



BLOCKCHAIN REVOLUTION

HOW THE TECHNOLOGY BEHIND
BITCOIN IS CHANGING MONEY,
BUSINESS, AND THE WORLD

DON TAPSCOTT

BESTSELLING AUTHOR OF *WIKINOMICS*

and **ALEX TAPSCOTT**

The technology likely to have the greatest impact on the future of the world economy has arrived, and it's not self-driving cars, solar energy, or artificial intelligence. It's called the blockchain.

The first generation of the digital revolution brought us the Internet of information. The second generation—powered by blockchain technology—is bringing us the 'Internet of value': a new, distributed platform that can help us reshape the world of business and transform the old order of human affairs for the better.

Blockchain is the ingeniously simple, revolutionary protocol that allows transactions to be simultaneously anonymous and secure by maintaining a tamperproof public ledger of value. Though it's the technology that drives bitcoin and other digital currencies, the underlying framework has the potential to go far beyond these and record virtually everything of value to humankind, from birth and death certificates to insurance claims and even votes.

Why should you care? Maybe you're a music lover who wants artists to make a living off their art. Or a consumer who wants to know where that hamburger meat really came from. Perhaps you're an immigrant who's sick of paying big fees to send money home to loved ones. Or an entrepreneur looking for a new platform to build a business.

As with major paradigm shifts that preceded it, the blockchain will create winners and losers. And while opportunities abound, the risks of disruption and dislocation must not be ignored.

Don Tapscott, the bestselling author of *Wikinomics*, and his son, blockchain expert Alex Tapscott, bring us a brilliantly researched, highly readable, and utterly foundational book about the future of the modern economy. *Blockchain Revolution* is the business leader's playbook for the next decade and beyond.

"The blockchain is one of the most fundamental inventions in the history of computer science. Read *Blockchain Revolution* to understand its profound implications."

—Marc Andreessen, cofounder, Netscape and Andreessen Horowitz

"Occasionally a book comes along that changes the global discourse. This is likely to be one of those books. Blockchains are at the heart of the fourth industrial revolution and the Tapscotts lucidly explain why and how to capture the opportunities and avoid the dangers."

—Klaus Schwab, founder and executive chairman, World Economic Forum

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THE TRUST PROTOCOL

It appears that once again, the technological genie has been unleashed from its bottle. Summoned by an unknown person or persons with unclear motives, at an uncertain time in history, the genie is now at our service for another kick at the can—to transform the economic power grid and the old order of human affairs for the better. If we will it.

Let us explain.

The first four decades of the Internet brought us e-mail, the World Wide Web, dot-coms, social media, the mobile Web, big data, cloud computing, and the early days of the Internet of Things. It has been great for reducing the costs of searching, collaborating, and exchanging information. It has lowered the barriers to entry for new media and entertainment, new forms of retailing and organizing work, and unprecedented digital ventures. Through sensor technology, it has infused intelligence into our wallets, our clothing, our automobiles, our buildings, our cities, and even our biology. It is saturating our environment so completely that soon we will no longer “log on” but rather go about our business and our lives immersed in pervasive technology.

Overall, the Internet has enabled many positive changes—for those with access to it—but it has serious limitations for business and economic activity. *The New Yorker* could rerun Peter Steiner’s 1993 cartoon of one dog talking to another without revision: “On the Internet, nobody knows you’re a dog.” Online, we still can’t reliably establish one another’s identities or trust one another to transact and exchange money without validation from a third party like a bank or a government. These same intermediaries collect our data and invade our privacy for commercial gain and national

BOOTSTRAPPING THE FUTURE: SEVEN DESIGN PRINCIPLES OF THE BLOCKCHAIN ECONOMY

Freedom is predicated on privacy,” said Ann Cavoukian, executive director of the Privacy and Big Data Institute at Ryerson University. “I first learned that thirty years ago when I started going to conferences in Germany. It is no accident that Germany is the leading privacy and data protection country in the world. They had to endure the abuses of the Third Reich and the complete cessation of all of their freedoms, which started with the complete removal of their privacy. When that ended, they said, ‘Never again.’”¹

And so it is ironic—or totally fitting—that one of the first decentralized peer-to-peer computational platforms to guarantee user privacy is called Enigma, also the name given to the machine developed by German engineer Arthur Scherbius to transcribe coded information. Scherbius designed Enigma for commercial use: through his device, global companies could quickly and safely communicate their trade secrets, stock tips, and other insider information. Within a few years, Germany’s military forces were manufacturing their own versions of Enigma to broadcast coded messages over radio to troops. During the war, the Nazis used Enigma to disseminate strategic plans, details of targets, and the timing of attacks. It was a tool of suffering and oppression.

