

Industries of the Future by Alec Ross

Book Notes & Quotes

[Introduction](#)

[Chapter 1: Here Come the Robots](#)

[Chapter 2: The Future of the Human Machine](#)

[Chapter 3: The Code-ification of Money, Markets, and Trust](#)

[Chapter 4: The Weaponization of Code](#)

[Chapter 5: Data: The Raw Material of the Information Age](#)

[Chapter 6: Data: The Geography of Future Markets](#)

[Conclusion: The Most Important Job You Will Ever Have](#)

Introduction

“The world in which I grew up, the old industrial economy, was radically transformed by the last wave of innovation. The story is by now well-known: technology, automation globalization.” - Pg. 4

“The coming era of globalization will unleash a wave of technological, economical, and sociological change as consequential as the change that shook my hometown in the 20th century and the changes brought on by the Internet and digitization as I was leaving college 20 years ago.” - Pg. 5

“Unlike the previous wave of digital-led globalization and innovation, which drew enormous numbers of people out of poverty in low-cost labor markets, the next wave will challenge middle classes across the globe, threatening to return many to poverty.” - Pg. 6

“This book explores the industries that will drive the next 20 years of change to our economies and societies. Its chapters are built around key industries of the future - robotics, advanced life sciences, the code-ification of money, cybersecurity, and big data - as well as the geopolitical, cultural, and generational contexts out of which they are emerging.” - Pg. 12

Chapter 1: Here Come the Robots

“The robot landscape will be vastly differentiated by country. Just as wealthier and poorer citizens reside at different technological levels, so do wealthier and poorer countries.” - Pg. 19

“About 70 percent of total robot sales take place in Japan, China, the United States, South Korea, and Germany - known as the ‘big five’ in robotics.” - Pg. 20

“Interestingly, less developed countries might be able to leapfrog technologies as they enter the robot landscape. Countries in Africa and Central Asia have been able to go straight to cell phones without building landline telephones, and in the same way they might be able to jump ahead in robotics without having to establish an advanced industrial base.” - Pg. 21

“The first wave of labor substitution from automation and robotics came from jobs that were often dangerous, dirty, and dreary and involved little personal interaction, but increasingly, robots are encroaching on jobs in the service sector that require personalized skills.” - Pg. 22

“Two key developments have dovetailed to make this possible: improvements in belief space and the uplink of robots to the cloud. Belief space refers to a mathematical framework that allows us to model a given environment statistically and develop probabilistic outcomes. It is basically the application of algorithms to make sense of new or messy contexts. For robots, modeling belief space opens the way for greater situational awareness.” - Pg. 23

“But advances in data analysis (described in Chapter 5) have combined with exponentially greater sets of experiential robot data to enable programmers to develop robots that can now intelligently interact with their environment.” - Pg. 23

“Linked to the cloud, robots can access vast troves of data and shared experience to enhance the understanding of their own belief space.” - Pg. 23

“Another major development in robotics arrives through materials science, which has allowed robots to be constructed of new materials.” - Pg. 24

“Nanorobots, still in the early phases of development, promise a future in which autonomous machines at the scale of 10^{-9} meters (far, far smaller than a grain of sand) can diagnose and treat human diseases at the cellular level.” - Pg. 24

“Accidents are caused by the four Ds: distraction, drowsiness, drunkenness, and driver error. The driverless car promises to reduce all of these significantly.” - Pg. 30

“The degree to which delivery drones fill the sky or driverless cars fill the streets will eventually be determined not by whether it is feasible technologically and economically - at some point it will be - but by whether humans accept the changes they bring about.” - Pg. 31

“The number of robotic procedures is increasing by about 30 percent a year, and more than 1 million Americans have already undergone robotic surgery.” - Pg. 32

“The next generation of robots will be mass-produced at declining costs that will make them increasingly competitive with even the lowest-wage workers.” - Pg. 36

“As the capex of robots to go down, the opex of humans becomes comparatively more expensive and therefore less attractive for employers.” - Pg. 37

“As the technology continues to advance, robots will kill many jobs. They will also create and preserve others, and they will also create immense value - although as we have seen time and again, this value won't be shared evenly.” - Pg. 37

Chapter 2: The Future of the Human Machine

“The last trillion-dollar industry was built on a code of 1s and 0s. The next will be built on our own genetic code.” - Pg. 44

“All cancers begin with damaged DNA. The DNA becomes damaged through time, or inherited genetic makeup, or environmental factors like cigarette smoke - and as a result it mutates. With cancer the mutated DNA and RNA, which generally work together to make proteins, are malfunctioning. They are failing to control the growth of unhealthy cells (creating a tumor) or failing in their role as the body's repair engine and allowing cells to become cancerous.” - Pg. 45

“To treat someone like Wartman, scientists want to know whether the protein is malfunctioning because the DNA is providing bad genetic programming or if the RNA's role in creating a protein is not working. Sequencing Wartman's healthy genes, cancer genome, and RNA was a way of pinpointing where the breakdown had occurred.” - Pg. 45

“Genome sequencing can be a very vexing endeavor. Even when sequencing can point out the offending genetic mutation, it's often the case that the medical community does not yet have any drugs or treatments that are capable of targeting the problem, especially if the mutation is rare.” - Pg. 46

“But the breakthrough that launched genomics on a collision course with medicine occurred in 1995, when the genome of a living organism - Haemophilus, a bacterium that causes severe infections, typically in children - was sequenced for the first time.” - Pg. 47

“The size of the genomics market was estimated at a little more than \$11 billion in 2013 and is going to grow faster than anyone can imagine.” - Pg. 48

“In addition to the falling cost of sequencing, Davis also cites our increasing ability to draw knowledge out of the genome's terabyte of data as a driver for the coming boom.” - Pg. 48

