu Xiucai had been going public for yea about the corruption, nepotism, and fraud in state-run institutions. He had also complained about th official interference in the private sector, crippling the competitiveness of potential nation champions. The accusations had weakened Liu Xiucai's political base considerably.[26]

Wang Zhizhou's patronage, meanwhile, had only grown stronger once he left Cathay. The centra government listed Hilead's diacids as national security interests. Neither foreign nor domest challengers were allowed to impede the commercial success of Hilead without severe repercussion Beijing stripped Cathay of one of its top patents when the company began its suit against Hilea Hilead filed a countersuit that accused Cathay of stealing patents from the Chinese Academy Sciences. Liu Xiucai again took the offensive.[27]

The American-trained researcher convinced a local Shandong court to send officials to Hilead manufacturing operation about 400-kilometers away to document that Hilead was using the sam technologies and fermenting processes to produce diacids. Guards at Hilead's company gate turned th officials away with the proclamation that Beijing authorities had designated Hilead a national securi interest. That meant that further intrusion into the factory compound would be tantamount espionage. Indirectly, Beijing could construe continued pursuit of a patent infringement case again Hilead as treason.[28]