Blockchain Technologies

James R. Reagan
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Management 4.0

Cases and Methods for the 4th Industrial Revolution

Springer

Blockchain Technologies

This book series aims to provide details of blockchain implementation in technology and interdisciplinary fields such as Medical Science, Applied Mathematics, Environmental Science, Business Management, and Computer Science. It covers an in-depth knowledge of blockchain technology for advance and emerging future technologies. It focuses on the Magnitude: scope, scale & frequency, Risk: security, reliability trust, and accuracy, Time: latency & timelines, utilization and implementation details of blockchain technologies. While Bitcoin and cryptocurrency might have been the first widely known uses of blockchain technology, but today, it has far many applications. In fact, blockchain is revolutionizing almost every industry. Blockchain has emerged as a disruptive technology, which has not only laid the foundation for all crypto-currencies, but also provides beneficial solutions in other fields of technologies. The features of blockchain technology include decentralized and distributed secure ledgers, recording transactions across a peer-to-peer network, creating the potential to remove unintended errors by providing transparency as well as accountability. This could affect not only the finance technology (crypto-currencies) sector, but also other fields such as:

Crypto-economics Blockchain
Enterprise Blockchain
Blockchain Travel Industry
Embedded Privacy Blockchain
Blockchain Industry 4.0
Blockchain Smart Cities,
Blockchain Future technologies,
Blockchain Fake news Detection,
Blockchain Technology and It's Future Applications
Implications of Blockchain technology
Blockchain Privacy
Blockchain Mining and Use cases
Blockchain Network Applications
Blockchain Smart Contract
Blockchain Architecture
Blockchain Business Models
Blockchain Consensus
Bitcoin and Crypto currencies, and related fields

The initiatives in which the technology is used to distribute and trace the communication start point, provide and manage privacy, and create trustworthy environment, are just a few examples of the utility of blockchain technology, which also highlight the risks, such as privacy protection. Opinion on the utility of blockchain technology has a mixed conception. Some are enthusiastic; others believe that it is merely hyped. Blockchain has also entered the sphere of humanitarian and development aids e.g. supply chain management, digital identity, smart contracts and many more. This book series provides clear concepts and applications of Blockchain technology and invites experts from research centers, academia, industry and government to contribute to it.

If you are interested in contributing to this series, please contact msingh@endicott.ac.kr OR loyola.dsilva@springer.com

More information about this series at http://www.springer.com/series/16276

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Introduction—Industry 4.0

What is the Fourth Industrial Revolution?

For the fourth time in recorded history, the way the world works is changing in ways that can only be called revolutionary. As with the first, second, and third industrial revolutions, these changes affect not only business but all humanity, transforming the way we work, play, and live.

But the *fourth industrial revolution*, which is the convergence of digital technologies to connect people and things in interdependent cyber-physical systems, differs from its predecessors in key ways.

This revolution, also known as *Industry 4.0*, is replacing old paradigms not only in business but in all aspects of daily life and is doing so with unprecedented speed. Rather than mere *innovations,* defined as improving an existing product or service in new and meaningful ways, the connected age is an era of *disruptions*—of not merely adding to existing markets, industries, and technologies, but destroying them, and replacing them with something completely new.

This book will explore 11 industries and how Industry 4.0 is affecting each:

- Agriculture,
- Automotive,
- Consumer,
- Energy,
- Financial services,
- Health care,
- Manufacturing,
- Media and entertainment,
- Retail,
- Transportation and travel.

A Social Impacts chapter will discuss the fourth industrial revolution's effects on society, and how the business sector can help ensure that those changes serve the greater good.

To finish, What's Next will explore the challenges and opportunities that lie ahead, including the fifth industrial revolution (Industry 5.0), in which humans and intelligent machines will work together; and how enterprises can prepare and position themselves for success in the new digital marketplace.

For the sake of brevity and clarity, we have paired each industry with only one of the technologies transforming it.

In the Agriculture chapter, for instance, we discuss how agribusiness is using *drones*, or remotely controlled flying robots, to inspect crops, plant seeds, determine soil composition, apply fertilizers and pesticides, and perform other tasks previously handled by humans. But farmers are also using the *data*, or computer-generated information, that drones collect to make decisions about how to extract the most value from their land and other resources; *autonomous vehicles*—vehicles that use artificial intelligence to operate themselves—such as self-driving tractors to plow fields and bale hay; and other technologies. Digital technologies promise to free agriculturalists from routine tasks so they may focus on their business strategies and improve the precision of their farming practices—watering only where fields are dry, for instance, or harvesting only the fruit that is ripe.

As you read, remember that all the technologies we will discuss throughout this course may affect any of the industries covered in these pages. Retailers use drones, too, to deliver products; nearly every business uses data; the transportation industry also uses autonomous vehicles.