“His latest effort is what he calls a 'liquid biopsy.' A blood sample is taken and tested for the presence of even the tiniest amounts of tumor DNA. A tumor detected by Vogelstein's liquid biopsy can be detected at just 1 percent the size of what is necessary to be detected by a MRI, currently the most reliable tool for finding cancer. The amount can be so small that the cancer is discovered even before any symptoms have developed. What this effectively means is that getting a blood test for cancer could

become part of everybody's annual medical checkup if the price goes down far enough, as Vogelstein believes it will." - Pg. 49

"Your oncologist sends in your tumor sample and a spit vial, allowing your cancer and normal cells to be compared. Once PDGx gets your samples, its scientists work their genomic sequencing magic. They clean your samples, scrubbing them down so they're ready to take a lengthy ride in a PDGx [Personal Genome Diagnostics] sequencing machine. Once in the machine, the samples silently churn for hours as every last bit of your DNA is crunched into data. And when the sequencing is done, your DNA's output is hundreds of gigabytes of information - big data now - waiting to be analyzed." - Pg. 51

"What sets PDGx apart is its proprietary computer program, developed at Hopkins, which functions as a high-speed detective. It parses out exactly where proteins are mutating. It makes sense of why your cancer is growing. It gives you more information about your tumor than any oncologist can." - Pg. 51

"Today there is a complete mismatch between the drug development process and the speed and precision made possible by genomics." - Pg. 51

"Developing drugs targeted to the genetics of an individual as opposed to just treating every cancer patient with chemotherapy is as unobtrusive a change in the practice of medicine as the introduction of anesthesia in the 19th century." - Pg. 52

"Scientists now want to break the brain's code and begin to leverage genomics to diagnose and treat neurological and mental illnesses." - Pg. 53

"The challenge is that unlike an ailment such as Huntington's disease, which is caused by a single genetic mutation, most mental disorders are caused by many contributing factors." - Pg. 55

"The very idea that someone would take a pill to prevent suicide works against long-held assumptions about mental illness, but this is the future made possible by genomics." - Pg. 56

"One of the primary concerns, and one of Luis Diaz's own worries, is that as genomics grows more sophisticated, it will begin a process of creating designer babies." - Pg. 56

"Another set of concerns about the rise of medicine rooted in our genetics comes from people who worry that the development of next-generation drugs arising from genomics will reduce people's focus on diet, environment, and lifestyle, which also damage DNA and cause cancer." - Pg. 59

"The first company, Synthetic Genomics, announced a project in 2014 that aims to genetically engineer pigs with organs that can be safely transplanted into human beings. The process, called xenotransplantation, involves modifying a pig genome so that a pig embryo can grow up with organs that can be harvested and transplanted into humans." - Pg. 62

“There are three necessary things to create breakthrough advances in the life sciences: great scientists, lots of capital for academic research, and a venture capital market to help turn academic research into commercial products. The main reason the United States is ahead today is that leading international scientists are still clamoring to join American universities.” - Pg. 64

“Technologies like genetic sequencing offer exciting new solutions for people like Lukas Wartman, but around the world, millions suffer preventable deaths because they’re unable to get access to simple medical information or treatments.” - Pg. 69

“Delivery of medical services will never be equal, but pioneering initiatives to expand access to care across socioeconomic lines are beginning to take hold and improve lives on a huge scale. The infrastructure that makes this possible is the mobile phone.” - Pg. 69

“Mobile phones are well suited for these functions because they’re nearly ubiquitous, people take their phones with them everywhere, and they’re easy to customize with special-purpose applications.” - Pg. 69

“A highly connected world will also give rise to new possibilities for medical specialization and globalize the supply chain for medical diagnoses.” - Pg. 73

“Genomics will become a trillion-dollar industry, extending lives and nearly eliminating diseases that kill hundreds of thousands of a people a year today.” - Pg. 75

Chapter 3: The Code-ification of Money, Markets, and Trust

“Money has long been primarily a physical and see something that can be held and weighed. Many of the world’s currencies, in their very names, reflect the notion of money as something tangible.” - Pg. 76

“But in the past half-century, the modern financial system has designed a series of conveniences that have allowed us to move away from physical cash.” - Pg. 77

“Today digital banking has become nearly universal in developed economies, as has mobile banking, with the ubiquity of cell phones. More than half of American adults use mobile banking, and globally, well over half a billion people do. By 2017, that number will jump to 1 billion.” - Pg. 77

“And while our genomes are being decoded over the next 20 years, our money will be coded - broken down into 1s and 0s and wrapped within powerful tools for encryption.” - Pg. 77

“With Square, Jack original insight is to invent a way to make everyday payments using a device that is growing even more precious than our wallet: our mobile phones.” - Pg. 78

“Its approach has been to try to eliminate the cost and complication of standard credit card transactions. Typically when merchants accept a credit card, they are assessed two types of fees. First they pay a series of fees to merchant account services providers, which act as the middlemen between the merchant and the bank that manages the merchant’s account.” - Pg. 79

“The second category comprises the fees paid directly to credit card companies. The biggest of these, called the “interchange fee,” accounts for the majority of credit card processing fees.” - Pg. 80

“Sounds confusing? It is. Fees vary based on the type of business and merchant runs, the market power it controls, and the rewards offered by credit card companies, among other variables.” - Pg. 80

“Square is designed precisely to make commerce more fluid, allowing consumers to complete transactions without being tied to their wallets and freeing merchants from being tied to a traditional cash register and credit card machine.” - Pg. 80