Our contemporary Enigma is a tool of freedom and prosperity. Designed at MIT Media Lab by Guy Zyskind and Oz Nathan, the new Enigma combines the virtues of blockchain’s public ledger, the transparency of

REINVENTING FINANCIAL SERVICES

The global financial system moves trillions of dollars daily, serves billions of people, and supports a global economy worth more than \$100 trillion.¹ It's the world's most powerful industry, the foundation of global capitalism, and its leaders are known as the Masters of the Universe. Closer up, it's a Rube Goldberg contraption of uneven developments and bizarre contradictions. First, the machine hasn't had an upgrade in a while. New technology has been welded onto aging infrastructure helter-skelter. Consider the bank offering Internet banking but still issuing paper checks and running mainframe computers from the 1970s. When one of its customers taps her credit card on a state-of-the-art card reader to buy a Starbucks grande latte, her money passes through no fewer than five different intermediaries before reaching Starbucks's bank account. The transaction takes seconds to clear but days to settle.

Then there are the large multinationals like Apple or GE that have to maintain hundreds of bank accounts in local currencies around the world just to facilitate their operations.² When such a corporation needs to move money between two subsidiaries in two different countries, the manager of one subsidiary sends a bank wire from his operation's bank account to the other subsidiary's bank account. These transfers are needlessly complicated and take days, sometimes weeks to settle. During that time, neither subsidiary can use the money to fund operations or investment, but the intermediaries can earn interest on the float. "The advent of technology essentially took paper-based processes and turned them into semiautomated, semielectronic processes but the logic was still paper based," said Vikram Pandit, former CEO of Citigroup.³

RE-ARCHITECTING THE FIRM: THE CORE AND THE EDGES

BUILDING CONSENSYS

July 30, 2015, was a big day for a global group of coders, investors, entrepreneurs, and corporate strategists who think that Ethereum is the next big thing—not just for business, but possibly for civilization. Ethereum, the blockchain platform eighteen months in the making, went live.

We witnessed the launch firsthand in the Brooklyn office of Consensus Systems (ConsenSys), one of the first Ethereum software development companies. Around 11:45 a.m., there were high fives all around as the Ethereum network created its “genesis block,” after which a frenzy of miners raced to win the first block of ether, Ethereum’s currency. The day was eerily suspenseful. A massive thunderstorm broke over the East River, triggering loud and random emergency flood warnings on everyone’s smart phones.

According to its Web site, Ethereum is a platform that runs decentralized applications, namely smart contracts, “exactly as programmed without any possibility of downtime, censorship, fraud, or third party interference.” Ethereum is like bitcoin in that its ether motivates a network of peers to validate transactions, secure the network, and achieve consensus about what exists and what has occurred. But unlike bitcoin it contains some powerful tools to help developers and others create software services ranging from decentralized games to stock exchanges.

Ethereum was conceived in 2013 by then-nineteen-year-old Vitalik Buterin, a Canadian of Russian descent. He had argued to the bitcoin core developers that the platform needed a more robust scripting language for

NEW BUSINESS MODELS: MAKING IT RAIN ON THE BLOCKCHAIN

Founded a month before the market crashed in 2008, Airbnb has become a \$25 billion platform, now the world's largest supplier of rooms as measured by market value and rooms occupied. But the providers of rooms receive only part of the value they create. International payments go through Western Union, which takes \$10 of every transaction and big foreign exchange off the top. Settlements take a long time. Airbnb stores and monetizes all the data. Both renters and customers alike have concerns about privacy.

We brainstormed with blockchain expert Dino Mark Angaritis to design an Airbnb competitor on the blockchain. We decided to call our new business bAirbnb. It would look more like a member-owned cooperative. All revenues, except for overhead, would go to its members, who would control the platform and make decisions.

BAIRBNB VERSUS AIRBNB

bAirbnb is a *distributed application* (DApp), a set of smart contracts that stores data on a home-listings blockchain. The bAirbnb app has an elegant interface: owners can upload information and pictures of their property.¹ The platform maintains reputation scores of both providers and renters to improve everyone's business decisions.