In addition to the analysis of an industry and one technology affecting it, each chapter also will contain:

- A *case study*, for example, of how T4IR is changing one specific enterprise within the spotlighted industry,
- A short list of terms introduced in the chapter, for you to learn, and
- Questions about what you've read.

Before we proceed, however, let's take a step back to examine the fourth industrial revolution in the context of time and events, and where it fits into the overall picture.

The Four Industrial Revolutions

For most of human history, people worked solely with their hands. Every item people used—clothing, tools, cooking implements, musical instruments, weapons—was made individually by someone, using raw materials collected or cultivated from the Earth. Our ancestors hunted and gathered all their food until about 10,000 years ago when people began farming, and domesticated animals helped with jobs requiring additional strength, endurance, and speed.

1. **The first industrial revolution** (mid-18th–mid-19th centuries) used the steam engine to mechanize manufacturing processes—something that had never been done before. As a result, factories sprang up, producing goods more quickly and cheaply than could be done by hand, enabling more people to procure and use the goods. These factories, although fairly small, also employed more paid workers, which raised the overall standard of living.
2. **The second industrial revolution** (early 20th century) used electricity to speed manufacturing processes even more, aided by the *assembly line*, pioneered by US automaker Henry Ford, in which items move progressively from worker to worker, each of whom completes a single step in product assembly. This method of manufacturing greatly increased productivity and allowed automobiles and other complex items to be mass-produced for wide distribution.
3. **The third industrial revolution** (late-20th century) occurred with the invention of the Internet, which enabled goods and services to be produced, marketed, and consumed globally and introduced digital technology worldwide.
4. **The fourth industrial revolution** (early 21st century), now underway, connects people and things with digital technologies including *artificial intelligence*, which uses computers to perform tasks that previously required human intelligence such as visual perception, speech recognition, decision making, and language translation; the *Internet of Things*, in which inanimate items communicate with humans and one another, and *cloud computing*, the delivery of computing services over the Internet to enable all this communication; and many others.

The Fourth Industrial Revolution

Cars, trucks, buses, and trains that drive themselves. Homes and offices that control themselves, using thermostats that adjust automatically; refrigerators that order groceries; doors that lock and unlock themselves as we leave and approach.

Factories whose robots assemble and manufacture goods alongside or instead of humans, make repairs, place and fill orders, and carry out many other functions autonomously. Medical technologies let us track and monitor our health, diagnose illnesses, and even treat ourselves. We can spend, save, and invest digital money without opening a bank account. Retail stores let us buy on the spur of any moment, from wherever we happen to be.

The "connected age" is bringing all this and more to people and organizations around the world at lightning speed. While the first industrial revolution took about one hundred years to manifest, Industry 4.0 is happening so quickly that most businesses are challenged just to keep pace. Even early adopters who have invested amply in technologies may find that, in a few years, they have fallen behind as new inventions and improvements render what they have obsolete.

Consumers, however, are not behind the curve. Instead, they are pushing ahead. Empowered in new ways by their mobile phones, tablets, and other computing devices, they are making new demands for around-the-clock, instant access to goods and services, customization and personalization of those goods and services, and novel, stimulating experiences.

The New Business Paradigm

The providers of these goods and services—primarily businesses—will operate differently than in the past. Tomorrow's businesses will be fully *customer-centric*, prepared to accommodate customers' demands, to innovate in the instant as those demands change, and to anticipate their future needs. Digital technologies will enable this new approach.

Being fully digital is already becoming imperative for enterprises in all industries. Business leaders will need to shift not only their mindset but also their business models. Every business will need a digital strategy, which will include deciding:

- Which technologies to use,
- The best ways to use technologies,
- How to secure digital data, networks, and systems,
- How to assist customers with the use of their technologies.

To get there, businesses will need to adopt new *paradigms*, or models. In Industry 4.0, they will move away from the linear *value chain*, which is the process by which a company turns raw materials into saleable goods, including production, marketing, and after-sales service. Rather than a top-down approach, the new model entails coordination, collaboration, and partnerships in *business ecosystems*, or networks of interconnected entities (including the customer) all working together to create or enhance a product or service.

When you have completed this course, you should understand the concepts and technologies driving the fourth industrial revolution; how the interconnection of digital technology, people, and things affects industries and societies; the challenges and opportunities this shift presents to the public and private sectors, and how businesses can adapt and change to increase their chances of success in the "connected age."

Germany's Industrie 4.0 program

The government of Germany wants to lead the way into the fourth industrial revolution. With the goal of establishing the nation as a world leader in manufacturing, government ministries have established Industrie 4.0, a strategic initiative funding technological research, forming industry networks, and standardizing technologies.