“Innovations like eBay and PayPal have had a significant impact in creating the first wave of coded markets. Despite PayPal’s desire to be a global payment system, there are many countries where service is limited or nonexistent. PayPal has created concern about the potential for illicit or terrorist financing, because e-transactions are less bounded to traditional systems that are routinely monitored by law enforcement and intelligence agencies.” - Pg. 82

“Coded markets will now reach into the world’s most isolated communities, and they will link emerging markets to the global economy even more closely.” - Pg. 83

“In this shantytown lived 72,000 refugees in shacks made of plastic tarps, corrugated iron, and heavy stones to hold their makeshift constructions in place. Children walked barefoot on black-gray volcanic rock. Even so, when I visited Mugunga, mobile phones were pervasive. The mobile penetration rate in the Congo is 44 percent.” - Pg. 84

“The refugees used them to send and receive money, even when they did not have a bank account.” - Pg. 84

“The mobile phones also enabled residents to store what little money they had inside mobile accounts. There, safe behind a passcode, it was more difficult to steal than cash.” - Pg. 84

“In communities where bank accounts are rare, M-Pesa allows customers to send a receive payments through their cell phones. In Kenya, M-Pesa has become wildly successful.” - Pg. 86

“International finance flows have a particular importance in the developing world because so much money is transferred home as remittances from workers who live abroad. Remittances are one of the primary sources of income across Africa.” - Pg. 87

“But the traditional remittance system does not work efficiently. Fees for sending remittances to Africa average 12 percent, depriving families in Africa of billions of dollars a year.” - Pg. 87

“Mobile remittance systems offer safer, easier, cheaper options. They, like Square, Stripe, and Apple Pay, are all trying to reduce the friction involved in payments and money transfers.” - Pg. 87

“In order to be effective, the code-ification of money, payments, and markets has also had to figure out how to code trust.” - Pg. 90

“From the start, e-commerce has grappled with the question of trust - first in getting users to trust that online companies like Amazon would safely fulfill their credit card purchases, than in getting users to trust one another without ever meeting or talking to or seeing one another.” - Pg. 90

“The next leap forward in the code-ification of trust and markets is in the so-called sharing economy.” - Pg. 91

“Coded markets like eBay and Airbnb simultaneously concentrate and disperse the market. With coded markets available to even the smallest vendors, a trend has arisen that pushes economic transactions away from physical stores or hotels and toward individual people, as they connect either locally or online. This is how the market is dispersed. The route through which it is dispersed, however, redirects each of those transactions through a small number of technology platforms usually based in California or China. This is how the market is concentrated.” - Pg. 93

“With these platforms, the Valley has become like ancient Rome. It exerts tribute from all its provinces.” - Pg. 94

“There’s value leaving local hubs and heading to Silicon Valley. But the drain is mitigated by a few factors. First, there is the near-inevitable fact that the large platforms in Silicon Valley will be going public.” - Pg. 95

“Also important is the fact that there is indeed new value being created in local hubs whenever platforms like Airbnb become an option.” - Pg. 95

“Uber and Airbnb have inspired a host of imitators, and the sharing economy is growing far beyond lodging and transport.” - Pg. 96

“Yet as these economic changes take place, a new set of norms is being established, rooted in coded markets and algorithms. These replace the norms that have traditionally been set by the government. Trust is determined by the platforms’ user rankings instead of consumer protections

provided by the government. Trust has become code-ified, and the role of the state as a regulator has been diminished.” - Pg. 97

“Currency has become fundamentally linked to our notion of national economies, nation power, and even national identity.” - Pg. 98

“Could digital technology go as far as replacing banks or governments as arbiters of trust and create a new protocol for doing business around the world?” - Pg. 98

“Bitcoin is a ‘digital currency’ - a currency that is stored in code and traded online” - Pg. 98

“Bitcoin has encapsulated many of the contradictions and possibilities of digital currencies in the world still largely defined by national economies and governments. Its origin comes from ideological communities deeply skeptical of governments, traditional financial institutions, and ‘fiat currency’ (money that draws its value from government law). Bitcoin has developed new community around an online currency trying to circumvent these established institutions.” - Pg. 99

“They seek to establish a trust-based financial system among themselves, relying on algorithms and encryption. Just about anything can be hacked on the Internet, so the core difficulty with the creation of a digital currency is creating something that cannot be stolen or counterfeited.” - Pg. 99

“At its core, the blockchain is the big ledger on which all transactions are logged. And every single transaction going back to the very first Bitcoin payment is recorded on the blockchain, though they're logged anonymously or pseudo-anonymously. One of the blockchain’s key characteristics is that it is public, and instead of being stored at one central location, it is distributed to every Bitcoin user.” - Pg. 101

“A widely distributed ledger lets everyone know who has what and prevents any individual from barging in with counterfeited property.” - Pg. 101

“In order for a block to be added to the chain, The computers in the network first needs to solve a complex, randomized, and time-consuming algorithm.” - Pg. 102

“The slight time buffer introduced by the algorithm also prevents any user from trying to double spend their bitcoins, since the delay allows the network time to snuff out any attempt to use the same funds twice.” - Pg. 102

“Because Bitcoin functions of the decentralized peer-to-peer digital network, there is no central bank to increase the money supply. New units of a specific digital currency are ‘mined’ by the computers in the network.” - Pg. 102

“By keeping the algorithms complex - they are optimized to take, on average, 10 minutes to solve - Bitcoin keeps the mining process taxing enough to regulate the steady introduction of new Bitcoins while also making it very difficult to tamper with transactions.” - Pg. 102

“Unlike a nation-state’s currency, there is to be a finite amount of bitcoins. They will be introduced at a steady rate determined by a mathematical equation, and over time the algorithms increase in complexity while the number of bitcoins released by solving the equation decreases. The goal is for 21 million bitcoins to be mined by 2140.” - Pg. 103