When you want to rent, the bAirbnb software scans and filters the blockchain for all the listings that meet your criteria (e.g., ten miles from

THE LEDGER OF THINGS: ANIMATING THE PHYSICAL WORLD

A power pole collapses at eight o'clock on a hot night in the remote outback of Australia. This is a problem for William and Olivia Munroe, who raise sheep and cattle one hundred miles outside the old gold mining town of Laverton, on the edge of the Great Victoria Desert.¹ In the summer, the temperature frequently soars close to 120 degrees Fahrenheit (48.9°C). Their children, Peter and Lois, attend school via satellite link, the family's only means of accessing health services in case of illness or emergency. Although the Munroes have a backup generator, it can't power the water pumps, communications, and air-conditioning for long. In short, the lives of the Munroe family depend entirely upon reliable energy.

At daybreak, nine hours later, the power utility sends out a team to find and fix the downed pole. Customer complaints give the company an idea of where the break occurred, but the team takes more than a day to identify, reach, and fix the pole. Meanwhile, the Munroes and nearby residents, businesses, and institutions go without power and connectivity at considerable inconvenience, economic impact, and physical risk. In the outback, blackouts are not just paralyzing; they're dangerous. To minimize these hazards, at great expense the company deploys teams of inspectors to check the extensive network regularly for downed or deteriorating poles.

Imagine how much safer, easier, and cheaper it would be if each power pole were a smart thing. It could report its own status and trigger actions for replacement or repair. If a pole caught fire or began to tip or fall for any

SOLVING THE PROSPERITY PARADOX: ECONOMIC INCLUSION AND ENTREPRENEURSHIP

A PIG IS NOT A PIGGY BANK

The Pacific coast of Nicaragua is one of the most beautiful landscapes in the Americas, where verdant green forest meets endless blue waters. Its rolling hills and stunning beaches make it a top destination for backpackers, sunbathers, and ecotourists alike. Nicaragua is also one of the poorest and least developed countries in the region. Sixty percent of the population lives below the poverty line. Those not employed in its tourism industry survive on near-subsistence-level agriculture and fishing. Nicaragua has the second-lowest nominal gross domestic product in the Americas, with 10 percent of its entire GDP from remittances—money earned overseas and repatriated by the Nicaraguan diaspora. Nineteen percent of Nicaraguans have a formal bank account, but only 14 percent are able to borrow and only 8 percent have formal savings.¹ Yet 93 percent have a mobile phone subscription, usually in the form of prepaid access.²

That is the reality that Joyce Kim faced when she took her team down to Nicaragua. Kim is the executive director of the Stellar Development Foundation, a not-for-profit blockchain technology organization (not to be confused with Stellar, the large architecture and construction firm). A Nicaraguan microfinance operation wanted to learn more about Stellar's financial platform. The woefully underdeveloped banking industry in Nicaragua keeps most people in an inescapable cycle of poverty and exacerbates the plight of would-be entrepreneurs. They struggle to start new businesses, register titles to their land and other assets, and resolve outstanding claims from the Sandinista government's mass land expropria-

REBUILDING GOVERNMENT
AND DEMOCRACY

The Republic of Estonia is a Baltic state with Latvia to the south and Russia to the east. With a population of 1.3 million, it has slightly fewer people than the city of Ottawa.¹ When Estonia regained its independence from the former Soviet Union in 1991, it had an opportunity to completely rethink the role of government and redesign how it would operate, what services it would provide, and how it would achieve its goals through Internet technologies.

Today, Estonia is widely regarded as the world leader in digital government, and its president, Toomas Hendrik Ilves, will be the first to say so: “We’re very proud of what we’ve done here,” he told us. “And we hope the rest of the world can learn from our successes.”²

Estonia ranks second of all countries on the social progress index for personal and political rights, tied with Australia and the United Kingdom.³ Estonia’s leaders have designed their e-government strategy around decentralization, interconnectivity, openness, and cybersecurity. Their goal has been to future-proof infrastructure to accommodate the new. All residents can access information and services online, use their digital identity to conduct business, and update or correct their government records. While much of Estonia’s work predates the blockchain, the country introduced a keyless signature infrastructure that integrates beautifully with blockchain technology.