The Technologies

Funded by the Ministry of Education and Research and the Ministry for Economic Affairs and Energy, Industrie 4.0 envisions improvements in manufacturing processes using such technologies as:

- **Data**: Collecting and analyzing data can help improve quality control by identifying weaknesses and flaws in the manufacturing system and finding solutions.
- **Autonomous vehicles**: Logistics vehicles operate themselves, moving goods automatically and intelligently from one production point to the next.

- **Cyber-physical systems**: In tomorrow's fully automated "smart" factories, machines oversee production for increased productivity, less downtime, and lower personnel costs.
- **Robotics**: Equipped with sensors, cameras, and digital connections, automated, autonomous robots can work on the factory floor, performing many tasks previously accomplished by humans without human error or fatigue.
- **Production line simulation**: *Digital twins*, or virtual prototypes, allow engineers to safely test production line designs for efficiency and effectiveness before they are implemented.

The Benefits

The government isn't the only investor in Industrie 4.0. A number of research centers, a consortium of industry stakeholders, and private industries are collaborating on the initiative.

The potential for gain is high: One study estimated that Industrie 4.0 could generate 79 billion euros' growth in the country by 2025 in six sectors: chemical engineering, automotive, mechanical engineering, IT and communication, electrical engineering, and agriculture.

- **More effective and efficient workplaces**. Factories can operate more smoothly and at lower cost using connected technologies, as can businesses in many research and developments in one sector benefits all.
- **Enhanced reputation as a world industrial center**. Manufacturing already makes up a large portion of the German economy, making it one of the most competitive nations in the world for industry. By looking to the future, the country hopes to maintain that status.
- **A competitive technological edge**. Industrie 4.0 is a private–public partnership, with research and development funded by the government as well as business dollars. Technologies developed and enhanced under the initiative may ultimately benefit these businesses as well as the German economy.
- **A boosted national economy**. Increased productivity, improved customer services, a workforce trained to perform in the digital age, and standard-setting technology products may stimulate investments in German business, industry, and infrastructure, creating jobs and revenues and enhancing the quality of life. The added gross value nationwide generated by Industrie 4.0 is expected to average 1.7 percent per year.

Case Study—Germany Industrie 4.0

(see Appendix 117–119)

Challenges and Lessons Learned

Security. Securing data is difficult enough, and the stakes are high for privacy and proprietary information. Securing all the devices used in a smart factory presents a unique set of challenges, with failure potentially causing breakdowns and even danger to human safety.

Infrastructure. Particularly in rural areas, Germany suffers from slow and even spotty Internet service. Without fast broadband, engineers and manufacturers may not even realize the possibilities the digital age offers to manufacturing.

Standardization. Although this is a goal of Industrie 4.0, many technology products are still available using many different platforms and interfaces. Smaller companies and suppliers, in particular, will have a harder time converting to digital if they have to continually buy new technologies and train workers in how to use each new software product.

Glossary of Terms

Fourth industrial revolution: The convergence of digital technologies to connect people and things in interdependent cyber-physical systems

Industry 4.0: Another name for the fourth industrial revolution

Innovation: Inventing a new product or service or improving an existing product or service in new and meaningful ways

Disruption: Not merely adding to existing markets, industries, and technologies, but destroying them, and replacing them with something completely new

Drone: A remotely controlled flying robot

Data: Computer-generated information

Autonomous vehicles: Vehicles that use artificial intelligence to operate themselves

Assembly line: A manufacturing method pioneered by US automaker Henry Ford in which manufactured items move progressively from worker to worker, each of whom completes a single step in product assembly

Artificial intelligence: A form of digital technology that uses computers to perform tasks that previously required human intelligence such as visual perception, speech recognition, decision making, and language translation

Internet of Things: Digital technologies that connect humans to inanimate things and things to one another

Cloud computing: The delivery of computing services over the Internet

Paradigm: A model or pattern

Value chain: The process by which a company turns raw materials into saleable goods including production, marketing, and after-sales service

Business ecosystem: A network of interconnected entities (including the customer) all working together to create or enhance a product or service

Digital twin: A virtual prototype that allows engineers to safely test factory production line designs for efficiency and effectiveness before they are implemented

Questions

1. Describe each of the three previous industrial revolutions. How does the fourth differ from these? How is it similar?
2. Name four technologies essential to business in the "connected age."
3. "The customer is always right." Is this still true in the fourth industrial revolution? What role does the customer now play, and how can businesses adapt?
4. What questions do business leaders need to consider as they develop their digital strategies?
5. What are some benefits of Germany's "Industrie 4.0" program? What are the challenges?

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