“Bitcoin, as a global full payment system anyone can use from anywhere at anytime, can be a powerful catalyst to extend the benefits of the modern economic system to virtually everyone on the planet.” - Pg. 104

“He said billions on top of billions of dollars are being killed through traditional fraud detection, and Bitcoin would be able to reduce declined transactions to zero.” - Pg. 106

“As the Mt. Gox episode shows, the real security threat to Bitcoin is not security of the blockchain but the infrastructure around it.” - Pg. 109

“Although the blockchain keeps personal identity secret behind cryptographic code, in order to access the blockchain, people must leave digital footprints that law enforcement agencies know how to follow.” - Pg. 111

“Bitcoin initially pitted Silicon Valley against the establishment in government, on Wall Street, and among leading economists. However, much of that same establishment now sees blockchain technology as a technological solution to many high-cost transactions.” - Pg. 111

“Governments have struggled to adopt their regulatory environments to Bitcoin because of the speed of its emergence, its potential for nefarious use, and the uncertainty surrounding its value and durability. As a result, many governments have found themselves in contradictory positions: backing down on bitcoin while laying the groundwork for its future use, confiscating bitcoins, and then, as a result, holding or selling bitcoins themselves.” - Pg. 113

“In my view, the best case for Bitcoin is not as a currency but as a protocol, relying on the new possibilities offered by the blockchain.” - Pg. 115

“In the same way HTML became the protocol markup language for the World Wide Web, the blockchain may have the technological ingenuity to become the protocol for trusted transactions.”
- Pg. 115

“I think the vast majority of the cryptocurrencies in circulation today will disappear to nothing, but the category will endure.” - Pg. 119

“It is bringing frontier economies on to the global playing field while destroying middlemen and traditional authorities.” - Pg. 120

Chapter 4: The Weaponization of Code

“The world has left the Cold War behind only to enter into a Code War.” - Pg. 121

“On Wednesday, August 15, 2012, a shadowy group linked to the Iranian government attacked Saudi Aramco, the world’s largest energy company. Their weapon of choice: a computer virus.” - Pg. 121

“Business leaders around the world took notice. If a cyberattack could happen to the world’s largest company [Saudi Aramco] operating in a secure environment, it could happen anywhere and to anyone.” - Pg. 123

“It is perhaps ironic that one of the earliest purposes of the Internet, among certain of its developers, was to create a decentralized, distributed communications network that should survive a nuclear attack. That same distributed structure has led to a whole new class of possible attacks. And as more individuals, businesses, and governments have been incentivized to move their assets online, the weaponization of code has grown more lucrative and more destructive.” - Pg. 123

“The weaponization of code is the most significant development in warfare since the weaponization of fissile material and has created a domain of conflict with no widely held norms or rules.” - Pg. 124

“There are three main types of cyberattacks today: attacks on a network’s confidentiality, availability, and integrity.” - Pg. 125

“Attacks that compromise confidentiality aim to steal or release secure information like credit card or social security numbers from a given system in a illicit or unauthorized manner.” - Pg. 125

“The second type of cyberattack hits a network’s availability - attacks typically known as denial-of-service (DoS) or distributed denial-of-service (DDoS) attacks. Denial-of service attacks aim to bring down a network by flooding it with a massive number of requests that render the site inoperable.” - Pg. 125

“Last, cyberattacks can also affect a network’s integrity. These attacks are more physical in nature. They alter or destroy computer code, and their aim is normally to cause damage to hardware, infrastructure, or real-world systems.” - Pg. 126

“Attacks can be blended.” - Pg. 126

“In light of the damage that even simple cyberattacks can cause, most countries are developing cyberdefense strategies. The most sophisticated governments in the cyberdomain are the United States, China, Russia, Israel, Iran, and the United Kingdom, each with different motives and boundaries for what is and what is not allowable behavior.” - Pg. 127

“But for all three [United States, Israel, UK], security - the idea that that they are protecting the homeland or the lives and territory of friendly governments - is what governs activity. Nations like China have been more aggressive when it comes to private enterprise.” - Pg. 128

“China’s most powerful cyberattacks have been rooted in corporate espionage: stealing intellectual property and trade secrets that it can use to help its state-owned and state-supported enterprises.” - Pg. 128

“They [the Chinese] are able to engage in cyberattacks without triggering extensive sanctions or punishments for treaty violations. They have a financial and political stake in things staying calm; they have incentives to steal but not to break.” - Pg. 130

“Electronic communications and electronic sensors have been around for some time, but the costs of sensors and data storage have recently plummeted - in part due to cloud computing. As a result, the stage is now set for what has become known as the ‘Internet of Things,’ where any object has the potential to transmit and receive data, from cars and farm equipment to watches and appliances, even clothing.” - Pg. 132

“The digitization of nearly everything is poised to be one of the most consequential economic developments over the next ten years.” - Pg. 132

“There’s one huge catch: with the rapid growth of these technologies, we are also creating an almost unimaginable new set of vulnerabilities and openings for cybersecurity hacks.” - Pg. 133

“As he was explaining this to me, I was imagining what could happen if a system controlling home care robots were hacked. Could it be a way to hurt people?” - Pg. 134

“What kind of malicious activity? For one, the computing power of these thingbots could be harnessed for DDoS attacks and as spam engines - anything that requires raw, dumb computing power.” - Pg. 134

“With connected homes, today’s smart burglar is able to hack inside a smart home network and monitor when people are home. They can gather precise data about the comings and goings of everybody living in the home. If there is a security system, they can turn it off.” - Pg. 135

“The emergence of cybercrime has created a new imperative for government to protect its critical infrastructure and its citizens.” - Pg. 135