Central to the model of e-Estonia is a digital identity. As of 2012, 90 percent of Estonians had an electronic ID card to access government services

FREEING CULTURE ON THE BLOCKCHAIN: MUSIC TO OUR EARS

It wasn't your typical yearling's birthday party. The celebration took place at the Round House an hour outside London, in a massive barn complete with sound-reactive LED tree, a bouncy castle, and a buffet fit for Henry VIII. The crowd was eclectic: a "contact" juggler, two dozen toddlers, their parents, neighbors, musicians, and a handful of blockchain developers. There was Vinay Gupta, a Scottish-Indian engineer best known for inventing the hexayurt, a small disaster relief shelter. Gupta is now explainer-in-chief when it comes to communicating blockchain technology to the masses. There was also Paul Pacifico, CEO of the Featured Artists Coalition. After a career in banking, Pacifico is now fighting for the rights of musicians. And, of course, there was our host, Imogen Heap, an accomplished composer and musician, voted "inspirational artist of the year" by readers of *Music Week*,¹ and the mother of one-year-old Scout.

"I want to know that the stuff I'm making could be worth something to Scout someday," Heap told us. She was expressing her deep concerns about the music industry. "It's so fragmented; there's so little leadership, and there's so much negativity around the business side of it," she said. "Everything is topsy-turvy. It's all upside down. The artists are at the end of the food chain. It just doesn't make sense. Music is everywhere, all the time. It's on our phones, it's in our taxis, it's everywhere. But the artists are getting less and less."²

And therein lies the rub. The Internet is a marvelous muse, both a

OVERCOMING SHOWSTOPPERS: TEN IMPLEMENTATION CHALLENGES

Lev Sergeyevich Termen was a gifted musician, but he preferred playing with physics. Born into Russian aristocracy before the turn of the twentieth century, Termen joined the Bolsheviks in dismantling the tsarist autocracy. One of his early missions was to create a device that could measure the electrical conductivity and capacity of various gases. He tried gas-filled lamps, he tried a high-frequency oscillator, and he even tried hypnosis.¹ The oscillator ended up working well, and so Termen's boss encouraged him to seek other applications for it. Two apps would become legendary. The more whimsical of the two started out as two metal terminals with nothing between them, like a lamp without the glass. Termen discovered that, if he infused this void with gas, he could gauge the gas's electrical properties. His design was brilliant: he substituted headphones for dials so that he could take acoustic rather than visual readings, monitoring the pitch of the signal that each gas produced. It was way ahead of its time, the stuff of Dr. Emmett Brown's garage in *Back to the Future*.

Devotees of TED talks and students of technological history already know the end of this story: Termen stumbled upon a means of making music out of thin air. Whenever he put his hands near the metal terminals, the pitch of the signal changed. He learned that he could manipulate the pitch by the precise position and motion of his hands. He called his device the "etherphone," known today as the theremin, an anglicized version of his name. The other app was a larger-scale version of this apparatus, one that was sensitive to movement within a radius of several meters. It was the

LEADERSHIP FOR THE NEXT ERA

Prolific is an adjective that should precede all titles used to describe twenty-one-year-old Vitalik Buterin, the Russian-born Canadian founder of Ethereum. (*Prolific* founder, that is.) Ask his legion of followers about Ethereum, and they'll tell you it's a "blockchain-based, arbitrary-state, Turing-complete scripting platform."¹ It has attracted IBM, Samsung, UBS, Microsoft, and the Chinese auto giant Wanxiang, and an army of the smartest software developers in the world, all of whom think that Ethereum may be the "planetary scale computer" that changes everything.

When Buterin explained "arbitrary-state, Turing-complete" to us, we got a glimpse of his mind. Listening to music is very different from reading a book or calculating the day's revenues and expenses, and yet you can do all three on your smart phone, because your smart phone's operating system is Turing complete. That means that it can accommodate any other language that is Turing complete. So innovators can build just about any digital app imaginable on Ethereum—apps that perform very dissimilar tasks, from smart contracts and computational resource marketplaces to complex financial instruments and distributed governance models.

Buterin is a polyglot. He speaks English, Russian, French, Cantonese (which he learned in two months on vacation), ancient Latin, ancient Greek, BASIC, C++, Pascal, and Java, to name a few.² "I specialize in generalism," he said. He is also a polymath, and a modest one at that. "I have all these different interests, and somehow bitcoin seemed like a perfect convergence. It has its math. It has its computer science. It has its cryptography. It has its economics. It has its political and social philosophy. It was this community that I was immediately drawn into," he said. "I found