“With the weaponization of code evolving to include infrastructure connected through the Internet of Things, Gosler calls for us [the USA] to recruit, train, and mobilize a new force of cyberwarriors.”
- Pg. 137

“They [companies] know that China is stealing their intellectual property, but they have not contemplated what it would mean if China's net behavior started looking more like Russia's.” - Pg. 138

“Tracking this kind of [cyberwarfare] activity requires looking for malware callbacks, which are basically the communications sent from infected or compromised computers back to the command-and-control server of the attacker.” - Pg. 139

“It illustrates how our definitions of combat and warfare are changing as nations exchange blows in the virtual world ahead of even instead of actual armed conflict.” - Pg. 141

“Any country, or even any rogue group or individual, that puts a little bit of time and effort into it can develop some nasty offensive cyber capabilities.” - Pg. 142

“To complicate matters even further, the layout of the Internet scrambles the traditional idea that both sovereign countries and warfare are tied to geography and physical place.” - Pg. 143

“I expect the total market size of the cyberindustry to increase even faster, reaching \$175 billion by the end of 2017.” - Pg. 147

“If handled wrong, the massive growth in the cybersecurity industry could hinge on cybersecurity experts capitalizing on our lack of technical knowledge just as hackers do.” - Pg. 48

“However the growth of the cybersecurity takes shape, one point that I have never heard anyone ever try to rebut is that the industry is going to get very big very fast.” - Pg. 150

“Government can and should work extensively with the private sector to make sure that the brightest minds are working to develop cyberdefenses, but there is an as yet unmet obligation by government to define its responsibilities to its citizens in this newest domain of conflict.” - Pg. 151

“We all want the liberty that comes with a vibrant online life, but liberty without security is fragile, and security without liberty is oppressive. The years ahead will force us to balance these two as we have not had to before.” - Pg. 151

Chapter 5: Data: The Raw Material of the Information Age

“We have adjusted to a reality where everyone is reachable at all times, even our children, and we expect and demand to be plugged in at all times. I don’t know if this is a good thing or a bad thing - probably a bit of both.” - Pg. 153

“The first time a child is handed a phone or plays his first video game, he begins building a stack of personal data that will grow throughout his lifetime, a stack that can be constantly collated, correlated, codified, and sold.” - Pg. 153

“The explosion in data creation is a very recent occurrence, and from its inception, data storage has grown exponentially.” - Pg. 153

“By 1996, there was so much data and computing had become sufficiently inexpensive that digital storage became more cost-effective than paper for the first time.” - Pg. 154

“Ninety percent of the work’s digital data has been generated over the last two years. Every year, the amount of digital data grows by 50 percent.” - Pg. 154

“*Big Data* is a catchall phrase used to describe how these large amounts of data can now be used to understand, analyze, and forecast trends in real time. The term can be used interchangeably with *big data analytics*, *analytics*, or *deep analytics*.” - Pg. 154

“There is a common misconception that the advances made possible by big data are simply a function of the amount of data gathered. In actuality, the growth in the amount of data without the ability to process it is not useful in and of itself.” - Pg. 154

“Big data is further aided by new developments in data visualization that allow humans to see and understand patterns that might not be apparent on a spreadsheet full of numbers.” - Pg. 155

“We’ve been gathering lots of data for a long time. So what ‘big data’ really means is the capacity to process lots of information in something that approximates real time so that we can actually do something with it. We can make different decisions based in a strategic way rather than purely a retrospective analysis, after the fact.” - Pg. 156

“Increase in data gathering and growth in computing power complement each other. The more data there is, the more investment there is in powerful computers and abundant storage to chew through the data and draw business intelligence from it. The more powerful computers are, the easier it is to gather large amounts of data and produce larger and more in-depth data sets.” - Pg. 157

“Academics have likened it to both a microscope and a telescope - a tool that allows us to both examine smaller details than could previously be observed and to see data at a larger scale, revealing correlations that were previously too distant for us to notice.” - Pg. 157

“It [big data] will have permeated parts of our lives that we do not think of today as being rooted in analytics.” - Pg. 157

“Professional translators argue that local dialects, inflections, and nuances are too complex for computers to ever account for sufficiently. But they are wrong.” - Pg. 158

“We just need more data, more computing power, and better software. These will come with the passage of time and will fill the communication gaps in areas including pronunciation and interpreting a spoken response.” - Pg. 159

“Universal machine translation with accelerate globalization on a massive scale.” - Pg. 159

“The only professional translators in ten years are going to be the people who work on the translation software.” - Pg. 160

“If my voice can be reconstructed in a way that makes the reconstruction difficult to distinguish from my ‘real’ voice, than it opens up new opportunities for fraud. - fraud in dozens of languages, no less.” - Pg. 161

“The best hope for feeding our more populated world comes from the combination of big data and agriculture - precision agriculture.” - Pg. 161

“The machine operates at a level of precision beyond even the wildest dreams of farmers from any other point in human history. Today’s versions barely hint at what’s possible.” - Pg. 163

“Precision agriculture is not based on huge enterprise software systems that take up half the barn. That expensive software is in the cloud and accessible on cheap devices like smartphones and the tablets I saw in the tractor’s ‘cockpit.’” - Pg. 164

“As the cost of equipment goes down, it will be more accessible to farmers in the developing world. This is where the impact may be greatest.” - Pg. 165

“Wall Street has taken advantage of big data as much as any industry. Of the roughly 7 billion shares that are traded in US equity markets every day, two-thirds are traded by preprogrammed computer algorithms that crunch data about share prices, timing, and quantity in order to maximize gains and minimize risk. This is called black-box or algorithmic trading and is now the norm in finance.” - Pg. 166

“The next impact of big data in the finance world will be in retail banking, the area where average people are customers, as opposed to investment banks or commercial banks that focus on serving corporations. The application of big data to enhance operations and product development in retail banking is known as ‘fintech.’” - Pg. 166

“In 2008, financial technology firms raised approximately \$930 million in investments globally. In 2013, these firms collectively raised about \$3 billion and that amount is expected to reach \$8 billion by 2018.” - Pg. 167

“A bank is a giant ledger that records how much money belongs to people and how much people owe them. At heart, that’s a data problem. I think that banks - and the ecosystem around banks - are just starting to realize that they’re digital companies.” - Pg. 168

“What banks do - storing value, moving value, and pricing risk - those are all the functions of a data company. Google could, if they wanted to, do those three things better than most banks.” - Pg. 169

“Why *hasn’t* Google - or some other analytics firm - created a digitally native bank? It’s a question Zac is intimately familiar with. ‘The problems are primarily regulatory,’ he explains.” - Pg. 169

“It is very hard to buy a bank. It is very hard to capitalize it. Regulators are very scared of innovation. They are very scared of a bank that does not make money in the way that other banks make money. The reason they’re uncomfortable is the reason we all should be uncomfortable: banks aren’t really meant to make money. They’re meant to serve as rock-solid repositories for other people’s money.” - Pg. 169

“In a coded market economy, a lender knows a merchant’s true value because it has real-time access to its books. Instead of checking a credit score, the data for every dollar going in and out of the store is immediately available. The lender knows a merchant’s value without ever having to physically open up his or her books.” - Pg. 171

“From 2005 to 2008, the CIA was Palantir’s sole customer. Since 2010, Palantir has also designed software systems for the NSA, the FBI, and the US military. Palantir specializes in data management, transforming massive and often messy data into visualized maps and charts.” - Pg. 173

“Palantir has also moved into the corporate world, helping companies in financial services, legal research, mortgage fraud, and cybercrime through its analytics program. It describes its core disciplines ‘data modeling, data summarization, and data visualization.’” - Pg. 173

“It is not just being able to scour a large database; once data has been analyzed, It needs to be summarized in an easy-to-understand way and presented visually so that humans can then apply their own expertise and make their own judgements.” - Pg. 173

“Often we give up our data in exchange for free or convenient services, coupled with a vague promise of security - but in recent years, it's become clear that once our data is handed over, it can often be used in secretive or questionable ways.” - Pg. 174

“Many of us are learning the hard way that once data is produced, it rarely fades away.” - Pg. 174

“Every few weeks, a new example arises that illuminates the problems accompanying the broader commercialization of our personal data.” - Pg. 177

“In response to worries over how technology eroding privacy, many European governments have established strong privacy regulations. The problem they encounter when trying to enact these regulations is twofold. First, most of these big data technologies do not collect information and organize its collection or distribution by country.” - Pg. 177

“Second, when countries do try to disallow their companies from building products that impinge on privacy regulations, they are in effect dialing down their ability to compete in one of the fastest growing segments of the global economy.” - Pg. 178

“Whether or not we may *want* to respect a stronger version of privacy, it's possible that we're now unable to turn back and actually reach that notion of privacy.” - Pg. 178

“The danger of genomic information being widely available is difficult to overstate.” - Pg. 179

“Over the next 15 years, with more of our lives captured by big data technologies, norms will shift even further. What constitutes scandalous behavior today won't be as novel or newsworthy. We will increasingly have to accept the fallibility that comes with being human, because each of us will have our errors and indiscretions preserved in indelible data.” - Pg. 179

“We may live more efficient lives as instincts are replaced by algorithms, but it is reasonable to fear that some of our most human qualities - love, spontaneity, autonomy - may be changed for the worse by our living more algorithmic lives.” - Pg. 180

“As it [big data] reaches into more and different aspects of our everyday lives, the combination of big data and behavioral science will subtly change our routines and expectations through a series of digital nudges that guide our choices through the day.” - Pg. 180

“Who owns the data is as important a question as who owned the land during the agricultural age and who owned the factory during the industrial age. Data is the raw material of the information age.” - Pg. 182

“The larger and more expensive the data sets are, the more correlations there are, both spurious and legitimate. And most big data programs do a poor job of identifying which correlations are more or less likely to be spurious.” - Pg. 182

“I don't see any developments in big data that that will change the old truism that machines are adept at things humans find difficult (such as working 24 hours straight or quickly solving a complex math problem) and humans are adept at things that machines find difficult (such as creativity or understanding social and cultural context).” - Pg. 182

“When data goes from being unstructured to structured, it takes on the values and prejudices baked in to its formulation. For example, in the future, it will be possible for a program to be built for human resources professionals that cross-matches health indicators with employment worthiness. Should predictive analytics be used to determine whether to hire someone who is likely to get a certain illness but doesn't currently have it? It seems unjustly discriminatory.” - Pg. 182

“Correlations made by big data are likely to reinforce negative bias. Because big data often relies on historical data or at least the status quo, it can easily reproduce discrimination against disadvantaged racial and ethnic minorities.” - Pg. 184

“Big data simultaneously help solve global challenges while creating an entirely new set of challenges.” - Pg. 184

“Slaby has made an impressive career out of developing big data tools, but even he recognizes that these tools work best when governed by human judgment.” - Pg. 185

The choices we make about how we manage data will be as important as a decisions about managing land during the agricultural age in managing industry during the Industrial Age. We have a short window of time - just a few years, I think - before a set of norms set end that will be nearly impossible to reverse. Let's hope humans accept the responsibility for making these decisions and don't leave it to the machines.” - Pg. 185

Chapter 6: Data: The Geography of Future Markets

“World leaders take notice: the 21st century is a terrible time to be a control freak.” - Pg. 186

“Silicon Valley has been home to technology-driven innovation for long time, but the 20-year period from 1994 to 2014 was something special. People all over the world witnessed a spectacular level of innovation and wealth creation, all emerging from a small 30-mile long 15-mile-wide strip of Northern California.” - Pg. 186

“The popular recipe for creating the ‘next’ Silicon Valley goes something like this:

- Build a beautiful, fully equipped technology park;
- Mix in R&D labs and university centers;
- Provide incentives to attract scientists, firms and users;
- Interconnect the industry through consortia and specialized suppliers;
- Protect intellectual property and tech transfer; and,
- Establish a favorable business environment and regulations.” - Pg. 187

“When I’m asked, ‘What can we do to create our own Silicon Valley?’ my response surprises many people: “You can’t,” I say. ‘It’s too late. Silicon Valley has a decades-long head start creating the perfect environment for creating Internet businesses. What you *can* do, though, is position your communities to compete and succeed in those areas of innovation that are still to come’ - those described in this book.” - Pg. 187

“Building an innovation-rich place like Silicon Valley requires specific cultural and labor-market characteristics that can contradict both a society’s norms and the more controlling impulses of government leaders.” - Pg. 187

“With the industries of the future, new avenues of opportunity for countries and people alike will hinge on domain expertise - deep knowledge about a single industry, which tends to concentrate in specific cities or regions.” - Pg. 187

“To understand domain expertise, consider the following question: Why do a ridiculously high percentage of Internet companies still come out of Silicon Valley when massive investment is being made around the world to compete with it? Many factors are at play, but domain expertise is the most important. For more than 20 years, the world's best computer scientists have overwhelmingly been based in Silicon Valley. It could have been born in anywhere, but they came to Silicon Valley for school (Stanford or Berkeley), employment (which creates self-reinforcing cycle that concentrates talent), and investment (with the Valley offering far and away the most access to early-stage capital in the world).” - Pg. 188

“But nothing like that exists yet for the industries of the future, where the most interesting and important innovations are taking place with greater geographic spread than we see with Internet-based innovation.” - Pg. 188

“In the current landscape, the most important work in the commercialization of genomics is clustered around universities where much of the original research and development took place.” - Pg. 188

“In cyber, the most interesting companies are often based proximate to government, where domain expertise was developed inside the best law enforcement and intelligence communities, including Washington, D.C., Tel Aviv, London, and Moscow.” - Pg. 189

“In robotics, domain expertise and the early commercial leadership is generally concentrated where there is preexisting domain expertise in electronics and advanced manufacturing - in countries like Japan, South Korea, and Germany.” - Pg. 189

“Yet even as the industries of the future offer new opportunities to rising hotbeds of innovation around the world, it’s interesting to watch how Silicon Valley’s influence lingers and continues to draw start-ups in almost every industry.” - Pg. 189

“Will big data serve to centralize businesses, pulling more industries into the gravitational field of Silicon Valley? Or will it allow more businesses to innovate wherever they are, in effect creating more opportunities in more places around the world than has been possible before now?” - Pg. 190

“It is also the case that while the powers that be in Silicon Valley might be the earliest movers in fields like precision agriculture, once success is achieved elsewhere, they don't just sit back as passive bystanders and watch it grow.” - Pg. 191

“They [other people] believe that big data, instead of absorbing and supplanting other industries, will serve as a broad tool that every existing industry can use to spur growth. The idea is that data will become widely usable and scalable enough that it won't have domain expertise in the same way that other high-barrier-to-entry industries of the future like genomics or robotics do.” - Pg. 192

“This effectively means to stop trying to chase after Silicon Valley and focus on the skills and processes that will unleash the next wave of innovation in fields in which there is already local expertise. My view is that the geographic spread of domain expertise in the industries of the future will ensure that the next stage of globalization produces centers of innovation and commercialization that are more geographically diverse than the last stage, when Silicon Valley enjoy 20 years of domination.” - Pg. 195

“The geographic foci for innovation are almost always cities. Why are cities growing so rapidly even as network technologies allow us to be more distributed, to do more at a distance?” - Pg. 196

“Cities are incubators of growth because they produce positive externalities, or spillover effects. They allow ideas, labor, and capital to flow rapidly and efficiently. Talent can be more effectively coordinated and markets can become more specialized.” - Pg. 196

“As cities get tech savvy, this effectively means that global centers with lots of money and the capabilities Goldsmith describes (like New York City, Dubai, London, San Francisco, Tokyo, & Seoul) are those likely to build big data applications that are highly appealing to citizens, and this attract the “next economy” class.” - Pg. 198

“But is that all it takes? But what drives much of the growth in the world's leading cities? It turns out that they share a common culture of openness, even those in countries where the official government line is much more closed. Cities that have historically been open to the world are linked by a culture that welcomes people from all corners of the globe and encourages the free flow of ideas and goods to make them attractive places to live and work.” - Pg. 198

“While leaders like Peter the Great, Catherine the Great and Mikhail Gorbachev wanted to open Russia to new ways of thinking and doing business , most of the czars and Soviet premiers, and now Putin, have wanted to impose control not only over Russian politics but also over Russian society, the Russian economy, even Russian thought. Putin, a former KGB agent, is symptomatic of this trend in Russian history.” - Pg. 204

“Putin’s paranoia about the outside is itself at odds with the requirements of a modern economy. To be successful in the next wave of globalization and innovation, a society must be open in order to exchange new ideas, conduct research free from political interference, and pursue creative projects, even if they fail. Innovation requires this type of openness. It cannot see outside markets as enemy territory.”
- Pg. 204

“Rarely do countries and societies have the opportunity to make a simple, binary choice about whether they are going to open or closed.” - Pg. 205

“Estonia and Belarus were in nearly the same position following independence [from the Soviet Union] and made opposite decisions about their future. While Estonia opened up, Belarus closed off.”
- Pg. 208

“President Ilves of Estonia explains, ‘I don’t think there was that big a difference in ’91 and ’92 between the two countries, but then autocracy takes its toll, and they didn’t undertake reforms.’” - Pg. 209

“This was representative of what I have seen during all my time in Estonia: extreme order combined with invention and design.” - Pg. 209

“Estonia has demonstrated how innovation in the industries of the future can do more than just generate wealth and employment; it can enhance our civic and political life. In this respect, we should stop asking about the next Silicon Valley and start asking about the next Estonia.” - Pg. 211

“Estonia and Belarus are two poles on the open-closed axis. Most of the world lies between them, and many countries, like Ukraine, are torn between the two. States as different as Turkey and Thailand regularly go through public convulsions as they try to reconcile diverging tendencies toward open and closed systems.” - Pg. 214

“Media and information environments, political agendas, social movements, governmental decision-making processes, and control over corporate brands have all been disrupted by citizens using what are now billions of devices and billions of Internet connections.” - Pg. 215

“How states respond to this systemic loss of control and the diffusion of power will greatly affect the character and performance of their economies.” - Pg. 215

“The world’s two most important rising economic powers, China and India, are both grappling with the growing need for openness in their own ways.” - Pg. 216

“For decades, China demonstrated that a somewhat open economy and a closed political system can achieve growth by being home to knowledge workers and manufacturing centers. But it is now seeking to prove that it can provide the conditions for innovation of its own.” - Pg. 217

“The [Chinese] government has realized that if the country is going to continue to grow, it can't merely be a center of low-cost manufacturing and copycat innovation.” - Pg. 217

“The contrasting effects of China's central planning versus India's more democratic and inefficient agenda setting are significant.” - Pg. 219

“India's development has taken place from the opposite direction of South Korea's and China's: it has a much higher degree of political openness, and the development of the economy has taken place away from the command-and-control-like structure of the central government. How it is trying to move toward more centralized control.” - Pg. 221

“The future of the global economy depends hugely on what happens in China and India, but countries around the world are facing the same predicaments. Some are adapting in brilliant, innovative ways, while others are languishing or failing to realize the shifting winds of the global economy.” - Pg. 222

“Treating women well is not just the right thing to do; it makes economic sense. Women are half of every nation's workforce - or potential workforce.” - Pg. 226

“Women's equality is an issue not just in Muslim or developing countries but everywhere around the world, even in an advanced economy like Japan.” - Pg. 227

“A second major condition necessary for societies to compete and succeed in the industries of the future is to have young people whose ideas are funded and whose place on organizational charts belies their youth.” - Pg. 230

“Many Asian societies have also recognized how youth can turbocharge innovation in their countries. The average age of a CEO of a company listed on the Shanghai Stock Exchange is 47. By contrast, in more rigidly hierarchical Japan, the average age of a CEO on the Tokyo Nikkei Index is 62.” - Pg. 232

“Can Africa - in its own way - pull off what India and China did in the last wave of globalization and innovation?” - Pg. 233

“As I've traveled through Africa, I have continued to see an increasing number of examples of frugal innovation. In an environment of scarcity, people can become wildly creative.” - Pg. 233

“And the recent increase in women's economic roles in the African economy has corresponded to the continent's longest and largest period of economic growth.” - Pg. 237

“What I have seen in Africa makes me believe that industries of the future will have more broadly distributed centers of innovation and wealth creation that was the case in the past 20 years, when Silicon Valley dominated all corners.” - Pg. 239

“When leaders wonder what they can do to position their societies for the industries of the future, they need to open up and resist control-freak tendencies.” - Pg. 239

Conclusion: The Most Important Job You Will Ever Have

“Robots that care for us as we grow old. Cyberattacks against our homes. Extinct animals brought back to life. Ubiquitous sensors eliminating privacy as we now know it. These changes are disorienting and more than a little scary.” - Pg. 240

“The most important job I will ever have is being a dad, and I can’t help wondering what all these coming changes - the ones that this book anticipates and the ones it does not - will mean for our children’s economic future.” - Pg. 240

“If a major lesson learned from Jared and Sheel is that multicultural fluency is increasingly important in a business world that is growing more global, other thinkers and experts I spoke to emphasized a different set of skills - or said that foreign language skills were only part of the equation. Many believe that today’s kids must also become fluent in technical, programming, or scientific language. If big data, genomics, cyber, and robotics are among the high-growth industries of the future, then the people who will make their livings in those industries need to be fluent in the coding languages behind them.” - Pg. 244

“I think it’s really important that people have at least two other languages: one that is traditionally classically linguistic and one that’s technical.” - Pg. 245

“[T]he biggest issue is simply the development of analytical skills. Most of the routine things people do will be done by computer, but people will manage the computers around them and the analytical skills will never go out of style.” - Pg. 248

“Today’s youth who will enter tomorrow’s workforce will need to be more nimble and more familiar with the broader workings of the world to be able to find a niche that they can fit into.” - Pg. 247

“Children growing up in environments of economic and social privilege will always have an advantage over those growing up under lesser circumstances.” - Pg. 247

“The growing economic diversity and increasing pace of change means that investors and people in global business will have to be as mobile and able to work across cultures as people newly entering the workforce.” - Pg. 248

“These changes mean new opportunities for all of us - for businesses, governments, investors, parents, students, and children. This book, I hope, will help us make the most of them.” - Pg. 249